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TRANSMITTAL

TO: Mr. Jonathan Bilmes
Director of Public Works
Town of Enfield
40 Moody Road
Enfield, CT 06082

DATE: August 22, 2016

PROJECT NAME: Town of Enfield Wastewater Facilities Plan

PROJECT NUMBER: 227363.01 and 227363.02

RE: Town of Enfield Wastewater Facilities Plan and Appendices

WE ARE SENDING:

☐ Quotation	☐ Drawing	☐ Bid Package	☐ CD/DVD
☐ Brochure	☐ Schedule	☐ Installation Package	☒ Report
☐ Change Order	☐ Manual	☐ Other (specify) _____	

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COMMENTS:

Enclosed please find a complete set of the Town of Enfield Facilities Plan and Appendices to be used to display for public review. Please have the reviewing party sign the accompanying sign-in sheet prior to viewing. Should you have any questions or require anything further, please do not hesitate to contact Mike Burns at 860-253-2461.

From: Debra A. Foshay, Sr. Project Assistant

Terry Gowey
8/22/16

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TRANSMITTAL

TO: Ms. Suzanne Olechnicki
Town Clerk
Town of Enfield
820 Enfield Street
Enfield, CT 06082

DATE: August 22, 2016

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From: Debra A. Foshay, Sr. Project Assistant

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TRANSMITTAL

TO: Ms. Susan Lather, Director
Senior Center
Town of Enfield
299 Elm Street
Enfield, CT 06082

DATE: August 22, 2016

PROJECT NAME: Town of Enfield Wastewater Facilities Plan

PROJECT NUMBER: 227363.01 and 227363.02

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From: Debra A. Foshay, Sr. Project Assistant

IRENE GIAMPETRO
Irene Giampetro 8/22/16

Wastewater Facilities Plan

for the Town of Enfield, Connecticut

1699 King Street | Suite 406
Enfield, CT 06082
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227363
Town of Enfield, CT
August 2016

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Jonathan Bilmes, P.E. – Director of Public Works

Town Manager's Office
Matthew Coppler – Town Manager
Derrik M. Kennedy – Assistant Town Manager
Courtney Hendricson – Assistant Town Manager

Town Council
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William F. Lee – Deputy Mayor
Joseph C. Bosco – District I
William J. Edgar, Jr. – District II
Edward N. Deni – District IV
Thomas Arnone – Councilor At-Large
Gregory T. Stokes, Sr. - Councilor At-Large
Gina L. Cekala - Councilor At-Large
Cynthia Mangini - Councilor At-Large
Donna H. Szewczak - Councilor At-Large
Carol A. Hall - Councilor At-Large

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Lynn Nenni – Finance Director
John Wilcox – Assistant Finance Director

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Denise Ruzicka – Director
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TABLE OF CONTENTS

SECTION **PAGE NO.**

Executive Summary ES-1
1. Introduction 1-1
   1.1 Background 1-1
   1.2 Project Goals 1-1
   1.3 Facilities Planning Overview 1-2
   1.4 Organization of Report 1-2
   1.5 Previous Studies 1-3
2. Project Planning Area 2-1
   2.1 Introduction 2-1
   2.2 Project Location and Planning Area 2-1
   2.3 Population and Demographics 2-1
   2.4 Land Use 2-3
   2.5 Topography 2-5
   2.6 Geology 2-5
   2.7 Surface Water Quality 2-6
   2.8 Groundwater Quality 2-6
   2.9 Air Quality 2-6
   2.10 Flood Zones 2-7
   2.11 Wetlands 2-8
   2.12 Endangered Species and Natural Resources 2-8
   2.13 Historic Districts and Significant Lands 2-8
   2.14 Sanitary Sewer Service 2-9
   2.15 On-Site Waste Disposal Systems 2-10
   2.16 Water Supply 2-10
   2.17 Housing Permits 2-11
   2.18 Anticipated Growth 2-12
      2.18.1 Residential 2-12
      2.18.2 Non-Residential 2-14
      2.18.3 Septage 2-14
      2.18.4 Consistency with the State Plan of Conservation and Development 2-15
   2.19 Permitting Requirements 2-17
      2.19.1 Municipal NPDES Permit 2-17
      2.19.2 General Permit for Nitrogen Discharges 2-18
      2.19.3 General Permit for the Discharge of Stormwater Associated with Industrial Activity 2-20
      2.19.4 Various General Permits Associated with Discharges to the WPCF 2-20
         2.19.4.1 Miscellaneous Discharges of Sewer Compatible (MISC) Wastewater 2-20
         2.19.4.2 Discharge of Groundwater Remediation Wastewater 2-20
         2.19.4.3 General Permit for the Discharge of Vehicle Maintenance Wastewater 2-21
         2.19.4.4 Discharge of Wastewater Associated with Food Preparation Establishments 2-21
         2.19.4.5 General Permit to Limit Potential to Emit from Major Stationary Sources of Air Pollution (Title V) 2-21
   2.20 Proposed Sewer Service Area 2-22
3. Flows and Loads 3-1
   3.1 Introduction 3-1
   3.2 Existing Wastewater Flows 3-1
      3.2.1 Residential Sanitary Flows 3-2
      3.2.2 Non-Residential Sanitary Flows 3-3

3.2.3 Septage 3-3
3.2.4 Inflow & Infiltration 3-3
3.3 Existing Wastewater Loads 3-4
3.4 Future Projections of Flows and Loads 3-5
3.5 Future Flows and Loads Summary 3-6
3.6 Flow Allocation Model 3-7
4. Collection System 4-1
4.1 Existing Conditions 4-1
4.2 Infiltration and Inflow Study 4-2
4.2.1 Introduction 4-2
4.2.1.1 Background 4-2
4.2.1.2 Prior Investigations 4-2
4.2.1.3 Purpose and Scope of Current Program 4-3
4.2.2 Data Collection Methods 4-3
4.2.2.1 Continuous Flow Monitoring 4-3
4.2.2.2 Rainfall Monitoring 4-5
4.2.2.3 Groundwater Monitoring 4-6
4.2.2.4 Data Consolidation & Processing 4-8
4.2.3 Data Analysis & Observations 4-8
4.2.3.1 Dry Day Base Infiltration 4-8
4.2.3.2 Rainfall Dependent Inflow and Infiltration 4-11
4.2.4 Summary 4-12
4.2.4.1 Composition and Magnitude of Extraneous Flows 4-12
4.2.4.2 Recommendations 4-14
4.3 Closed Circuit Television Inspections 4-14
4.4 Manhole Inspections 4-17
4.5 Smoke Testing 4-19
4.6 Collection System Hydraulic Model 4-24
4.7 Pumping Stations 4-24
4.7.1 Flood Resiliency 4-25
4.7.2 Indian Run Pump Station 4-25
4.7.2.1 Description 4-25
4.7.2.2 Deficiencies 4-27
4.7.3 Sharp Street Pump Station 4-27
4.7.3.1 Description 4-27
4.7.3.2 Deficiencies 4-29
4.7.3.3 Replacement Investigation 4-29
4.7.3.4 Alternative 1 4-29
4.7.3.5 Alternative 2 4-29
4.7.4 South Maple Street Pump Station 4-30
4.7.4.1 General Description 4-30
4.7.4.2 Deficiencies 4-32
4.7.5 Grape Brook Pump Station 4-32
4.7.5.1 General Description 4-32
4.7.5.2 Deficiencies 4-34
4.7.6 South River Pump Station 4-34
4.7.6.1 General Description 4-34
4.7.6.2 Deficiencies 4-37
4.7.7 Moody Road Pump Station 4-38
4.7.7.1 Deficiencies 4-38
4.7.7.2 Replacement Investigation 4-38

4.7.8 Taylor Road Pump Station 4-39
4.7.8.1 Deficiencies 4-39
4.7.8.2 Replacement Investigation 4-39
4.7.9 Pheasant Hill Pump Station 4-40
4.7.9.1 Description 4-40
4.7.9.2 Deficiencies 4-40
4.7.10 Plainfield Street Pump Station 4-41
4.7.10.1 Deficiencies 4-41
4.7.11 High Meadow Pump Station 4-41
4.7.11.1 Deficiencies 4-42
4.7.12 Brookside Pump Station 4-42
4.7.12.1 Deficiencies 4-43
4.7.13 West Shore Drive Pump Station 4-44
4.7.13.1 Deficiencies 4-44
4.7.14 Windsor Court Pump Station 4-45
4.7.14.1 Deficiencies 4-46
4.7.14.2 Replacement Investigation 4-46
4.7.15 Enfield Terrace Pump Station 4-46
4.7.15.1 Deficiencies 4-47
4.7.16 Simon Road Pump Station 4-47
4.7.16.1 Deficiencies 4-48
4.7.17 Sparkle Street Pump Station 4-49
4.7.17.1 Deficiencies 4-50
5. Water Pollution Control Facility 5-1
5.1 Evaluation of Existing WPCF and capacity analysis 5-1
5.1.1 Overview 5-1
5.1.2 Preliminary Treatment 5-2
5.1.3 Secondary Treatment 5-4
5.1.3.1 Aeration Tanks 5-5
5.1.3.2 Aeration System 5-11
5.1.3.3 Aeration Control System 5-11
5.1.3.4 Secondary Clarifiers 5-13
5.1.3.5 Return and Waste Activated Sludge 5-13
5.1.4 Disinfection System 5-14
5.1.5 Plant Water System 5-17
5.1.6 Potable Water System 5-18
5.1.7 Solids Handling 5-19
5.1.7.1 Sludge Conditioning 5-19
5.1.7.2 Sludge Dewatering 5-21
5.1.7.3 Sludge Incineration 5-22
5.1.8 Septage Receiving Station 5-22
5.1.9 Odor Control System 5-25
5.1.10 Building Facilities 5-27
5.1.11 Miscellaneous Treatment Plant Unit Processes 5-27
5.1.11.1 Emergency Power and Fuel Oil System 5-27
5.1.11.2 Heating, Ventilation, and Air Conditioning (HVAC) System 5-28
5.1.11.3 Plumbing System 5-28
5.1.11.4 Electrical Service 5-29
5.1.11.5 SCADA System 5-29

5.1.12 Hydraulic Profile 5-29
5.1.13 Vulnerability Assessment 5-30
5.2 WPCF Existing Limitations and Deficiencies....5-31
5.2.1 Preliminary Treatment Systems 5-31
5.2.2 Primary Treatment Systems 5-32
5.2.3 Secondary Treatment 5-33
5.2.4 Secondary Clarifiers 5-34
5.2.5 Sludge Pumping Station 5-34
5.2.5.1 Sludge Pumps 5-34
5.2.5.2 Plant Water System 5-35
5.2.6 Disinfection System 5-35
5.2.7 Solids Handling Systems 5-35
5.2.8 Miscellaneous Plant Systems 5-36
5.2.8.1 Incinerator 5-36
5.2.8.2 Building Facilities Improvements 5-36
5.2.8.3 Electrical Service 5-37
5.2.8.4 HVAC and Plumbing Systems 5-38
5.2.8.5 Fuel Oil System 5-38
5.2.8.6 Vehicle Wash Station 5-38
5.2.8.7 SCADA System 5-38
5.3 Summary of WPCF Needs 5-39
6. Alternatives Analysis 6-1
6.1 Purpose and Overview 6-1
6.2 Evaluation of Biological Treatment Alternatives 6-1
6.2.1 Development of Alternatives 6-1
6.2.2 Common Facilities 6-1
6.2.3 Do Nothing Alternative 6-2
6.2.4 Alternative 1 – BIOMAG Process 6-2
6.2.5 Alternative 2 – Four-Stage BNR Process 6-5
6.2.6 Alternative 3 – Variable Operating Mode (VOM) – BNR Process 6-8
6.2.7 Alternative 4 – IFAS Process 6-12
6.2.8 Economic and Technical Evaluation of Alternatives 6-15
6.2.8.1 Evaluation and Selection Process 6-15
6.2.8.2 Life Cycle Cost Analysis 6-15
6.2.8.2.1 Basis of Cost Estimates 6-15
6.2.8.2.2 Alternative Cost Comparison 6-16
6.2.8.3 Technical Comparison 6-19
6.2.8.4 Environmental Considerations 6-19
6.2.8.5 Recommended Alternative 6-19
6.3 Evaluation of Biological Reactor mixing system alternatives 6-21
6.3.1 Development of Alternatives 6-21
6.3.2 Alternative 1 – Surface Floating Mixing 6-21
6.3.3 Alternative 2 – Hyperbolic Vertical Shaft Mixing 6-21
6.3.4 Alternative 3 – Compressed Gas Mixing 6-22
6.3.5 Economic Evaluation of Alternatives 6-23
6.3.5.1 Life Cycle Cost Analysis 6-23
6.3.5.2 Technical Comparison 6-23
6.3.6 Recommended Alternative 6-25

6.4 Evaluation of Sludge Processing Alternatives 6-26
6.4.1 Development of Alternatives 6-26
6.4.1.1 Sludge Storage 6-26
6.4.1.2 Sludge Dewatering 6-27
6.4.2 Alternative 1 – Screw Press 6-28
6.4.2.1 Technology Description 6-28
6.4.2.2 Huber Press Piloting Results 6-29
6.4.3 Alternative 2 – Rotary Press 6-30
6.4.3.1 Technology Description 6-30
6.4.3.2 Fournier Press Piloting Results 6-30
6.4.4 Alternative 3 – Centrifuge 6-31
6.4.4.1 Technology Description 6-31
6.4.4.2 Westfalia Centrifuge Bench Testing Results 6-31
6.4.5 Throughput and Performance Comparisons 6-32
6.4.6 Economic Evaluation of Alternatives 6-32
6.4.6.1 Life Cycle Cost Analysis 6-32
6.4.6.2 Technical Comparison 6-34
6.4.6.3 Evaluation Criteria 6-35
6.4.6.4 Recommended Alternative 6-37
6.5 Odor Control Evaluation 6-38
6.5.1 Economic Evaluation of Alternatives 6-39
6.6 Summary of Existing Treatment Facilities and Future Needs 6-42
6.6.1 Preliminary Treatment 6-42
6.6.2 Primary Treatment 6-42
6.6.3 Aeration Tanks 6-42
6.6.4 Secondary Clarifiers 6-42
6.6.5 Sludge Pump Station and Disinfection System 6-43
6.6.6 Miscellaneous Items 6-43
6.6.7 Summary of Recommendations for Common Facilities 6-43
6.7 Evaluation of Building Alternatives 6-46
6.7.1 Structural Evaluation of the Operations Building 6-46
6.7.2 Alternative 1A – Rehab Operations Building 6-47
6.7.3 Alternative 1B – Rehab Operations Building and New Gravity Thickeners (GTs) 6-48
6.7.4 Alternative 2 – New Admin Building, Sludge Handling Building, Blower Building, and GTs 6-49
6.7.5 Alternative 3A – Rehab Operations Building, New Sludge Handling Building and GTs 6-49
6.7.6 Alternative 3B – Rehab Operations Building, New Blower Building and GTs 6-50
6.7.7 Alternative 3C – Rehab Operations Building, New Administration Building and GTs 6-51
6.7.8 Economic Evaluation of Alternatives 6-51
6.7.8.1 Life Cycle Cost Analysis 6-51
6.7.8.2 Technical Comparison 6-52
6.7.8.3 Recommended Alternative 6-52
6.8 Energy Opportunity Evaluation 6-57
6.8.1 Pump Stations Energy Evaluation 6-57
6.8.1.1 Summary of Energy Use and Proposed Measures 6-57
6.8.2 WPCF Energy Evaluation 6-59
6.8.2.1 Summary of Energy Use and Proposed Measures 6-59
6.8.2.2 Summary of Renewable Energy Options 6-61
6.8.3 Funding For Pump Stations and WPCF Energy Efficiency Improvements 6-61

6.9 Environmental Impact Evaluation 6-62
6.9.1 General 6-62
6.9.2 Surface Water Quality 6-62
6.9.3 Groundwater Quality 6-62
6.9.4 Stormwater Discharge 6-62
6.9.5 Wetlands 6-63
6.9.6 Flood Zones 6-63
6.9.7 Aquifer Protection Areas 6-63
6.9.8 Wild and Scenic Rivers 6-64
6.9.9 Air Quality 6-64
6.9.10 Land Use 6-65
6.9.11 Endangered Species and Natural Resources 6-65
6.9.12 Historic Districts and Significant Lands 6-65
6.9.13 Prime Farmland 6-65
6.9.14 Pesticides, Toxic, or Hazardous Materials 6-66
6.9.15 Aesthetics 6-66
6.9.16 Noise 6-66
6.9.17 Traffic 6-66
6.9.18 Socioeconomic Impacts 6-67
6.9.19 Induced Growth 6-67
6.9.20 Permitting Requirements 6-67
6.9.21 Proposed Sewer Service Area 6-68
6.9.22 Summary of Mitigation 6-68
6.10 Conclusion 6-68
7. Recommended Plan 7-1
7.1 Introduction 7-1
7.2 Collection System Recommendations 7-1
7.3 Pump Station Recommendations 7-2
7.3.1 High Priority Pump Station Improvements 7-2
7.3.1.1 Grape Brook 7-2
7.3.1.2 South River 7-3
7.3.1.3 Indian Run Pump Station 7-3
7.3.1.4 South Maple Street 7-4
7.3.1.5 Sharp Street 7-4
7.3.1.6 Sparkle Street 7-4
7.3.2 Moderate Priority Pump Station Improvements 7-5
7.3.2.1 Brookside 7-5
7.3.2.2 High Meadow 7-5
7.3.2.3 Taylor Road 7-5
7.3.2.4 Pheasant Hill 7-5
7.3.3 Low Priority Pump Station Improvements 7-6
7.3.3.1 Plainfield Street 7-6
7.3.3.2 Simon Road 7-6
7.3.3.3 Moody Road 7-6
7.3.3.4 Enfield Terrace 7-6
7.3.3.5 Windsor Court 7-7
7.3.3.6 West Shore Drive 7-7
7.3.4 Summary of Pump Station Costs 7-7
7.4 WPCF Recommendations 7-7
7.4.1 Preliminary Treatment 7-8
7.4.2 Primary Treatment 7-9

7.4.3 Aeration Tanks 7-9
7.4.4 Secondary Clarifiers 7-10
7.4.5 Sludge Pump Station 7-10
7.4.6 Sludge Processing 7-11
7.4.7 Odor Control System 7-12
7.4.8 Disinfection System 7-12
7.4.9 Chemical Feed Systems 7-13
7.4.9.1 Sodium Hypochlorite System 7-13
7.4.9.2 Sodium Hydroxide System 7-13
7.4.9.3 Polymer System 7-13
7.4.9.4 Sodium Permanganate System 7-13
7.4.9.5 Carbon Addition System 7-14
7.4.10 Plant Water System 7-14
7.4.11 Operations Building and Support Facilities 7-14
7.4.11.1 Operations Building 7-15
7.4.11.2 Laboratory Facilities 7-16
7.4.11.3 HVAC and Plumbing 7-16
7.4.12 Electrical Infrastructure 7-17
7.4.13 Controls and Instrumentation 7-17
7.4.14 Hydraulic Profile 7-18
7.4.15 Miscellaneous Items 7-18
7.5 Process Modeling of Recommended Treatment Alternative 7-19
7.6 Plan Development and Public Review Process 7-19
7.7 Opinion of Probable Project Cost 7-20
7.7.1 Basis of Cost Estimate 7-20
7.7.2 Conceptual Level Capital Cost 7-20
7.8 Public Outreach and Participation 7-21
7.9 Project Implementation 7-22
7.9.1 General Permit Requirements 7-22
7.9.2 Anticipated Staffing Needs 7-23
7.9.2.1 Staffing Background Information 7-24
7.9.2.2 NPDES Permit Staffing Requirements 7-24
7.9.2.3 Current WPCF Staffing 7-24
7.9.2.4 NEIWPCC Staffing Recommendations 7-25
7.9.2.4.1 Process Operations 7-26
7.9.2.4.2 Equipment Maintenance 7-26
7.9.2.4.3 Laboratory Operations 7-26
7.9.2.4.4 Collection System Operations 7-26
7.9.2.4.5 Sludge Handling Operations 7-27
7.9.2.5 Staffing Summary Results & Recommendations 7-28
7.9.3 Plant Classification 7-29
7.9.4 Project Financing 7-29
7.9.4.1 Calculation of Five Year Sewer Rates 7-31
7.9.4.2 Sewer Rate Performance to Date 7-31
7.9.5 Implementation Schedule 7-32

TABLES

Table ES-1: Unit BI for the Enfield Collection System
Table ES-2: Future Flows
Table ES-3: Treatment Alternatives Cost Comparison
Table ES-4: Opinion of Probable Project Cost Summary
Table 2-1: CTSDC Population Projections
Table 2-2: Land Use
Table 2-3: Zoning Categories
Table 2-4: Lot Area Requirements by Zoning Category
Table 2-5: 2013 Hartford County Air Quality Index Summary
Table 2-6: National Register of Historic Places
Table 2-7: Average Daily Flows of Potable Water
Table 2-8: Housing Permits Issued
Table 2-9: Future Developments and Applicable Growth Management Principles
Table 2-10: Summary of Final Effluent Constituents with Established Discharge Limits
Table 2-11: Enfield WPCF Nitrogen Credit Exchange Program Results, 2002 - 2015
Table 3-1: Existing Wastewater Flows (January 2010 – December 2013)
Table 3-2: Existing Wastewater Loading (January 2010 – December 2013)
Table 3-3: Additional Flows
Table 3-4: Future Flows
Table 3-5: Future Loads
Table 4-1: Collection System Composition by Pipe Material
Table 4-2: Collection System Composition by Pipe Diameter
Table 4-3: Metering Basin Characteristics
Table 4-4: Storm Events
Table 4-5: Sliicer Output Data Summary
Table 4-6: Pipe Defects and Recommendations
Table 4-7: Internal Manhole Inspection Repair Recommendations
Table 4-8: Confirmed Inflow Sources and Recommendations
Table 4-9: Number of Suspected Inflow Sources
Table 4-10: Indian Run Pump Station
Table 4-11: Sharp Street Pump Station Specifications
Table 4-12: South Maple Street Pump Station
Table 4-13: Grape Brook Pump Station
Table 4-14: South River Pump Station
Table 4-15: Brookside Pump Station
Table 4-16: West Shore Drive Pump Station
Table 4-17: Windsor Court Pump Station
Table 4-18: Simon Road Pump Station Specifications
Table 4-19: Sparkle Street Pump Station
Table 5-1: Existing Plant Design Criteria
Table 5-2: Existing Preliminary Treatment Equipment Design Data
Table 5-3: Existing Primary Clarifiers Design Data
Table 5-4: Existing Secondary Treatment Process Design Criteria
Table 5-5: Existing Secondary Clarifiers Design Criteria
Table 5-6: Existing RAS, WAS, and Scum Pumps Design Data
Table 5-7: Existing Chlorination System Design Criteria
Table 5-8: Existing Plant Water System Design Criteria
Table 5-9: Existing Polymer Feed System Design Data
Table 5-10: Existing Sludge Dewatering System Design Data

Table 5-11: Existing Septage Receiving Station Design Data
Table 5-12: Existing Interim Odor Control System Design Data
Table 5-13: Hydraulic Profile Assessment Conditions
Table 5-14: Summary of Needs and Opportunities for Existing Facilities
Table 6-1: BioMag Alternative – Conceptual Design Summary
Table 6-2: BioMag Alternative – Aeration Tanks Proposed Configuration
Table 6-3: 4-Stage BNR Process Alternative – Conceptual Design Summary
Table 6-4: 4-Stage BNR Process – Aeration Tanks Proposed Configuration
Table 6-5: VOM - BNR Process Alternative – Conceptual Design Summary
Table 6-6: VOM – BNR Process Alternative – Aeration Tanks Proposed Configuration
Table 6-7: IFAS Process Alternative – Conceptual Design Summary
Table 6-8: IFAS Process Alternative – Aeration Tanks Configuration
Table 6-9: Proposed Biological System Effluent Requirements
Table 6-10: Nitrogen General Permit Requirements[1] - 2015
Table 6-11: Comparative Costs – Biological System Alternatives Evaluation
Table 6-12: Equivalent Present Worth Cost (PWC)
Table 6-13: Equivalent Uniform Annual Cost (EUAC)
Table 6-14: Summary of Advantages & Limitations of Alternatives Proposed
Table 6-15: Comparative Costs - Aeration Tank Mixing System Alternatives Evaluation
Table 6-16: Equivalent Uniform Annual Cost (EUAC)
Table 6-17: Equivalent Present Worth Cost (PWC)
Table 6-18: Advantages and Limitations of Mixing System Alternatives
Table 6-19: Future Sludge Quantities
Table 6-20: Advantages & Limitation of Sludge Storage Alternatives
Table 6-21: Huber Screw Press Piloting Results
Table 6-22: Huber Sludge Test Conclusions
Table 6-23: Fournier Rotary Press Piloting Results
Table 6-24: Westfalia Centrifuge Lab Results
Table 6-25: Comparison of Throughput and Performance
Table 6-26: Comparative Costs - Solids Processing Alternatives Evaluation
Table 6-27: Equivalent Uniform Annual Cost (EUAC)
Table 6-28: Equivalent Present Worth Cost (PWC)
Table 6-29: Advantages & Limitations of Sludge Processing Alternatives
Table 6-30: Rating Matrix – Solids Processing Evaluation
Table 6-31: Summary of Air Flows and Loadings
Table 6-32: Summary of Odorous Air Treatment Alternatives
Table 6-33: Comparative Costs - Odor Control System Alternatives Evaluation
Table 6-34: Equivalent Uniform Annual Cost
Table 6-35: Equivalent Present Worth Cost (PWC)
Table 6-36: Summary of Recommended Project Costs for Common Facilities
Table 6-37: Comparative Costs - Building Layout Alternatives Evaluation
Table 6-38: Equivalent Uniform Annual Cost (EUAC)
Table 6-39: Equivalent Present Worth Cost (PWC)
Table 6-40: Summary of Advantages & Limitations of Building Alternatives Considered
Table 6-41: Enfield Pump Station Energy Usage Summary – 2014 and 2015
Table 6-42: Annual Electrical Usage and Costs Summary – 2014 and 2015
Table 6-43: Projected Annual Cost and Savings Summary – Pump Stations
Table 6-44: Enfield WPCF Energy Usage Summary – 2013
Table 6-45: Projected Annual Cost and Savings Summary – Upgrade ECMs
Table 6-46: Projected Annual Cost and Savings Summary – Short-Term ECMs
Table 6-47: Renewable Energy Alternative Summary

Table 7-1: Recommended Collection System Repair Cost Summary
Table 7-2: Recommended Pump Station Improvements Cost Summary
Table 7-3: Conceptual Level Cost Estimate Summary – Recommended Plan (2016 Costs)
Table 7-4: List of Permits Required
Table 7-5: Summary of Current Staffing and License Holding
Table 7-6: Tabulated NEIWPCC Staffing Recommendations
Table 7-7: Summary of Current and Recommended Staffing
Table 7-8: Enfield WPCA Rate Structure
Table 7-9: Cost of Service Projection
Table 7-10: Revenues Generated During First 12 Months of Sewer Rate

FIGURES

Figure 2-1: Town Zoning Map
Figure 2-2: Elevation Contours
Figure 2-3: Flood Hazards
Figure 2-4: Septic System Repairs, Surficial Materials, and Proposed Sewer Extensions
Figure 2-4A: Legend
Figure 2-5: Wetlands
Figure 2-6: Natural Diversity Areas
Figure 2-7: Open Space
Figure 2-8: Aquifer Protection Areas
Figure 2-9: Septic Systems within Sewer Service Area
Figure 2-10: Existing DEEP Sewer Service Area
Figure 2-11: Approved Development and Zoning
Figure 2-12: OPM 2013-2018 Conservation & Development Policies Map
Figure 2-13: Proposed Sewer Service Area
Figure 3-1: WPCF Flow Composition
Figure 3-2: Collection System Model
Figure 4-1: Collection System & Pump Station Service Map (D Size)
Figure 4-2: Gravity Sewer Pipe Material
Figure 4-3: Gravity Sewer Pipe Diameter
Figure 4-4: Enfield WPCF Rainfall/Groundwater – Flow Relationship
Figure 4-5: Flow Metering Map
Figure 4-6: CCTV Location Map
Figure 4-7: Manhole Survey Map
Figure 4-8: Sharp Street Pump Station Replacement – Alternative 1
Figure 4-9: Sharp Street Pump Station Replacement – Alternative 2
Figure 4-10: Smoke Testing Map
Figure 4-11: Smoke Testing Confirmed Inflow Source Locations
Figure 4-12: South Maple Street Pump Station Flood Elevations
Figure 4-13: Windsor Court Pump Station Flood Elevations
Figure 4-14: Flow Monitoring Schematic
Figure 4-15: Flow Monitoring Period Rainfall
Figure 4-16: Local Groundwater
Figure 4-17: Regional Groundwater
Figure 4-18: Sliicer Output – Wastewater vs. Base Infiltration
Figure 4-19: Sliicer Output – Normalized Wastewater vs. Base Infiltration
Figure 4-20: Sliicer Output – RDII per Basin by Storm
Figure 4-21: Sliicer Output – Normalized RDII per Basin by Storm
Figure 4-22: Percent of Total Normalized BI by Basin
Figure 4-23: Percent of Total Normalized RDII by Basin for 4/8/2015 Storm

Figure 5-1: Enfield WPCF Aerial View
Figure 5-2: Enfield WPCF Existing Flow Diagram
Figure 5-3: Enfield WPCF FEMA Flood Map
Figure 5-4: Enfield WPCF Existing Hydraulic Profile
Figure 6-1: BIOMAG Process Configuration
Figure 6-2: Four-Stage BNR Process Configuration
Figure 6-3: Variable Operating Mode (VOM) Alternative – Conceptual Process Flow Schematic
Figure 6-4: IFAS System Configuration
Figure 6-5: Cost Analysis Matrix
Figure 6-6: Aquifer Protection and Sewer Service Areas
Figure 6-7: Natural Diversity and Sewer Service Areas
Figure 6-8: Farmland Soils and Sewer Service Areas
Figure 6-9: Wetlands and Sewer Service Areas
Figure 7-1: Proposed Site Layout
Figure 7-2: Proposed Process Flow Diagram
Figure 7-3: Conceptual / Proposed Headworks Building
Figure 7-4: Proposed Hydraulic Profile
Figure 7-5: Water Consumption by Tier (20kG/qtr)
Figure 7-6: Implementation Schedule

EQUATIONS

Equation 3-1: Manning Equation for Open Channel Flow
Equation 4-1: Stevens-Shutzbach Equation for Base Infiltration

APPENDICES

Appendix A: NPDES Permit
Appendix B: Fish and Wildlife Service Correspondence
Appendix C: CCTV Inspection Report
Appendix D: Flow Monitoring Report
Appendix E: Collection System Hydraulic Modeling Report
Appendix F: Manhole Inspection Reports
Appendix G: Smoke Testing Report
Appendix H: Existing Plant Design Criteria
Appendix I: Unit Process Capacity Analysis
Appendix J: Pre-Renovation Hazardous Materials Inspection
Appendix K: Manufacturers Proposals for Biological Treatment System
Appendix L: Manufacturers Proposals for Aeration tank Mixing System
Appendix M: Conceptual Design Criteria for Recommended Plan
Appendix N: Huber Screw Press Pilot Test Report – Conceptual Drawing
Appendix O: Fournier Rotary Press Pilot Test Report- Conceptual Drawing
Appendix P: Westfelia Centrifuge Bench Test Report
Appendix Q: Odor Control Evaluation Report
Appendix R: Cost Estimates
Appendix S: Conceptual Layouts for Building Alternatives
Appendix T: Pump Stations Energy Evaluation Report
Appendix U: WPCF Energy Evaluation Report
Appendix V: Dynamic Treatment Process Model Results
Appendix W: NEIWPCC Staffing Analysis

EXECUTIVE SUMMARY

The Town of Enfield is a well-established community located in Hartford County, eighteen miles north of Hartford, Connecticut and eight miles south of Springfield, Massachusetts. The Town encompasses 34.2 square miles, and had a population of 44,654 during the 2010 Census.

The Town of Enfield owns and operates a sanitary collection system and water pollution control facility (WPCF) that serve the needs of the Town's sewered population. This Facilities Plan includes an evaluation of the wastewater needs of the Town to achieve water quality objectives over the next 20 years. Facilities planning must be performed to satisfy the Connecticut Department of Energy and Environmental Protection Agency (DEEP) whenever major changes are planned to a collection or treatment system.

KEY GOALS OF THE FACILITIES PLAN

This facilities plan was written to determine the wastewater collection and treatment needs of the Town of Enfield for a planning period of twenty years. Strategies to meet those needs are included, as well as a financial plan to pay for the required improvements. The key issues facing the Town of Enfield include: 1) collection system deficiencies; 2) aging and deteriorating infrastructure at the water pollution control facility; and 3) old and inefficient equipment at the pumping stations.

The primary objectives of the Facilities Plan include:

- Identify future needs of the treatment plant by estimating future flows and loads over the next 20 years;
- Identify and prioritize collection system areas with excessive amounts of infiltration and inflow (I/I) and determine if it is cost effective to make repairs or continue to transport and treat these flows;
- Evaluate and identify pump station and WPCF infrastructure deficiencies and limitations and develop a comprehensive sewerage plan to systematically and cost-effectively address these needs;
- Establish a funding strategy which examines the use of grants, low interest loans, and other contributions to finance capital improvements;
- Implement a public outreach program that assures future improvements are supported by the community; and
- Provide an implementation schedule for the recommended improvements.

COLLECTION SYSTEM EVALUATION

The sanitary collection system includes approximately 210 miles of gravity sewer pipe, 16 pump stations and associated force mains. Portions of the system were constructed in the 1930's and were designed to convey both wastewater and stormwater. Several studies and projects were performed from the 1970's through the early 2000's to identify and remove sources of infiltration and inflow (I/I). While these efforts were successful in removing a large portion of I/I entering the system, flows and loads analysis indicate that on an average day, approximately 0.75 million gallons per day (mgd) of inflow is entering the collection system due to rainfall events and 0.55 mgd of infiltration enters when the groundwater is high.

In an attempt to locate and quantify sources of clean water entering the system, an I/I study and a Sanitary Sewer Evaluation Survey (SSES) were completed as part of this plan. The I/I study goals include: (a) performing rainfall, groundwater and flow monitoring to examine I/I during various groundwater conditions and precipitation events; (b) initiating infiltration investigations using flow monitoring results and (c) identifying and prioritizing basins with I/I problems. The SSES study goals include: (a) locating specific I/I sources, (b) ranking and prioritizing observed I/I sources and (c) performing a cost effectiveness analysis of removing I/I sources.

Twelve (12) temporary flowmeters were installed throughout the collection system to measure flowrates over a period of 8 weeks, from March 17 to May 20, 2015. Infiltration and inflow unit rates were identified for each flow-metering basin to identify infiltration and inflow problem areas, respectively. The Connecticut Department of Energy and Environmental Protection Agency (DEEP) does not publish guidelines for excessive amounts of I/I, but the Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection Agency (MassDEP) do and therefore these standards were utilized for comparison purposes. As shown in Table ES-1, no flow metering basins (FM) exhibited Base Infiltration (BI) rates above the EPA or MassDEP thresholds, indicating that infiltration is not a significant contributor to extraneous flow in the Enfield collection system.

Table ES-1: Unit BI for the Enfield Collection System

EPA Threshold	MassDEP Threshold	Maximum Infiltration (FM1)	Minimum Infiltration (FM3)
3,000 gpd/idm	4,000 gpd/idm	1,829 gpd/idm	398 gpd/dim

In terms of wet weather inflow, three flow metering basins showed excessive unit Rainfall Dependent I/I (RDII) rates as compared to the remaining collection system. The three areas (FM7, FM8, and FM9) together accounted for close to 75% of all RDII in gallons per foot of pipe for the 4/8/2015 storm. These basins are all located in the Thompsonville area of Town, which contains the oldest pipes.

The following conclusions are made from the I/I study:

- The lack of significant BI rates during high groundwater conditions suggests that infiltration is not a significant component of I/I in Enfield; and
- The majority of inflow originates in the Thompsonville part of the collection system.

As part of the SSES, closed circuit television (CCTV) inspection of sewer pipes, manhole inspections, and smoke testing were performed to locate specific I/I sources. The SSES activities were targeted in high priority areas identified during the I/I study. A summary of the major findings for each program are listed below:

- CCTV Sewer Pipe Inspections – Sewer pipes were inspected in the Thompsonville area and Grape Brook pump station service area. Defects found indicating I/I include root infested pipe joints, mineral deposits, and active infiltration. Pipe fractures and deformations on Whitworth Street are prioritized for structural repair. Other lower priority structural defects on High Street and North Main Street are also recommended for repair. Overall, little evidence of direct infiltration was found.
- Manhole Inspections – Manholes were located and inspected throughout the Thompsonville area of the collection system, primarily due to a lack of existing mapping in that area. Evidence of I/I includes isolated active infiltration, mineral deposits, and root intrusions. High priority structural and maintenance issues were noted, including hydrogen sulfide deterioration, defective covers, debris and sediment buildup, and structural defects. Repair recommendations were made for five manholes, including rebuilding of bench and inverts, repair of cementitious lining, and resetting of a frame and cover.
- Smoke Testing – Smoke testing was performed throughout most of Thompsonville. The initial results indicate that several roof leaders from private homes and businesses are connected to the Town's sanitary collection system. A few catch basins and yard drains were also found to be connected. It is recommended that these sources be disconnected.

A detailed survey of the Connecticut River interceptor pipe and manholes was performed to confirm capacity and identify structural issues. Both the hydraulic model and the flow allocation spreadsheet indicate that is a capacity concern with a 24-inch diameter pipe on the interceptor, located between Meetinghouse Lane and Bridge Lane. The rest of the interceptor consists of primarily 30 to 36-inch diameter pipe. The installation of a relief sewer between Meetinghouse Land and Bridge Lane is recommended to prevent possible surcharging.

PUMP STATION EVALUATIONS

The Town owns and operates sixteen pumping stations including:

- 7 submersible stations;
- 3 pneumatic ejector stations;
- 5 conventional wet well/dry well stations; and
- 1 suction lift station.

The condition of the pumping stations varies from poor to satisfactory. Pneumatic ejection is an older technology that uses an air compressor to pressurize a metal vessel to convey wastewater. The metal vessels are located at the end of a deep underground shaft which puts the safety of workers at risk while they're being maintained. We recommend that the ejectors be replaced with submersible pumps, which will require new concrete wet wells to be installed. Upgrades required at other pump stations include replacing pumps with more energy efficient models, generators, automatic transfer switches, and other improvements. The South River pump station in particular requires complete replacement due to failing structural integrity of the building, and aging pumps and equipment.

Four pump stations, including Sharp Street, Windsor Court, Moody Road and Taylor Road, were investigated for feasibility of replacement with gravity sewer. In each case, replacement of the pump station with gravity sewer was found to not be feasible due to elevation or topography. Other alternatives for the Sharp Street pump station were investigated including replacing the existing station, which is nearly 40 feet deep, with two separate smaller stations or grinder pump systems for residents and one new pump station. We recommend replacing the station with two smaller stations.

WPCF EVALUATION

The WPCF was originally constructed in the late 1930's and updated in the early 1970's. It utilizes mostly aging and outdated equipment that has required an increasing amount of maintenance. The WPCF was originally designed to treat 10 million gallons per day (MGD), and currently treats an average daily flow (ADF) of approximately 5.3 MGD. The future ADF is estimated to increase to 5.5 MGD. In general, the effluent leaving the WPCF meets the current permitted requirements, and more stringent effluent permit requirements are not anticipated in the future.

The existing treatment processes at the WPCF comprise of preliminary treatment (screening / comminution and grit removal), primary sedimentation (two circular clarifiers), secondary treatment (four aeration basins and four secondary clarifiers), and disinfection using sodium hypochlorite. Waste activated sludge is co-settled in the primary clarifiers before it is dewatered using two belt filter presses.

An assessment of the physical condition and remaining useful life of the existing WPCF equipment was performed as part of this report. The results of the assessment were used to estimate the cost to modify or rehabilitate existing facilities. The general findings of the condition assessment are that much of the WPCF unit processes and equipment have surpassed their design lives and should be considered for replacement or major rehabilitation. Repairing or replacing the aging facilities will require a significant investment in the next 20 years. The major findings and replacement needs are summarized in Table 5-13.

PROJECTED FUTURE NEEDS

Future capacity needs of the WPCF were developed by projecting the influent flow and loads to the WPCF over the next twenty years. These projections were based on water usage records, population trends, and historical WPCF monthly operating report data. Anticipated growth was checked for consistency with both the State and Town Plans of Conservation and Development. We also met with Town Planners and officials from nearby communities to account for expected growth and future sewer users in the Town of Enfield. The existing and future flows are presented in Table ES-2.

Table ES-2: Future Flows

	Peaking Factor	Existing	Future	Unit
Flow				
Average Annual		5.25	5.50	mgd
Peak Hour	3.1	16.2	17.0	mgd
Maximum Month	1.4	7.2	7.6	mgd
Minimum Month	0.7	3.9	4.0	mgd
Maximum Week	1.9	9.9	10.3	mgd
Maximum Day	2.7	14.1	14.8	mgd

As shown, the future flows are not expected to be much higher than the existing flows.

TREATMENT ALTERNATIVES EXPLORED

To achieve compliance with the requirements of the NPDES permit, enhance nitrogen removal capabilities, and improve wet weather flow management, a range of potential treatment alternatives are available. The following were considered the most viable alternatives worthy of consideration:

1. Biomag Process
2. Four-Stage Biological Nutrient Removal (BNR) Process
3. Variable Operating Mode (VOM) / BNR Process
4. Integrated Fixed-film Activated Sludge (IFAS)

The viable alternatives were evaluated with respect to capital, O&M, site layout, and process control flexibility to treat the estimated 20-year projection of flows and loads. Each alternative is capable of meeting the anticipated effluent permit requirements.

The “do nothing” alternative was investigated. In this alternative, the estimated costs associated with leaving the WPCF in its existing configuration are evaluated, without making any upgrades. The do nothing alternative is not feasible at the Enfield WPCF because the equipment has surpassed the useful design life and will not last another 20 years. Without the replacement of existing equipment and a reconfiguration of the existing process, the plant will not be able to consistently treat the estimated future flows and loads and meet the permit requirements.

A cost comparison of each alternative is presented in Table ES-3. Operating costs include operational, electricity, sludge processing, chemicals, and maintenance. All of the alternatives have a significant capital cost, but each will result in improved performance and reliability. As shown in Table ES-3, the Four Stage BNR and VOM / BNR Processes have similar low capital and O&M costs compared to the other two alternatives. We recommend the

Table ES-3: Treatment Alternatives Cost Comparison

Alternative	Total Capital Cost	O&M Annual Cost	Total PWC
1 – Biomag	$10,284,000	$391,000	$16,677,000
2 – Four Stage BNR	$5,146,000	$162,000	$7,795,000
3 – VOM / BNR	$5,219,000	$146,000	$7,606,000
4 - IFAS	$9,722,000	$221,000	$13,336,000
Notes: Costs presented in 2015 dollars. PWC: Present Worth Cost			

VOM / BNR alternative be selected based on lower equivalent present worth cost and improved operational flexibility over the Four Stage BNR process.

RECOMMENDED PLAN

COLLECTION SYSTEM RECOMMENDATIONS

Overall, little evidence of I/I was found during the SSES. This is not surprising since the flow to the WPCF never exceeded four times the average daily flow during the past four years, which is a relatively low ratio. The only deficiencies that were found included structural defects that must be repaired and illicit connections from private properties. Recommended repairs for manholes and pipes are intended to address structural issues noted during inspection. Our opinion of probable cost for the recommended collection system repairs is $354,000, including contingency and overhead. We recommend that the Town develop a program to televise and clean their collection system on a regular basis.

PUMP STATION RECOMMENDATIONS

The following major recommendations were made as a result of the pump station evaluation. These recommendations are critical to reduce preventative O&M, increase reliability, and improve emergency readiness:

- Replace pneumatic ejector stations with submersible pump stations to improve reliability and increase worker safety;
- Replace the Sharp Street pneumatic ejector station with two separate pump stations to reduce the required wetwell depth from 40 feet to 20 feet or less;
- Replace the South River Street pump station with a new wet well and dry well configuration on a new site;
- Replace two of the existing pumps and related electrical, and replace the roof at the Grape Brook pump station; and
- Replace the existing pumps and related electrical, and replace the roof at the South River pump station

Our opinion of probable project cost to upgrade the pump stations is $8,710,000.

WPCF RECOMMENDATIONS

To meet the Town's NPDES Permit requirements, improve nitrogen removal capabilities, and accommodate for future flows and loads that are projected over the next twenty years, the following improvements are recommended:

- Headworks: Replace the existing mechanical bar screen with a new unit, and upgrade the existing comminutor to a new mechanical screen. Replace the existing screenings washer and compactor with a new unit that is capable of handling screenings from both new screens. Enclose this new equipment inside a new Headworks structure to be located on top of the existing headworks structure. Treat odorous air from inside this building using new odor control equipment to be located inside the Operations Building.
- Grit Chamber: Replace diffusers and install a new clamshell or other type of grit removal equipment to remove grit from the existing chambers. Provide new aeration blowers that will be dedicated to the grit chambers to improve performance. Treat the odorous air from the headspace in the grit chamber to reduce odors at the plant.
- Primary Clarifiers: Replace the primary clarifier equipment, motors, gear reducers, walkways, handrails, weirs, and baffles. This equipment has been in service for over 40 years and has surpassed its useful design life. The slide gates in the distribution box upstream of the primary clarifiers leak excessively and also need to be replaced. Some of the valves and piping inside the primary sludge pump gallery might also need to be replaced.
- Liquid Treatment: Replace the 43-year-old centrifugal aeration blowers with newer, energy efficient blowers. Upgrade all of the ceramic style diffusers with membrane diffusers that will be more efficient and easier to maintain. Replace the mixing system in the anoxic zones of the biological reactors with a compressed gas mixing system. The recommended VOM / BNR process will allow for operational flexibility depending on seasonal temperature variations and is designed to protect from washout during extreme wet weather flow events. As part of this upgrade, new sludge recirculation and wasting pumps will also be installed.
- Solids Processing: Replace the two belt filter presses with two rotary screw presses. The dewatered sludge will be conveyed to the roll-off container using new shaftless screw conveyors. The new presses and conveyors will reduce odors, water use, and the labor required to process sludge. We also recommend constructing two new gravity thickeners. This equipment will improve the liquid treatment process and increase sludge processing performance. The estimated cost to construct these is approximately $4.3 million, so we suggest that they be included as a design alternate.
- Effluent Plant Water System: Replace the existing effluent plant water system with a new packaged plant water pumping system in the lower level of the proposed blower/ sludge building. The system will be designed to maintain a constant system discharge pressure at variable flow demands and will supply water throughout the WPCF.
- Support Facilities: Provide additional improvements at the Operations Building. These improvements include providing bathrooms that meet the Americans with Disabilities Act (ADA) requirements, demolishing the incinerator to make room for the new sludge processing and aeration equipment, providing a larger space for the laboratory, structural improvements including removing and replacing a portion of the exterior walls to allow the old sludge processing equipment to be removed, replacing the roof, updating of the heating and ventilation equipment, and other architectural improvements including new windows and doors.
- Chemical Systems: The chemical feed systems proposed include: (1) a low-cost sodium hydroxide storage and feed equipment to provide pH adjustment if needed; (2) polymer addition requirements for the proposed sludge processing equipment; and (3) storage and feed pumps for a carbon source which may be needed to enhance nitrogen removal.

A proposed site plan and process flow diagram indicating the recommended improvements to the WPCF are presented in Figures 7-1 and 7-2, respectively. Our opinion of probable costs for the recommended WPCF upgrade, pump station improvements, and collection system repairs is $36 million. This opinion of probable cost does not include the $4.3 million for the gravity thickeners. A breakdown of the opinion of probable cost is presented in Table ES-4.

Table ES-4: Opinion of Probable Project Cost Summary

Item #	Item	Cost
1	Facilities Plan & I/I Study	$1,111,559
2	WPCF Upgrades	$25,801,000
3	Collection System Repairs	$354,000
4	Pump Station Upgrades	$8,710,000
Total Project Cost		**$35,977,000**

FUNDING / FINANCING

Because the Town decided to switch from an *ad valorem* to a user-based system, this project is eligible for funding through the State's Clean Water Fund (CWF) program. The CWF program provides grants and low-interest loans for wastewater abatement projects. Furthermore, the Town recently implemented a sewer fee program that was designed to pay for the improvements recommended as part of this plan. This fee is expected to generate $5,681,000 per year over the next 5 years and will fund annual debt service associated with a CWF loan. After a period of 5 years, it is recommended that the Town reassess its sewer fees for possible changes in funding requirements. The flat 5-year sewer fee was designed to meet projected FY2016 revenue requirements.

In addition to the standard loans and grants of the CWF as detailed above, the Town of Enfield will qualify for grant money from Eversource for upgrading to premium efficient motors, replacing outdated lighting and HVAC equipment, and for other energy efficiency improvements at the WPCF and the pumping stations.

The proposed WPCF upgrade will result in a cost effective and reduction in the discharge of pollutants from the WPCF. In addition, the long term reliability of the plant will be enhanced through the replacement and upgrade of various aging systems at the plant in order to improve wet weather operations and handle future flows and loads.

IMPLEMENTATION PLAN

An implementation schedule for the project is presented in Figure 7-6. This schedule is based upon this report being approved by DEEP in September of 2016. In preparing the schedule of implementation, the following prioritization has been assigned to the recommendations:

- Proceed with the design of the WPCF, pump station, and collection system improvements;
- Construction of high priority collection system and pump station improvements;
- Construction of the WPCF improvements; and
- Construction of the remaining collection system and pump station improvements.

1. INTRODUCTION

1.1 BACKGROUND

The Town of Enfield is located in Hartford County, eighteen miles north of Hartford, Connecticut and eight miles south of Springfield, Massachusetts. The Town encompasses 34.2 square miles, and had a population of 44,654 during the 2010 Census.

The Enfield Water Pollution Control Facility (WPCF) is a publicly owned, activated sludge facility that was originally constructed as a primary treatment facility in 1938. Treated effluent from the facility is discharged to the Connecticut River. The last major upgrade occurred in 1972 when secondary treatment was added. A sludge processing system upgrade that was completed in 1996 when two belt filter presses, a sludge storage tank, and an odor control system were installed. Another retrofit was completed in 2004 when baffles and equipment were added to the aeration tanks to enhance nitrogen removal. Other minor improvements have occurred over the years, but the majority of the existing equipment exceeds its design life.

In addition to the 10 million gallons per day (MGD) WPCF, the Town also owns and operates a sanitary sewer collection system comprised of approximately 210 miles of sewer pipes, sixteen pump stations, and two inverted siphons. The sanitary wastewater is collected from private, commercial, and industrial users throughout the Town serving approximately 97% of the Town's residents.

The Town of Enfield previously used an *ad valorem* tax structure, based on assessed property values, to apportion capital and annual O&M costs to the WPCF and collection system. The *ad valorem* funding structure faced many challenges in its ability to consistently fund a sewer program. In an *ad valorem* system, each sewer improvement puts pressure on the Town's mill rate and sewer often loses out to other capital needs of the community. Additionally, an *ad valorem* funding system is not considered an equitable means of apportioning sewer costs because low volume sewer users in higher valued properties pay a larger sewer fee than high volume sewer users in lower valued properties. For these reasons, Enfield implemented a sewer fee based on water usage per user in January of 2014.

Based upon our projections, a sewer use charge billed directly to each household and business owner based upon their specific water consumption provides the Town with more equitable means of sharing sewer costs and access to external funding resources not available to municipalities that use property tax-based funding systems.

1.2 PROJECT GOALS

In addition to an aging WPCF and collection system, the Town of Enfield is facing compliance schedules through their new National Pollution Discharge Elimination System (NPDES) permit, shown in Appendix A. The State of Connecticut Department of Energy and Environmental Protection (DEEP) issued Notices of Violation in September 2010, requiring the Town to correct outstanding issues with the Odor Control System, mechanical bar screen, and leaking slide gate upstream of the primary clarifiers. The new NPDES permit in November 2013 requiring compliance with the new bacteria limits (Escherichia Coli), and implementation of corrective measures aimed at controlling objectionable odors. For these reasons, the Town of Enfield retained Woodard & Curran in 2014 to complete this Wastewater Facilities Plan.

The overall purpose of the facilities planning process is to understand the current and estimate the future wastewater generation needs of the Town and to determine the most cost-effective manner of providing collection and treatment facilities to meet those needs. Based upon the current status of the Town of Enfield's WPCF, collection system, and schedule of financial appropriation, the facilities planning effort will be performed in two phases. The phase 1 tasks focus almost entirely on the WPCF and include an estimation of future flows, and an alternatives analysis to satisfy the requirements of the recently issued permit. Phase 2 of the project includes an evaluation of the pumping stations, identifying deficiencies within the collection system including locating and quantifying sources of infiltration and inflow.

A hydraulic model of the collection system was also created, as was mapping of the Thompsonville area of the collection system.

1.3 FACILITIES PLANNING OVERVIEW

Facilities planning is the process used to determine the water pollution control system needs for a 20-year planning period. Strategies are developed within the plan to meet those needs, and the basis for subsequent design and construction is provided. In addition to an evaluation of the existing wastewater treatment facilities and future system needs, the existing and projected demographic characteristics, topographic, hydrologic and institutional features of the study area and their impact on the wastewater treatment needs are also examined. Analysis is provided herein for historic and future planning periods. In this plan, the historic period includes the operating years from January 2010 through December of 2013. Facility operations are evaluated during this period relative to the treatment plant capacity and operation and include concerns such as flow rates, pollutant loadings, permit compliance and operating efficiency.

The future planning period includes the 20-year period beginning in the year 2019 and extending through the year 2039, which represents 20 years beyond the date in which the proposed facilities are expected to be operational. It is during this timeframe that the future wastewater treatment needs are evaluated. A number of liquid and solids handling techniques were investigated to determine the most feasible for meeting the Town's needs as well as anticipated regulatory requirements during the future planning period.

1.4 ORGANIZATION OF REPORT

This Report has been organized such that it is compatible with the Facilities Planning guidance document entitled "Construction Grants 1985" (CG-85) published by the Environmental Protection Agency in 1985. In addition, the "TR-16 - Guides for the Design of Wastewater Treatment Works" as published by the New England Interstate Water Pollution Control Commission, and the "MOP-8 - Design of Municipal Wastewater Treatment Plants" as published by the Water Environment Federation and the American Society of Civil Engineers were also used. A brief description of the chapters contained in this Plan and their content is described below.

- ***Chapter 1*** - Includes background information related to the Wastewater Facilities Planning process, defines the project goals, describes the organization of the plan, and provides a list of previous studies used as reference for this plan.
- ***Chapter 2*** - Includes information on the existing physical, organizational, environmental and demographic conditions within the Study area. This information is used to establish the existing conditions, determine trends, possible development potential and predict future conditions within the study area that are pertinent to the future wastewater treatment requirements. This chapter also includes information relative to the existing environmental conditions within the study area. Environmental conditions include land use requirements, air quality, climate, subsurface soil conditions, flood and floodway zones, public water supply analysis, hydrology of the area and other considerations that may have an impact on the results of this Plan.
- ***Chapter 3*** – Establishes the current wastewater flows and nutrient loads at the WPCF and establishes the flows and loads directly related to domestic and commercial uses, industrial, and septage. This information on individual waste characterizations is then used in conjunction with demographic projections to estimate the future flows and nutrient loads at the treatment plant for the planning period.
- ***Chapter 4*** – Includes the capabilities and limitations of the existing collection system and pump stations as well as recommended improvements. This evaluation is then used to recommend the most cost-effective alternative to meet future needs.
- ***Chapter 5*** - This chapter includes a review of the capabilities and deficiencies of the existing WPCF. A summary of needs is also included in this Chapter.

- ***Chapter 6*** – This chapter includes an evaluation of the wastewater treatment and sludge processing alternatives. These include increasing the capacity to accommodate the predicted flows and loads, improving performance during wet weather, improving the management of odors, and enhancing nutrient removal. This Chapter also includes a detailed analysis of viable alternatives investigated. Consistency of these alternatives with future planning needs and wasteload allocations are provided. This analysis is the basis for evaluation of viable alternatives. An investigation into energy recovery and energy saving alternatives and cost estimates of each alternative are also included in this Chapter. The environmental impact evaluation is also included in this Chapter.
- ***Chapter 7*** - Provides a detailed presentation of the selected plan. As part of this presentation, a detailed description of the proposed treatment works is provided. Preliminary building layouts and design information are presented in this chapter. A discussion of the reuse of existing facilities is presented as well as a description of each unit process and its fit within the overall plan. Finally, financial analysis and schedule of implementation of the selected plan are provided.

1.5 PREVIOUS STUDIES

Previous engineering studies have been performed that have addressed various wastewater needs for the Town. These reports have been utilized as applicable within this Plan and include the following:

- Metcalf & Eddy - WPCF O&M Manual – 1972;
- Metcalf & Eddy report entitled "Report to Town of Enfield, Connecticut on Waste Water Treatment Facilities Main Trunk Sewer and Asnuntuck Pumping Station," dated September 15, 1967;
- F&O - Sludge Processing Upgrade Report – 1996;
- CDM - Interim Nitrogen Retrofit Report – 2004; and
- Peter J. Smith & Company – Town of Enfield Plan of Conservation & Development – 2011.

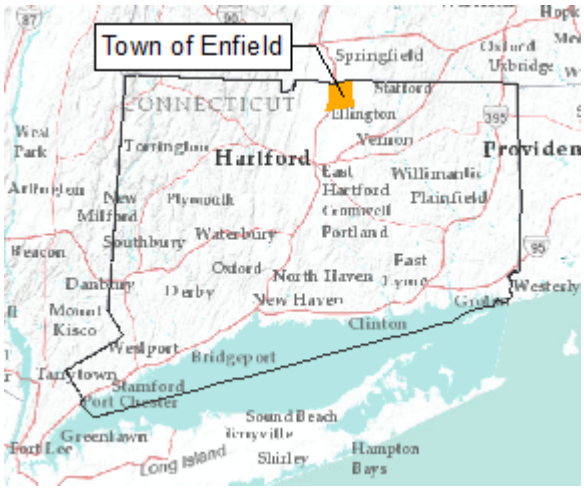
2. PROJECT PLANNING AREA

2.1 INTRODUCTION

The information contained in this chapter defines the planning area and describes the existing physical conditions and demographics within the study area. This information provides the basis for the determination of existing and future flows and loads, the analysis of alternatives, and the assessment of environmental impacts. In addition, the existing sewer service area and proposed changes to the sewer service area are discussed.

2.2 PROJECT LOCATION AND PLANNING AREA

The Town of Enfield encompasses a total area of 34.2 square miles and lies east of and adjacent to the Connecticut River. Enfield shares borders with Suffield and Windsor Locks to the West, East Windsor and Ellington to the South, Somers to the East, and Longmeadow and East Longmeadow, Massachusetts to the North. As shown in the figure on this page, the Town of Enfield is located along Route 91 between the cities of Hartford, Connecticut and Springfield, Massachusetts.



Project Location and Planning Area

The study planning area includes the Town of Enfield's wastewater collection system and Water Pollution Control Facility (WPCF). The adjacent towns of Suffield, Windsor Locks, East Windsor, Somers, and Longmeadow are served by their own sewer systems, but a prison complex in Somers and a restaurant in East Windsor are connected to the Enfield collection system. All wastewater collected in the Enfield system is treated at the Enfield WPCF. The majority of Enfield residents and businesses are served by the collection system, however a number of homes use on-site subsurface wastewater disposal systems. Most of the equipment at the treatment facility that serves a portion of the Town of Somers has surpassed its useful design life, so there is a potential that wastewater generated from Somers would be treated in Enfield. Additional information related to the flows from the facility is included in Chapter 3. None of the other neighboring towns are planning to connect to the Enfield sewer system within the 20-year planning period, so potential wastewater flows from these communities are not considered in this plan.

2.3 POPULATION AND DEMOGRAPHICS

The Town of Enfield is part of the Capitol Region planning area of the state, which comprises the towns of Andover, Avon, Berlin, Bloomfield, Bolton, Bristol, Burlington, Canton, Cromwell, East Granby, East Haddam, East Hampton, East Hartford, East Windsor, Ellington, Enfield, Farmington, Glastonbury, Granby, Hartford, Hebron, Manchester, Marlborough, Middletown, Newington, New Britain, Plainville, Portland, Rocky Hill, Simsbury, Somers, South Windsor, Southington, Stafford, Suffield, Tolland, Vernon, West Hartford, Wethersfield, Windsor, and Windsor Locks. The Capitol Region Council of Governments (CRCOG) is the regional planning authority for the Capitol Region.

Demographic information has been obtained and compiled from several sources, including the Connecticut State Data Center (CTSDC), the U.S. Census Bureau, and the CRCOG. See Table 2-1 for a summary of the Town, County, and State census populations and population projections for the years 2015, 2020, and 2025. As of the 2010

Table 2-1: CTSDC Population Projections

		Enfield		Hartford County		State of Connecticut	
	Year	Population	Growth Rate	Population	Growth Rate	Population	Growth Rate
Census	1950	15,464	-	539,661	-	2,007,280	-
	1960	31,464	103.5%	689,555	27.8%	2,535,234	26.3%
	1970	46,189	46.8%	816,737	18.4%	3,031,709	19.6%
	1980	42,695	-7.6%	807,766	-1.1%	3,107,576	2.5%
	1990	45,532	6.6%	851,783	5.4%	3,287,116	5.8%
	2000	45,212	-0.7%	857,183	0.6%	3,405,565	3.6%
	2010	44,654	-1.2%	894,014	4.3%	3,574,097	4.9%
Projected	2015	43,573	-2.4%	910,921	1.9%	3,644,546	2.0%
	2020	42,304	-2.9%	925,491	1.6%	3,702,472	1.6%
	2025	40,776	-3.6%	936,811	1.2%	3,746,184	1.2%

census Enfield's population was 44,654. The Town's population has remained relatively stable from 1990 to 2010, but has decreased slightly in the last decade. Projections based on 1990 to 2010 data by the CTSDC[1] show that this trend of decreasing population is likely to continue for the foreseeable future. In comparison, Hartford County and the State of Connecticut both experienced continuous growth from 1990 to 2010, and are projected to continue growing through 2025. Enfield is one of 15 communities in Connecticut to experience population loss from 1990 to 2010, including Hartford and Vernon, which are also part of the Capitol Region[2]. Population data for the Town, County, and State were retrieved from the U.S. Census; all projections were retrieved from the CTSDC.

Enfield is defined by the CRCOG as a suburban community with a 2010 population density of 1,306 people per square mile. In contrast, the state of Connecticut had a 2010 density of 645 people per square mile, meaning the State on average is considered suburban. The oldest area within the Town of Enfield is Thompsonville, which had a population density of 3,798 per square mile according to the 2010 census. A population density of less than 500 is considered rural, 500 to 1,250 suburban, 1,251 to 3,000 fully suburban, and greater than 3,000 urban.

The Connecticut Department of Economic and Community Development (ECD) reported an increase in net housing gain in Enfield from 2000, which peaked in 2004, and has since continued to decrease to the present. Net housing gain is defined as the difference between new permits issued and demolitions. The average net gain in housing in Enfield was 27 per year from 2000 to 2009. Since 2010, the average net gain in housing has decreased to 3 per year.

The 2010 census reported 16,794 households in Enfield, with an average size of 2.43 people per household. The State average is 2.52. The average household size in Enfield has decreased from 2.53 in 2000, when it matched the State average.

[1] Connecticut State Data Center at the University of Connecticut Libraries Map and Geographic Information Center - MAGIC. (2012). *2015-2025 Population Projections for Connecticut at State, County, Regional Planning Organization, and Town levels - November 1, 2012 edition.* Retrieved from http://ctsdc.uconn.edu/projections.html.
[2] Connecticut General Assembly. *OLR Research Report* (December 4, 2012). Retrieved from http://www.cga.ct.gov/2012/rpt/2012-R-0509.htm

2.4 LAND USE

The Town of Enfield is zoned by residential, commercial, industrial, and other special development districts. The 2011 Town of Enfield Plan of Conservation and Development (POCD) details land use within the Town. A summary of Enfield's land use is shown in Table 2-2. Figure 2-1 shows the current Town zoning by color overlay. The most common land use in the Town is residential, at 29.6% of the total land area, followed by agricultural, at 18.0%.

Table 2-2: Land Use

Land Use	Acres	Percent (%)
Residential	6,509	29.6
Commercial	1,143	5.2
Industrial	1,243	5.6
Institutional	1,434	6.5
Total Developed	**10,329**	**46.9**
Agricultural	3,961	18.0
Open Space	2,398	10.9
Vacant Land	2,566	11.7
Total Undeveloped	**8,925**	**40.5**
Water	921	4.2
Road Right of Way	1,842	8.4
Total Land	**22,017**	**100.0**

Retrieved from the 2011 Enfield Plan of Conservation and Development

Institutional land use includes government facilities, schools, churches, and community facilities. A complex of three prisons in the northeast corner of town make up the majority of the institutional land use, and includes the Enfield, Robinson, and Willard-Cybulski Correctional Institutions.

The POCD outlines the Town's desire to protect agricultural land, historic villages, and open space while focusing on residential and commercial infill development. Of particular focus is the Thompsonville area, designated as a Transit Orientated Development of potential culture and arts district, where special development would allow for a combination of residential and commercial units. The central business district, located between Elm Street and Hazard Avenue east of I-91, is identified as the center of increasing commercial development density. Industrial development is to remain in currently defined industrial zoned areas.

Current zoning of the Town of Enfield is summarized in Table 2-3. Zoning codes HR-33, HV-33, HV-44, HV-88, R-33, R-44, R-88, and MFHD are residential; HVBG, HVBL, BL, BG, BP, BR, and LO are commercial; I-1, I-1M, I-2, and IP are industrial; and SDD and TVC are designated special districts. While 29.6% of land is developed as residential, approximately 75.3% of the Town is zoned as residential. The majority of agricultural land in the Town is located on land zoned as residential. The Thompsonville Village Center and Special Development District are both designed to allow for a combination of residential and commercial development along targeted routes in Thompsonville. Areas with no zoning designation include the Connecticut River and the I-91 corridor.

Table 2-3: Zoning Categories

Zoning	Description	Acres	Percent (%)
No Zone	None	806.8	3.7
BG	General Business	81.4	0.4
BL	Local Business	249.9	1.1
BP	Professional Business	161.9	0.7
BR	Regional Shopping	438.5	2.0
HR-33	Historic One Family Residence	293.0	1.3
HV-33	Historic Village	38.6	0.2
HV-44	Historic Village	0.5	0.0
HV-88	Historic Village	2.9	0.0
HVBG	Historic Village General Business	4.6	0.0
HVBL	Historic Village Local Business	18.2	0.1
I-1	Industrial	2,770.2	12.7
I-1M	Industrial/Medical	157.6	0.7
I-2	Industrial	142.4	0.7
IP	Industrial Park	444.8	2.0
LO	Limited Office	3.6	0.0
MFHD	Multifamily Housing District	69.8	0.3
R-33	One Family Residence	6,882.9	31.5
R-44	One Family Residence	4,189.5	19.2
R-88	One Family Residence	4,947.8	22.7
SDD	Special Development District	42.5	0.2
TVC	Thompsonville Village Center	75.2	0.3
TOTAL		**21,822.7**	**100.0**

Based on February 24, 2014 Town of Enfield Zoning GIS Data

Current zoning regulations require residential developments in R/HR-33, R-44, and R-88 to conform to minimum lot sizes of approximately 0.75, 1, and 2 acres, respectively. Table 2-4 shows a summary of the Enfield zoning regulations applicable. Not listed in the 2011 POCD is the Multi-Family Housing District (MFHD), which is part of the 2014 zoning regulations. Currently, one new housing subdivision in Town is designated as MFHD, off Mayfield Drive along the Massachusetts border.

Table 2-4: Lot Area Requirements by Zoning Category

Zoning	Minimum Lot Requirements			Maximum Lot Requirements			
	Lot Area	Floor Area (SF)	Frontage (FT)	Density (dwelling units / acre)	Coverage (building or structures)	Impervious Coverage	Height (FT)
HR-33	33,000 SF	-	150	1.25	20%	-	35
R-33	33,000 SF	-	150	1.25	20%	-	35
R-44	44,000 SF	-	175	1	15%	-	35
R-88	88,000 SF	-	175	0.5	10%	-	35
MFHD	60 Acres	-	175	10	30%	66%	35
BL	30,000 SF	-	150	-	20%	66%	24
BG	22,500 SF	-	150	-	25%	66%	36
BP	3 Acres	-	300	-	15%	60%	36
BR	10 Acres	80,000	400	-	25%	66%	72
TVC	5,000 SF	0/600[2]	50	-	85%	85%	40
SDD	5 Acres	10,000	-	-	-	-	-
LO	12,500 SF	-	75	-	[2]	60%	35
I-1	40,000 SF	-	200	-	50%	66%	25
I-2	40,000 SF	-	200	-	50%	66%	25
IP	87,120 SF	5,000	200	-	20/25/33.3% [1]	66%	2.5 Stories/ 30 FT

1 - 20% coverage applies to lots between 2 and 3.99 acres; 25% to lots 4 to 10 acres; and 33.3% to lots greater than 10 acres. See Enfield Zoning Regulations for exceptions regarding abutting open space.
2 - Varies depending on Commercial or Residential use and abutting lot zoning. See Enfield Zoning Regulations for Details.
Data retrieved from the Town of Enfield Zoning Regulations revised February 2, 2014.

2.5 TOPOGRAPHY

Connecticut is divided into four physiographic provinces, including the eastern uplands, western uplands, coastal slope, and central valley, the latter of which Enfield is part. Figure 2-2 shows the elevation contours throughout Enfield. Elevations range from a low of approximately 20 feet to a high of 450 feet above sea level. The elevation in general gradually increases from the Connecticut River towards the eastern end of Town; however, the Scantic River valley cuts through the southeastern corner of Town at a minimum elevation of approximately 50 feet. The maximum elevation in Town is a hill along the border with Somers in the southeast corner.

2.6 GEOLOGY

Surficial geology in Enfield varies significantly throughout the Town. Generally the southwest corner of Town is characterized by fines (very fine sand, silt, and clay) and some till. Much of the northern end of Town is composed of sand overlying fines, with scattered areas of fines, sand, or gravel. The southeast corner of Town is predominately sand or sand and gravel, with scattered smaller areas of till or fines overlying sand or gravel. The Scantic River valley is characterized as alluvial sand and gravel with some fines, and is surrounded by primarily fines overlying sand and gravel. See Figure 2-4 for a map of surficial materials in Enfield.

2.7 SURFACE WATER QUALITY

Enfield lies within the Connecticut Major Watershed basin, which includes the Connecticut River and extends from the Canada and New Hampshire border to Long Island Sound. Two regional watersheds exist in the Town of Enfield including the Connecticut Main Stem and Scantic Watersheds. The Scantic Watershed encompasses the south-eastern corner of Town, while the Connecticut Main Stem accounts for the remainder. The Scantic River flows south into East Windsor before joining with the Connecticut River.

The Connecticut River is the largest water body in Enfield, constituting the entirety of the Town's western border. Many smaller water bodies are scattered across the Town, including rivers, ponds, brooks, and wetlands, the most notable of which is the Scantic River, Crescent Lake, and Shaker Pond.

Surface water and groundwater within Enfield are classified by the DEEP according to their current and long term goals for water quality. The DEEP issued "Water Quality Classifications Map" for Enfield shows surface water and groundwater quality classes as well as areas of contribution to public supply wells, aquifer protection areas and major basin boundaries. Water quality classifications for surface waters in Enfield are described below:

- AA – Designated existing or proposed drinking water supplies, habitat for fish or other aquatic life and wildlife, recreation, and water supply for industry and agriculture. Recreational uses may be restricted. Surface waters which are not specifically classified shall be considered as Class A or Class AA.
- A – Designated habitat for fish and other aquatic life and wildlife, potential drinking water supplies, recreation, navigation, and water supply for industry and agriculture.
- B – Designated habitat for fish and aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Class B surface water bodies are required to be treated prior to human consumption.

The Connecticut and Scantic Rivers are designated Class B surface water bodies. The remaining surface waters in the Town of Enfield are designated Class A.

2.8 GROUNDWATER QUALITY

Groundwater is classified in a similar manner as surface water. Groundwater quality classes in Enfield are summarized below:

- GAA – Designated uses are existing or potential public supply of water suitable for drinking without treatment and baseflow for hydraulically-connected surface water bodies.
- GA – Designated uses are existing private and potential public or private supplies of water suitable for drinking without treatment and baseflow for hydraulically-connected surface water bodies.
- GB – Designated uses are industrial process water and cooling water and baseflow for hydraulically-connected water bodies and is presumed not suitable for human consumption without treatment.

The majority of groundwater in Enfield is designated Class GA. Most of the areas of contribution to public supply wells are designated Class GAA, and the remainder are Class GA. Three (3) areas in Enfield have groundwater designated Class GB and are located adjacent to the Connecticut River, including the Bigelow Commons complex, the WPCF, and an industrial area roughly bounded by the Connecticut River, Depot Hill Road, and King Street.

2.9 AIR QUALITY

The Connecticut Department of Energy and Environmental Protection's (DEEP) Bureau of Air Management, Ambient Air Monitoring Group, monitors air quality throughout the state, as directed by the EPA 1990 Clean Water Act. Six

criteria pollutants are monitored according to the National Ambient Air Quality Standards (NAAQS) including the following:

1. Particulate Matter
2. Sulfur Dioxide
3. Ozone
4. Nitrogen Dioxide
5. Carbon Monoxide
6. Lead

The nearest stations that measure these pollutants are located in Hartford and East Hartford, except for lead, which is only monitored at one station in the state, in New Haven.

General air quality is represented by the Air Quality Index (AQI), a composite number representing the relative danger of criteria pollutant concentrations to health. Table 2-5 summarizes the number of days throughout the year 2013 during which Hartford County experienced Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, Very Unhealthy, and Hazardous air quality conditions. The established AQI limits for each category are also shown in the table. The maximum AQI experienced during the year was 127, designated as Unhealthy for Sensitive Groups. The median AQI for the year was 46, falling within the good range.

Table 2-5: 2013 Hartford County Air Quality Index Summary

	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy	Hazardous	Total
Days	220	137	8	0	0	0	365
AQI Limits	0 - 50	50 - 100	100 - 150	150 - 200	200 - 300	300 - 500	-

2.10 FLOOD ZONES

The Federal Emergency Management Agency (FEMA) developed a set of national Flood Insurance Rate Maps (FIRM) to aid individuals and communities in determining flood risks at the local level. Special flood hazard areas of high, moderate, and low risk of inundation are categorized into zones. The flood hazard areas that appear in Enfield include the following:

- Zone A – High risk areas subject to inundation by the 1-percent-annual-chance flood event, or 100-year flood. No flood depths are shown because detailed hydraulic analyses have not been performed.
- Zone AE – High risk areas subject to inundation by the 1-percent-annual-chance flood event, or 100-year flood, determined by detailed methods. Flood depths are shown.
- Zone X (shaded) – Moderate risk areas within the 0.2-percent-annual-chance floodplain (500-year flood) areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No flood depths are shown.
- Zone X (unshaded) – Low risk areas with minimal chance of flooding. These areas encompass land not subject to inundation by 100-year or 500-year floods.

Much of the WPCF site and some surrounding areas are located within Zone AE and Zone X (shaded) to a lesser extent, meaning that most of the WPCF site is at high or moderate risk of flooding. The WPCF site sits between approximately 45 and 55 feet above sea level (FASL). The WPCF site is surrounded by a berm that is above the 100-year flood elevation to prevent flooding, however, a portion of that berm is composed of porous railroad ballast and operators have reported visible flow through the berm during high-intensity wet-weather events. FEMA's FIRM data is shared with DEEP and is freely available as GIS data on their website. See Figure 2-3 for a map of Enfield overlaid with FEMA's flood zone data and Section 5.1.13 (Hydraulic Profile) for an assessment of flood impact on the treatment facility and its processes. Section 4.7.1 includes flooding impacts on pumping stations.

2.11 WETLANDS

According to the EPA, wetlands contribute to downstream water bodies, trap floodwaters, recharge groundwater aquifers, filter out contaminants, and provide habitat for fish and other wildlife. Swamps, marshes, and bogs are all categorized as wetlands. DEEP provides spatial wetland data for the state of Connecticut through their GIS data portal. Figure 2-5 shows a map of surface waters in Enfield including wetlands. Wetlands in Enfield are primarily situated along waterways such as the Scantic River, Freshwater Brook, and Connecticut River. Relatively large areas of wetland are Crescent Lake in the northeast of Town. A scattering of low lying areas in the southwest corner of Town are also designated wetlands.

2.12 ENDANGERED SPECIES AND NATURAL RESOURCES

Correspondence was initiated with two government agencies, including the DEEP and the U.S. Fish and Wildlife Service (FWS), to examine the possibility that endangered, threatened, or protected species may reside in the Town of Enfield, specifically near the WPCF site.

The DEEP Natural Resources Center maintains the Natural Diversity Database (NDDB), which compiles critical biological resources throughout the State, including threatened or endangered species. The purpose of the NDDB program is to evaluate the impact of potential development projects on listed species and biodiversity. Upon review of the DEEP issued Enfield NDDB map, it was discovered that the WPCF and 5 out of the Town's 16 pump stations lie within natural diversity areas. See Figure 2-6 for a map of the Enfield wastewater collection system overlaid with the NDDB areas. Accordingly, a request for NDDB review was submitted to the DEEP on June 5, 2014. A response was received on August 11, 2014, indicating that no negative impacts to state listed species are anticipated based on the scope of activities described in this facilities plan, as shown in Appendix B.

There are no endangered or threatened species listed by the FWS in Enfield. One proposed endangered species, the Long-eared Bat, is found statewide, but is not listed as endangered or threatened and is not a candidate species; therefore, no consultation with FWS is required, as shown in the supplied letter (See Appendix B for FWS correspondence). There are no protected species listed under the FWS in Enfield.

2.13 HISTORIC DISTRICTS AND SIGNIFICANT LANDS

The Natural Historic Preservation Act defines procedures for consultation and commentary by the Advisory Council on Historic Preservation for all EPA grant actions that will affect a property listed or eligible to be listed on the National Register of Historic Places. To this end, the State Historic Preservation Office (SHPO) was contacted. SHPO confirmed that any construction on the WPCF site or any of the 16 pump station sites would have no effect on existing historic properties. However, SHPO stated in further email correspondence that four (4) of the 16 pump stations are situated near recorded archaeological sites, including the Indian Run, South Maple Street, Brookside Road, and Rye Hill pump stations. In addition, the WPCF and many of the pump stations are located in areas considered archaeologically sensitive. SHPO requested coordination with their office should ground disturbing activities be proposed at any of these sites. See Appendix B for SHPO correspondence.

Table 2-6: National Register of Historic Places

Name	Location/Address	Certification Date
Bigelow Carpet Mills Historic District	Roughly bounded by Lafayette Street, Hartford Avenue, Alden Avenue, Pleasant, High, Spring, South, and Prospect Streets	November 25, 1994
Enfield Historic District	1106-1492 Enfield Street	August 10, 1979
Enfield Shakers Historic District	Shaker, Taylor, and Cybulski Roads	May 21, 1979
Enfield Town Meetinghouse	Enfield Street at South Road	September 10, 1974

Locations in Enfield that are classified historic as of June 2014 are tabulated in Table 2-6 along with their dates of registry. Historic places in Enfield include individual buildings, such as the Town Meetinghouse, and districts such as the Shakers Historic District. All structures within a historic district are included on the National Register.

A map of protected open space is shown in Figure 2-7. State, municipal, and private parks are all considered protected open space. Prominent open spaces include the Scantic River State Park, Mark Twain Park, and Neelans Park.

2.14 SANITARY SEWER SERVICE

According to data provided by the Town, approximately 97.1% of Enfield's residential and industrial users are sewered. Figure 2-8 includes a topographic map of the Town overlaid with the existing DEEP Sewer Service Area and Enfield's sanitary sewer layers. The figure shows that the existing DEEP Sewer Service Area for Enfield is out of date. The proposed sewer service area is discussed in Section 2.13.

According to current DEEP Sewer Service Area data, approximately 11.8 square miles out of the total 34.2 square miles in Enfield are sewered. There is approximately 210 miles of sewer installed in town. Existing sanitary sewer record drawings show construction of sewers as far back as 1965, however sewer pipes in the area of Thompsonville are constructed from materials commonly used in the 1930s. The most recent sanitary sewer constructions on record are a sewer line extension on State Street and a cross-country sewer extension between two unnamed roads in a partially developed housing area off Bridge Lane and Riverview Street, both constructed in 2008.

The Town of Enfield's sanitary sewer system conveys flow from the Towns of Somers and East Windsor. Two prisons in Somers, including the Osborn and Northern Correctional Institutions, connect to the Enfield sewer system on Shaker Road. The Golden Irene Restaurant located on Mullen Road in East Windsor is also connected to the Enfield sewer.

Woodard & Curran contacted several individuals representing their respective towns regarding potential sewer connections with Enfield, including Jeff Bord, Town Engineer of Somers, Dennis Milanovich, Town Engineer of Stafford, and Art Enderle, WPCF Superintendent of East Windsor. In a June 9, 2014 meeting with Enfield Town Planning, Assistant Town Manager Courtney Hendricson mentioned the possibility of the Johnson Memorial Hospital in Stafford connecting to the Enfield collection system. However, Dennis Milanovich indicated that the hospital would be connecting to the Stafford collection system. East Windsor is currently installing new sewer along Route 140, precluding the need for that town to make additional connections to the Enfield system.

The Town of Somers owns and operates a WPCF that is designed to treat 65,000 gpd. The current average daily flow treated at the WPCF is approximately 15,000 gpd, with peak flows as high as 40,000 gpd. The WPCF is located off Route 190 near the Town of Enfield and is reported to be near the end of its useful design life. It is therefore possible that wastewater generated in the Town of Somers will be treated at the Enfield WPCF sometime within the next 20 years. Therefore, wastewater from the Somers facility will be added to the future flows at the Enfield WPCF, as described in Section 2.17.

Other neighboring communities are unlikely to connect to the Enfield collection system for geographical or geopolitical reasons, such as Suffield, Windsor Locks, and Longmeadow. Suffield and Windsor Locks are both currently sewered, have their own wastewater treatment facilities, and are located across the Connecticut River. Longmeadow, Massachusetts is currently sewered and sends flows to the Bondi's Island WPCF in Springfield, MA.

2.15 ON-SITE WASTE DISPOSAL SYSTEMS

Residents not served by sanitary sewers practice on-site wastewater disposal, which roughly equates to 2.9% of the residences in Town. The State of Connecticut Department of Public Health (DPH) regulates subsurface sewage disposal systems through the Connecticut Public Health Code and publishes the "Technical Standards for Subsurface Sewage Disposal Systems".

Current health code requirements for sizing of subsurface disposal systems dictate that each residence provide a minimum 1,000 gallon septic tank for settling out solids and a leaching field with at least 375 square feet of effective area (or larger depending on the number of bedrooms in the house and the soil conditions). In addition, 100% reserve areas are required to be located on-site and there are further requirements for distance from water supply wells and lot boundaries. These standards apply to construction of new septic systems.

Subsurface sewage disposal systems typically have a service life of approximately 25 years, but variables such as volume of use, soil conditions, maintenance, and depth to groundwater can reduce this number. The North Central District Health Department (NCDHD) oversees the implementation of public health code relating to subsurface sewage disposal systems, and maintains a database of current disposal systems, constructions, and repairs. Woodard & Curran contacted the NCDHD on May 29, 2014 and received a partial copy of this database containing dates and addresses of recorded septic system repairs in Enfield since 1998. According to NCDHD most septic system repairs indicated a full system replacement. Figure 2-4 shows the geocoded locations of each septic system repair in the Town. The densest clusters of repairs generally coincide with unsewered housing areas, such as the intersection of Powder Hill Road and Abbe Road, Broad Brook Road, and the area around Depot Hill Road and Pleasant Road. Dense areas of septic system repairs can be used to identify potential locations for sewer extensions, where small lot sizes and/or poor soils may exist.

As shown in Figure 2-9, there are about 257 users within or close to the existing sewer service area that are not connected to the sewer system. According to the WPCF Superintendent, the Town did not require users served by septic to connect to sewer when they were installed. However, the Town is considering changing this regulation to require those within the area to connect if their septic system fails. Furthermore, the regulations will require any new homes that are within 100-feet of the sewer service area to connect to sewer.

2.16 WATER SUPPLY

Two privately owned public utilities supply water to the Town of Enfield, including the Connecticut Water Company, and the Hazardville Water Company. The prisons in Enfield and Somers are served by wells that are operated and maintained by the State of Connecticut. The Shaker Pond area of Town is served by a separate private well system. Enfield's drinking water supply is taken entirely from groundwater sources. Connecticut Water serves approximately 8,300 customers in Enfield based on water use data from 2010 through 2012, and serves the Thompsonville and North Thompsonville neighborhoods. Connecticut Water uses three well fields as drinking water sources in Enfield, including the O'Bready, Powder Hollow, and Spring Lots well fields. Hazardville Water also utilizes three well fields in the Town of Enfield, including Queen Street, Scitico, and Town Farm well fields. Hazardville Water serves approximately 7,200 customers total in Enfield, East Windsor, and Somers. The Hazardville Water Company has been in operation in Enfield since 1892 and currently serves the Hazardville, Scitico, and Southwood Acres neighborhoods. The remaining customers utilize private wells.

Over the three-year period of 2010 through 2012, the two water companies provided a combined average daily flow of approximately 3.0 million gallons per day (MGD) of potable water to the Town of Enfield. A summary of average daily flows from this period is shown in Table 2-7, broken down by company and user type.

Table 2-7: Average Daily Flows of Potable Water

Company	Average Daily Flow (MGD)		
	Residential	Non-Residential	Total
Connecticut Water	1.3	0.4	1.7
Hazardville Water	1.1	0.2	1.3
Total	2.4	0.6	3.0

Figure 2-8 shows DEEP designated aquifer protection areas in Town, each representing a public water supply well field used by Connecticut Water and Hazardville Water Companies. The intent of aquifer protection areas is to identify contributing groundwater sources to well fields. Final mapping of the aquifer protection areas was completed through detailed modeling of the local groundwater flow at each well field. Municipalities are required to adopt land use regulations to protect groundwater quality in aquifer protection areas.

2.17 HOUSING PERMITS

A good indicator of net growth in a community is the issuance of housing permits. Table 2-8 shows the total number of construction and demolition housing permits in the Town of Enfield from the year 2000 to 2013, and the net change in housing, which is the total number of units constructed minus the number of demolitions. Housing units constructed peaked in the year 2004 and have since gradually declined. The overall decrease in the rate of housing construction aligns closely with the population trend noted for the Town in Table 2-1.

Table 2-8: Housing Permits Issued

Year	Total Units Constructed	Demolitions	Net Change
2000	32	11	21
2001	30	1	29
2002	50	12	38
2003	50	2	48
2004	57	0	57
2005	50	10	40
2006	24	1	23
2007	17	2	15
2008	15	3	12
2009	9	4	5
2010	12	3	9
2011	2	3	-1
2012	9	8	1
2013	7	4	3

2.18 ANTICIPATED GROWTH

To evaluate future wastewater treatment system needs, the expected flows and loads in the 20-year planning period must be established. To accomplish this, historic trends in Town, the available land for residential, commercial and industrial development, projections of water use and population growth must be quantified. The best professional judgment is used in conjunction with historic data to help establish the future trends, flows and loads.

The following sections describe how future development and population were estimated for the planning period. These projections are used to determine the best means to accomplish wastewater treatment to meet the permitted requirements.

2.18.1 Residential

The Town of Enfield has delineated an existing Sewer Service Area that was presented in Figure 2-10. This sewer area includes all of the properties that could potentially be served by existing sewers. Approximately 43,300 people are connected to the sewer system which comprises 97.1% of the Town's population listed in the 2010 census. The amount of available land that could potentially be used for residential development within the Sewer Service Area was also reviewed to determine if it could accommodate this additional population. This was evaluated using information from the Town's Plan of Conservation and Development. It was determined that the amount of available land for residential development is much greater than the projected population, therefore development would not be limited due to the unavailability of residentially zoned land.

There are four categories of residential development identified in the Town of Enfield that may contribute to additional wastewater flow:

1. New Development Within the Existing Sewer Service Area – Flows may increase when new homes or subdivisions are built within the Sewer Service Area. The Interim Director of Planning was contacted and indicated that the following residential subdivisions, consisting of both single family homes and condominiums, have been approved:

    - Mayfield Apartments 340 Units
    - Meeting House 15 Units
    - Simon Road 3 Units
    - Cherrywood 16 Units
    - Enfield Properties 96 Units

    These subdivisions are shown as crosshatched parcels in Figure 2-11. Of the listed residential subdivisions only the Cherrywood development is outside the sewer service area and is far enough away from existing sewer to be highly unlikely to connect within the planning period. It follows that 454 residential units are approved for construction and are likely to connect to the Enfield collection system. Using this information and an average household size of 2.43 people per household, it is estimated that approximately 1,103 additional people will connect to the sanitary collection system from new development within the existing Sewer Service Area.

2. Infill Development – Many homes within the sewer service area have sewer access but are not connected to the sewer system. These homes may connect to the sewer system at a later date when the septic system fails. According to Town records, there are 257 such homes within the Town of Enfield, shown in Figure 2-9. Using this information and the average household size of 2.43 people per household, approximately 625 additional people are expected to connect to the sewer system from connection of existing homes in the Sewer Service Area.

3. Existing Homes Outside the Sewer Service Area – The North Central Health District was contacted to determine if there are areas in Town that have been experiencing septic system problems. Many of these problems are due to poor soil conditions, seasonal high groundwater levels, small lot sizes, or advanced system age. Figure 2-4 shows the location of septic system repairs performed since 1998 and predominant soil types. Two areas were identified as likely to require sewer service in the next 20 years and are highlighted with hatching in the figure. Both are located in the southeast corner of Town, and each is centered around two clusters of septic system repairs located off the intersection of Long Hollow Road and Abbe Road, and between Salerno Drive and Charnley Road on Broad Brook Road. A total of 77 equivalent dwelling units (EDUs) are expected to connect from these homes within the 20 year planning period, for a total connected population increase of 187 people, assuming 2.43 people per household. Since these homes are outside the existing sewer service area, new sewers will need to be installed to connect them to the existing system. As part of the future flows projection, an allowance for inflow and infiltration (I/I) based on a rate of 375 gallons per day per inch diameter mile, which is the median flow rate recommended in TR-16, was used. The total length of additional sewer pipe required to sewer these areas is approximately 12,000 linear feet. Assuming a pipe diameter of 8 inches, the total inch-diameter-miles (idm) of pipe required is approximately 18, for an additional 7,000 gpd of I/I.

4. Town of Somers - As described earlier, wastewater from residential sources in the Town of Somers may be treated at the Enfield WPCF at some point within the next 20 years. The Somers WPCF is designed to treat an average daily flow of 65,000 gpd, but currently only treats approximately 15,000 gpd. For the purposes of this report, it is assumed that the average daily flow from Somers will be 65,000 gpd.

2.18.2 Non-Residential

The Assistant Town Manager of Development Services, Courtney Hendricson and the Town Manager, Matt Coppler were interviewed to get a better understanding of non-residential developments planned in Town. A new high-speed rail is currently being designed to run between New Haven, CT and Springfield, MA and is expected to be operational by 2016 with a stop located in Thompsonville, a village in Enfield. The economic development team in Town is planning to revitalize this area. Changes were recently recommended to the zoning regulations to encourage the conversion of existing industrial complexes to mixed-use facilities that will attract desired businesses to the area. The Town also wants to reestablish the village center to maintain the historic core of the area. Since the Thompsonville area is already heavily populated, it is assumed that there will be no net increase in wastewater flow from that area of Town. This assumption was confirmed during a workshop that was held with the Town.

As mentioned earlier, wastewater from the prisons located in Enfield and Somers is treated at the Enfield WPCF. The State's Office of Policy and Management (OPM) Criminal Justice Policy and Planning Division was contacted to estimate the future prison growth. The OPM does not project the prison populations over the next 20 years, but the population is expected to decline at a moderate pace through January 2016. The State currently has no plans to expand or close any of these prisons, so it is assumed that the wastewater flow rate from the prisons will essentially be the same over the next 20 years.

Plans have been developed to expand the Metro Park North Business Park located in the southwest section of Town. This parcel currently includes a 113,000 square foot Class A office building that is nearly fully occupied and also encompasses approximately 146 acres of undeveloped land. The plot is zoned with an Industrial 1 Medical designation (shown in Figure 2-11) and the Town has pre-approved the space for multiple office and warehouse buildings. Plans have been developed to construct approximately 530,000 square feet of a combination of warehouse, storage, and office space. The Town has also been speaking to a developer that would like to construct a biomedical campus within the development, although plans have not yet been finalized. Additionally, non-residential development is planned as part of the Enfield Properties subdivision, which includes 40,000 square feet of commercial multi-unit buildings. The Town currently has approved construction of a total of 570,000 square feet of industrial and commercial development. Using the Connecticut DPH standards for septic systems[3] unit flow rate of 0.1 gallons per day per square foot (gpd/sqft), and multiplying by the total non-residential square footage yields an approximation of the additional non-residential flow expected within the planning period, about 57,000 gpd.

Recent expansions that have occurred in Town include the Lego Distribution Center located in the northeastern section of Town and the Advance Auto Parts Distribution Center in the northwestern section of Town. The Town does not expect additional expansions from either of these facilities during the planning period.

A new microbrewery recently opened in the Hazardville section of Town. The Powder Hollow Brewing LLC is located on Hazard Avenue and serves microbrews. The wastewater generated by the brewery is less than 500 gpd.

2.18.3 Septage

Since the Town's population is not expected to increase over the planning period, the volume of septage received at the WPCF is correspondingly not expected to increase significantly. The average contribution of septage to the average daily plant flow was approximately 2,000 gpd, or 0.04% of the total flow over the data collection period.

[3] Connecticut Public Health Code – "On-site Sewage Disposal Regulations, and Technical Standards for Subsurface Sewage Disposal Systems", January 2011.

2.18.4 Consistency with the State Plan of Conservation and Development

The Connecticut Office of Policy and Management (OPM) prepared a Conservation and Development Policies Plan (CDPP) for Connecticut spanning the period of 2013 to 2018. As part of the CDPP, OPM also developed a Locational Guide Map to assist municipalities with determining the consistency of proposed development with the CDPP. The Locational Guide Map GIS data is freely available on the OPM website, and is presented in Figure 2-12, which summarizes the areas designated as Priority Funding Areas and Conservation Areas. In the CDPP Enfield is described as being a regional center.

Priority Funding Areas, shown in red, are rated according to the number of criteria met. These criteria include urban designation, mass-transit systems, water and sewer service areas, or local bus service. The shade of red on the map indicates the number of criteria met in the census block, lighter red being less criteria and darker red more. Conservation Areas, shown in brown, are based on the presence of environmental and natural resource factors including core forest areas, drinking water supply sheds, aquifer protection areas, wetland soils, important agricultural soils, hurricane inundation zones, 100-year flood zones, critical habitats, and locally important conservation areas. A darker shade of brown indicates the presence of more natural resource factors. Shown in yellow are Balanced Priority Funding Areas, where both Priority Funding Areas and Conservation Areas overlap. Protected Lands, which are not to be developed, are shown in gray and will be excluded from the sewer service area. OPM Protected Lands are identical to the Protected Open Space depicted in Figure 2-7.

When determining a project's consistency with state policy, both the CDPP and Locational Guide Map must be reviewed. A project must be consistent with state policy to be eligible to receive state funding. Exceptions may be granted for projects located in Conservation Areas, where CDPP growth management principles apply or the municipal plan of conservation and development requires it. Growth related projects located in Balanced Priority Funding Areas generally may proceed without an exception, if the municipality documents how environmental and natural resources will be protected.

The planned developments and proposed additions to the Sewer Service Area map were reviewed to confirm that they are consistent with the state policies of the Plan. Presented in Table 2-9 are the areas included in the future flow projections and their applicability to the OPM growth management principles.

Table 2-9: Future Developments and Applicable Growth Management Principles

Development	Zoning	Description	Growth Management Principle #
Mayfield Apartments	Residential	Enfield's zoning ordinance traditionally allowed only single family housing. Addition of a Multi-Family Housing District (MFHD) aligns with State CDPP objectives to expand housing opportunities to accommodate a variety of housing types and needs. MFHD likely created by town to meet this requirement as identified in Town POCD.	2
Meeting House	Residential	Development is consistent with zoning ordinance, but is lower density than the surrounding existing development.	2
Simon Road	Residential	Development is consistent with zoning ordinance, but is lower density than the surrounding existing development.	2
Cherrywood	Residential	Development is consistent with existing zoning and density, but built within Town POCD Agricultural Preservation Area. The Town POCD encourages preserving farmland and maintaining economic viability of farming by improving flexibility of zoning ordinance for farmers. State CDPP also encourages preservation of agricultural areas. Although the development is located within the agricultural preservation area, no existing farmland is being redeveloped. The development will remain outside of the sewer service area.	4
Enfield Properties	Residential /Commercial	Development consistent with existing zoning ordinance. Elderly housing located within residential zone and commercial development within industrial zone. Expands elderly housing opportunities.	2
King Street	Industrial Medical	Development consistent with existing zoning ordinance. Development located along a major transportation corridor per State CDPP including I-91 and Route 5.	3

The growth management principles outlined in the CDPP and referenced in Table 2-9 include the following:

1. Redevelop and Revitalize Regional Centers and Areas with Existing or Currently Planned Physical Infrastructure – This growth management principle focuses on infill development and redevelopment around existing infrastructure (including sewer and public transportation), while promoting adaptive reuse of existing facilities and developed properties. While none of the future development areas listed in Table 2-9 fall under this category, the Town of Enfield's plan for the Thompsonville area includes revitalization and addition of transportation infrastructure. The conversion of industrial facilities to mixed-use in this area aligns with the CDPP goal of redevelopment.

2. Expand Housing Opportunities and Design Choices to Accommodate a Variety of Household Types and Needs – The second growth management principle aims to support mixed-income neighborhoods by providing both ownership and rental opportunities, and promote affordable housing opportunities including multi-family housing. Existing housing in Enfield is predominately composed of single-family occupant owned homes. Mayfield Apartments and Enfield Properties each meet the State CDPP goal of expanding housing opportunities by increasing the variety of housing available in the Town, including apartments and elderly

housing, respectively. The Meeting House and Simon Road developments are assumed to provide luxury or higher cost housing, which act to further expand the variety of housing available in Town.

3. Concentrate Development Around Transportation Nodes and Along Major Transportation Corridors to Support the Viability of Transportation Options – The third growth management principle encourages improvements to public transportation, pedestrian and bicycle paths, and transit-oriented development. The planned industrial Medical development off King Street is located to make use of existing transportation infrastructure including both the interstate and state highway systems.

4. Conserve and Restore the Natural Environment, Cultural and Historical Resources, and Traditional Rural Lands – Protecting permanently preserved open space and expanding protected open space are the primary objectives of the fourth growth management principle. In addition, archaeological and heritage areas are to be preserved. The Cherrywood development is situated in a predominately farmland area, but does not redevelop any existing farmland or open space. The Cherrywood development will not be served by sewers.

5. Protect and Ensure the Integrity of Environmental Assets Critical to Public Health and Safety State Agency Policies – The fifth growth management principle includes protecting water supply resources, maintaining air quality standards, reducing carbon emissions, preventing pollution, and promoting transportation alternatives.

6. Promote Integrated Planning across all Levels of Government to Address Issues on a Statewide, Regional, and Local Basis – The last growth management principle encourages sharing of information across POCD planning and wastewater facility plan requirements, coordination between planning organizations and economic development districts for regional planning, and establishing water and sewer need protocols for municipalities.

2.19 PERMITTING REQUIREMENTS

The following permits, although not all encompassing, impact the Town of Enfield WPCA either as the Permittee or as a party to the oversight and enforcement of the permit, as well as permits with limits for which the Town WPCA should be aware of despite not currently having a direct impact on operations.

2.19.1 Municipal NPDES Permit

The National Pollutant Discharge Elimination System (NPDES) permit (CT-0100200) regulates the discharge of treated wastewater from the WPCF to the Connecticut River. The current permit, as shown in Appendix A, has a 5-year duration period, and an expiration date of November 25, 2018.

This permit requires the monitoring and reporting of numerous wastewater constituents, as well as toxicity testing, at various points in the treatment process, however, only the following constituents, shown in Table 2-10, have current discharge concentration limits:

Table 2-10: Summary of Final Effluent Constituents with Established Discharge Limits

Parameter	Units	Frequency	Limit or Allowable Range (Avg Monthly / Max Daily / Instantaneous)
Flow (Design Flow Rate)	MGD	Continuous	10.0
Biochemical Oxygen Demand (5 Day)	mg/L	3 / week	30 / 50 / NA
Total Residual Chlorine	mg/L	4 / work day	NA / NA / 0.2-1.5
Fecal Coliform	CFUs / 100 mL	3 / week	200* / 400*
Escherichia Coli	CFUs / 100 mL	3 / week	NA / NA / 410
pH	S.U.	1 / work day	NA / NA / 6-9
Total Suspended Solids	mg/L	3 / week	30 / 50 / NA
BOD (5 Day) % Removal	% of influent	3 / week	85 / NA / NA
Total Suspended Solids Removal	% of influent	3 / week	85 / NA / NA

* See NPDES permit for additional specific requirements for the calculation of reportable values.

This permit also outlines additional requirements, including but not limited to, basic billing limits, basic restrictions on waste streams the WPCF may receive, back-up power sources, flow limitations, flow meter calibrations, and limitations on temperature impact to receiving waters.

Based on current trends and information supplied by the DEEP, the future permit limits are expected to be similar to the existing limits.

2.19.2 General Permit for Nitrogen Discharges

Nutrients, specifically nitrogen, and the subsequent growth and decay of algae, are the primary cause of oxygen-deficient conditions currently present in the bottom waters of the Long Island Sound. The General Permit for Nitrogen Discharges and the Nitrogen Credit Exchange Program were established to authorize the discharge of nitrogen from publically owned treatment works in the State of Connecticut, including the Town of Enfield WPCF with an effective date of January 1, 2011 (initially released January 2, 2002) and a current expiration date of December 31, 2015.

This program, however, also created a system to reward facilities that elected to reduce their nitrogen discharges by issuing those facilities with “selling” credits to offset the cost of their capital improvements, while simultaneously penalizing facilities with “buying” credits for failing to reach established goals. In order to facilitate continuous improvement throughout the period of the program, the goals, or “Annual Discharge Limits for Total Nitrogen,” became increasingly stringent on an annual basis, and in order to place the highest level of motivation on the dischargers with the most direct impact on nitrogen levels in the sound, equivalency factors were established.

From the advent of the program to 2013, the Enfield WPCF has received a net total "selling" credit of over $60,000 and has reduced its discharge of total nitrogen to the Connecticut River by over 70%, as shown in Table 2-11.

Table 2-11: Enfield WPCF Nitrogen Credit Exchange Program Results, 2002 - 2015

Calendar Year	Credit Value ($/lb)	Actual Annual Nitrogen Discharge Rate (lbs/day)	Annual Nitrogen Discharge Rate Limit (lbs/day)	Total Annual Credit Value* ($)
2002	$1.65	914	556	-$40,965
2003	$2.14	839	517	-$47,788
2004	$1.90	275	471	$25,826
2005	$2.11	535	410	-$18,291
2006	$3.40	331	405	$17,448
2007	$4.36	218	347	$39,005
2008	$4.50	272	338	$20,597
2009	$4.54	282	328	$14,483
2010	$4.59	248	318	$22,282
2011	$5.42	324	306	-$6,766
2012	$5.01	219	292	$25,363
2013	$5.61	252	285	$12,839
2014	TBD	TBD	278	$11,217
2015	TBD	TBD	278	TBD

* Calculated as the product of the unused remainder of the nitrogen discharge limit, the applicable equivalence factor (0.19), the credit value, and 365 days per year. A negative credit value indicates that the Town had to make a payment.

Although successful at encouraging total nitrogen discharge reductions, the program carries an increasingly high annual credit deficit that must be subsidized by the state. Projections for 2018, following the current program, place the subsidized annual deficit at $5 million, which is not sustainable for a variety of reasons. The program is expected to continue, but it will move towards a self-sufficient structure in 2015 with numerous program modifications under

consideration. Unfortunately, the program modifications will likely include a substantial decrease in the value of sold credits with those credits being funded solely by the credits bought in the same period.

2.19.3 General Permit for the Discharge of Stormwater Associated with Industrial Activity

The general permits for the discharge of stormwater regulate the discharge of stormwater runoff to surface waters. The Enfield WPCF discharges its stormwater runoff to the Connecticut River as a component of its plant effluent.

As a publically owned treatment works, with a design capacity greater than 1 MGD, the Enfield WPCF meets the general permit's definition of "Industrial Activity." The current general permit has an effective date of October 1, 2011 (modified December 3, 2013) and an expiration date of September 30, 2016. The WPCF is registered as an industrial stormwater discharger (Permit# GSI001885) with an authorization date of October 18, 2011.

This permit outlines numerous requirements, including the following:

- Registration;
- Monthly routine and semi-annual comprehensive inspections;
- Quarterly visual analyses of stormwater discharges;
- Semi-annual and annual discharge sampling and analysis;
- Sample analysis specific to impaired receiving water bodies (i.e. E. Coli, PCBs); and
- Required management and record keeping practices.

Additional requirements may apply if the site is utilized for DPW vehicle maintenance or salt storage; this testing would include, at a minimum, Chlorides and Cyanide.

As of December 12, 2014 the Enfield WPCF was failing to meet benchmarks on two of the ten standard parameters with 4-period averages of 182 mg/L of TSS (90 mg/L benchmark) and 0.53 mg/L of TP (0.40 mg/L benchmark). However, it should be noted that these results were heavily skewed by low-intensity storm events during two of the four sampling events; the results show a clear negative exponential correlation between storm intensity and constituent concentration. Samples collected during the higher intensity storm events produced excellent results and trends indicate that sampling during events that result in a total rainfall of greater than one inch would produce results under benchmark.

2.19.4 Various General Permits Associated with Discharges to the WPCF

2.19.4.1 Miscellaneous Discharges of Sewer Compatible (MISC) Wastewater

The MISC Permit was issued October 31, 2013 and expires October 30, 2018. The intent of this permit is to simplify the general permit registration process by creating a single permit covering multiple waste streams. The permit allows the discharge of numerous wastewater types with varying limitations and registration requirements depending on group classification, level of pre-treatment, and flow rate and includes screening requirements and discharge concentration limitations. This permit requires written approval from the receiving Publically Owned Treatment Works (POTW) prior to discharge.

2.19.4.2 Discharge of Groundwater Remediation Wastewater

This permit was issued August 13, 1996 and re-issued February 15, 2008 with an expiration date of February 15, 2018. The permit allows discharges up to 50,000 gallons per day of groundwater investigation or remediation wastewaters to a POTW, and is excluded, by definition, from classification as a miscellaneous sewer compatible wastewater. Before

the water is discharged, it must be screened and certain discharge limitations must be satisfied. Written approval from the receiving POTW must be obtained before groundwater remediation wastewater is discharged.

2.19.4.3 General Permit for the Discharge of Vehicle Maintenance Wastewater

The general permit for the discharge of vehicular maintenance wastewater was issued January 23, 2011 and has an expiration date of January 23, 2021. This permit allows the storage and transportation, or direct discharge of up to 15,000 gallons per day of vehicle maintenance wastewater to a Publically Owned Treatment Works (POTW) and is excluded, by definition, from classification as a miscellaneous sewer compatible wastewater. This permit requires written approval from the receiving POTW prior to discharge. This permit also covers washing vehicles, which was previously covered by a separate permit. The permit includes screening requirements and discharge concentration limitations for operations exceeding a "small volume" threshold by definition, as well as specified best management practices.

2.19.4.4 Discharge of Wastewater Associated with Food Preparation Establishments

This permit was issued on September 30, 2005 and has an effective duration of ten years. The permit allows food preparation establishments to discharge wastewater to a sanitary sewer. Specific management practices, inspection schedules, and construction requirements must be enforced by the Town, Water Pollution Control Authority, or other jurisdiction issuing the permit for compliance.

There are no flow limits or registration requirements under this permit, and discharges under this permit do not require written approval from the receiving POTW, however;

- The discharger must notify the POTW immediately if an authorized discharge exceeds specified limitations or may adversely affect the POTW or its collection system, and
- The Enfield Town Code is given direct authority to establish limitations and registration requirements in addition to those outlined in the general permit. With this authority, the Town Code, Chapter 86: Utilities, outlines additional requirements including:
    - Registration
    - Maintenance, Operations and Mechanical Failure Notifications
    - Record Keeping and Availability
    - Maintaining Grease Traps

The general permit allows the Town to grant a waiver if a limited potential exists for fats, oils, and grease discharge.

2.19.4.5 General Permit to Limit Potential to Emit from Major Stationary Sources of Air Pollution (Title V)

The release of various volatile organic compounds and greenhouse gases is an unavoidable component of biological wastewater treatment and emergency generator operation. This permit requires registration for sources of those gases if the source has the potential to exceed various thresholds. The primary threshold of concern is the 100,000 tons per year of Equivalent CO_2 (CO_2e) and it applies to total emissions from stationary sources on contiguous property and adjacent properties under the same ownership.

The EPA offers guidance on estimating potential direct emissions from stationary sources of fuel combustion and wastewater treatment.

- The WPCF maintains a diesel generator at the treatment facility and at each pump station in order to comply with its NPDES permit.
  - Based on fuel type, consumption rate at 100% load, and 24/7 run-time, the largest generator, located at the main facility, is estimated to have the potential to emit less than 6,000 tons per year (tpy) of CO_2e (including estimated CH_4 and NO_2 emissions).
  - Smaller generators supporting the various pump stations are assumed to carry lower greenhouse gas emission potential than the largest generator.
- The WPCF includes an aerated treatment process with anoxic zones for nutrient removal.
  - Based on influent flow rates, average influent BOD and removal rate, and primarily clarifier effluent TKN, the WPCF is estimated to have the potential to emit less than 700 tpy CO_2e (including estimated CH_4 and NO_2 emissions).
  - Calculations are based on biological treatment process emissions only; emissions from sludge incineration were not included.

The Enfield WPCF falls short of the minimum emission levels needed to qualify as a "Major Stationary Source" Therefore, no registration is required.

2.20 PROPOSED SEWER SERVICE AREA

Presented in Figure 2-13 is the proposed sewer service area and OPM designated Protected Lands. The proposed sewer service area is based as closely as possible on existing parcels that are known to be connected to existing sewer. Also included in the proposed service area are the approved developments that were discussed in Section 2.18. The borders of the existing sewer service area were modified to remove any parcels designated by the OPM as Protected Land. Other environmentally sensitive areas, including groundwater, wetlands, natural resource areas, and farmland soils, are expected to be impacted by revising the sewer service area. The proposed sewer service area is designed to include only existing sewered areas.

Legend

- WPCF
- Pump Station
- Force Main
- Gravity Sewer

Commercial

- BG Business General
- BL Business Local
- BP Business Professional
- BR Business Regional
- LO Limited Office

Industrial

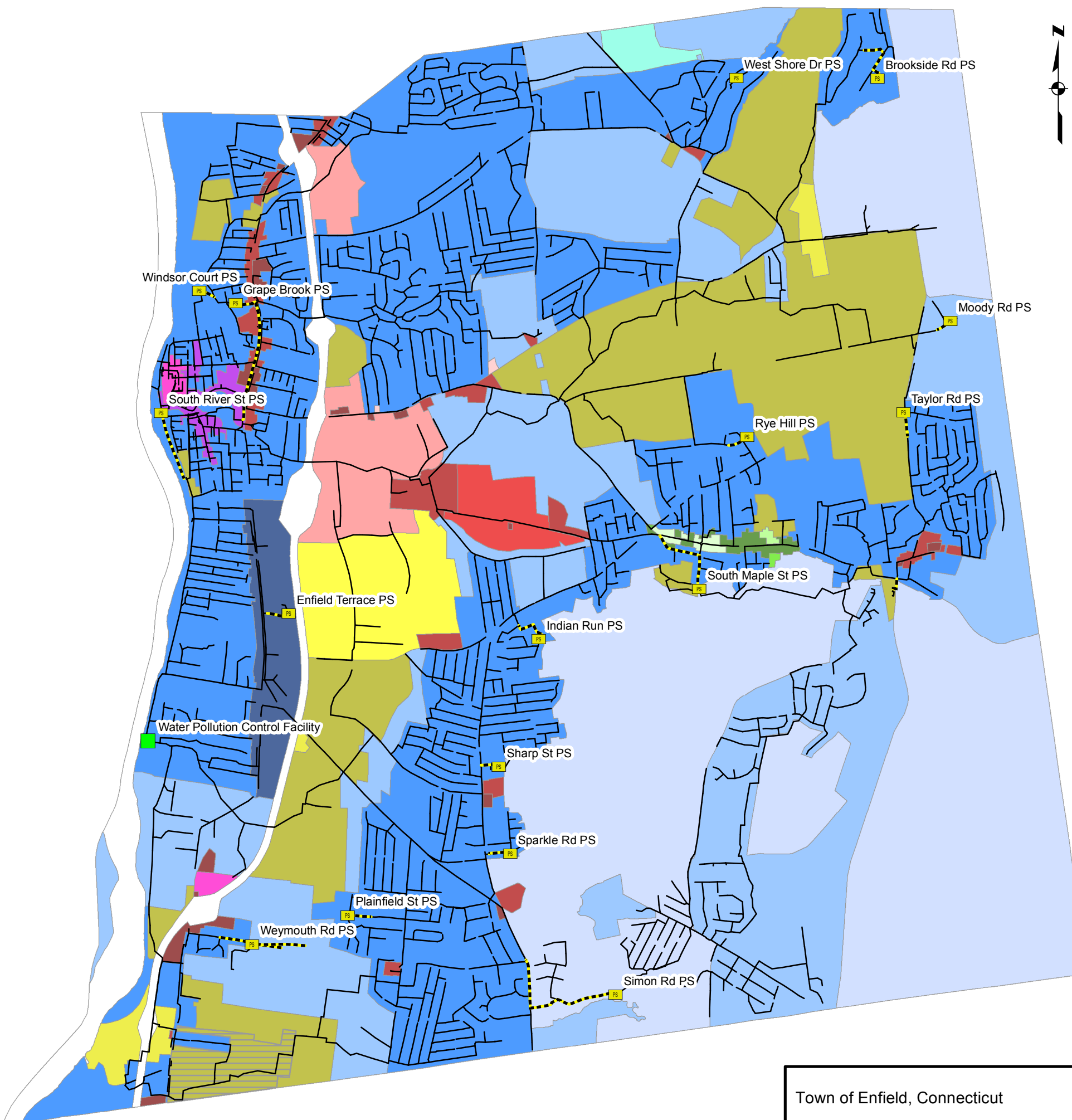
- I-1
- I-1 Medical
- I-2
- IP Industrial Park

Residential

- HR-33 Historic
- R-33
- R-44
- R-88
- MFHD Multi-Family Housing District

Other

- HV33 Historic Village
- HV44 Historic Village
- HV88 Historic Village
- HVBG Historic Village
- HVBL Historic Village
- SDD Special Development District
- TV Thompsonville Village
- No Zoning



0 1,750 3,500 7,000 Feet

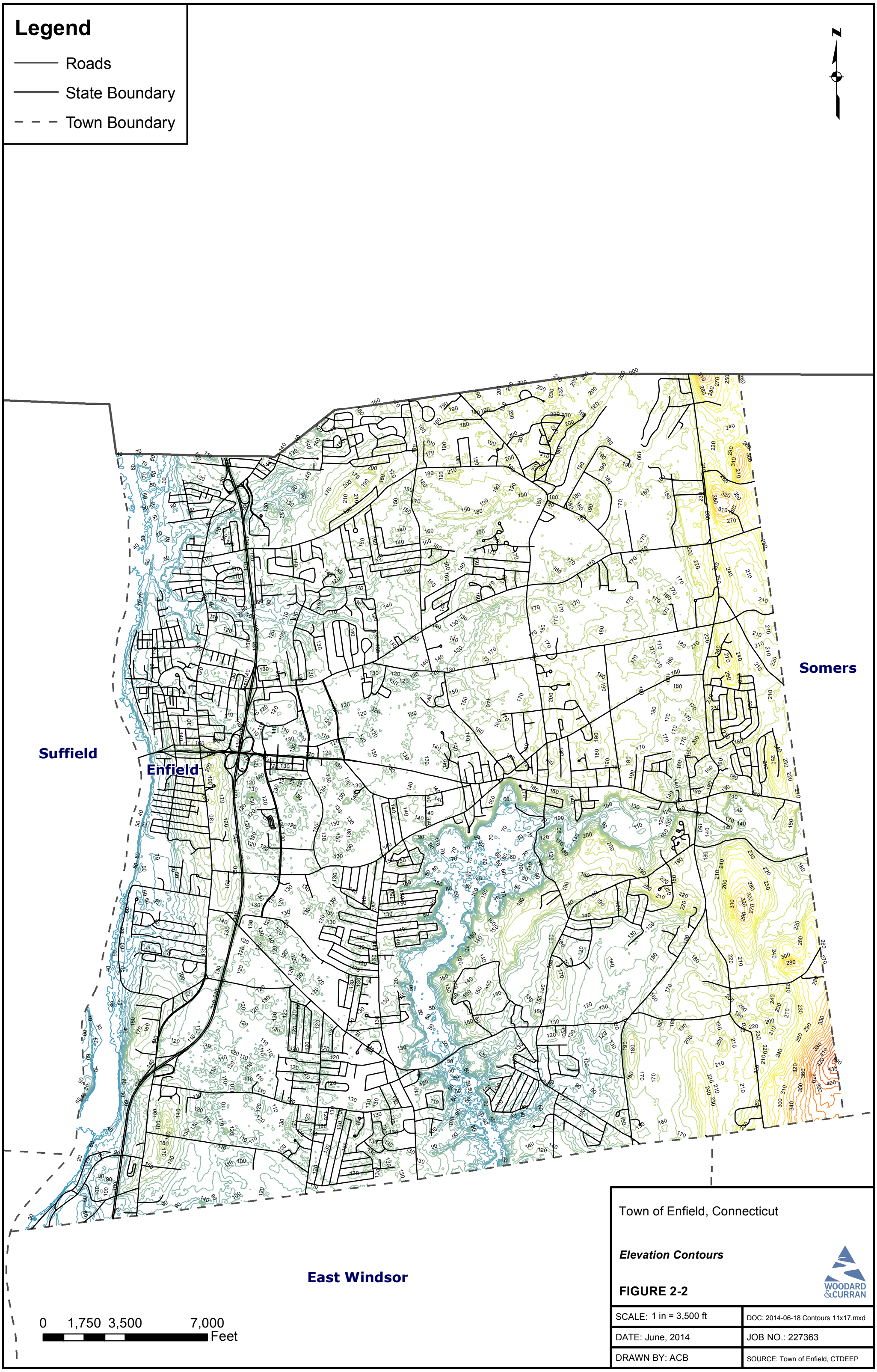
Town of Enfield, Connecticut

Town Zoning Map

FIGURE 2-1

WOODARD &CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2014-06-18 Zoning 11x17.mxd
DATE: October, 2014	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield



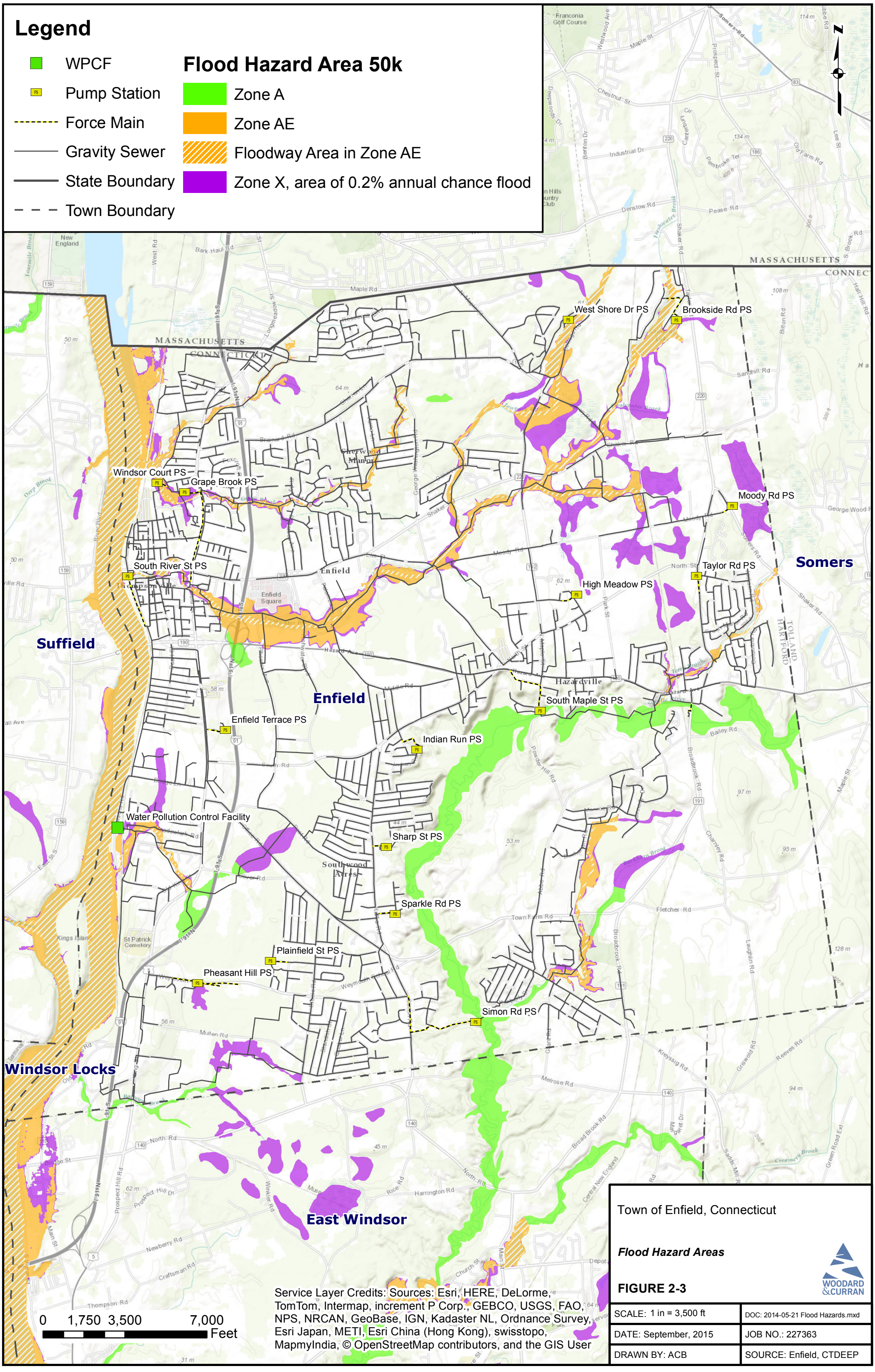
Town of Enfield, Connecticut

Elevation Contours

FIGURE 2-2

WOODARD &CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2014-06-18 Contours 11x17.mxd
DATE: June, 2014	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield, CTDEEP



Town of Enfield, Connecticut

Flood Hazard Areas

FIGURE 2-3

WOODARD & CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2014-05-21 Flood Hazards.mxd
DATE: September, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Enfield, CTDEEP

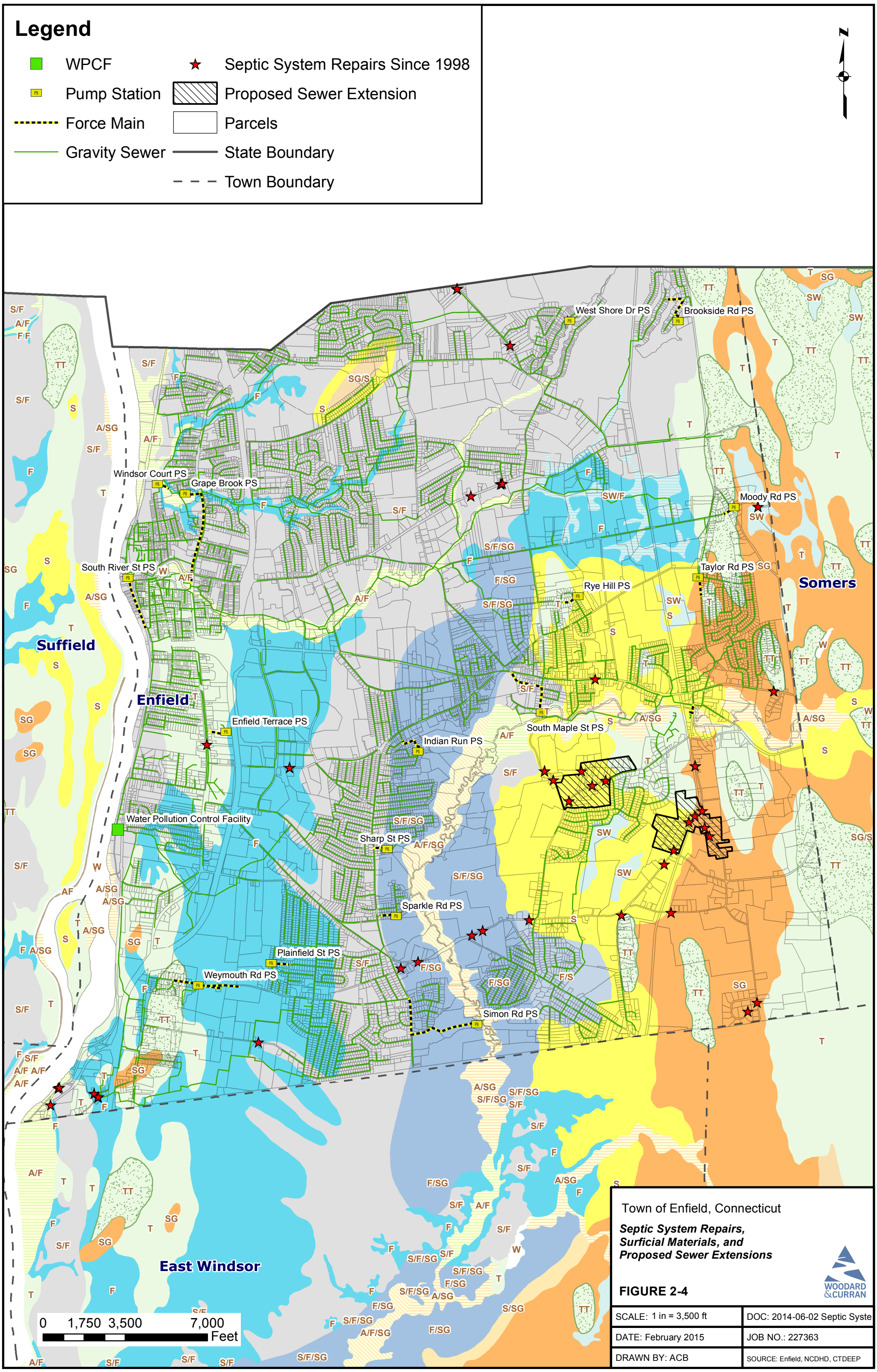

Legend
WPCF
Pump Station
Force Main
Gravity Sewer
Septic System Repairs Since 1998
Proposed Sewer Extension
Parcels
State Boundary
Town Boundary
N
West Shore Dr PS
Brookside Rd PS
Windsor Court PS
Grape Brook PS
Moody Rd PS
South River St PS
Taylor Rd PS
Rye Hill PS
Suffield
Somers
Enfield
Enfield Terrace PS
Indian Run PS
South Maple St PS
Water Pollution Control Facility
Sharp St PS
Sparkle Rd PS
Plainfield St PS
Weymouth Rd PS
Simon Rd PS
East Windsor
0 1,750 3,500 7,000
Feet
Town of Enfield, Connecticut
Septic System Repairs, Surficial Materials, and Proposed Sewer Extensions
FIGURE 2-4
WOODARD &CURRAN
SCALE: 1 in = 3,500 ft
DOC: 2014-06-02 Septic Syste
DATE: February 2015
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Enfield, NCDHD, CTDEEP

Figure 2-4A: Legend

Surficial Materials

GLACIAL ICE-LAID DEPOSITS

Thin Till	*T*
Thick Till	*TT*

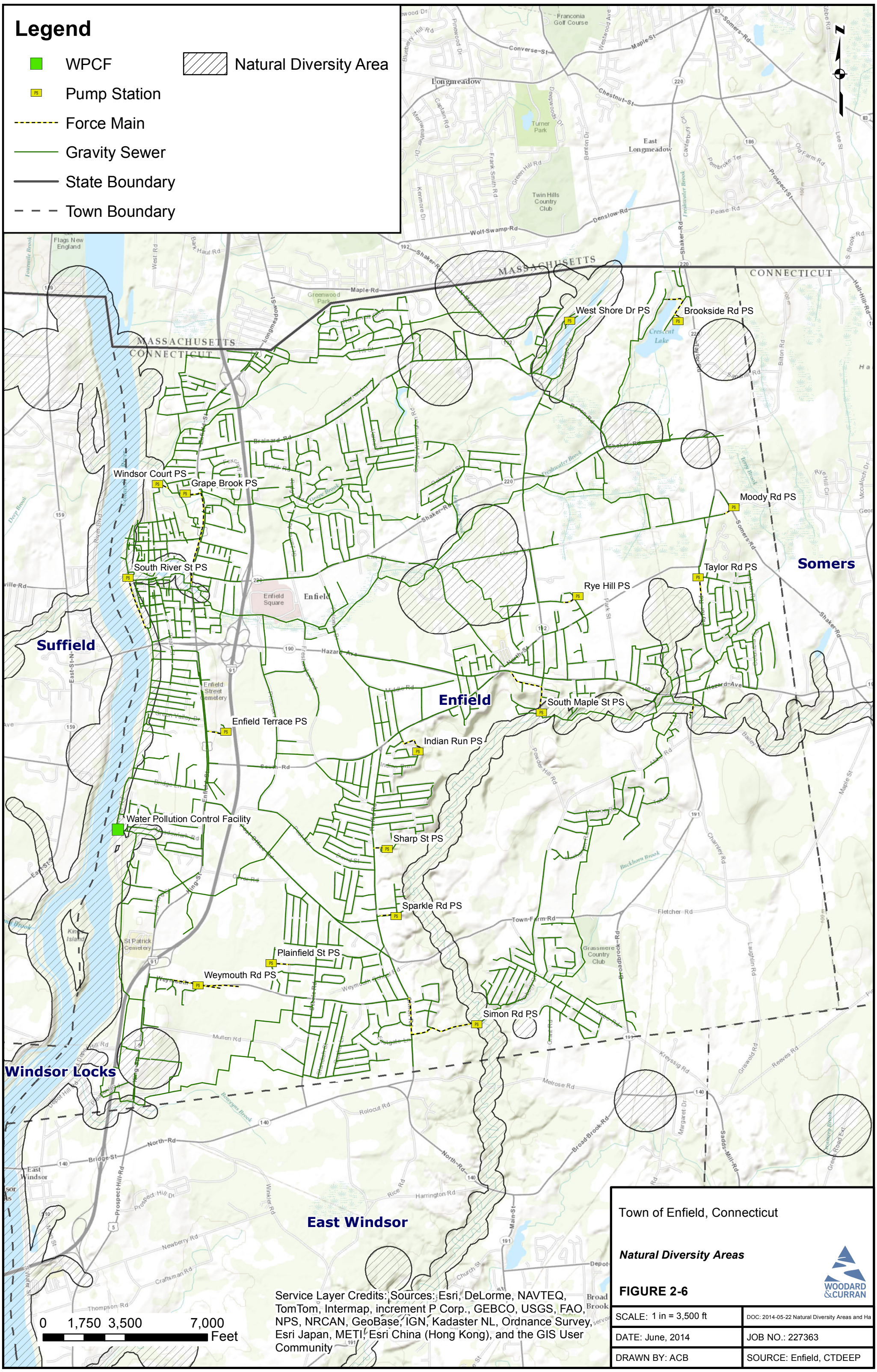
GLACIAL MELTWATER DEPOSITS

Fines (very fine sand, silt, and clay)	*F*
Sand and Gravel	*SG*
Sand	*S*
Sand and Gravel overlying Sand	*SG/S*
Sand overlying Sand and Gravel	*S/SG*
Sand overlying Fines	*S/F*
Fines overlying Sand and Gravel	*F/SG*
Fines overlying Sand	*F/S*

POSTGLACIAL DEPOSITS

Alluvium overlying undifferentiated Coarse Deposits	*A/SG*
Alluvium overlying Fines	*A/F*
Alluvium overlying undifferentiated Fine Deposits overlying Coarse Deposits	*A/F/G*
Swamp deposits	*SW*
Swamp deposits overlying Fines	*SW/F*
Artificial Fill	*AF*

Legend
WPCF
Pump Station
Force Main
Gravity Sewer
State Boundary
Town Boundary
Wetland
Surface Water
West Shore Dr PS
Brookside Rd PS
Windsor Court PS
Grape Brook PS
Moody Rd PS
South River St PS
Taylor Rd PS
Rye Hill PS
South Maple St PS
Enfield Terrace PS
Indian Run PS
Water Pollution Control Facility
Sharp St PS
Sparkle Rd PS
Plainfield St PS
Weymouth Rd PS
Simon Rd PS
Suffield
Enfield
Somers
Windsor Locks
East Windsor
MASSACHUSETTS
CONNECTICUT
0 1,750 3,500 7,000 Feet
Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community
Town of Enfield, Connecticut
Wetlands
FIGURE 2-5
WOODARD &CURRAN
SCALE: 1 in = 3,500 ft
DOC: 2014-05-21 Wetlands.mxd
DATE: June, 2014
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Enfield, FWS



Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

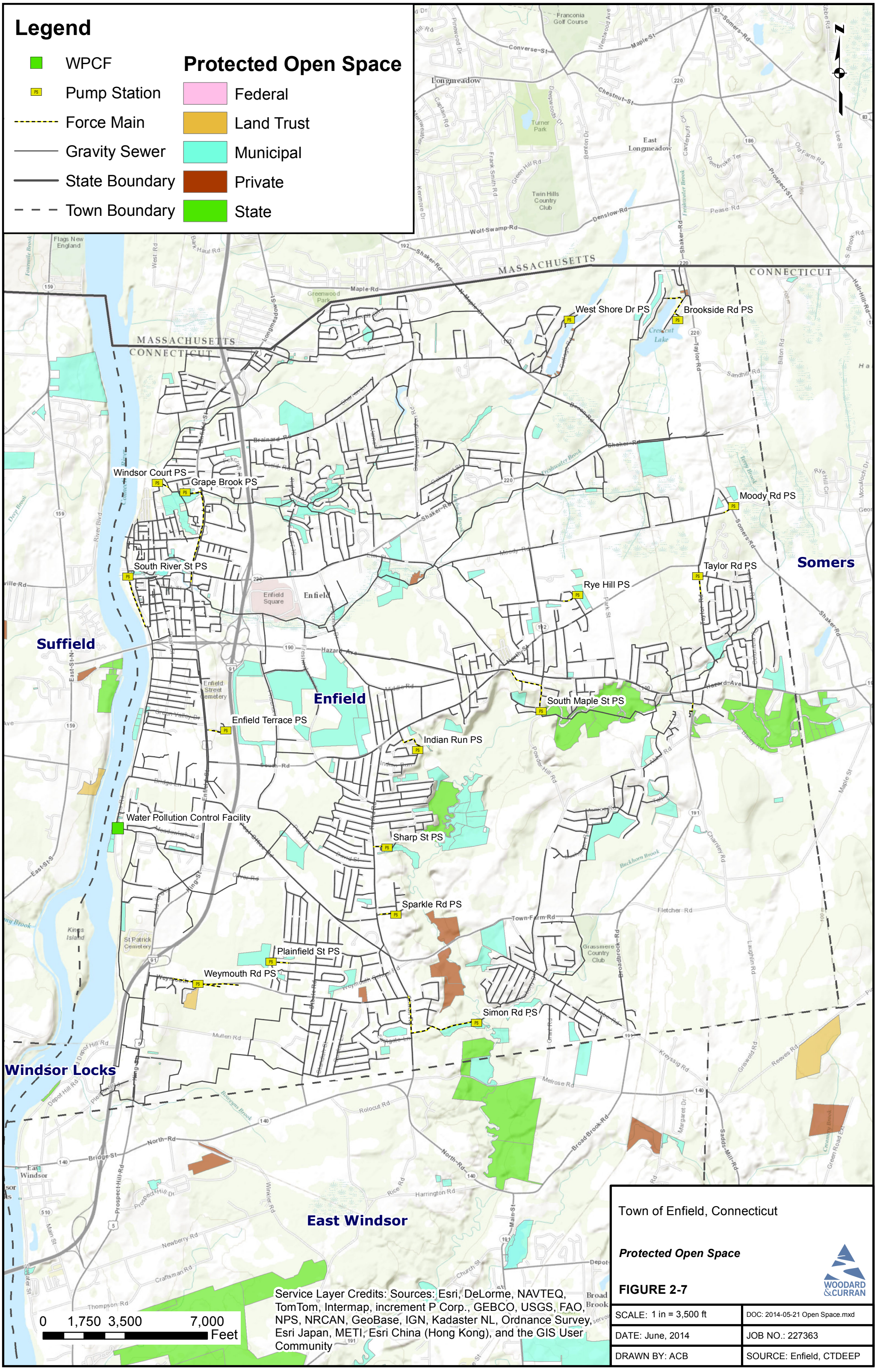
Town of Enfield, Connecticut

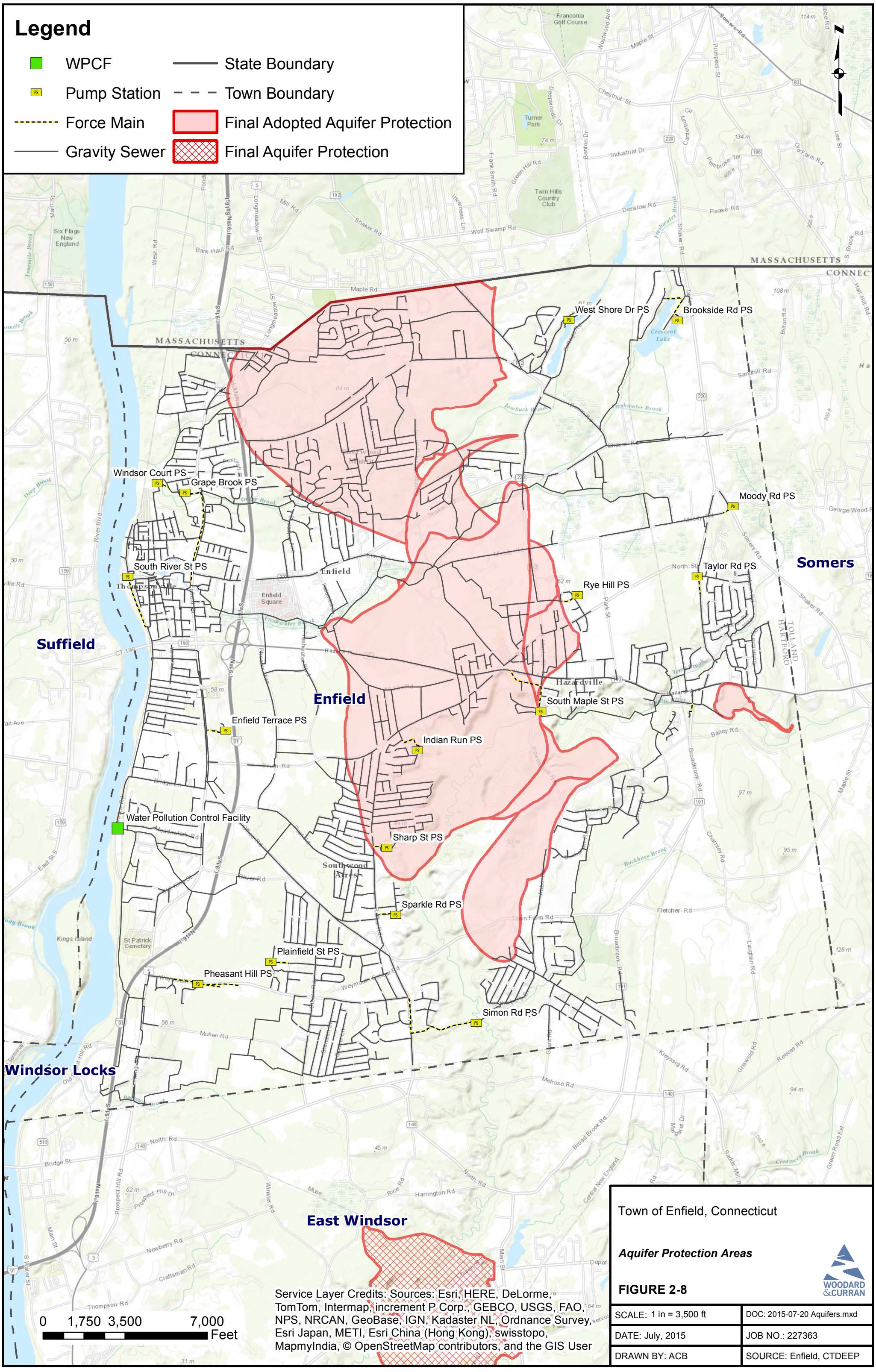
Natural Diversity Areas

FIGURE 2-6

WOODARD & CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2014-05-22 Natural Diversity Areas and Ha
DATE: June, 2014	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Enfield, CTDEEP


Legend
WPCF
Pump Station
Force Main
Gravity Sewer
State Boundary
Town Boundary
Protected Open Space
Federal
Land Trust
Municipal
Private
State
MASSACHUSETTS
CONNECTICUT
West Shore Dr PS
Brookside Rd PS
Windsor Court PS
Grape Brook PS
Moody Rd PS
South River St PS
Taylor Rd PS
Rye Hill PS
Somers
Suffield
Enfield
South Maple St PS
Enfield Terrace PS
Indian Run PS
Water Pollution Control Facility
Sharp St PS
Sparkle Rd PS
Plainfield St PS
Weymouth Rd PS
Simon Rd PS
Windsor Locks
East Windsor
0 1,750 3,500 7,000 Feet
Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community
Town of Enfield, Connecticut
Protected Open Space
FIGURE 2-7
WOODARD &CURRAN
SCALE: 1 in = 3,500 ft
DOC: 2014-05-21 Open Space.mxd
DATE: June, 2014
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Enfield, CTDEEP



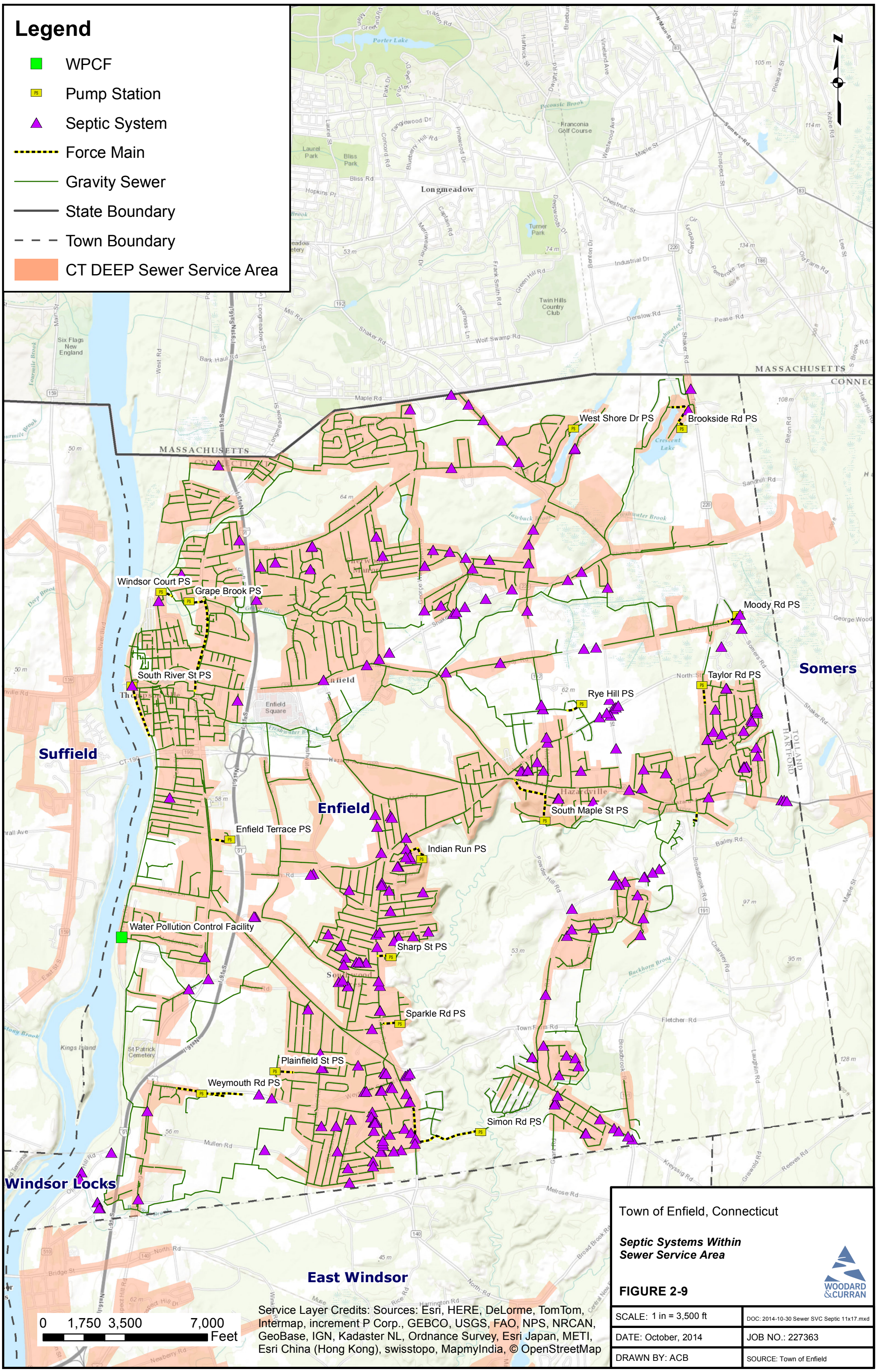
Town of Enfield, Connecticut

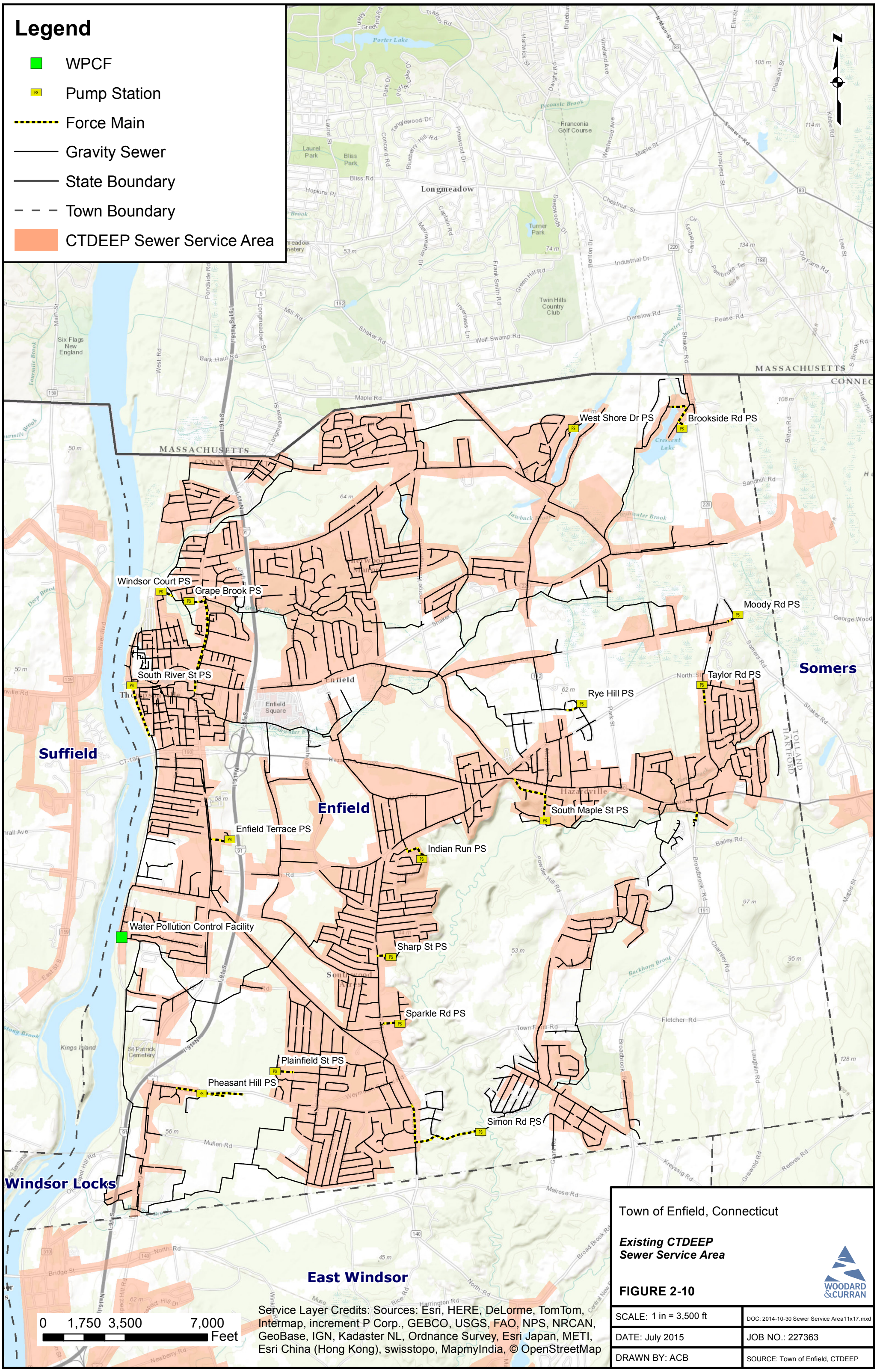
Aquifer Protection Areas

FIGURE 2-8

WOODARD & CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2015-07-20 Aquifers.mxd
DATE: July, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Enfield, CTDEEP


Legend
WPCF
Pump Station
Septic System
Force Main
Gravity Sewer
State Boundary
Town Boundary
CT DEEP Sewer Service Area
West Shore Dr PS
Brookside Rd PS
Windsor Court PS
Grape Brook PS
Moody Rd PS
South River St PS
Taylor Rd PS
Rye Hill PS
Enfield Terrace PS
South Maple St PS
Indian Run PS
Water Pollution Control Facility
Sharp St PS
Sparkle Rd PS
Plainfield St PS
Weymouth Rd PS
Simon Rd PS
Suffield
Enfield
Somers
Windsor Locks
East Windsor
MASSACHUSETTS
CONNECTICUT
Longmeadow
Hazardville
Enfield Square
Franconia Golf Course
Twin Hills Country Club
Six Flags New England
0 1,750 3,500 7,000 Feet
Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap
Town of Enfield, Connecticut
Septic Systems Within Sewer Service Area
FIGURE 2-9
WOODARD &CURRAN
SCALE: 1 in = 3,500 ft
DOC: 2014-10-30 Sewer SVC Septic 11x17.mxd
DATE: October, 2014
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Town of Enfield



Town of Enfield, Connecticut

Existing CTDEEP Sewer Service Area

FIGURE 2-10

WOODARD & CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2014-10-30 Sewer Service Area11x17.mxd
DATE: July 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield, CTDEEP

Legend

- Developments
- Parcels

Commercial

- BG Business General
- BL Business Local
- BP Business Professional
- BR Business Regional
- LO Limited Office

Industrial

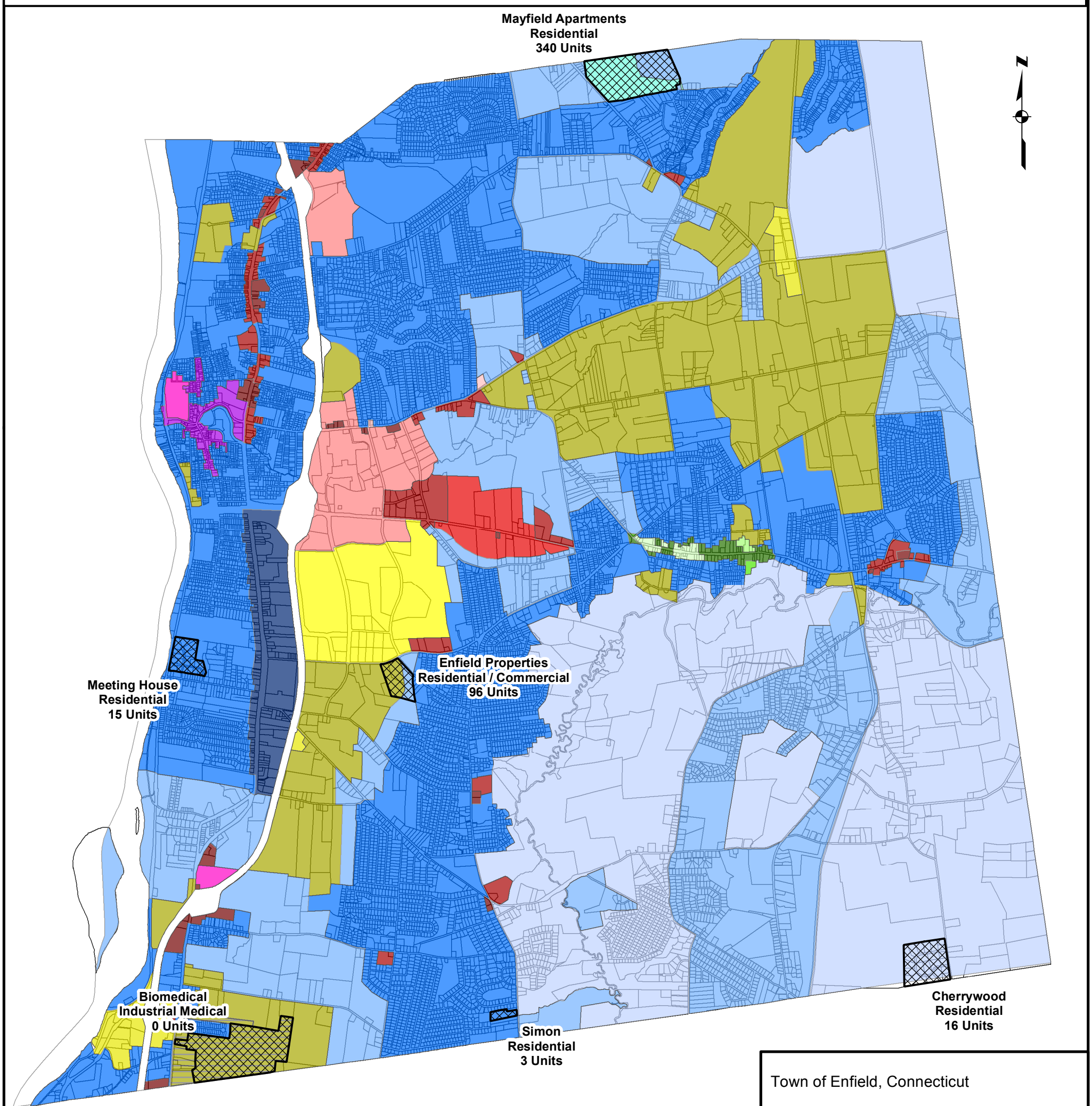
- I-1
- I-1 Medical
- I-2
- IP Industrial Park

Residential

- HR-33 Historic
- R-33
- R-44
- R-88
- MFHD Multi-Family Housing District

Other

- HV33 Historic Village
- HV44 Historic Village
- HV88 Historic Village
- HVBG Historic Village
- HVBL Historic Village
- SDD Special Development District
- TV Thompsonville Village
- No Zoning



Town of Enfield, Connecticut

Approved Development & Zoning

FIGURE 2-11

WOODARD &CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2014-10-08 Development.mxd
DATE: July 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield

Legend

- State Boundary
- Town Boundary
- Roads
- Water
- Protected Lands
- Local Historic District

Priority Funding Areas

- 1-2 Criteria
- 3-4 Criteria
- 5 Criteria
- Balanced Priority Funding Area

Conservation Areas

- 1-3 Conservation Factors
- 4-5 Conservation Factors
- 6-7 Conservation Factors

N

Suffield

Somers

Enfield

Windsor Locks

East Windsor

0 1,750 3,500 7,000 Feet

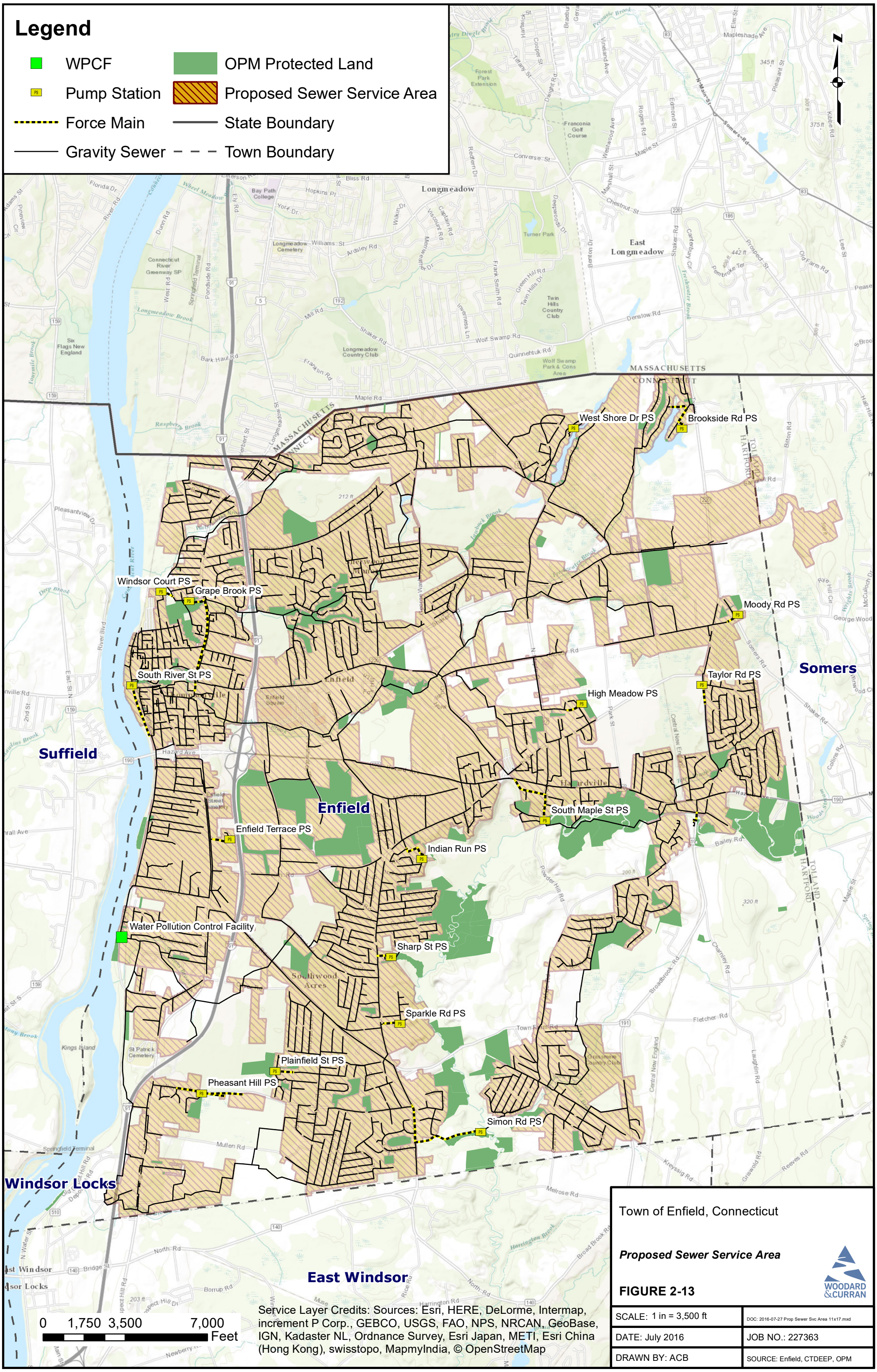
Town of Enfield, Connecticut

OPM 2013-2018 Conservation & Development Policies Map

FIGURE 2-12

WOODARD &CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2015-02-12 OPM CD Map 11x17.mxd
DATE: July 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield



Town of Enfield, Connecticut

Proposed Sewer Service Area

FIGURE 2-13

WOODARD & CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2016-07-27 Prop Sewer Svc Area 11x17.mxd
DATE: July 2016	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Enfield, CTDEEP, OPM

3. FLOWS AND LOADS

3.1 INTRODUCTION

Included in this section is the establishment of existing WPCF flow and its components, residential, municipal, commercial, industrial, institutional, septage, and inflow and infiltration. Wastewater constituent loads and their variability are identified, as these wastewater characteristics greatly impact treatment options identified and analyzed elsewhere in this Facilities Plan. Projections for future flows and loads are also included in this chapter, and are based on population trends identified in Chapter 2, and approved developments identified by the Town Staff.

3.2 EXISTING WASTEWATER FLOWS

With the exception of the prisons in Somers and the Golden Irene Restaurant on Mullens Road in East Windsor, wastewater at the Enfield WPCF is generated from Town residences and businesses. Enfield WPCF Monthly Operating Report (MOR) data was reviewed for the period spanning January 2010 through December 2013 to quantify existing flows and loads treated at the WPCF. Peaking factors are also included that illustrate the ratio of the given flow condition relative to average daily flow. Presented in Table 3-1 are the existing wastewater flows for the Enfield WPCF. Peaking factors are also included that illustrate the ratio of the given flows condition relative to average daily flow.

Table 3-1: Existing Wastewater Flows (January 2010 – December 2013)

	Peaking Factor	Flow	Units
Average Daily		5.25	mgd
Maximum Monthly	1.4	7.2	mgd
Maximum Weekly	1.9	9.9	mgd
Maximum Daily	2.7	14.1	mgd
Peak Hourly	3.1	16.2	mgd

Following is a brief description of methodology used to derive these flows:

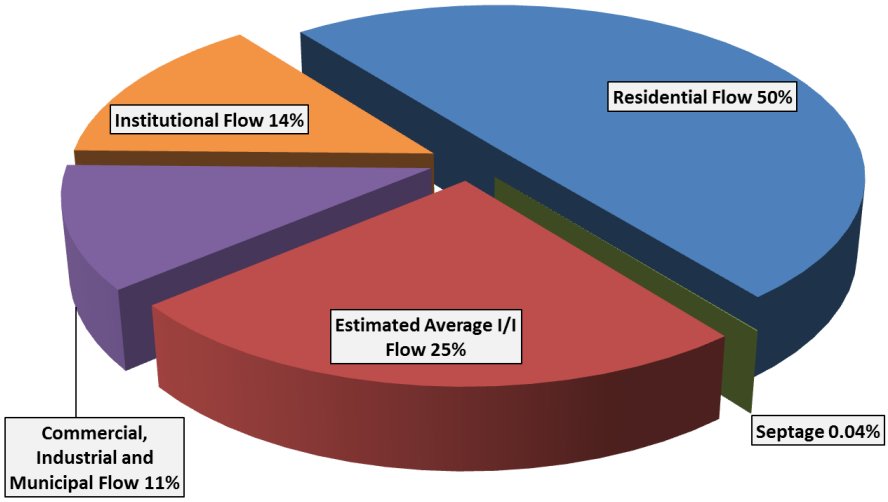
1. Average Daily – The average daily flow or load condition over the entire range of data considered. The period over which the data is averaged is either year-round or seasonal depending on the situation. For Enfield, this is daily data throughout the entire year.
2. Maximum Monthly – The maximum monthly conditions represent conditions that are expected to be exceeded once every 12 occurrences, or 30.4 days per 365-day year. This is determined by developing the frequency distribution for all the relevant data and selecting the value closest to the 91.7% exceedance value (i.e., exceeded 8.3% of the time).
3. Maximum Weekly – The maximum weekly conditions represent conditions that are expected to be exceeded once every 52 occurrences, or 7 days per year. This is determined by developing the frequency distribution for all the relevant data and selecting the value closest to the 98.1% exceedance value (i.e., exceeded 1.9% of the time).
4. Maximum Daily – The maximum daily conditions represent conditions that are expected to be exceeded once every 365 occurrences, or one day per year. This is determined by developing the frequency distribution for all the relevant data and selecting the value closest to the 99.7% exceedance value (i.e., exceeded 0.3% of the time).

5. Peak Hourly – The peak hourly conditions to be used for process evaluation and design are limited to peak flow only. This value has been determined by using a frequency distribution for the single highest peak flow experienced each day. These values are ranked and the peak flow corresponding to the 99.7 percentile is selected for process evaluation. This value corresponds to the peak flow condition that exceeded the equivalent of a portion of one day per year. The single highest peak flow condition recorded over the period in question is used to evaluate peak hydraulic capacity requirements (peak instantaneous).

Wastewater flows are comprised of a number of components each with their own characteristics, including sanitary flows, inflow and infiltration (I/I), and septage. Sanitary wastewater originates from residential, municipal, commercial, industrial, and institutional sources connected to the sanitary sewer. Residential wastewater generally varies little in strength, although a prevalence of garbage disposal units can increase loadings above typical values. Non-residential wastewater, including municipal, commercial, industrial, and institutional sources, varies in strength based on the industry and processes involved. I/I is defined in detail in section 4.2.

Septage is a separate component not found in the collection system itself but is delivered to the WPCF. Septage is collected from local residences on septic systems, not connected to the sanitary sewer system. Septage typically has a higher strength than residential wastewater but is a small flow component. Figure 3-1 shows the average origin of wastewater sources entering the WPCF.

Figure 3-1: WPCF Flow Composition



3.2.1 Residential Sanitary Flows

The residential component of total wastewater flows at the Enfield WPCF was estimated using residential water consumption data. As mentioned in Chapter 1, the Town of Enfield recently switched from collecting sewer revenue on an *ad valorem* (tax rate) basis to a user rate system. Sewer bills were generated using water consumption data from the Connecticut Water Company and Hazardville Water Company, but the Hazardville Water Company could not provide the number of users served. Therefore, we used data provided by the Connecticut Water Company to determine the per capita residential flow. These records are broken down into residential and non-residential users. For the period of 2010 through 2012, an average of 7,752 residential accounts consumed an average annual volume

of 461,873,000 gallons of water. Using a value of 2.43 people per household, based on the 2010 census, yields a per capita consumption rate of 66 gallons per capita per day. This is slightly lower than the minimum recommended value of 70 gallons per capita per day listed in TR-16[4], but is a reasonable rate that will be used to estimate future residential wastewater flow rates.

3.2.2 Non-Residential Sanitary Flows

The non-residential components of total sanitary flow were determined from two sources, water consumption records and metered wastewater flow data. Water consumption records from the Connecticut Water Company and Hazardville Water Company were used to estimate municipal, commercial and industrial wastewater flow. According to records, the average annual water consumption for the period of 2010 through 2012 was 219,314,000 gallons, resulting in a municipal, commercial, and industrial base flow of approximately 600,000 gallons per day (gpd). Based on Connecticut Water Company usage data only, the average flow per municipal, commercial, or industrial connection is approximately 820 gpd.

The institutional component of sanitary flows was determined based on metered wastewater flow records of the Enfield prisons, provided by the Enfield WPCF. The Enfield prisons contributed a total of 272,961,000 gallons in 2013, which yields an average daily flow of approximately 748,000 gpd. The Town of Enfield Non-Residential sanitary flow is a combination of municipal, commercial, industrial, and institutional flows, and is approximately 1,348,000 gpd on average.

Non-residential wastewater flows sometimes include industrial wastes of varying strength, which can impact WPCF processes. Typically, an industrial waste survey of industries located in the service area is conducted to determine the industrial waste component of wastewater. According to Town staff, discharge monitoring reports (DMR's) for the industries in Enfield were not available for review since the majority of the industries in Town have general permits and reporting requirements are not required. Based on the information provided, it appears that no industrial discharges would be inhibitory to any proposed treatment process or would increase the plant loadings beyond that normally expected.

3.2.3 Septage

Only septage generated from residents is accepted at the WPCF, and haulers have historically been able to dispose of it at the WPCF at no charge. Between 2010 and 2013, the WPCF accepted approximately 350,000 gallons per year. Beginning in 2014, the WPCF began charging $60 per 1,000 gallons to accept residential septage and $80 per 1,000 gallons of industrial / commercial septage. As a result, the amount of septage delivered to the plant dropped substantially. Between January and July of 2014, the WPCF only accepted 17,750 gallons of septage. Nearby communities including East Windsor and Suffield accept septage at their Water Pollution Control Facilities at a slightly lower cost than Enfield.

3.2.4 Inflow & Infiltration

See section 4.2 for a detailed definition of I/I Infiltration is most noticeable during the spring months after the snow has melted and the groundwater level is high. Inflow is typically characterized by an increase in flow for a relatively short period of time during and immediately following a rainfall event.

The average base flow (calculated from average daily flows from characteristically dry months), including residential, municipal, commercial, industrial, institutional and septage flows, was calculated to be approximately 3,957,000 gpd.

[4] TR-16 Guides for the Design of Wastewater Treatment Works, 2011 Edition.

The average daily I/I at the WPCF was estimated by subtracting the base flow from the average daily WPCF flow of 5,245,000 gpd. Therefore, the estimated average I/I component of WPCF flow is estimated to be 1,289,000 gpd.

3.3 EXISTING WASTEWATER LOADS

Historical data was used to calculate the existing wastewater pollutant loadings to the WPCF and project future loadings. Table 3-2 includes the influent, primary clarifier effluent, and final effluent biochemical oxygen demand (BOD), total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP), as well as percent removals for the period of January 2010 to December 2013. Wastewater loads are given as pounds of contaminants entering the WPCF per day (lb/day) at each point in the treatment process (Influent, primary effluent, and final effluent).

As defined in Section 3.2, the maximum month, week and day loads are values to be exceeded 30 days out of each year, seven days each year, and one day each year, respectively. The influent peaking factor is a ratio of maximum loading to average daily loading, which will be used for determining maximum month, week, and day loadings for future flows. Average concentration of each contaminant at each point in the treatment process is given as milligrams per liter (mg/L). Percent removal shows the effectiveness of the respective treatment process at removing each contaminant, and is calculated as the pounds of contaminant removed over the influent load as a percent. For example, Table 3-2 shows that the primary clarifiers remove on average 39% of BOD from the influent wastewater. Secondary percent removal is based on the total mass removed between the plant influent and the secondary treatment process. No influent or primary effluent TP loading or concentration data is available to calculate percent removal.

Examination of the pollutant concentrations shows the Enfield WPCF influent is characterized as medium strength wastewater with BOD, TSS, and TN of 215, 196, and 32 mg/L, respectively. This is a reasonable characterization considering the relatively low level of heavy industrial development and high residential flow component common with suburban areas.

Table 3-2: Existing Wastewater Loading (January 2010 – December 2013)

	Influent Peaking Factor	Influent	Primary Effluent	Final Effluent	Units	Primary Percent Removal	Overall Percent Removal
Biochemical Oxygen Demand (BOD)							
Average Daily		215	129	5.4	mg/l	39%	97%
Average Daily		9,087	5,568	325	lb/day		
Maximum Month	1.3	11,922	7,762	580	lb/day		
Minimum Month	0.8	6,970	3,830	138	lb/day		
Maximum Week	1.8	16,075	11,011	1,508	lb/day		
Maximum Day	2.4	21,380	18,113	3,872	lb/day		
Total Suspended Solids (TSS)							
Average Daily		196	60	3.4	mg/l	68%	98%
Average Daily		8,322	2,621	203	lb/day		
Maximum Month	1.3	10,926	3,616	337	lb/day		
Minimum Month	0.7	5,774	1,691	79	lb/day		
Maximum Week	2.0	16,996	6,382	654	lb/day		
Maximum Day	3.2	26,572	11,489	2,262	lb/day		
Total Nitrogen (TN)							
Average Daily		32	27	6.1	mg/l	14%	80%
Average Daily		1,355	1,139	261	lb/day		
Maximum Month	1.3	1,722	1,416	359	lb/day		
Minimum Month	0.8	1,108	946	176	lb/day		
Maximum Week	1.7	2,266	1,743	511	lb/day		
Maximum Day	2.4	3,187	1,749	845	lb/day		
Total Phosphorous (TP)[1]							
Average Daily		4.0	-	2.1	mg/l	-	47%
Average Daily		153	-	81	lb/day		
Maximum Month	1.3	192	-	100	lb/day		
Minimum Month	0.8	121	-	63	lb/day		
Maximum Week	1.3	206	-	128	lb/day		
Maximum Day	1.4	210	-	136	lb/day		

1. No primary effluent TP data is available. Influent and Final Effluent TP data were not measured between January 2010 and December 2013. The data shown was collected between January and December 2014.

3.4 FUTURE PROJECTIONS OF FLOWS AND LOADS

One of the key elements in facilities planning is to forecast conditions in the study area throughout the future planning period. The planning period is defined as being 20 years past the date when the proposed upgrades to the WPCF are

expected to be completed. The period of 20 years is the expected useful life of most mechanical and electrical equipment used to treat wastewater. A 20-year period is also considered a typical planning horizon relative to changes in service population and major regulatory initiatives. For the purposes of this report, the upgrades are expected to be completed in 2019, so the flow estimates are projected until the year 2039.

3.5 FUTURE FLOWS AND LOADS SUMMARY

Tables 3-3 and 3-4 include a summary of the future flows and loads which are based on the anticipated connections described in Chapter 2. As indicated, the expected average annual future flows are only 6% greater than the existing. This seems reasonable considering the expected population decline and low number of net construction permits that have been issued in the past several years.

Table 3-3: Additional Flows

Source	Flow	Unit
New Residential Development Within Service Area	73,000	gpd
New Non-residential Development Within Service Area	57,000	gpd
Infill Development	41,000	gpd
Existing Homes Outside Service Area	12,000	gpd
Additional I/I from New Sewers	7,000	gpd
Town of Somers	65,000	gpd
Total	**250,000**	**gpd**
Total	**0.25**	**mgd**

Table 3-4: Future Flows

	Peaking Factor	Existing	Future	Unit
Flow				
Average Annual		5.25	5.50	mgd
Peak Hour	3.1	16.2	17.0	mgd
Maximum Month	1.4	7.2	7.6	mgd
Minimum Month	0.7	3.9	4.0	mgd
Maximum Week	1.9	9.9	10.3	mgd
Maximum Day	2.7	14.1	14.8	mgd

As shown in Table 3-5, the influent loadings are expected to increase by about 8.5% each, which is consistent with the additional connected population increase of approximately 8%, including wastewater from the Town of Somers. The existing estimated population on sewer is 43,342. An estimated 3,702 additional users are expected to connect over the planning period, for a total connected future population of 47,043. Load per capita is a function of average annual influent load and population, and is not expected to change over the planning period. The future influent BOD, TSS, TN and TP loadings were calculated using the existing per capita rates of 0.21, 0.19, 0.03, and 0.004 pounds per capita per day, respectively. These rates are similar to the typical domestic wastewater rates of 0.20, 0.17, 0.04, and 0.006 pounds per capita per day, as published in TR-16.

3.6 FLOW ALLOCATION MODEL

The flow allocation model simulates flow assuming all pipes are free of obstruction and damage. Pump station and force main capacity were not considered as part of the model. The flow allocation model was programmed as an Excel spreadsheet for ease of end-user use. The spreadsheet may be modified to include additional future EDUs and calculate the impact on capacity of downstream pipes.

The preliminary version of the flow allocation model calculates pipe capacities for all of the major interceptors in the Enfield collection system. For the purpose of this analysis, Woodard & Curran delineated ten interceptors from the existing GIS pipe data, which are shown in Figure 3-2. All other pipes, shown in gray in the figure, are considered contributing pipes, the capacities of which are not modeled. The flow allocation model currently only calculates capacities of the interceptor pipes. Flows originating from all connected parcels in the system are accounted for, as well as estimated quantities of I/I per unit idm of interceptor and contributing pipe. The flow allocation model calculates flow capacity in each individual pipe, assuming full flow at ¾ the depth of the pipe, using the Manning equation shown below:

Equation 3-1: Manning Equation for Open Channel Flow

$$Q = A\frac{1.49}{n}R^{2/3}S^{1/2}$$

Where Q equals flow in ft^3/s, A is area in ft^2, n is the Manning roughness coefficient, R is the hydraulic radius in ft, and S is slope in ft/ft. Hydraulic radius is a function of the wetted perimeter and the cross sectional area of flow in the pipe. The Manning roughness coefficient was chosen based on the pipe material as given in the Open Channel Flow Measurement Handbook[5] and the Civil Engineering Reference Manual[6].

Preliminary results of the model indicate that under peak hourly flow conditions the Connecticut River interceptor may be experiencing surcharging. Several assumptions were made in the development of the flow allocation model, including the following:

- Slope – Slope used for calculation of flow capacity was determined using either the slope calculated from pipe geometry or the minimum design slope noted in TR-16. If the calculated slope was less than the minimum design slope or resulted in a velocity greater than 12 ft/s (scouring velocity), the design slope was used instead.
- Residential Loading – Assumed one EDU per residential parcel and 160 gpd/EDU.
- Commercial and Industrial Loading – Assumed 0.1 gpd/sqft of building area from the Enfield assessor's data.

Institutional Loading – The average daily flow of the five prisons in Enfield and Somers was 747,838 gpd for 2013 and was applied to SMH-2972.

[5] ISCO Open Channel Flow Measurement Handbook. Sixth Edition. Teledyne Isco, Inc. 2008.
[6] Civil Engineering Reference Manual for the PE Exam. Thirteenth Edition. Michael R. Lindeburg. Professional Publications, Inc. 2012.

Table 3-5: Future Loads

	Influent Peaking Factor	Existing Influent	Future Influent	Primary Effluent Peaking Factor	Existing Primary Effluent	Future Primary Effluent[1]	Unit
Biochemical Oxygen Demand (BOD)							
Average Annual		215	215		129	132	mg/l
Average Annual		9,087	9,863		5,568	6,061	lb/day
Maximum Month	1.3	11,922	12,940	1.4	7,762	8,450	lb/day
Minimum Month	0.8	6,970	7,565	0.7	3,830	4,169	lb/day
Maximum Week	1.8	16,075	17,448	2.0	11,011	11,988	lb/day
Maximum Day	2.4	21,380	23,206	3.3	18,113	19,720	lb/day
Total Suspended Solids (TSS)							
Average Annual		196	197		60	64	mg/l
Average Annual		8,322	9,032		2,621	2,924	lb/day
Maximum Month	1.3	10,926	11,859	1.4	3,616	4,034	lb/day
Minimum Month	0.7	5,774	6,267	0.6	1,691	1,887	lb/day
Maximum Week	2.0	16,996	18,447	2.4	6,382	7,121	lb/day
Maximum Day	3.2	26,572	28,841	4.4	11,489	12,819	lb/day
Total Nitrogen (TN)							
Average Annual		32	32		27	27	mg/l
Average Annual		1,355	1,471		1,139	1,260	lb/day
Maximum Month	1.3	1,722	1,869	1.2	1,416	1,567	lb/day
Minimum Month	0.8	1,108	1,203	0.8	946	1,047	lb/day
Maximum Week	1.7	2,266	2,460	1.5	1,743	1,928	lb/day
Maximum Day	2.4	3,187	3,459	1.5	1,749	1,935	lb/day
Total Phosphorous (TP)[2]							
Average Annual		4.0	3.6		-	-	mg/l
Average Annual		153	166		-	-	lb/day
Maximum Month	1.3	192	208	-	-	-	lb/day
Minimum Month	0.8	121	131	-	-	-	lb/day
Maximum Week	1.3	206	224	-	-	-	lb/day
Maximum Day	1.4	210	228	-	-	-	lb/day

1. Calculated assuming future primary removal efficiency will not change.
2. Influent TP data were collected between January and December 2014. No primary effluent TP data is available.

Figure 3-2: Collection System Model

4. COLLECTION SYSTEM

4.1 EXISTING CONDITIONS

The Town of Enfield's collection system includes approximately 210 miles of sewer, 16 pumping stations, and two inverted siphons, a detailed map of which is shown in Figure 4-1. The Thompsonville area of Town includes the oldest sewers, which date back to the 1930's or earlier. When originally constructed, the system was a combined system that conveyed both stormwater and sanitary flows. Several studies and construction projects were performed over the past 40 years to separate this system and reduce the amount of clean water entering it.

As shown in Figure 4-2, the collection system gravity sewer includes a variety of piping materials, such as vitrified clay, asbestos cement, polyvinyl chloride, ductile iron, cast iron, and reinforced concrete. Table 4-1 includes a summary of the total length of pipe in the collection system by material. The significant quantity of unknown material in the system (15.7%) is suspected to consist of primarily vitrified clay tile pipe in the Thompsonville area, but would have to be verified through detailed survey.

Table 4-1: Collection System Composition by Pipe Material

Gravity Sewer Pipe Material	Length of Pipe (ft)	Length of Pipe (Mi)	Percent of System
Asbestos Cement	497,015	94.1	45.7%
Cast Iron	1,493	0.3	0.1%
Ductile Iron	10,395	2.0	1.0%
Polyvinyl Chloride	216,638	41.0	19.9%
Reinforced Concrete	126,642	24.0	11.7%
Vitrified Clay	64,089	12.1	5.9%
Unknown	170,318	32.3	15.7%
Total	**1,086,589**	**205.8**	**100.0%**

Figure 4-3 and Table 4-2 show the collection system gravity sewer composition by pipe diameter. Pipes shown as "Other" include pipes of unknown diameter and multiple barrel pipes with varying diameters. Both the siphon crossing Freshwater Brook and the Scantic River are included under the "Other" category.

Table 4-2: Collection System Composition by Pipe Diameter

Gravity Sewer Pipe Diameter (in)	Length of Pipe (ft)	Percent of System	Gravity Sewer Pipe Diameter (in)	Length of Pipe (ft)	Percent of System
6	6,625	0.6%	20	1,912	0.2%
8	781,631	71.9%	21	33,654	3.1%
10	67,027	6.2%	24	22,306	2.1%
12	48,918	4.5%	27	18,625	1.7%
15	55,820	5.1%	30	12,944	1.2%
16	173	0.0%	36	8,784	0.8%
18	23,333	2.1%	Other*	4,840	0.4%
Total Length (ft)	**1,086,589**				

* Includes inverted siphons of multiple barrels with varying diameters and pipes of unknown diameter

An I/I study was performed as part of this plan, and the results are presented in this section. Smoke testing, closed circuit television (CCTV) inspections, and manhole inspections were also performed to locate and quantify infiltration and inflow sources in the collection system. A hydraulic model of the collection system was developed to identify potential capacity limitations in the collection system. A flow allocation spreadsheet was also developed to determine the effects of future sanitary sewer connections on the collection system capacity. Finally, the condition of each pumping station was evaluated and the WPCA staff was interviewed to determine the condition of the force mains. Results from all of these investigations are included in this chapter.

4.2 INFILTRATION AND INFLOW STUDY

4.2.1 Introduction

4.2.1.1 Background

Extraneous water that enters a sewer system, i.e. groundwater or surface water runoff not originating from a sanitary source such as residential or commercial sewer users, is referred to as Inflow and Infiltration (I/I). I/I may generate significant flows but is relatively clean and contains relatively small concentrations of BOD, TSS, and nutrients.

Wastewater consists of sanitary flows, including residential and non-residential sources, and I/I. The latter is composed of base infiltration (BI) and rainfall dependent I/I (RDII). These components of I/I are defined as follows:

- ***Base Infiltration*** – BI is the result of groundwater entering the collection system through faulty joints, cracks or breaks in sewer pipes and manholes. BI is most noticeable during the spring months after snow has melted and groundwater is high.
- ***Rainfall Dependent I/I*** – RDII is composed of inflow from roof drains and catch basins, uncapped cleanouts, storm water cross connections, faulty manholes or covers, yard drains and temporarily increased groundwater levels due to precipitation events. As surface water leaches through the soil, the base groundwater table elevation can increase for several days following rainfall. The sources of rainfall dependent infiltration are identical to those included in BI.

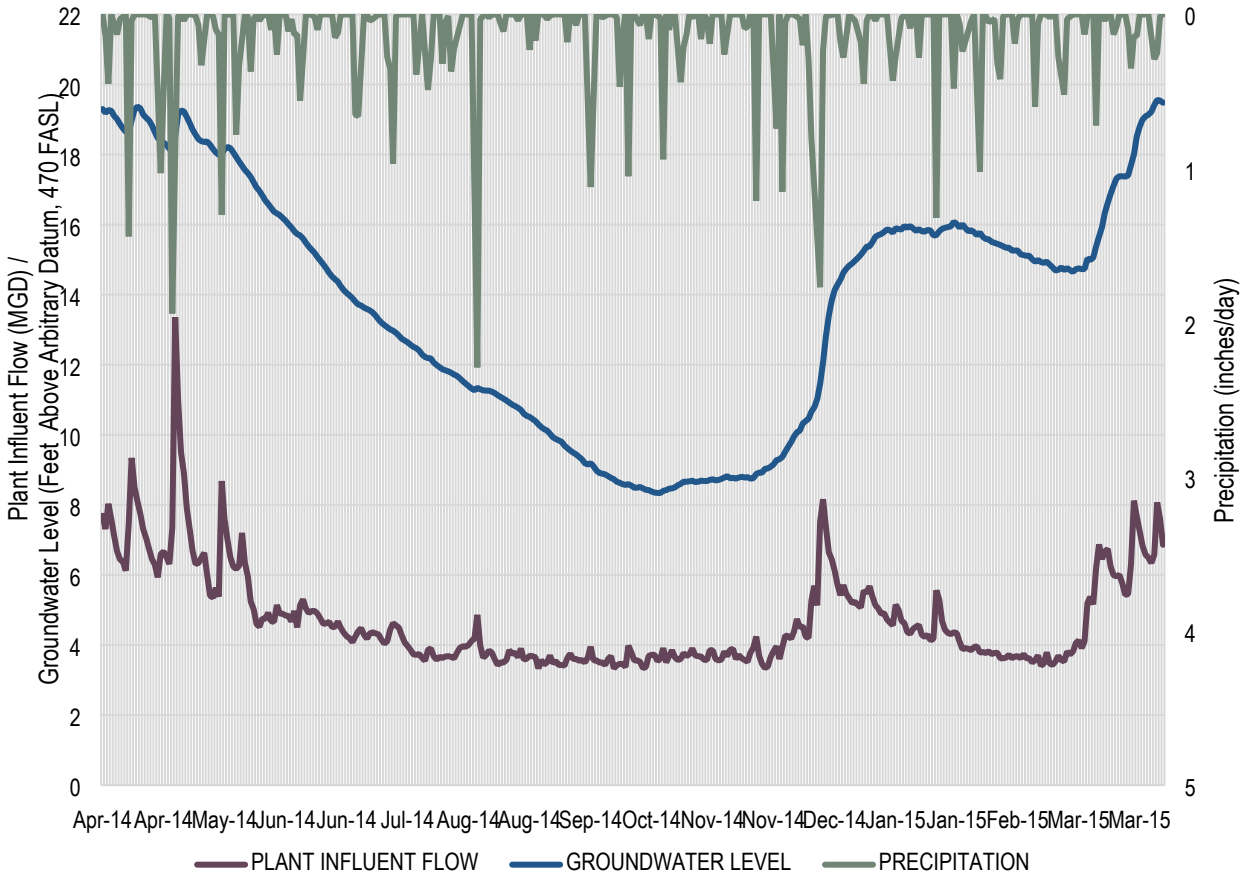
4.2.1.2 Prior Investigations

Over the last 40 years, multiple studies have been conducted to identify locations of I/I and construction projects resulting from the studies have reduced the amount of clean water entering the system. Studies from the 1970's indicate that the total daily flowrate treated at the plant often exceeded 80 MGD during periods of high groundwater and

significant rainfall events. Over the past 5 years, the peak instantaneous flowrate recorded at the plant reached 18 MGD only once.

Presented in Figure 4-4 are the flowrates recorded at the WPCF between April of 2014 and April of 2015. Also shown are the depth to groundwater and rainfall data during the same period. During this period, the peak flowrate recorded was consistently less than 15 MGD, and was often less than 10 MGD. However, the flow data indicates that some I/I is still entering the system. The general curve of influent flow follows a similar pattern to gradually changing groundwater depths and peaks during significant rain events, but only when the groundwater is also high.

Figure 4-4: Enfield WPCF Rainfall/Groundwater – Flow Relationship



Source: Precipitation – The Weather Channel, LLC ©, Weather Underground, Weather History for KBDL
Groundwater – United States Geological Survey, Site No. 414831072173002-MS 80 Mansfield, CT

4.2.1.3 Purpose and Scope of Current Program

In an effort to locate and quantify sources of infiltration and inflow entering the collection system, the investigations included temporary flow monitoring, smoke testing, CCTV inspections, and manhole inspections. Results from these efforts are described in this section.

4.2.2 Data Collection Methods

4.2.2.1 Continuous Flow Monitoring

As part of this facilities plan, twelve temporary flowmeters were installed throughout Town for a period of eight weeks beginning on March 17, 2015. ADS Environmental Services (ADS) were subcontracted to perform continuous flow monitoring. All flow meters were removed by May 20, 2015. Two groundwater gages were installed to monitor local

groundwater levels. As part of the flow monitoring study two rain gages were also installed onsite at the Grape Brook and South River pump stations. Table 4-3 includes a summary of the flow metering basin characteristics including upstream basin relationship, piezometer location, total length and inch-diameter miles, and approximate land area.

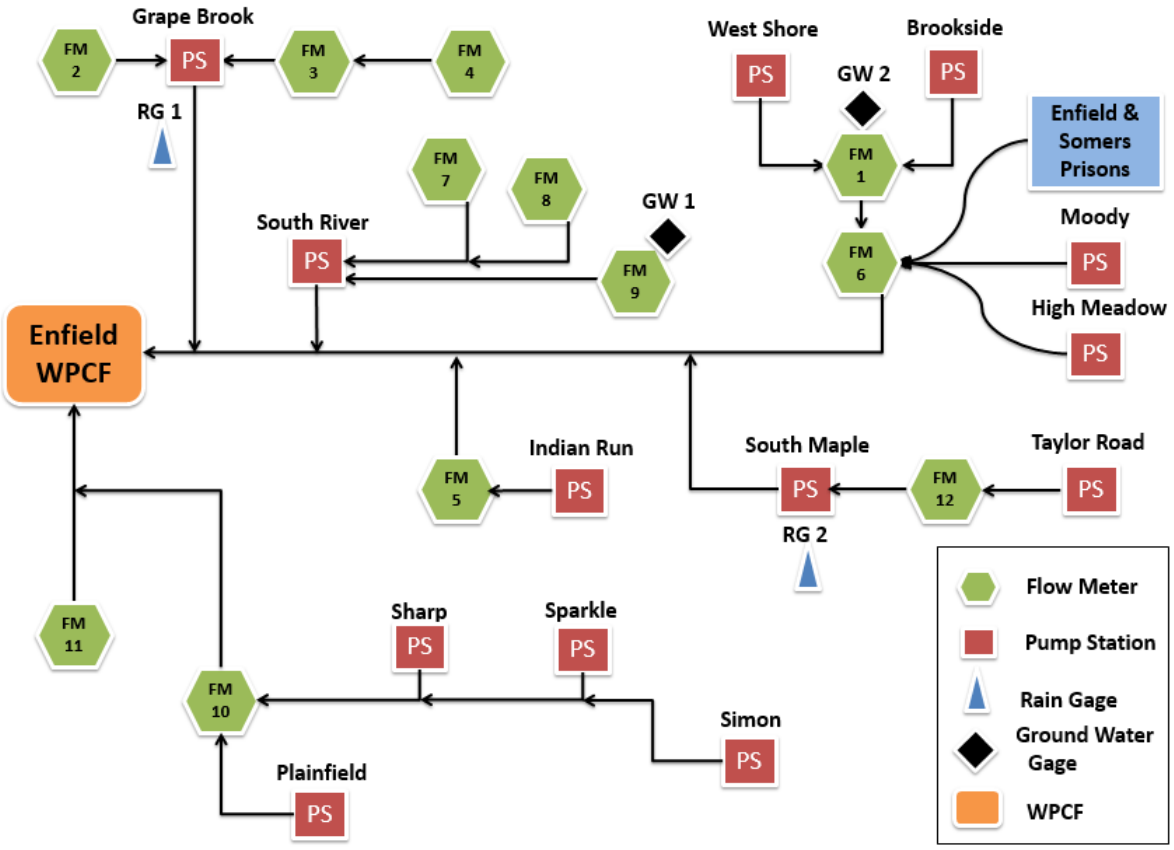
Table 4-3: Metering Basin Characteristics

Flow Meter/Basin	Upstream Basins	Groundwater Gage	Feet of Pipe	Inch-Diameter Miles	Acres
1	-	Y	35,652	61.2	386
2	-	N	73,072	130.2	781
3	4	N	92,234	153.3	818
4	-	N	27,017	44.3	229
5	-	N	30,690	48.7	297
6	1	N	103,612	231.8	1,777
7	-	N*	31,281	62.1	155
8	-	N	13,871	26.3	92
9	-	Y*	6,359	16.8	22
10	-	N	184,076	352.6	1,670
11	-	N	53,584	88.3	396
12	-	N	88,082	160.3	807
		Total	**739,530**	**1,375.8**	**7,430**

*Groundwater Gage 1 was initially installed in the same manhole as Flow Meter 7 but was moved to the same manhole as Flow Meter 9 due to lack of data.

A schematic diagram of the flow monitoring program is shown in Figure 4-14, with black arrows indicating the direction of flow. The relative locations of rain gages and ground water gages are also shown. Groundwater gages were installed in flow metering manholes. Rain gages were set up onsite at the adjacent pump stations. A map of the collection system, with flow meter installation locations, is shown in Figure 4-5, where the colored polygons represent the flow meter service areas. Appendix D contains a detailed flow monitoring report from ADS outlining the installation locations and flow data validity and accuracy. This report does not identify or make recommendations regarding I/I sources or repair.

Figure 4-14: Flow Monitoring Schematic



4.2.2.2 Rainfall Monitoring

Rainfall data was collected using tipping bucket rain gages, where a funnel collects rainwater, filters out debris and fills a double-sided bucket. Figure 4-15 shows the rainfall data collected throughout the flow metering study from both Rain Gage #1 (RG1) and Rain Gage #2 (RG2). Four storms significant enough for analysis were identified from these data and are summarized in Table 4-4. The values given in Table 4-4 are averages of both RG1 and RG2. Accumulated data varied little between the two gages.

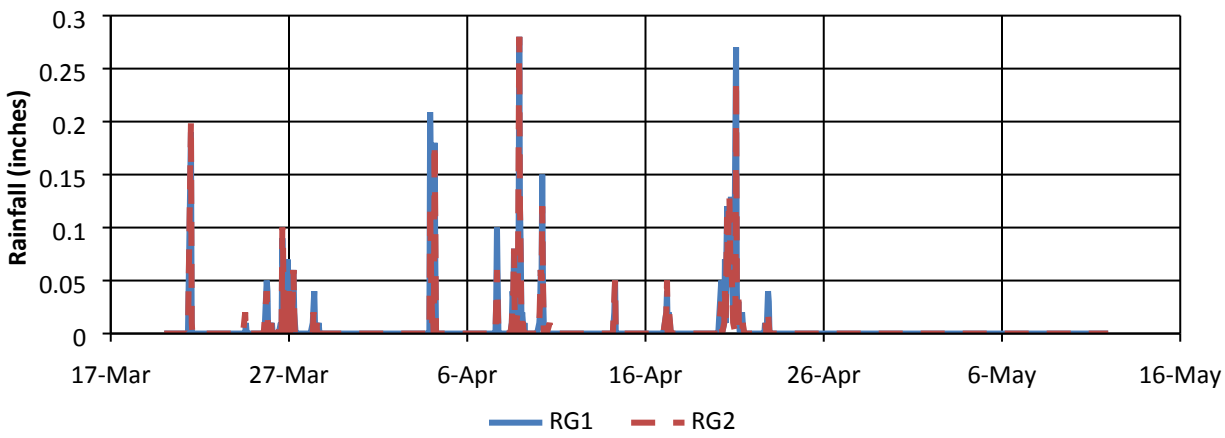
Table 4-4: Storm Events

Storm Event	Total Rainfall (in)	Peak Intensity (in/hr)
3/27/2015*	0.53	0.10
4/03/2015	0.63	0.19
4/08/2015	1.10	0.28
4/20/2015	1.34	0.26

*Exhibited delayed flow reaction likely due to snowmelt.

Of the four storms identified only two provided total volumes of greater than one inch of rainfall, April 8 and 20, 2015, while none had a peak intensity of more than 0.3 inches per hour. For the analysis of the flow metering data, the March 27, 2015 storm was not used due to delayed I/I reactions, likely resulting from snowmelt. Overall, none of the storms recorded during the flow monitoring study contributed significant I/I to any of the flow metering basins.

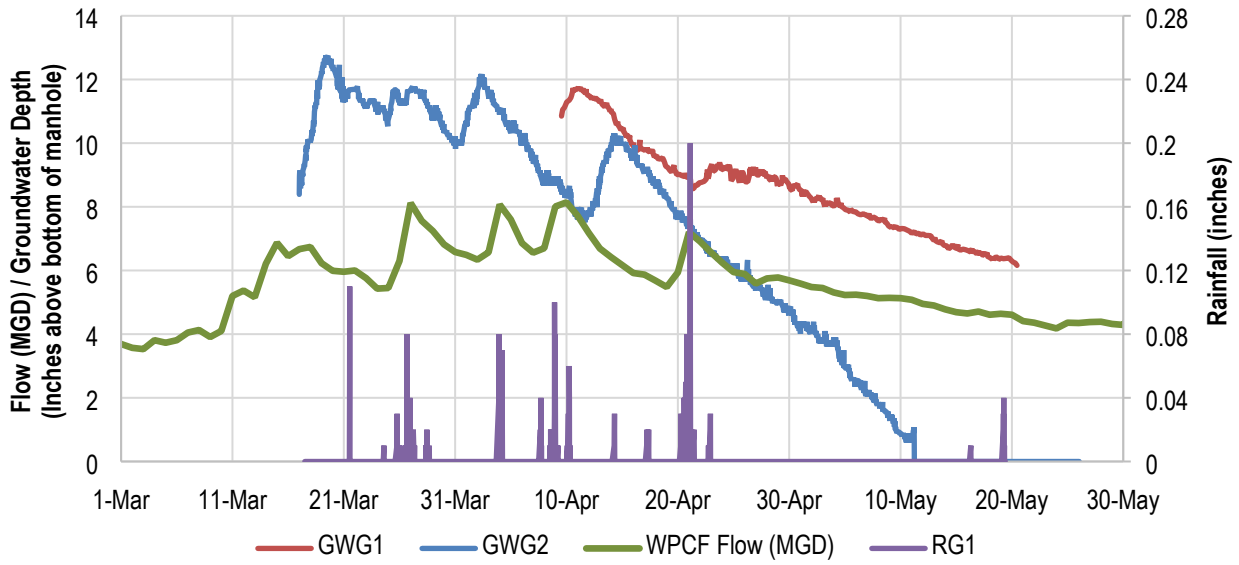
Figure 4-15: Flow Monitoring Period Rainfall



4.2.2.3 Groundwater Monitoring

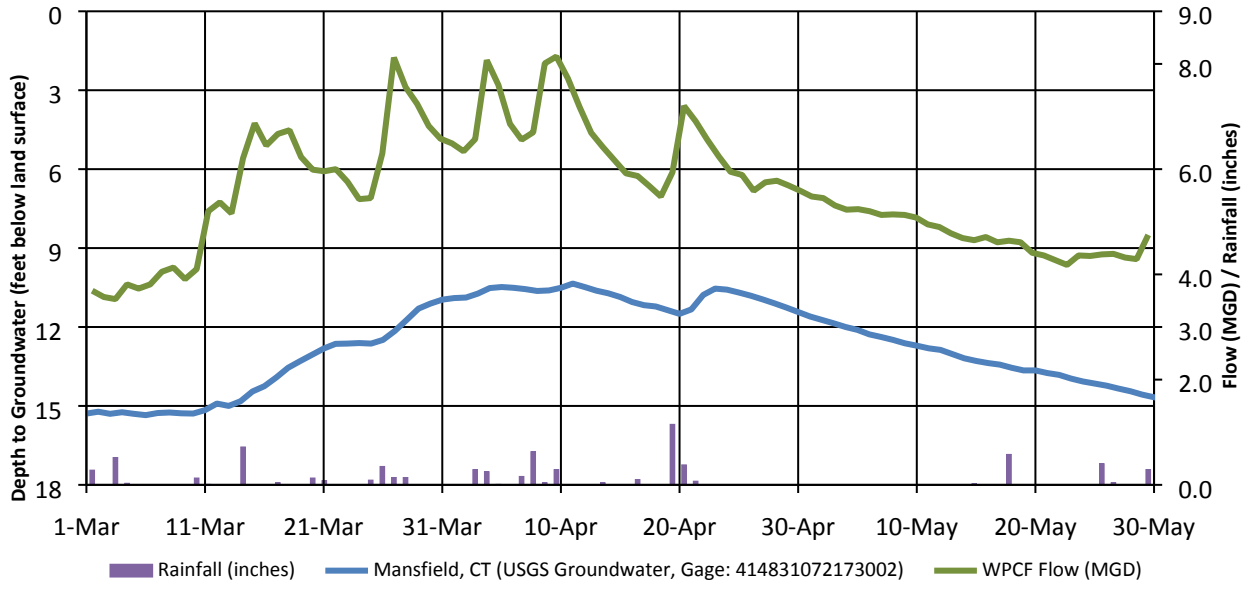
Two piezometers equipped with pressure transducers were installed to monitor local groundwater levels throughout the study. Figure 4-16 shows local groundwater levels plotted against precipitation and average daily plant flow. Groundwater gage #1 (GWG1) was originally installed in the same manhole as Flow Meter 7 but measured no groundwater. GWG1 was subsequently moved to the same manhole as Flow Meter 9. Local groundwater data was collected by GWG1 and GWG2, which displayed similar trends to both regional groundwater and plant flow, as shown in Figure 4-17. However, the local groundwater levels do not show rainfall dependent I/I (RDII) reactions to all storms. For example, the most significant storm of the flow monitoring period on April 20, appears to have no impact on the trend measured at GWG2. Although Figure 4-16 shows a clear relationship between rainfall and increases in WPCF flow, there appears to be much less correlation between local groundwater levels and WPCF flow.

Figure 4-16: Local Groundwater



Regional groundwater data was also collected from the USGS Groundwater Gage 414731072173002 to provide a more reliable comparison of groundwater depth and WPCF flow. Groundwater data however, was not used to directly calculate volume of infiltration, only to establish correlation between groundwater depth and WPCF flow. Regional groundwater shows a much clearer relationship between plant flow and groundwater depth as shown in Figure 4-17, which also shows regional rainfall. Generally, periods of rainfall are followed by peaks in WPCF flow and minor increases in regional groundwater level. The lack of significant rainfall during the flow monitoring period indicates that the generally increasing trend in groundwater level is likely due to snow melt, as it coincides with the seasonal shift to spring at the end of March.

Figure 4-17: Regional Groundwater



4.2.2.4 Data Consolidation & Processing

All flow meter, ground water and rainfall metering data was consolidated and loaded into Sliicer®, ADS Environmental Services' server-based data analysis software specifically designed for interpreting I/I from flow data. Among its many capabilities, in addition to generating scatter-chart displays of collected data, Sliicer will isolate data collected under wet-weather conditions, compare dry-weather (weekend and weekday trends) and wet-weather data to estimate I/I, trend and remove background I/I based on data immediately preceding an event, and compare normalized I/I measurements between sewer sheds.

Sliicer calculates I/I during storm events by establishing a dry day pattern and subtracting that from the metered flow during a storm event. The difference is equivalent to RDII. Sliicer can also compensate for flow collection error caused by variations in flow, such as holidays or varying BI. Sliicer's output consists of BI flow per flow metering basin and volume of RDII per basin per storm. Overall, this tool offers a swift and clear method of consolidating raw data into useful results.

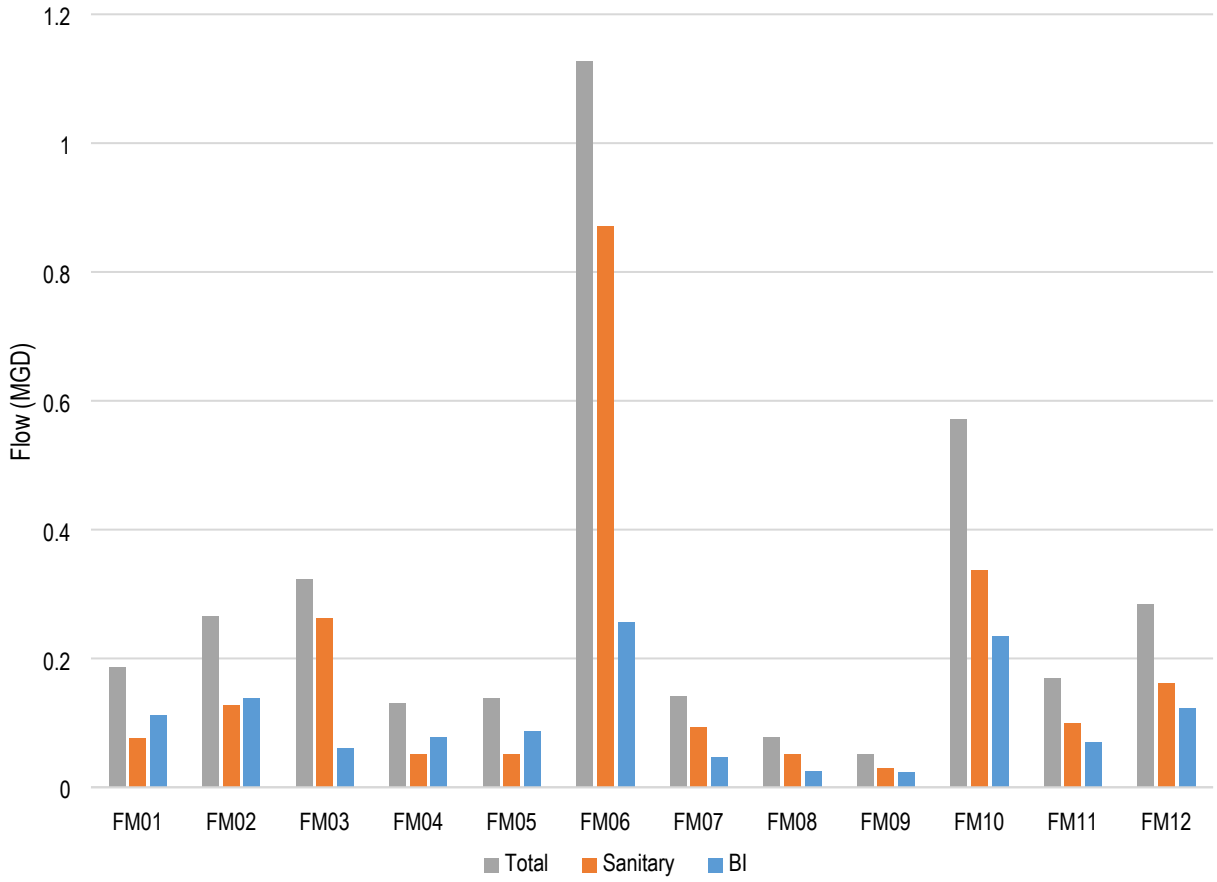
4.2.3 Data Analysis & Observations

The results from the Sliicer analysis are shown graphically in the figures below and summarized with recommendations in tabular format in the following section.

4.2.3.1 Dry Day Base Infiltration

Figure 4-18 depicts total flow through each flow meter (Total), divided into wastewater (Sanitary) and BI, on dry days for weekdays only. Only dry days are included to separate the effects of RDII from BI. The results between weekdays and weekends varied little. For simplicity, only weekdays are shown, which make up the majority of dry days. Sliicer selects dry days based on user definable cumulative rainfall in consecutive days and ignores any days that are outside of a user definable range as a percent of the average. In all Sliicer output the prefix "Net" indicates total flow or volume of a basin minus that of all upstream basins. The large sanitary wastewater component flow of basin FM6 (0.871 MGD) consists primarily of the Enfield and Somers prison flow with an average total daily flow of 0.748 MGD. The total volume of BI measured between the 12 flow meters is approximately 1.3 MGD, confirming that during the flow metering study groundwater was elevated, contributing more to I/I than in average conditions described in Section 3.

Figure 4-18: Sliicer Output – Wastewater vs. Base Infiltration



Sliicer uses the Stevens-Shutzbach equation to estimate BI:

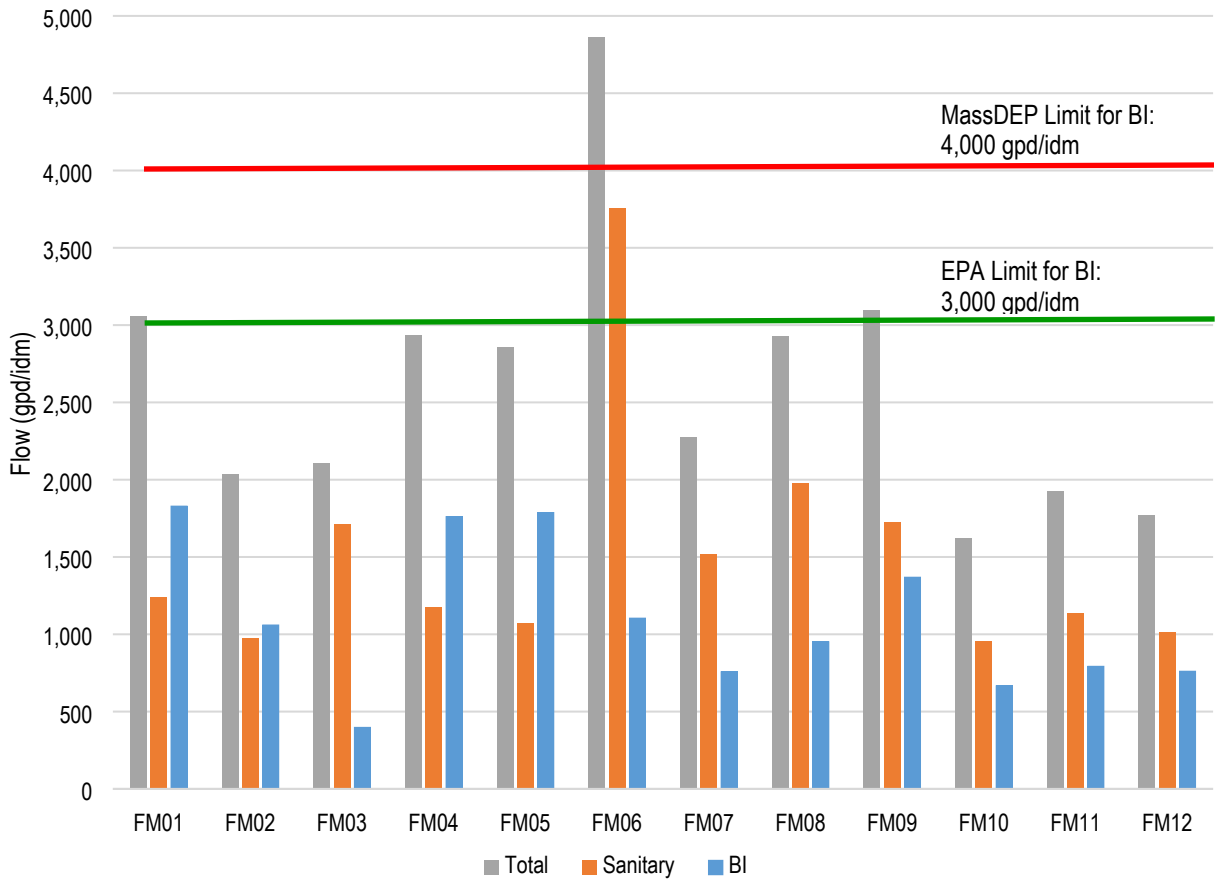
Equation 4-1: Stevens-Shutzbach Equation for Base Infiltration

$$BI = \frac{0.4(MDF)}{1 - 0.6(MDF/ADF)^{ADF^{0.7}}}$$

BI is base infiltration
MDF is minimum daily flow rate in MGD
ADF is average daily flow rate in MGD.

Figure 4-18 indicates that flow metering basins FM6 and FM10 contribute the greatest total volumes of flow and the greatest volume of BI. However, basing repair recommendations on total results by basin would be misleading given the differing size of the basins. Referring to Table 4-3, the basins range in size from 17 to 353 inch-diameter-miles (idm) of pipe, meaning the larger the basin the larger the flow of infiltration. The unit idm takes into account pipe length as well as diameter to quantify the overall surface area through which infiltration can occur. In order to identify BI problem areas, flow for each basin should be normalized by the idm of the basin. Figure 4-19 shows unit total flow, sanitary wastewater and BI for each flow metering basin normalized as gpd per idm of pipe.

Figure 4-19: Sliicer Output – Normalized Wastewater vs. Base Infiltration



Although FM4 contributes little BI overall, as shown in Figure 4-18, it has one of the highest volumes of BI per idm of pipe. On a unit basis, FM1, 4, 5, 6 and 9 each produce a similar volume of BI and contribute the greatest overall volume of unit BI. However, unlike the other basins, FM9 does not have boundaries known with complete certainty. Given that the unit total flow to the FM9 basin is unusually high (without the presence of a large flow source, such as the prisons), it is likely that flows in this basin are over estimated. Given the proximity to basins FM7 and FM8, and the similar dates of original sewer construction, FM9 likely has actual BI closer to that of basins FM7 and FM8, approximately 900 gpd/idm. FM6 has a high Total flow to idm ratio because it includes flow from the Enfield and Somers prisons that contribute a high flow within a relatively short section of pipe.

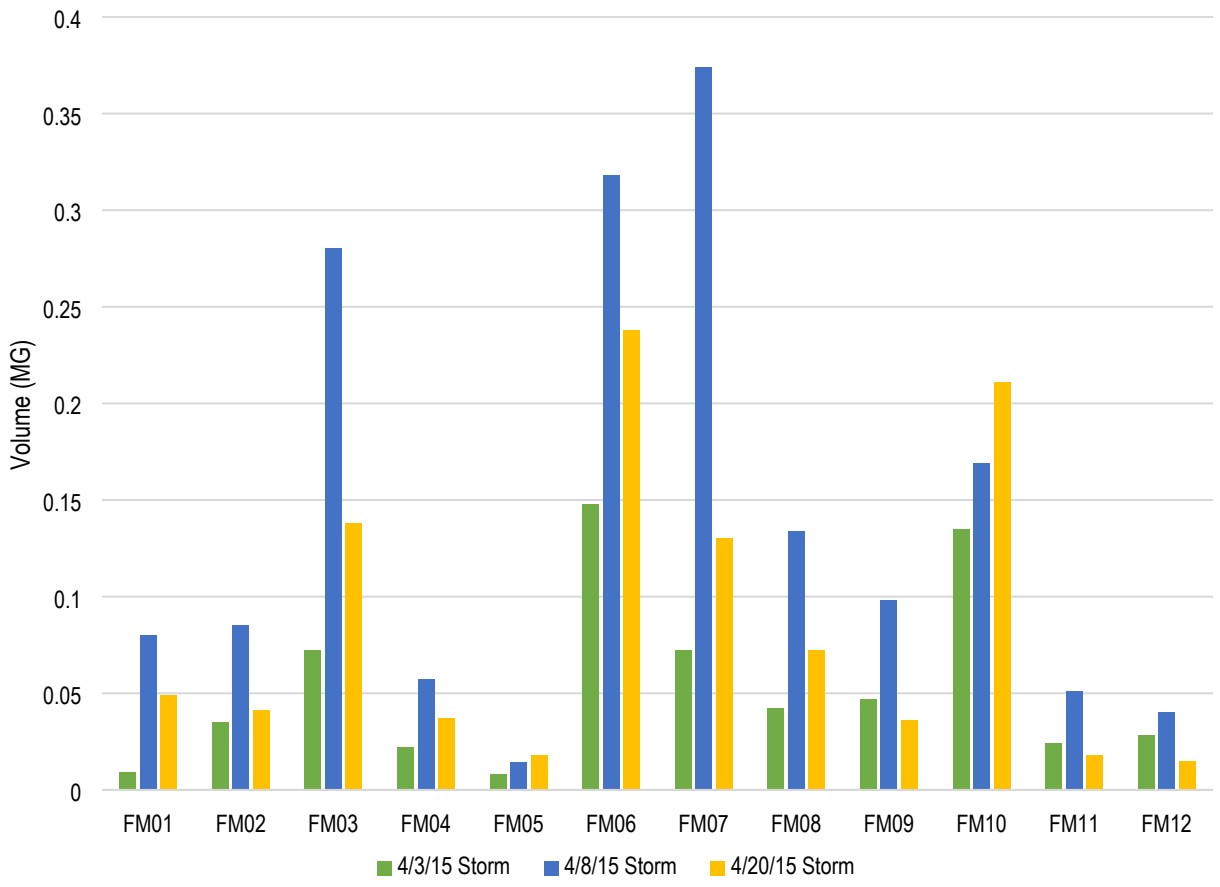
Also shown on Figure 4-19 are the EPA[7] (green) and MassDEP[8] (red) guidelines for BI thresholds, of 3,000 and 4,000 gpd/idm, respectively. These guidelines indicate that unit BI above the given thresholds warrant further

investigation into reduction of I/I. Every flow metering basin displayed BI rates of less than 3,000 gpd/idm, with FM1 having the greatest at 1,829 gpd/idm. Overall, the Sliicer results indicate that BI is not of major concern within the metered portions of the Enfield collection system.

4.2.3.2 Rainfall Dependent Inflow and Infiltration

The Sliicer results indicate that the total volume of RDII during the flow monitoring study was greatest in basins FM3, 6, 7, and 10, as shown in Figure 4-20. Although the total rainfall during the study period was highest in the April 20 storm (totaling 1.34 inches, shown in yellow), generally the April 8 storm (totaling 1.10 inches, shown in blue) produced the greatest volume of RDII in most basins. Both storms had very similar peak intensities and the total rainfall volume only differed by 0.24 inches. The regional groundwater depth at the time of the April 8 storm was one foot higher than at the time of the April 20 storm. Increased groundwater levels could be a reasonable explanation for the large volume of RDII increase seen in most basins on the April 8 storm over the April 20.

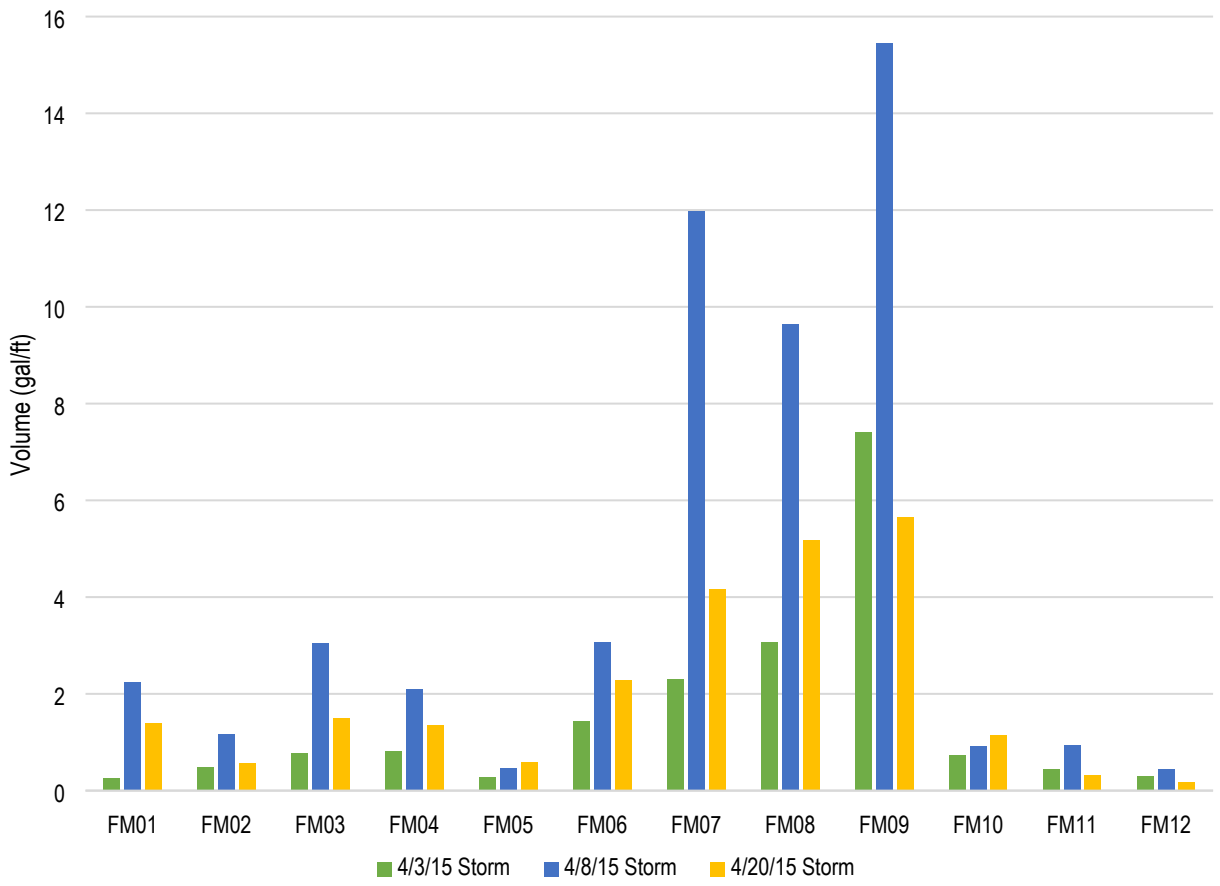
Figure 4-20: Sliicer Output – RDII per Basin by Storm



[7] 1981 EPA Handbook: Facilities Planning Municipal Wastewater Treatment (EPA Report Number 430/9-81-002)
[8] 1993 Mass DEP Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Survey

Figure 4-21 shows the total RDII volume for each basin normalized by foot of pipe. Normalizing by foot of pipe takes into account the size of the metering basin while ignoring the diameter of pipes, which has no impact on inflow since inflow results from point sources connecting to the system. Taking into account the size of each basin, FM7, 8 and 9 have the most significant volumes of RDII per foot of pipe, each with an April 8 RDII volume of more than three times that of the next highest basin, FM6. The FM9 basin is suspected to have exaggerated RDII volumes due to unknown basin boundaries. Nevertheless, given that the FM7 and 8 basins also had similarly high RDII volumes through all three storms, it is reasonable to assume that the FM9 basin also has significant RDII. Based on these results, Woodard & Curran conducted smoke testing and CCTV investigations in basins FM7, 8 and 9.

Figure 4-21: Sliicer Output – Normalized RDII per Basin by Storm



4.2.4 Summary

4.2.4.1 Composition and Magnitude of Extraneous Flows

Table 4-5 summarizes BI flow and RDII volumes per basin shown in the previous figures, normalized by surface area and length of pipe.

Table 4-5: Sliicer Output Data Summary

	Net Flow (gpd/idm)			Net RDII (gal/ft)		
	Total	Sanitary	BI	4/3/15 Storm	4/8/15 Storm	4/20/15 Storm
FM01	3,054	1,241	1,829	0.25	2.24	1.39
FM02	2,036	976	1,060	0.48	1.17	0.56
FM03	2,107	1,709	398	0.78	3.04	1.49
FM04	2,935	1,174	1,761	0.81	2.09	1.35
FM05	2,856	1,069	1,788	0.27	0.46	0.59
FM06	4,862	3,758	1,104	1.43	3.07	2.29
FM07	2,272	1,514	757	2.31	11.97	4.17
FM08	2,930	1,979	951	3.06	9.65	5.17
FM09	3,096	1,726	1,369	7.42	15.45	5.66
FM10	1,622	956	666	0.74	0.92	1.14
FM11	1,926	1,133	793	0.45	0.95	0.33
FM12	1,772	1,011	761	0.31	0.45	0.17

Figure 4-22 organizes the results shown in Table 4-5 by percent of total BI throughout the study period, in order to identify high priority areas for I/I reduction work. In terms of unit BI, the overall range of contributed infiltration did not vary greatly from basin to basin. However, FM1, 4, 5 and 9 appeared to contribute the most and but the overall amount of BI measured still does not warrant additional investigations. An arbitrary division must be defined to delineate between high and low priority basins for rehabilitation. In this case, the most significant difference exists between basins FM6 and FM9.

Figure 4-22: Percent of Total Normalized BI by Basin

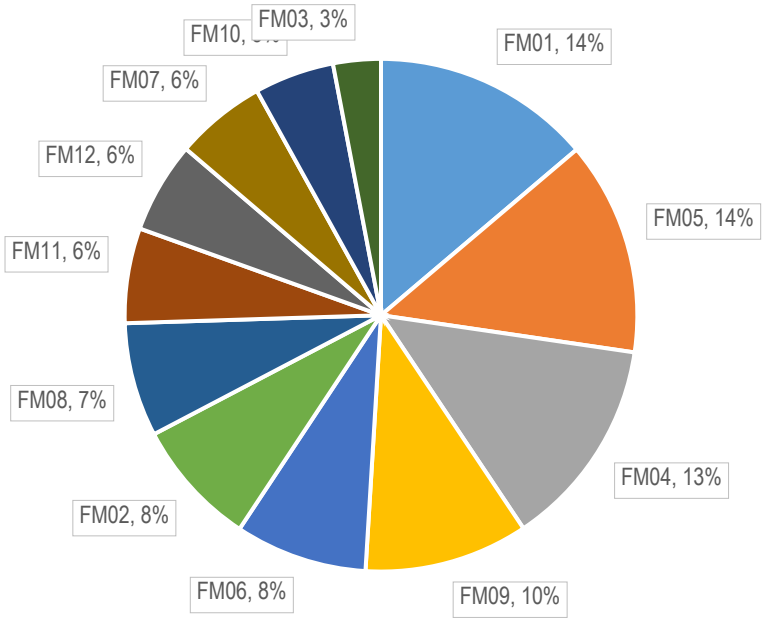
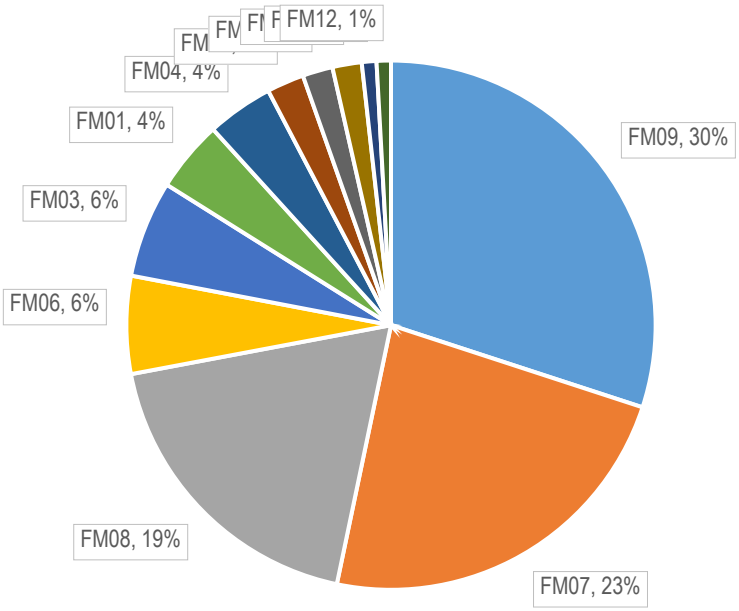


Figure 4-23 shows results from the April 8 storm only, as it displayed the most significant RDII. In this storm the basins exhibit greater variation in RDII volume. FM7, 8 and 9 have increased rates of RDII as together they make up

approximately 72% of the total normalized RDII metered during this storm event. Therefore, basins FM7, 8 and 9 are designated high priority for additional inflow investigations. These metered basins make up the majority of the South River pump station service area, which consists of much of the oldest sections of sewer in Thompsonville. While Figures 4-22 and 4-23 indicate where I/I is most significant within the metered system, they do not describe the overall impact of I/I on the collection system as a whole.

Figure 4-23: Percent of Total Normalized RDII by Basin for 4/8/2015 Storm



4.2.4.2 Recommendations

In summary, the Sliicer data analysis has shown that BI within the metered portion of the Enfield collection system is not significant according to EPA and MassDEP guidelines. Additionally, RDII has been shown to be elevated in basins FM7, 8 and 9, which constitute the majority of the South River pump station service area. Woodard & Curran recommends the following based on the results:

- BI – Do not perform additional investigations to locate infiltration. However, CCTV work should be performed in the Thompsonville area of Town (the oldest portion of the collection system) to determine the structural condition of the existing infrastructure. Also, manhole inspections should be performed to determine the condition of the manholes and to determine the invert elevations, pipe sizes, and material types since record drawings do not exist.
- RDII – Proceed with smoke testing in basins exhibiting elevated unit volumes of RDII, FM7, 8 and 9.

4.3 CLOSED CIRCUIT TELEVISION INSPECTIONS

The results from the temporary flow monitoring study and comments from WPCF staff indicated that I/I was most significant in Thompsonville and the Grape Brook pump station service area. Closed circuit television (CCTV) inspections were performed to identify specific sources of I/I as well as structural defects in these locations, as shown in Figure 4-6. Additionally, CCTV inspections were performed in these areas due to the known age of sewer infrastructure.

Light cleaning was performed in all pipes prior to inspection to allow for easier identification of defects and passage of the camera. Light cleaning typically consists of one to three passes of pressurized water from a vactor truck, which also vacuums up debris removed from the pipe, including sand, gravel, trash, and organic matter. While performing the CCTV inspections, many pipes had excessive grit that had to be removed with heavy cleaning. Heavy cleaning consists of four to six passes from the vactor truck. The material removed from the sewers was disposed of at the WPCF septage receiving station. The Town typically disposes of the septage receiving screenings at the Manchester, Connecticut landfill. However, the Town's permit to discharge grit at the landfill expired and the CCTV work had to be postponed until a new permit was obtained. As of November 12, 2015 CCTV work has resumed and is currently ongoing. All defects and recommendations are based on inspection completed prior to November 20, 2015.

Deficiencies found during the CCTV inspections are listed in Table 4-6. In total, 116 pipe segments were inspected. Twenty-seven pipes segments were identified with defects rated as fair, poor, or immediate attention required designations. Woodard & Curran assigned an overall condition rating to each pipe indicating the combined severity of defects and priority for repair to that pipe. Defect severity of a segment depends on the number of individual defects as well as the condition of those defects. In general, little evidence of I/I was observed. Direct evidence for I/I includes flow of clear water from pipe joints above the flow of sanitary wastewater. Indirect evidence of I/I includes mineral buildup or staining around pipe joints. Overall, few major defects were found and all active infiltration noted appeared to contribute much less than one gpm per defect. A full report of the inspections performed and deficiencies identified in April 2015 is included in Appendix C.

Table 4-6: Pipe Defects and Recommendations

Flow Meter Basin	Street	Downstream Manhole	Upstream Manhole	Pipe Material	Severity	Defects	Recommendation
2	Wood Dr	SMH2507	SMH2506	AC	Minor	Protruding Service Line	None
2	Wood Dr	SMH2509	SMH2508	RC	Minor	Surface Aggregate Delamination	None
7	Hartford Ave	SMH4659	SMH4660	VC	Minor	Fractures, Roots, Pipe Sag	None
7	Hartford Ave	SMH4658	SMH4659	VC	Minor	Fractures, Roots, Pipe Sag	None
7	Lafayette St	SMH4653	SMH4658	VC	Minor	Fracture	None
7	Lafayette St	SMH4651	SMH4653A	VC	Minor	Fractures	None
7	Lafayette St	SMH4648	SMH4650	VC	Minor	Fractures, Roots	None
7	College St	SMH4741	SMH4742	VC	Minor	Fracture	None
7	Pleasant St	SMH4723	SMH4741	VC	Minor	Protruding Service Lines	None
7	Whitworth St	SMH4725	SMH4723	VC	Minor	Fractures, Protruding Service Lines	None
7	Whitworth St	SMH4726	SMH4725	VC	Major	Pipe Deformation, Fractures, Mineral Deposits	Structural Liner
8	N Main St	SMH4754	SMH4819	VC	Minor	Roots	None
8	N Main St	SMH4819	SMH4770	VC	Medium	Pipe Deformation, Fractures, Roots	Short Liners
9	High St	SMH4805	SMH3892	VC	Medium	Fractures	Short Liner
9	High St	SMH4806	SMH4805	VC	Medium	Fractures	Short Liner
9	Asnuntuck St	SMH3878	UNK	VC	Minor	Active Infiltration	None
9	Asnuntuck St	SMH4813	SMH3881	VC	Minor	Fractures, Mineral Deposit	None

Flow Meter Basin	Street	Downstream Manhole	Upstream Manhole	Pipe Material	Severity	Defects	Recommendation
9	Asnuntuck St	SMH4813A	SMH4813	VC	Minor	Fractures	None
7	West St	SMH4708	SMH4707A	VC	Minor	Fractures, Roots	None
7	West St	SMH4676	SMH4708	VC	Minor	Active Infiltration, Mineral Deposits	None
7	West St	SMH4757	SMH4677	VC	Minor	Fractures, Active Infiltration, Pipe Deformation, Mineral Deposits	None
-	Asnuntuck St	SMH4750	UNK	VC	Medium	Roots	Clean and Inspect*
-	Birch St	SMH4223	SMH4221	AC	Medium	Active Infiltration, Mineral Deposits	None
7	Church St	SMH4704	SMH4705	VC	Minor	Longitudinal Crack, Circular Fracture	None
7	Windsor St	SMH4647	SMH4646	VC	Medium	Pipe Breaks with Voids	Short Liners

We recommend completing the designated repairs listed in Table 4-6 for all defects of medium and major severity only. The benefit of repairing minor severity defects at this time is negligible given that none contribute significant volume of I/I or are likely to cause sewer failure in the near future. Generally, repairs are only recommended for defects of structural concern, as little evidence of I/I was noted. The cost to correct these deficiencies is approximately $44,000 and was estimated based on recent bid results and industry standards.

Example Defect Requiring Open Cut Repair (SMH4673 to SMH4648)

The Town has indicated that existing funds have been allocated for repair of defects contributing to I/I. Defects requiring immediate correction, such as the collapsed pipe pictured at right, are recommended for immediate repair. Using these existing funds would allow immediate correction without waiting for the completion of the facilities planning process and subsequent design phase. The example image shows a pipe defect on Windsor Street in basin FM7 requiring excavation to replace the damaged section of pipe. Additional defects were noted during CCTV inspection of the Connecticut River interceptor. Woodard & Curran recommends using the Town I/I budget for repair of these defects through cured in place pipe lining as part of a program of preventative maintenance. An approximately 550-foot long section of pipe behind Kelly Fradet Lumber Yard on Prospect Street (between SMH-4801 and SMH-4679) is recommended for structural lining due to longitudinal cracking along much of the pipe. Another segment of the interceptor, between Birch Street (SMH-4223) and Fairview Avenue (SMH-4225), has suffered from hydrogen sulfide deterioration of the concrete pipe where the aggregate is exposed. We recommend repairing this section of pipe with cured in place pipe lining to prevent further deterioration.

The pipe on Asnuntuck Street between SMH4750 and an unknown manhole is recommended for further cleaning and inspection, however roots and debris prevented complete inspection. Cleaning and root removal can not be performed without access to the downstream manhole (SMH4750), the location of which is unknown. This manhole cannot be located and is likely buried. Smoke testing revealed possible structural damage to this length of pipe. As such, completing inspection of this pipe is highly recommended. Further efforts to locate and uncover this manhole will be required before this reach of pipe can be fully inspected.

4.4 MANHOLE INSPECTIONS

Surface and internal manhole inspections were performed to accomplish two goals:

1. Gather missing collection system geometry data to input into the sewer model.
2. Locate manhole defects and sources of I/I.

Enfield's existing geodatabase contains geometry information for most of the collection system that is based on existing record drawings, but the Town does not have record drawings of any of the sewers in the Thompsonville area of Town. Therefore, it was necessary to determine the collection system geometry in Thompsonville through field survey in order to create a complete hydraulic model of the system. Data collected included manhole invert elevations, rim elevations, and inlet and outlet pipe invert elevations. Existing plans were referenced to correct inaccurate data within the geodatabase where possible.

Manhole and pipe invert depths were measured from the manhole rim for every pipe connected to the manhole in tenth of a foot increments. The center of manhole covers were horizontally located using GPS coordinates. Vertical rim elevations were not collected via GPS methods due to poor accuracy. On average, maximum vertical elevation accuracy was calculated to within 1 meter, which is insufficient for use in a sewer modeling program. Figure 4-7 shows the locations of manholes surveyed in red. Approximately 219 of the 660 manholes targeted for inspection in the Thompsonville area of Town could not be located or opened. To complete the sewer model, missing invert elevations were linearly interpolated, assuming constant slopes between the nearest upstream and downstream manholes with measured invert elevations.

Detailed internal inspections were performed on 13 manholes to identify defects and sources of I/I. Of the 441 surveyed in the surface inspection, these manholes appeared to have the greatest potential for I/I or exhibited obvious structural defects. Results and repair recommendations from the internal inspections are summarized in Table 4-7, and are ranked by relative severity of the defects. Defects found include active infiltration, mineral deposits, hydrogen sulfide deterioration, defective covers, root intrusions, debris and sediment buildup, and structural defects. Figure 4-7 also shows the location of each manhole internally inspected.

Table 4-7: Internal Manhole Inspection Repair Recommendations

MH ID	Street	Defect Description	Category	Recommendation
SMH-3783	Enfield St	Infiltration, mineral deposits, roots, H_2S Deterioration	Major	Rebuild Bench and Invert, Cementitious Line
SMH-4129	Belmont Ave	Infiltration, mineral deposits, bench and invert in very poor condition	Major	Rebuild Bench and Invert, Cementitious Line
SMH-3046	High St	Infiltration, mineral deposits	Medium	Cementitious Line
SMH-4146	Warriner Ave	Inflow from defective cover, infiltration, mineral deposits	Medium	Replace frame and cover, Rebuild bench and invert and Cementitious Line
SMH-4362	Enfield St	Roots and debris buildup	Medium	Root Treatment and Cementitious Line
SMH-4279	Easement	Buried Manhole	Medium	Raise to Grade
SMH-4279A	Easement	Buried Manhole	Medium	Raise to Grade
SMH-4279B	Easement	Buried Manhole	Medium	Raise to Grade
SMH-3522	Easement off Foxcroft Rd	Infiltration, mineral deposits	Minor	None

MH ID	Street	Defect Description	Category	Recommendation
SMH-3999	Yale Ct	Infiltration	Minor	None
SMH-4236	Hathaway Ave	Infiltration, Debris build up	Minor	None
SMH-4357	Purple Heart Pl	Roots, staining and sediment buildup	Minor	None
SMH-4675	Tariff St	Bench in Poor condition	Minor	None
SMH-4742	College St	Very Minor Staining	Minor	None
SMH-4772	Main St	Rectangular Brick and Stone MH, debris build up	Minor	None
SMH-516	Gatewood Dr	None	None	None

While none of the inspected manholes exhibited evidence of extreme I/I, repairs should be performed on the Major and Medium category manholes as preventative maintenance. Deterioration in the Major category manholes may result in structural failure in less than 10 years, requiring rebuilding of part or all of each manhole. Collapse of the manhole structure can result in blockage and potential buildup of solids which may lead to a sanitary sewer overflow.

Example manhole exhibiting mineral buildup requiring rebuild of the bench and invert and cementitious lining (SMH-4129)

Sanitary manhole (SMH) 3783 in particular suffers from hydrogen sulfide deterioration of the brick mortar, most likely due to the length of the Grape Brook pump station force main, which feeds into SMH-3783. Long force mains tend have increased fluid residence times that may lead to septic conditions in the pipe, where anaerobic bacteria grow and produce hydrogen sulfide gas as a byproduct. Hydrogen sulfide gas acts as an acid in the presence of moisture, destroying the structural integrity of concrete and mortar. The bench and invert of SMH-4129 is shown above, where mineral depsits, active infiltration, and structural damage are evident. Grouting and cementitious lining will be performed after rebuilding of the bench and invert to prevent further damage from infiltration.

Several manholes recommended for repair were not internally inspected, consisting of SMH-4279, 4279A and 4279B, but were located during CCTV inspection of the Connecticut River interceptor. We recommend uncovering and raising these buried manholes to grade to enable access for emergency and maintenance measures. All three of these manholes are located behind the Enfield High School athletic field east of the fence running along the rail road.

Table 4-7 includes recommendations for the following repairs to manholes:

- Grout – Grouting of a manhole involves injection of chemical grout into the wall of a manhole until voids behind the wall are filled and leaks are sealed. Chemical grout is most often used when active infiltration or mineral deposits are observed inside a manhole. Grouting is typically performed prior to monolithic lining.
- Cementitious and Polymeric Monolithic Lining – Monolithic lining is recommended when leaks are more serious or there is surficial damage in the manhole. Monolithic lining involves coating the manhole interior with a cementitious or polymeric compound, reinforcing the structural integrity of the manhole. Only polymeric monolithic lining offers protection from further corrosion due to hydrogen sulfide, as cementitious lining is also vulnerable to corrosion.

- Root Treatment – Root treatment is typically performed prior to grouting to prevent further root growth after the removal of intruding roots. Root intrusions into manholes are typically accompanied by I/I and may lead to surcharging if roots collect debris, or structural failure if root growth is left unchecked.
- Structural Repairs – Manholes with significant structural damage may require replacement of existing portions of the manhole including the frame and cover or the bench and invert. Loose or improperly fitted manhole frames or covers may allow elevated volumes of inflow. A deteriorated bench and invert can result in poor hydraulics, surcharging or eventual collapse of the manhole.
- Raise to Grade – Buried manhole covers are not accessible for maintenance or emergency access. Uncovering and raising of these manhole covers to grade is recommended for both routine and emergency access. New brickwork is constructed on top of the existing manhole to raise the frame and cover to grade.

The total cost of performing the repairs recommended in Table 4-7 is approximately $24,000. Detailed reports for each internally inspected manhole are included in Appendix F.

4.5 SMOKE TESTING

Smoke testing identifies sanitary sewer connections that allow inflow into the system, such as storm drain-sewer cross connections, downspouts, area drains, or broken pipes. Testing is typically performed during dry weather under low groundwater conditions. Smoke is introduced to a tested reach of pipe by igniting smoke candles, which generate plumes of white smoke as they burn, and suspending them inside the manhole.

Blower installed over a manhole

A blower, pictured at right, is installed over the manhole frame, which pushes smoke along upstream and downstream sewer mains and up service laterals. Smoke will exit through building plumbing vents and through inflow sources not equipped with a water trap. Defective plumbing can also be identified for repair to prevent sewer gases from entering residences. Occasionally, smoke escaping through holes in pavement or ground surfaces may identify broken buried pipes.

Confirmed downspout connection to sewer

ADS Environmental Services was subcontracted to complete the smoke testing work, performed July 22 through 30, 2015, and performed testing on approximately 37,358 linear feet of sewer. Figure 4-10 shows the locations where smoke testing was performed, including the Thompsonville area and the Pheasant Hill residential development. The I/I study indicated Thompsonville has the highest volume of RDII per length of pipe in the system. An example of a positive identification of an illicit source of inflow is shown on the next page, where white smoke is exiting an exposed sewer connection. A downspout funnels rainwater directly into the sewer through this connection. The homeowner should be required to remove the connection to comply with building code. The surface area of the roof draining into the downspout is used to estimate the approximate volume of inflow over time, assuming a peak rate of rainfall of 0.87 inches per hour. Effective drainage areas were calculated by applying a runoff coefficient of 0.9 for asphalt and rooftops, and 0.3 for grass and soil.

Suspected sources of inflow, where a downspout connects to a buried pipe but no smoke is identified, are also noted. Suspected inflow sources are later verified for connectivity to the sewer through dye testing. Several conditions could exist where a suspected fixture would not emit smoke. The drain may connect to storm sewer, lead to an outflow at the base of a retaining wall or a sub-surface leaching field, or the service lateral or sewer main may be blocked by rags or roots which would prevent the smoke from reaching the fixture.

Confirmed parking lot drain connection to sewer

Shown at right is a confirmed parking lot drain connection with a drainage area of approximately 1,600 square feet. Correcting cross connections with large drainage areas may have a noticeable impact on reducing inflow to the South River Pump Station. As such, all confirmed inflow sources are recommended for repair. In most cases, the property owner is responsible for removing or repairing inflow sources. However, the Town may be required to enforce removal. Confirmed inflow sources identified through smoke testing, recommended remediation measures for each, estimated drainage area, and approximated peak flow under 1-Year storm conditions are summarized in Table 4-8. Figure 4-11 shows the locations of properties in Thompsonville where confirmed inflow sources were identified. In the figure, inflow sources are categorized as roof leaders, storm drains, and other sources, which includes foundation cracks, sidewalk cracks, and holes in the ground. Most inflow sources identified were roof leaders on residential properties or uncapped pipes with no connection to roof leaders. Smoke emitting from foundation and sidewalk cracks, and holes in the ground are indicative of broken buried pipes, and are recommended for repair. No drainage area was assigned to uncapped pipes and cleanouts as they were above grade and no peak inflow could be calculated.

Table 4-8: Confirmed Inflow Sources and Recommendations

From SMH	To SMH	Location	Inflow Source	Drainage Area (sqft)	Estimated Peak Inflow Rate (GPD)	Recommendation
4660	4661	14-16 Hartford Ave	Roof Leader Into Ground - Pipes Smoking	1,000	12,909	Remove Connection
4659	4658	49-51 Hartford Ave	Left Front Pipe Into Ground - Smoking	16	207	Remove Connection
4658	4653	6-8 Lafayette St	Rear Roof Leader Smoking	600	7,745	Remove Connection
4650	4648	70-72 Windsor St	Old Roof Leader Pipes Smoking	32	413	Remove Connection
4750	4704	99-101 Church St	Roof Leader Pipes Smoking	1,350	17,427	Remove Connection
4704	4719	95 Church St	Old Roof Leader Pipe Smoking - Smoke Coming From Under Foundation, Right Front	16	207	Remove / Repair
4704	4719	78 Church St	Left Front Roof Leader Smoking	400	5,163	Remove Connection
4719	4672	5 Whitworth St	Roof Leader Smoking	600	7,745	Remove Connection
4653	4651	18 Lafayette St	Right Rear & Right Front Ground Pipe Smoking	32	413	Remove Connection
4651	4648	27-29 Union St	Left Front Roof Leader Into Ground Pipe Smoking	45	581	Remove Connection

From SMH	To SMH	Location	Inflow Source	Drainage Area (sqft)	Estimated Peak Inflow Rate (GPD)	Recommendation
4651	4648	27 Lafayette St	Left Front Roof Leader Into Ground Pipe Smoking	900	11,618	Remove Connection
4648	4647	81 Windsor St	Left Front, Left Rear Ground Pipe Smoking	16	207	Remove Connection
4705	4704	107 Church St	Right Rear Roof Leader To Ground Pipe Smoking	1,600	20,654	Remove Connection
4705	4704	117-121 Church St	Left Front, Right Front Ground Pipe Smoking	900	11,618	Remove Connection
4705	4704	135-137 Church St	Middle Front Ground Pipe Smoking	1,600	20,654	Remove Connection
4675	4703	12 Martin St	Right Front Roof Leader Smoking	30	387	Remove Connection
4676	4708	90 West St	Right Front Roof Leader To Ground Pipe Smoking	1,600	20,654	Remove Connection
4672	4670	28 Alden St	Right Front Roof Leader Into Foundation	900	11,618	Remove Connection
4672	4670	27 Alden St	Left Front Ground Pipe Smoking	16	207	Remove Connection
		St. Adalberts Alden St	Left Front, Left Middle Roof Leader To Ground Pipe Smoking	2,000	25,817	Remove Connection
4744	3884	68-70 College St	Hole In Ground In Front Of House Smoking - Next To Gas Meter	2	26	Repair
4742	4746	32 Church St (Burnt House)	Pipe On Right Front Of House Smoking	16	207	Remove Connection
4741	4773	36 Pleasant St	Gutters On Left Side Of House In Ground Pipe - Smoking	200	2,582	Remove Connection
4744	4742	Russell St At College St	Right Rear Roof Leader Smoking At Ground Pipe	3,600	46,471	Remove Connection
4744	4742	63 College St	Middle Rear Roof Leader Smoking - Connected To Ground Pipe	900	11,618	Remove Connection
4744	4745	32 Russell St	Left Front Roof Leader Connected To Ground Pipe - Smoking	2,500	32,271	Remove Connection
4742	4741	36-40 College St	Left Side Rear Roof Leader Smoking - Connected To Ground Pipe	2,500	32,271	Remove Connection
4742	4741	53 College St	Front Left Side Roof Leader Smoking - Connected To Ground Pipe	650	8,391	Remove Connection
4742	4722	63-65 Church St	Right Side Ground Pipe Smoking	16	207	Remove Connection
4742	4722	Church St At Whitworth St - Ministry Of Hope	Smoke From Parking Lot Drain	1,600	20,654	Remove Connection

From SMH	To SMH	Location	Inflow Source	Drainage Area (sqft)	Estimated Peak Inflow Rate (GPD)	Recommendation
4773	3877	22 Pleasant St	Left Front, Left Rear, Middle Rear Roof Leaders Connected To Ground Pipes - Smoking	5,150	66,479	Remove Connection
4754	4753	River Road At Main St	Middle Rear Roof Leader Into Foundation - Smoking	900	11,618	Remove Connection
4749	4750	32 Cottage Green	Right Front Roof Leader- Heavy Smoke	600	7,745	Remove Connection
			Left Front Roof Leader - Light Smoke	600	7,745	Remove Connection
			Right Rear Roof Leader - Heavy Smoke	600	7,745	Remove Connection
4749	4750	5 Cottage Green	Right Front Roof Leader- Heavy Smoke	480	6,196	Remove Connection
4747	T-IN	25-31 Cottage Green	Right Rear Roof Leader - Heavy Smoke	480	6,196	Remove Connection
			Left Rear Roof Leader- Heavy Smoke	480	6,196	Remove Connection
			Left Front Roof Leader - Heavy Smoke	480	6,196	Remove Connection
4823	4748	40 Thompson Court	Left Side Center Roof Leader - Heavy Smoke	320	4,131	Remove Connection
			Right Rear Roof Leader - Heavy Smoke	320	4,131	Remove Connection
		48 Prospect St	Right Front Roof Leader- Heavy Smoke	16	207	Remove Connection
		75-77 Prospect St	Left Rear Roof Leader- Light Smoke	200	2,582	Remove Connection
		120 Propect St - At Lumber Yard	Heavy Smoke Coming From All Cracks In Basement Floor			Repair Sewer Lateral
4750	4749	10-16 Cottage Green	Left Rear Roof Leader Ground Pipe Smoking	36	465	Remove Connection
4813	4750	37-43 Asnuntuck St	Left Front Roof Leader Ground Pipe Smoking	16	207	Remove Connection
			Hole In Ground On Front Lawn Smoking	16	207	Repair Sewer Lateral
4813	4750	47-53 Asnuntuck St	Left Front Roof Leader Ground Pipe Smoking	18	232	Remove Connection
4750	4751	Asnuntuck St - At Bend In Road Before Over Pass	3 Holes In Ground Smoking	9	116	Repair Sewer Main
Tee In	4747	26-28 Cottage Green Alley	Middle Rear Roof Leader Smoking	200	2,582	Remove Connection
Tee In	4747	22 Cottage Green Alley	Middle Rear Roof Leader Smoking	200	2,582	Remove Connection
Tee In	4747	12-16 Cottage Green Alley	Middle Rear Roof Leader Smoking	200	2,582	Remove Connection
Tee In	4747	8-10 Cottage Green Alley	Middle Rear Roof Leader Smoking	200	2,582	Remove Connection
Tee In	4747	5 Cottage Green Alley	Middle Rear Roof Leader Smoking			Remove Connection

From SMH	To SMH	Location	Inflow Source	Drainage Area (sqft)	Estimated Peak Inflow Rate (GPD)	Recommendation
Tee In	4747	21 Cottage Green Alley	Middle Rear Roof Leader Smoking	200	2,582	Remove Connection
4748	4823	38-36 Thompson Court	Right Front Roof Leader			Remove Connection
4748	4823	30-34 Thompson Court	Left Front Roof Leader			Remove Connection
3257	3258	29 Prospect St	Left Side Ground Pipe - Smoking			Remove Connection
4802	4792	14-20 Spring St	Hole In Ground Rear Of House - Smoking	36	465	Remove Connection
		7-9 Wallace St	Center Front Roof Leader Smoking	24	310	Remove Connection
		6 Sullivan Avenue	Smoking Roof Leaders All Sides	2,025	26,140	Remove Connection
		High St At Spring St	Catch Basin Smoking	9	116	Remove Connection
4802	4786	15-23 Cross St	Right Front Ground Pipe - Smoking	4	52	Remove Connection
4802	4792	Cross St At Spring St	Smoke From Catch Basin On Corner, Hole By Catch Basin, & Crack In Side Walk	6,000	77,451	Remove Connection/Repair Lateral
4785	4784	47-49 Spring St	Left Front Ground Pipe - Smoking	16	207	Remove Connection
4806	4787	Saint Patricks Church Pearl Steet At High St	Smoke From All Roof Leaders At Church	19,500	251,716	Remove Connection
4806	4787	64 Pearl St	Catch Basin Smoking In Front Of 64 Pearl St	3,000	38,726	Remove Connection
				Total	**877,429**	

Suspected sources of inflow are summarized in Table 4-9, where the number of suspected sources is identified by type. The majority of roof leaders identified belong to residential buildings, with the minority belonging to commercial and industrial structures. These suspected inflow sources could be verified for connection to the sanitary sewer by dye testing. All confirmed inflow sources are recommended for repair or removal.

Table 4-9: Number of Suspected Inflow Sources

Roof Leaders	Driveway Drains	Yard Drains
> 70	2	2

While most confirmed inflow sources are the responsibility of the respective property owners to correct, several repairs will need to be performed by the Town. A potential sewer main break was identified (as smoking holes in the ground) adjacent to 37 Asnuntuck Street between SMH 4750 and 4751. This sewer main collects flow from the entirety of Flow Metering Basin #9 and has the potential to cause backups into nearby homes should a complete collapse or surcharge occur. Woodard & Curran recommends CCTV inspection of the affected pipeline to assess its condition.

Four storm drains with confirmed connections to sewer were identified (noted as catch basins in Table 4-8 and the attached smoke testing report), three of which lie within the Town's sewer right of way. Dye tests performed with Town staff indicated that the two catch basins located on High Street, between Spring Street and Pearl Street, are likely

connected directly to the sanitary sewer. CCTV Inspection of these catch basins is planned as part of the ongoing CCTV program to determine the connection location and subsequent repair costs. We estimate the cost to repair these cross connections to be approximately $20,000. Cross connections may be corrected simply by plugging crossed pipes. Providing new storm sewer connections will require excavation, new pipe, paving and curb repair, and possibly new manholes. Costs to repair these storm drains were calculated assuming new connections will be required, regardless of cost effectiveness.

The catch basins located on Cross Street and Pearl Street do not appear to drain directly into the sanitary sewer, but may have incompletely blocked cross connecting pipes. The high volume of flow admitted into these storm drains without any measurable increase in sanitary flow indicates that significant volumes of inflow through these catch basins is unlikely.

The total cost of performing the repairs recommended in Table 4-8 are the responsibility of the property owner. The ADS smoke testing report contains detailed sketches and photos showing the location of each positive inflow source identified. Each suspected inflow source is also listed with an address and approximate location on the property. The smoke testing report is shown in Appendix G.

4.6 COLLECTION SYSTEM HYDRAULIC MODEL

Bentley's SewerGEMS® V8i software was used to model the Enfield collection system. A detailed separate Collection System Hydraulic Modeling Report is attached as Appendix E and summarizes the source data, methodology, and results of the model simulation. In summary, the model was constructed using existing collection system GIS data, plans, profiles and pump name plate data, and manhole survey data collected to fill in missing information.

The model was calibrated by comparing modeled flow at each of the 12 flow meter locations with actual metered data and by comparing simulated flow to the WPCF with MOR data. Input flows to the model were initially set to match the wastewater flow components identified in Section 3, and were modified to match flow data as closely as possible.

Preliminary results of the hydraulic model indicate that there may be a capacity concern with a 24-inch diameter pipe on the Connecticut River interceptor (see Figure 3-2), which consists of primarily 30 to 36-inch diameter pipe. A detailed survey of the upstream and downstream manholes is currently ongoing to confirm the diameter and slope of the pipe. If insufficient capacity is confirmed installation of a larger pipe or a relief sewer is recommended to prevent possible surcharging, which may lead to overflow or sewage backup into nearby residences. A preliminary design and cost estimate for constructing a relief sewer pipe and flow distribution structure is approximately $114,000. Assuming the existing 24-inch pipe has a minimum slope of 0.0008 in/in a relief sewer of at least 27-inch diameter is required to pass an estimated peak flow of 11 mgd. Note that approximately 4.0 mgd of the WPCF ADF of 5.25 MGD passes through this 24-inch pipe, according to the models.

4.7 PUMPING STATIONS

The Town of Enfield owns and operates sixteen pump stations to convey wastewater to the WPCF. Several privately owned pump stations are also connected to the system but these are not operated or maintained by the Town and are therefore not included in this report. The sixteen pump stations include:

- 7 submersible stations;
- 3 pneumatic ejector stations;
- 5 conventional wet well/dry well stations; and
- 1 suction lift station.

The location and service area of each pumping station is shown in Figure 4-1. The mechanical, electrical, architectural and structural condition of each station. Staff were also interviewed to provide information on the condition of the existing stations. In general, most of the pump stations are functioning but much of the equipment is approaching the

end of its design life. In addition, the feasibility of replacing three (3) pump stations with gravity sewer was investigated. These three pump stations include Sharp Street, Moody Road, and Taylor Road pump stations. A description of the findings and recommendations from each pumping station is included in the following sections.

4.7.1 Flood Resiliency

According to TR-16, pumping stations should be designed such that all electrical and mechanical equipment is protected from physical damage by waters at or above the 100-year flood plain elevation. In addition, the guide states that pump stations should remain operational and accessible during 25-year flood conditions. TR-16 is currently being revised to provide additional protection from floodwaters. The new recommendations were not available at the time this report was written. Figure 2-3 shows the Town of Enfield overlaid with FEMA's flood zone data and the pump station locations. Section 2.10 defines and discusses the FEMA flood zone data in detail.

Of the 16 pump stations in Town, five stations intersect with FEMA flood zone layers. Of those five stations, the South River, Grape Brook and Pheasant Hill pump stations lie within the 500-year flood plain and do not require modification to meet design standards as set forth in TR-16. The remaining two pump stations, South Maple Street and Windsor Court, intersect the FEMA 100-year flood plains.

The South Maple Street pump station lies partially within the FEMA 100-year flood elevation. Figure 4-12 shows the South Maple Street pump station overlaid with FEMA's flood zone layers (shown in green). FEMA has not developed flood elevation profiles for this region of the Scantic River. DEEP 2-foot elevation contours, shown in the figure, show the floodwater elevation to be approximately 80 feet near the pump station. The first floor of the pump station is at an elevation of 85.25 feet above sea level (FASL) according to as built drawings. The existing pump station appears to be adequately protected from 100-year flood conditions.

The Windsor Court pump station lies within the 100-year flood plain at approximately 56 feet above sea level. Due to backwater effects from the Connecticut River, the 100-year flood elevation is also 56 feet. The existing wet well access hatch is one foot above grade. Figure 4-13 shows an orthographic view of Windsor Court pump station overlaid with FEMA's flood zone layers. As shown in the figure, the Windsor Court pump station may be subject to flooding during the 100-year flood event, given that the wet well hatch and generator are about one foot above grade.

4.7.2 Indian Run Pump Station

4.7.2.1 Description

The Indian Run pump station was constructed in 1967 and is located near the intersection of Raffia Road and South Road. The station services Rim Street, Chief Street, Dune Road, and part of Arrow Street and Indian Run.

This pump station is equipped with two pneumatic ejectors that convey flow through approximately 1,300 linear feet of 6-inch cast iron force main to the northern end of Indian Run. Two Quincy basic single stage air compressors are used to pressurize the ejectors. These compressors are less than five years old, but are very loud when they are in service. Information related to the pump station is summarized in Table 4-10.

Indian Run Pump Station

The building lacks insulation and shows signs of corrosion. The ejector type station is an antiquated technology and the existing mechanical components of the ejectors are corroded. The can structure is also susceptible to corrosion. The dry pit reaches very high

temperatures in the summer due to operation of the compressors. High temperatures likely increase the rate of corrosion.

Table 4-10: Indian Run Pump Station

Equipment	Design
Inlet Pipe Diameter	Dual 6-inch
Force Main Diameter	6-inch
Dry Well Diameter	8 FT
Pneumatic Ejectors	
Number of Pneumatic Ejectors	2
Design Capacity (each)	100 GPM @ 50 FEET
Ejector Pot Volume	140 GAL
Ejector Pot Working Pressure	100 psi
Year	1967
Air Compressors	
Model	QR-25 Series Model 270
Year	2010
Motor	7.5 HP
Generator	
Manufacturer	Onan
Year	1967
Fuel	Propane
Power	30 kW

The main electrical service originates from a pole mounted transformer located on the opposite side of the street from the Pump Station building. The service is fed overhead to a wooden pole located adjacent to the pump station and continues down the pole underground to a main circuit breaker inside the station.

The main circuit breaker is 70 amp, 3-pole, 480 volt housed in a separate enclosure. It appears to be 1960's vintage and was manufactured by the Federal Pacific Company. The main circuit breaker feeds a 277/480 volt, 100 amp, 3 pole automatic transfer switch which has several splices or taps on the outgoing wires to feed the Pump Control Panel and a 120/240 volt single phase load center via a small 480-120 volt transformer. The load center houses the lights and receptacle circuit breakers for the station.

An Onan propane fueled generator, installed in 1967, provides emergency power to the entire station. Propane is stored in an underground tank. The main seal on the generator is leaking oil. The generator is rated at 30kw, 37.5kva, 277/480V, 3-phase, and contains a Main Circuit Breaker. Adjacent to the service equipment is a 100 amp, 3-phase, 4-wire, 480 volt ATS which appears to be in fair condition.

Outside the pump station there is an underground propane tank which fuels the generator. Upon inspection of the access hole to the regulator it appeared ground water had been leaking into the filler area of the tank and is currently submerging the tank regulator.

4.7.2.2 Deficiencies

The following deficiencies exist at the Indian Run Pump Station:

- Generator – Original to 1967, difficult to find parts for, leaking main seal, leaking propane fill cap and regulator, propane valve pit regularly floods with water and requires emptying by hand.
- Building – Lacks insulation for heating and sound deadening.
- Pneumatic Ejectors – Controls are located in the dry pit, which reaches very high temperatures during summer due to compressor operation. Operators have also reported extensive corrosion within the mechanical components of the ejectors.

4.7.3 Sharp Street Pump Station

4.7.3.1 Description

The Sharp Street pump station is located off Raffia Road and was constructed in 1973. The station services Sharp Street, Keen Court, Cloud Street, Light Street, Eds Drive, and part of Moon Street and Clear Street. The sewer service piping is comprised of approximately 6,100 linear feet of 8-inch asbestos cement and ductile iron gravity pipe, constructed between 1973 and 1974. Wastewater from the pump station is conveyed through approximately 700 linear feet of 6-inch diameter ductile iron force main to the Raffia Road sewer main.

Sharp Street Pump Station

This pump station is equipped with two pneumatic ejectors that have been in service since 1973. The pneumatic ejectors have been welded at least twice since they were installed. The air compressors were replaced with Quincy basic single stage air compressors in 2010. An Onan 45 kW propane fueled generator, installed in 1973, provides backup power. Propane is stored in an underground tank. The dry well, generator, and controls are housed within a steel building. The pump station specifications are summarized in Table 4-11.

The ejector type station is an antiquated technology and the existing mechanical components of the ejectors are corroded. The can structure is also susceptible to corrosion. The dry pit reaches very high temperatures in the summer due to operation of the compressors. High temperatures likely increase the rate of corrosion.

Table 4-11: Sharp Street Pump Station Specifications

Equipment	Design
Inlet Pipe Diameter	8-inch
Force Main Diameter	6-inch
Dry Well Diameter	8 FT
Pneumatic Ejectors	
Number of Pneumatic Ejectors	2
Pump Design Capacity	100 GPM @ 50 FT TDH
Sewage Pot Volume	140 GAL
Sewage Pot Working Pressure	100 psi
Year	1973
Air Compressors	
Model	QR-25 Series Model 270
Year	2010
Motor	7.5 HP
Generator	
Manufacturer	Onan
Year	1973
Fuel	Propane
Power	45 kW

The main electrical service enters the pump station underground from a wooden riser pole and terminates at a main 60 amp, 3-pole, 240 volt circuit breaker. The main circuit breaker appears to be 1960's vintage and was manufactured by General Electric. The main circuit breaker feeds a 277/480 volt, 100 amp, 3 pole ATS which then feeds into a sheet metal wireway which has several splices or taps. The taps off the main service wires include the following

- A Feeder to the Pump Control Panel;
- A Feeder to a 50 amp disconnect switch for the Ejector Pump; and
- A Feeder to a small transformer, which serves a 120/240 volt load center for general receptacles and lighting in the pump station.

The existing Onan propane fueled generator serves the entire pump station and is located inside the building. The generator is rated at 45kw, 56kva, 3-phase, and contains a Main Circuit Breaker. The generator is the same vintage with an associated Generac ATS located adjacent to the main electrical service equipment.

4.7.3.2 Deficiencies

The following deficiencies currently exist at the Sharp Street Pump Station:

- Generator – Original to 1973, difficult to find parts for, propane regulator pressure gage dry rotted and unreadable.
- Building – Lacks insulation for heating and sound deadening. The door does not close properly, and the siding has been damaged.
- Pneumatic Ejectors – The ejectors have surpassed their useful design life and have been repaired at least twice. Ejectors are not as reliable as submersible pumps. Operators also reported extensive corrosion to the mechanical components of the ejectors. The controls are located in the dry pit, which reaches very high temperatures during summer due to compressor operation. High temperatures likely increase the rate of corrosion once it has started. The access ladder to the dry pit is secured to the wall with zip ties.

4.7.3.3 Replacement Investigation

The feasibility of two Sharp Street Pump Station replacement alternatives were evaluated: (1) replacing the pump station with a pair of new pump stations to eliminate a cross-country gravity sewer and excessively deep manholes, and (2) removing the Sharp Street pump station and replacing it with a gravity sewer. The existing pump station is approximately 35 feet deep, utilizes antiquated pumping and backup power equipment, and the building is in poor condition. Safety concerns include high temperatures in the dry well, an unsecured ladder, and a non-functional propane regulator gage.

4.7.3.4 Alternative 1

Preliminary review of the Sharp Street Pump Station service area record drawings indicated that the existing pump station utilizes approximately 1,000 feet of cross-country gravity sewer and five cross-country manholes. The manholes and cross country line could be eliminated if two new pump stations were constructed. In addition, the replacement pump stations would require significantly less deep wet wells and therefore lower pumping head requirements.

The current Sharp Street Pump Station service area consists of Sharp Street, Keen Court, Eds Drive, Light Street, Cloud Street, and parts of Moon Street and Clear Street. New Pump Station #1 could be constructed adjacent to and north of the existing station on the same lot (shown on Figure 4-8) and tie in to the existing sewer line running north to south toward the existing pump station. An additional manhole installed approximately half the length of the 75-foot pipe would be required to connect the new pump station. This new pump station would service only Sharp Street and Keen Court and therefore would require less capacity than the existing station. The minimum depth required of the new pump station is approximately 16 feet to the bottom of the wet well. The maximum manhole depth to invert in this pump station's service area would be approximately 9 feet.

New Pump Station #2 would need to be constructed on either lot adjacent to the existing easement off Clear Street. This design assumes that either lot is available for use by the WPCA. At this time, these lots are vacant. A new manhole would be constructed on the existing 8-inch asbestos cement pipe adjacent to the pump station to collect wastewater flows. The remaining Sharp Street Pump Station Service Area would be served by New Pump Station #2, including Eds Drive, Light Street, Cloud Street, and parts of Moon Street and Clear Street. The minimum depth required of this pump station is approximately 19 feet to the bottom of the wet well.

4.7.3.5 Alternative 2

Relying on gravity alone to convey flow from Sharp Street and Keen Court to Raffia Road is not feasible without the aid of a pump station. Most of the properties on Sharp Street and Keen Court have service laterals at elevations below that of the nearest manhole on Raffia Road. The remaining service area (consisting of Eds Drive, Light Street, Cloud Street, and parts of Moon Street and Clear Street) also partially lies in a depression below that of potential connection

points. Gravity flow from this service area to an existing manhole is not feasible. The invert elevations of the nearest manholes on Moon Street and Raffia Road are greater than the ground elevation in part of the service area. In both cases, a pump station is required. Additionally, reconstruction of the existing manholes on Raffia Road to lower the inverts would not be cost effective. In order to lower the existing manhole inverts to adequate depths, further reconstruction of downstream manholes would also be required.

Alternately, it is feasible to construct new gravity sewer on Sharp Street and Keen Court serving houses 3, 4, 5 and 6 (see Figure 4-9). Due to the drop in elevation towards the east end of Sharp Street and the south end of Keen Court, houses 1, 2, 6, 7, 8, 9, 11, and 15 would have to be served by low pressure gravity sewer. No pump station would be required to serve Sharp Street and Keen Court. However, the remaining existing service area would need to be served by a new pump station constructed on Clear Street in the same location as New Pump Station #2 on Figure 4-8. The advantages of this alternative include removing an excessively deep pump station, several deep manholes, and abandonment of the cross country sewer line. The new pump station would be less than 20 feet deep, as opposed to the existing Sharp Street Pump Station which is approximately 35 feet deep. As with Alternative 1, this design assumes that either lot adjacent to the existing sewer easement off Clear Street is available for use by the WPCA to construct the new pump station.

4.7.4 South Maple Street Pump Station

4.7.4.1 General Description

The South Maple Street pump station was constructed in 1973 and serves the majority of area south of North Street, east of the North Street and Hazard Avenue intersection, and north of Abbe Road, and is located adjacent to the Scantic River. The sewer service piping is comprised of approximately 113,400 linear feet of asbestos cement, reinforced concrete, ductile iron, cast iron, and PVC gravity pipe, ranging in diameter from 8 to 24 inches and was installed between 1973 and 2005. Wastewater from the pump station is conveyed through approximately 2,700 linear feet of 16-inch diameter cast iron force main to the Hazard Avenue sewer main. The South Maple Street pump station receives flows from the Taylor Road pump station as well as a private pump station, both of which are within the South Maple service area.

The pump station includes a three-story concrete and brick building with a wet well and dry well configuration. Dual wet wells are located in the west side of the building, while the dry well is in the east side of the building. A diesel generator on the ground floor supplies emergency power. In addition, at ground level is a bathroom, storage room, HVAC equipment, MCC, and motorized louvers. The pump motors, air compressors, and non-functioning venturi flow meter are located one level below grade. The bottom level houses the pumps, hydraulically actuated check-valves, manual gate valves, and associated piping. The west side of the building has two levels located above the dual wet wells, the lower of which contains an influent flow channel equipped with a comminutor. The pump station features are summarized in Table 4-12. One of the duty pumps was replaced in 2014, but the other has been in service since 1973.

South Maple Street Pump Station

Space for a third pump was left on the bottom floor, but the existing and projected future flows are not great enough to require it. A new oil burner was installed on the boiler in 2013. A 3,000 gallon stainless steel hydrogen peroxide storage tank exists on-site for the odor control system that has been out of service for a number of years.

The main electrical service originates from a pad mount transformer located adjacent to the pump station building. The service is fed underground to a 600A Main Circuit Breaker located in the MCC.

The MCC has been in service since the station was constructed but has been retrofitted to include two sections of Square – D Variable Speed Drives being retrofitted into the end section of the MCC for the 125hp Pumps 1 and 3. The MCC also houses a new automatic transfer switch (ATS) that was installed in the Summer of 2014 after the original one failed. The MCC has a bus rated at 600 amp, 480 volt, 3-phase, 3-wire with a 600 amp main circuit breaker and was manufactured by the Furnas Electric Company; in addition to the Variable Frequency Drives, the MCC also houses multiple circuit breaker and motor starter buckets.

Adjacent to the MCC is a 100A, 120/208V, three phase, four wire panelboard that was installed when the station was originally constructed. This panelboard provides power for local receptacles and general 120-volt power for the pump station. All the circuits in this panelboard are currently used and lack any ability to expand. The panelboard is located behind the existing oil storage tank for the generator. This panel also lacks the required 3-feet of working clearance in front of the panel that is required by the National Electrical Code.

Table 4-12: South Maple Street Pump Station

Equipment	Design
Inlet Pipe Diameter	24-inch
Force Main Diameter	16-inch
Wetwell Dimensions (2 EA)	16.5'x11.5'x17.5', 9'x11.5'x17.5' with sloped floors
Total Wetwell Volume	Approximately 33,000 GAL
Duty Pumps	
Number of Pumps	2
Pump Model	Cornell 6NHM-VF18DB
Pump Design Capacity	1550 GPM @156 FT
Size	6 x 15
Year	One Pump – 1973, One Pump - 2014
Pump Motor	Marathon Electric 125 HP, 1775 RPM, 480V/3Φ/60Hz
Influent Channel Comminutor	
Motor	Reliance Electric 3 HP, 1745 RPM, 460V/3Φ/60Hz
Generator	
Manufacturer	Unknown
Year	1973
Fuel	Diesel
Power	250 kW
ATS	Cummins

The existing diesel fueled generator provides adequate power to serve the entire pump station and is located inside the building. The generator is rated at 230kw, 287.5kva, 480V, 3-phase, and contains a 400 amp Main Circuit Breaker. Adjacent to the generator is a diesel fuel tank, which provides fuel for both the existing boiler and the generator. There is a new Cummins 600 amp, 4 pole automatic transfer switch stored at the pump station that is available for installation at a later date.

The pump station lighting consists of single open lamp fluorescent fixtures controlled by manual wall switches. There are various fixtures from the 1960's vintage which provide a fair to poor light level.

4.7.4.2 Deficiencies

The following deficiencies currently exist at the South Maple Street Pump Station:

- The roof leaks onto the generator control panel;
- Aging generator;
- Odor Control System is no longer functional;
- Failing backflow preventers due to sediment build up;
- Venturi flow meter is no longer functional;
- Small leaks from wet well into the dry well;
- Wet well electric heaters are not functional; and
- Lack of slide gates to isolate flow to wet wells.

4.7.5 Grape Brook Pump Station

4.7.5.1 General Description

Grape Brook Pump Station

The Grape Brook pump station was constructed in 1965 with a service area encompassing much of North Thompsonville and the northern half of the Town, west of West Shore Drive Pump Station, and north of Elm Street and Shaker Road. The Grape Brook Pump Station also pumps flow from the Windsor Court Pump Station. The sewer service piping is comprised of approximately 232,300 feet of gravity sewer ranging from 6 to 18 inches in diameter. Pipe materials include asbestos cement, reinforced concrete, PVC, vitrified clay, and possibly other materials. Flow is pumped through an 18-inch asbestos cement force main, approximately 4,700 linear feet in length, to a 36-inch trunk line sewer, which crosses Route 5 near Elm Street. Sewer service piping in the area was constructed between 1965 and 2008.

The Grape Brook pump station was built as a combination wet well and dry well configuration inside a brick and concrete building. The pump station building has two levels. Four pumps are currently installed, but only three are operational. The lower level houses a non-functional break water tank, backflow preventers for the water seal system, and a mechanical check valve/water hammer arrestor on the effluent piping. The generator, MCC, SCADA panel, autodialer system, bathroom, diesel fuel tank, air compressors, pneumatic louvers, and oil-fired boiler are located on the ground level. The wet well is located in a separate room in the west side of the building and is equipped with an influent channel and comminutor. The pump station features are summarized in Table 4-13.

A controls upgrade was performed in the early 1990s and included a pump failure alarm, low and high wet well alarm, and a dry well float to indicate flooding. Alarms are transmitted through the radio telemetry system.

Table 4-13: Grape Brook Pump Station

Equipment	Design
Inlet Pipe Diameter	18-inch
Force Main Diameter	18-inch
Duty Pumps	
Number of Pumps	2
Pump Model	Cornell 6NHTA-VC180B Vertical Centrifugal
Pump Design Capacity	1,800 GPM @ 85 FT TDH
Year	2005
Pump Motor	Reliance Electric 50 HP, 1775 RPM, 460V/3Φ/60Hz
High Flows Pump	
Pump Model	Vertical Centrifugal
Pump Design Capacity	to be confirmed during design
Year	1960s
Pump Motor	200 HP
Non-Functional Pump	
Pump Model	Vertical Centrifugal
Pump Design Capacity	to be confirmed during design
Year	to be confirmed during design
Pump Motor	20 HP
Influent Channel Comminutor	
Motor	Reliance Electric 3 HP, 1745 RPM, 460V/3Φ/60Hz
Generator	
Manufacturer	Cummins Onan
Year	1990
Fuel	Diesel
Power	250 kW

The main electrical service originates from three 50kva pole mounted transformers located adjacent to the Pump Station building. The service is fed overhead to a wooden pole located inside the fenced in area of the pump station and continues down the pole underground to the MCC located in the Pump Station.

The MCC has been in service since the station was constructed and has a bus rated at 600 amp, 480 volt, 3-phase, 3-wire with a 600 amp main circuit breaker and was manufactured by the General Electric Company. The MCC contains a section for local power company monitoring equipment, a 600 amp main circuit breaker and an ATS, which is no longer in use. The MCC also contains various circuit breaker/motor starter buckets for the pump station loads along with abandoned buckets that are no longer in use.

Adjacent to the MCC is a 100A, 120/240V, single phase, three wire panelboard which appears to be 1960's vintage. This panelboard provides power for local receptacles and general 120 volt power for the pump station. All circuits in

the panelboard are in use and there is no room for expansion. The panelboard is in poor condition. At the lower level, the local start/stop station enclosures for the existing motors are severely corroded and need to be replaced.

The existing diesel fueled generator serves the entire pump station and is located inside the pump station building. The generator is manufactured by Cummins and is rated at 250kw, 312.5kva, 277/480V, 3phase, and contains a 400 amp Main Circuit Breaker. According to Cummins, the generator and ATS are from the mid 1990's. Adjacent to the generator is a separate room housing the diesel fuel tank for the generator and a 400 amp, 3 pole ATS. Town Personnel report that the generator and ATS are in satisfactory condition and have not experienced any recent failures or breakdowns.

The pump station lighting consists of single open lamp fluorescent fixtures controlled by manual wall switches. Various fixtures from the 1960's vintage provide a fair light level.

The station has one large pump to handle very high flows, two duty pumps and a jockey pump. The high flow pump operates on rare occasions. The pump runs in three stages, but the two highest stages are rarely used. The pump is considered unsafe and has the potential to arc flash. The jockey pump is not in operation. The inlet and outlet pipe manifolds are showing signs of corrosion. The outlet pipe manifold was repaired within the last few years,

The Grape Brook PS does not have a connection available for emergency bypass. If there was an emergency at the station, there is no convenient way to redirect flows.

The HVAC system is in need of replacement. The HVAC on both the wet and dry well side of the station show signs of corrosion. The system on the wet well side is non-functional.

4.7.5.2 Deficiencies

Enfield WPCF personnel expressed concerns about several issues with the Grape Brook pump station, including:

- The original 3-speed control panel for the 200 HP pump experiences unsafe electrical issues including arc flashing. This pump and control panel should be replaced;
- The jockey pump is non-operational;
- The back flow preventers do not meet code as installed;
- The check valve on one of the pumps needs to be replaced;
- The HVAC on both sides of the pump station are in need of replacement;
- There is exposed aggregate in the wet well channel from hydrogen sulfide deterioration;
- Concrete pad and step outside of building needs repair;
- Outlet pipe manifold is in poor condition and an emergency repair was performed in the past. The inlet pipe manifold is also in need of replacement;
- The roof leaks and the doors are in poor condition; and
- Lacks a bypass vault.

4.7.6 South River Pump Station

4.7.6.1 General Description

Originally constructed in 1938 and updated in 1990, The South River pump station services an area including the majority of Thompsonville between Hazard Ave and Laurel Street, and I-91 and the Connecticut River. Bigelow Commons and the Town Hall are included in this service area. The service area consists of at least 52,000 linear feet of gravity sewer, ranging in diameter from 8 to 24 inches. Pipe materials used include vitrified clay, asbestos cement, PVC, and possibly others. A 2,300 linear foot 20-inch force main heads south along South River Street and feeds into

a 24-inch gravity main, which runs along the Connecticut River to the WPCF, gradually increasing in diameter from 24 to 36 inches. Sewer piping was known to be installed between 1965 and 1978, however older piping exists in the service area.

The pump station is built as a combination wet well and dry well configuration inside a concrete and concrete block building. The generator and associated control panels are housed in a separate adjacent building constructed as part of the 1990 upgrade. The main building has two levels. The lower level houses three pumps including the jockey pump and its motor, associated piping, and a sump pit. The duty pump motors, control panels, SCADA panel, and autodialer system are located on the ground level of the building. The wet well influent channel is located in a separate room in the main building and is equipped with a Channel Monster that was installed in 2015. Flow from the influent channel flows over a broad crested weir into the wet well.

South River Pump Station

The autodialer operates on battery power and is activated by high water level via a mechanical float to alert personnel of emergencies via phone. The SCADA system sends alarms to the WPCF SCADA interface. The duty pumps are automatically exercised once per day because they are used infrequently. The Jockey pump handles most of flows experienced at the South River pump station. The variable frequency drives that control pump speed were replaced between 2002 and 2003 and are in good working order. The HVAC in the wet well side of the building is rusted and failing and is slated to be replaced. The pump station features are presented in Table 4-14.

Table 4-14: South River Pump Station

Equipment	Design
Inlet Pipe Diameter(s)	8-inch, 15-inch, 24-inch
Force Main Diameter (2 EA)	20-inch
Duty Pumps	
Number of Pumps	2
Pump Model	Fairbanks Morse B5400 Non-Clog Vertical Centrifugal
Pump Design Capacity	2,843 GPM @ 56.6 FT TDH
Year Installed	1991
Pump Motor	Marathon Electric 60 HP, 885 RPM, 460V/3Φ/60Hz
Jockey Pump	
Number of Pumps	1
Pump Model	Chesterton
Pump Design Capacity	700 GPM @ 60 FT TDH
Year Installed	1991
Pump Motor	Baldor Electric 25 HP, 1175 RPM, 460V/3Φ/60Hz
Influent Channel Comminutor	
Motor	Reliance Electric 2 HP, 1735 RPM, 460V/3Φ/60Hz
Generator	
Manufacturer	Detroit Diesel
Year	2005
Fuel	Diesel
Power	105 kW

The main electrical service originates from a 460 volt, 3-phase pad mount transformer located adjacent to the generator building. The service is fed underground to a 600A Main Circuit Breaker in the Generator Building and continues to the Automatic Transfer Switch (ATS). The ATS load side feeder runs underground to feed the Pump Station Motor Control Center (MCC) located in the Pump Station Building.

The original MCC is 1960's vintage with two sections of Adjustable Speed Drives being retrofitted in from the 1990's for Pumps P1 and P3. Adjacent to these drives is the Seal Water Pump Drive, which appears from the 1990,'s vintage and is no longer in use. The MCC has a bus rated at 600 amp, 240 volt, 3-phase, 3-wire with a 600 amp main circuit breaker and was manufactured by the General Electric Company; along with the Adjustable Drives the MCC also houses multiple circuit breaker/motor starter buckets, many of them no longer in use.

Adjacent to the MCC is a 100A, 120/240V, single phase, three wire panelboard which appears from the 1960's vintage. This panelboard provides power for local receptacles and general 120 volt power for the pump station. All circuits in the panelboard are in use and there is no room for expansion. The panelboard is in fair condition.

The existing diesel fueled generator provides power for the entire pump station and is located in a dedicated generator building adjacent to the Pump Station building. The generator was manufactured by Detroit Diesel and is rated at

105Kw, 131kva, 120V/240V, 3phase, and contains a 400 amp Main Circuit Breaker. The generator's manufacturer label indicates a manufacturer date of July of 2005. Located adjacent to the generator building is an outdoor diesel tank, which is the source of supply for the fuel to the generator.

The Automatic Transfer Switch (ATS), located in the generator building, is rated for 600 amps, 460 volt, 3-phase, 4 wire and is manufactured by Russ Electric and appears to be in good condition with Town Personnel report that they have not experienced any failures.

The pump station lighting consists of single open lamp fluorescent fixtures and are controlled by manual wall switches. There are various fixtures from the 1960's vintage, which provide a fair light level.

The force main turns 90 degrees and is partially exposed, shown at right, before crossing under a railroad and entering a gravity sewer manhole. The exposed portion of pipe is restrained by concrete structures at both ends and is supported by two concrete piers. Additionally, a tee and drain valve are installed which allow for draining the force main into the Connecticut River. The drainage valve cannot be used to fill tanker trucks or for bypass pumping. Given regulations that prohibit drainage of raw sewage into natural water bodies and there has been no precedent for exercising the valve, which likely no longer functions, removal of the valve should be considered.

South River Pump Station Exposed Force Main

4.7.6.2 Deficiencies

The following deficiencies currently exist at the South River Street pump station, including:

- The roof leaks onto VFDs;
- The wet well is undersized;
- Sections of the pump building are settling, cracking, and separating;
- The plumbing is corroding;
- Two large pumps cannot be operated simultaneously;
- SCADA alarm system does not transmit alarms to personnel;
- The force main check valve is rusted and likely to fail; and
- A portion of the force main is above grade and equipped with a drain valve designed to flow to the Connecticut River and cannot be used for draining to a tanker truck.

4.7.7 Moody Road Pump Station

The Moody Road pump station is a wet pit submersible station with two submersible pumps. The submersible pumps were installed in 1988, and new guide rails were recently installed. The pumps are reaching their typical service life, but they serve approximately 21 residential lots. Because of the low volume of service, we are not recommending replacement. The wet well structure is precast concrete and appears to be in good condition. The generator was last upgraded in 2002 and is in good working order. It is currently fed by an underground propane storage tank. This pump station is adjacent to a natural gas line in the street which offers an opportunity to remove the propane tank and connect to the natural gas line. The pump station appears to be in good working order and there are no recommendations beyond connecting to the natural gas line in the street.

During the site visit, the operator noted that the new check valves plug often. At this point in time we do not recommend replacement of the valves.

Moody Road Pump Station

The main electrical service originates from a pad mounted transformer located adjacent to the Pump Station. The service runs underground to a Utility meter and then to a main circuit breaker mounted on a plywood backboard located within the station's fenced area.

The main circuit breaker is 100A, 3-pole, 208V housed in a separate enclosure and manufactured by General Electric (GE). The main circuit breaker feeds a 120/208V, 100A, 3-pole automatic transfer switch that feeds outgoing wires to a 100 amp Panelboard. The Panelboard contains a 70 amp – 3pole circuit breaker for the Pump Control Panel and multiple 20 amp, single pole circuit breakers.

A Detroit Diesel, propane generator provides emergency power to the entire station. The generator is rated at 20KW, 25KVA, 120/208V, 3-phase, and contains a 80 amp Main Circuit Breaker, is skid mounted with a weatherproof enclosure. The 100 amp Automatic Transfer Switch was installed in 2004 and appears in good condition.

4.7.7.1 Deficiencies

The following deficiencies exist at the Moody Road Pump Station:

- The Panelboard has minor rust and is in fair condition;
- The Main Circuit Breaker Enclosure has minor rust and is in fair condition; and
- The Automatic Transfer Switch has minor corrosion on its cover and appears to be in fair condition.

4.7.7.2 Replacement Investigation

The feasibility of removing the Moody Road Pump Station from service and replacing with a gravity sewer system was investigated. The service area includes approximately 21 residential lots that are separated from an adjacent service area by a hill peaking at 245 feet in elevation. The manhole on the pump station side of the hill sits at approximately 225 feet in elevation at grade, and the manhole at the base of the opposite side of the hill sits at approximately 215 feet in elevation at grade.

Redesigning all of the manholes and piping from the eastern-most manhole on Moody Road to the manhole at the intersection of Moody Road and Taylor Road could allow for the abandonment of the Moody Road pump station with a maximum pipe slope of approximately 0.0085 ft/ft. This would require the installation of approximately 1,200 feet of new pipe at depths up to 35 feet and at least five new manholes along the new pipe.

If it is determined that removing sanitary sewer lines with existing residential connections at the peak of Moody Road is not practical, an additional line may be installed carrying the Moody Road Pump Station wastewater to the Taylor Road intersection, parallel to and substantially deeper than the existing line. This design would only require modifications to the manhole at the intersection of Moody Road and Somers, and the two manholes east of that location, and an additional connection at the manhole at the Taylor Road and Moody Road intersection.

A variation of this alternative method may include modifying the existing sewer line at the peak of Moody Road, or running one or multiple shallow gravity sewer lines parallel with the new deep gravity line. These shallow sewer lines could accept connections from the existing residential lots and feed into the new line at the manholes.

Although the installation of a gravity line to replace the existing pumped system may be possible, the effort would be prohibitively expensive and the product would be exceptionally difficult to maintain due to the deep, low-slope pipes stretching long distances. Justifying the replacement of the pump station with a gravity line based solely on return on investment will be difficult, if not impossible. Operation of a pump station at the current location is the most cost effective method of conveyance.

4.7.8 Taylor Road Pump Station

The Taylor Road pump station is a wet pit submersible station. The valves are located in the wet well, which leads to corrosion and is not common practice. The wet well is a steel can and shows some corrosion. The submersible pumps were installed in 2004 and run well.

The main electrical service originates from a pole-mounted transformer located adjacent to the Pump Station. The service runs underground to a Utility meter and then to a main circuit breaker mounted on a plywood backboard located within the station's fenced area.

Taylor Road Pump Station Wet Well Cover

The main circuit breaker is 100A, 3-pole, 208V housed in a separate enclosure and manufactured by General Electric (GE). The main circuit breaker feeds a 120/208V, 100A, 3-pole automatic transfer switch that feeds outgoing wires to the Pump Control Panel and a 120V, single-phase GE load center. The load center houses the lights and receptacle circuit breakers for the station.

A Detroit Diesel, propane generator provides emergency power to the entire station. The generator was last upgraded in 2006 and there are no reported issues with its operation. The generator is fed by an underground propane storage tank and is rated at 40KW, 50KVA, 120/208V, 3-phase, and contains a 100 amp Main Circuit Breaker. Adjacent to the service equipment is a 100 amp, 3-phase, 208 volt automatic transfer switch that appears to be in fair condition.

4.7.8.1 Deficiencies

- The existing meter enclosure has corrosion and is in poor condition;
- Wet well structure and valves are corroded;
- The Main Circuit Breaker Enclosure has sever corrosion and is in poor condition; and
- The Automatic Transfer Switch has corrosion on its cover and appears to be rusting through the enclosure.

4.7.8.2 Replacement Investigation

The feasibility of removing the Taylor Road Pump Station from service and replacing with a gravity sewer system was investigated. Preliminary review indicates replacing the pump station with a gravity sewer system is technically feasible.

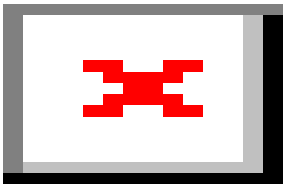
Approximately 4,100 feet of new 8-inch diameter gravity sewer is required and would run between the existing pump station location, west along North Street, and then north adjacent to the railroad to the intersection with Moody Road. Approximately 20 feet of head between the lowest manhole invert in the existing Taylor pump station service area and the nearest manhole on Moody Road would allow for a pipe run slope of about 0.005. The TR-16 minimum design standard for 8-inch pipe is 0.004. The new sewer would be between 13 and 16 feet deep at most points along the route.

Not including any required permitting, this new sewer would cost approximately $1.5 million to construct, whereas the cost to upgrade the existing pump station is significantly less. Assuming an escalation rate of 2% and a 20-year pay off period, the new sewer construction would cost the Town around $90,000 per year. At this same rate, the pump station could be upgraded in less than 2 years and the annual operation and maintenance cost would be significantly less than the remainder. Therefore, replacing the Taylor Road pump station with gravity sewer is not a financially sound proposition. We recommend retaining the existing pump station and upgrading as required.

4.7.9 Pheasant Hill Pump Station

4.7.9.1 Description

The Pheasant Hill pump station replaced the Weymouth Road pump station in the early 1990s. It is located off Weymouth Road and conveys wastewater approximately 1,100 feet through a 4-inch diameter polyvinyl chloride pipe.



Pheasant Hill Pump Station Wet Well

This pump station is equipped with two wet pit submersible pumps, a fiberglass wet well, and a separate valve vault. New rails for the submersible pumps were installed in 2012 or 2013. A 19 kW Kohler propane fueled generator was installed in 1990 and provides backup power. Propane is stored in an underground tank. The generator is severely corroded and has a coolant leak.

The main electrical service originates from a pole-mounted transformer located on the opposite side of the street from the Pump Station. The service is fed overhead to a wooden pole located adjacent to the pump station and continues down the pole underground to a main circuit breaker inside a service entrance enclosure within the station's fenced area.

The main circuit breaker is 100A, 3-pole, 208V housed in a separate enclosure and manufactured by General Electric (GE). The main circuit breaker feeds a 120/208V, 100A, 3-pole automatic transfer switch that feeds outgoing wires to the Pump Control Panel and a 120V, single-phase GE load center. The load center houses the lights and receptacle circuit breakers for the station.

A Detroit Diesel, natural-gas generator provides emergency power to the entire station. The generator is rated at 20KW, 25KVA, 120/208V, 3-phase, and contains a Main Circuit Breaker and was installed in 2015. Adjacent to the service equipment is a 100 amp, 3-phase, 4-wire, 208 volt automatic transfer switch that was also installed in 2015.

4.7.9.2 Deficiencies

The following deficiencies exist at the Pheasant Hill Pump Station:

- The generator is severely corroded and has a coolant leak.

There is a wetland area adjacent to the pump station. Pumps run twice as long in the spring as in the summer. The Pheasant Hill area is a focus of the inflow and infiltration study and findings are discussed in Section 4 of this report.

4.7.10 Plainfield Street Pump Station

Plainfield Street Pump Station Wet Well

The Plainfield Street pump station is a dry pit submersible station. Wastewater is conveyed 800 feet under Silver Lane through a 6-inch force main. The dry pit submersible pumps were upgraded in 1988. The pump station is equipped with two dry pit submersible pumps that are located in a below grade metal can. The metal dry well can appears to be in good condition from the inside, but the metal can thickness should be measured. The ladder is in good condition. The well is precast concrete and is in good condition except for the ladder that is corroded.

The main electrical service originates from a pad-mounted transformer located next to the pump station. The service is fed underground to a main circuit breaker inside an enclosure within the station's fenced area.

The main circuit breaker is 100A, 3-pole, 208V housed in a separate enclosure and manufactured by General Electric (GE). The main circuit breaker feeds a 120/208V, 100A, 3-pole automatic transfer switch that feeds a Pump Control Panel and a 120V, single-phase GE load center that powers the lights and receptacles for the station.

A Detroit Diesel, propane generator provides emergency power to the entire station. The generator is rated at 20KW, 25KVA, 120/208V, 3-phase, and contains a 70 amp Main Circuit Breaker. Adjacent to the service equipment is a 100 amp, 3-phase, 4-wire, 208 volt automatic transfer switch that appears to be in fair condition.

This pump station is adjacent to a natural gas line in the street, which offers an opportunity to remove the propane tank and connect to the natural gas line.

The Town recently replaced the wet well top with a new precast concrete section and aluminum hatch.

4.7.10.1 Deficiencies

- Fall protection is missing from the new wet well hatch;
- The wet well ladder is corroded; and
- The metal can dry well is susceptible to corrosion and should be evaluated.

4.7.11 High Meadow Pump Station

High Meadow Pump Station Wet Well

The High Meadow (Rye Hill) pump station is a wet pit submersible station. Wastewater is conveyed 700 feet through a 4-inch polyvinyl chloride force main by submersible pumps that have been in service since 1986. The pump station is equipped with two submersible pumps and separate precast concrete wet well and valve vaults. During the site visit the operator indicated that there are ragging issues that cause the pumps to clog. The pump control panels are located outside and are corroded.

The main electrical service is fed underground to an outdoor electrical service entrance enclosure within the fenced in pump station area. The service entrance enclosure contains a 200 amp main circuit breaker, a 120/240 volt load center, automatic transfer switch and pump controls.

The generator on site was installed in 2015 and provides emergency power to the entire station. The generator is skid mounted with a weatherproof enclosure and has a 125 amp main circuit breaker. The pressure of the underground

propane storage tank is sometimes insufficient and the generator does not run properly. Operators have also reported indicators of a fuel tank leak.

4.7.11.1 Deficiencies

The following deficiencies exist at the High Meadow Pump Station:

- Electrical Service Entrance – The enclosure has severe corrosion and is in poor condition, all electrical equipment within the enclosure is from the 1970's vintage, has outlived its service life and is in poor condition;
- Pump control panels are corroded; and
- Pumps have been in service for 29 years and have reached the end of their useful service life.

4.7.12 Brookside Pump Station

The Brookside pump station is a wet pit submersible station constructed in 1982, the pumps are original to the station. The station is equipped with two submersible pumps and a fiberglass wet well conveying wastewater 1,800 feet through a 3-inch polyvinyl chloride force main. The station is very shallow and the pumps cycle frequently. Additionally, the force main has cracked multiple times in recent history in the section of force main immediately outside of the wet well walls. The cracking may be due to settling of the wet well that has put pressure on the force main. There are major grease issues at the station and small access door over the wet well makes it difficult to clean.

Brookside Pump Station Wet Well

The propane generator was installed in 2005. The generator is fed by an underground propane storage tank. There are no issues with the generator, however, operators have reported that the propane storage tank may be leaking.

The main electrical service originates from a pole-mounted transformer located adjacent to the Pump Station. The service runs underground to a utility meter and then to a main circuit breaker mounted on a plywood backboard located within the station's fenced area. Information related to the pump station is summarized in Table 4-15

Table 4-15: Brookside Pump Station

Equipment	Design
Duty Pumps	
Number of Pumps	2
Pump Model	Flygt
Pump Design Capacity	80 GPM @ 35 FT
Year	1982
Generator	
Manufacturer	Detroit Diesel
Year	2005
Fuel	Propane
Power	20 kW

The service is rated for 100A, 120/240 volt, single phase and has a 100 amp, 3-pole main circuit breaker housed in a separate enclosure and manufactured by General Electric (GE). The main circuit breaker feeds a 120/240V, 125A, automatic transfer switch that feeds outgoing wires to the Pump Control Panel and a 120V, single-phase GE load center. The load center houses the lights and receptacle circuit breakers for the station.

A Detroit Diesel, propane generator provides emergency power to the entire station. The generator is rated at 20KW, 120/240V, single phase, and contains an 80 amp Main Circuit Breaker housed in a weatherproof enclosure.

4.7.12.1 Deficiencies

The following deficiencies exist at the Brookside Pump Station:

- The existing meter enclosure is corroded and is in poor condition;
- The Main Circuit Breaker Enclosure is corroded and is in poor condition;
- The Automatic Transfer Switch has corrosion on its cover and appears to be in poor condition;
- The Load Center has corrosion and appears in poor condition;
- The wet well is undersized and maintenance is difficult;
- Pumps have reached the end of their useful service life; and
- Force main has cracked outside the wet well.

4.7.13 West Shore Drive Pump Station

The West Side Drive pump station is a wet pit submersible station constructed in 1982. The station is equipped with two submersible pumps and a fiberglass wet well conveying wastewater approximately 150 feet through a 4-inch polyvinyl chloride force main. The station is relatively shallow but does not have the same issues as Brookside with frequent starts. There are grease issues at this station and the check valves are not working properly. Level is measured by a Hydroranger and a high level float, both of which were replaced recently.

West Shore Drive Pump Station Wet Well

The generator and controls are located outside and the propane tank is buried underground. Operators have reported indications of a fuel leak. The generator was installed in 2004 and runs well. Table 4-16 summarizes the pump station specifications.

Table 4-16: West Shore Drive Pump Station

Equipment	Design
Duty Pumps	
Number of Pumps	2
Pump Model	Myers
Pump Design Capacity	80 GPM @ 50 FT
Year	1982
Generator	
Manufacturer	Detroit Diesel
Year	2004
Fuel	Propane
Power	20 kW
ATS	None

4.7.13.1 Deficiencies

The following deficiencies exist at the West Shore Drive Pump Station:

- The existing meter enclosure is corroded and is in poor condition;
- The Automatic Transfer Switch has corrosion on its cover and appears to be in poor condition;
- The wetwell is undersized; and
- The pumps have reached the end of their useful life.

4.7.14 Windsor Court Pump Station

Windsor Court Pump Station Wet Well

The Windsor Court Pump Station is a wet pit submersible station constructed in 1992. The station is equipped with two submersible pumps and a metal can wet well conveying wastewater approximately 500 feet through a 4-inch cast iron force main. The wet well is showing signs of corrosion. The galvanized rails and lifting chains for the pumps are corroded as well as the ladder within the wet well. The operator reported that the pumps run often. The likely reason for this is the wetwell is undersized.

The main electrical service originates from a pole-mounted transformer bank located adjacent to the Pump Station. The service runs underground to a Utility meter and then to a main circuit breaker mounted on a plywood backboard located within the station's fenced area. Table 4-17 summarizes the pump station specifications.

Table 4-17: Windsor Court Pump Station

Equipment	Design
Duty Pumps	
Number of Pumps	2
Pump Model	Myers
Pump Design Capacity	80 GPM @ 50 FT
Year	1992
Generator	
Manufacturer	Detroit Diesel
Year	2002
Fuel	Natural Gas
Power	20 kW
ATS	Detroit Diesel

The service is rated for 100A, 120/208 volt, three phase, 4-wire and has a 100 amp, 3-pole main circuit breaker housed in a separate enclosure and manufactured by General Electric (GE). The main circuit breaker feeds a 240V, automatic transfer switch that feeds outgoing wires to a 100 amp, 120/240 volt, 3 phase, 4-wire Load Center. The Load Center feeds the Pump Control Panel, lights, and receptacle circuit breakers for the station.

A Detroit Diesel, propane generator provides emergency power to the entire station. The generator is rated at 20KW, 25kva, 120/208V, three phase, and contains a 90 amp Main Circuit Breaker and is housed in a weatherproof enclosure. The generator and controls are located outside. The generator was installed in 2002 and starts slow in cold weather. The generator should be evaluated by the Weld Power Generator Service Company, which the Town contracts with to troubleshoot problems.

4.7.14.1 Deficiencies

The following deficiencies exist at the Windsor Court Pump Station:

- The existing meter enclosure has corrosion and is in poor condition;
- The angle brackets that support the Plywood Backboard housing the electrical equipment are rusting and loose;
- The metal can wetwell is corroded;
- The wetwell may be undersized; and
- The wetwell hatch and generator are elevated one foot above grade within the FEMA defined 100-year flood plain, which will not meet likely future TR-16 design requirements.

4.7.14.2 Replacement Investigation

The feasibility of replacing the Windsor Court pump station with a gravity sewer line to the nearest manhole in the Grape Brook pump station service area was investigated. After reviewing the site conditions and requirements, installing a gravity sewer line between the existing Windsor Court pump station service area and the Grape Brook pump station service area (a distance of approximately 530 feet) is not feasible. Due to a dip in topography between the start and end manholes, a straight gravity run of pipe cannot be installed and maintain the minimum four feet of cover required to remain below the frost line. Therefore, an inverted siphon would have to be installed in order to maintain adequate cover. However, two conditions preclude the use of a siphon in this design:

1. Scouring velocity will not be met – The Windsor Court pump station service area includes approximately 111 bedrooms total. Using the Connecticut DPH standard[9] of 150 gpd/bedroom results in a peak design flow of 16,650 gpd. Assuming the minimum design pipe diameter of 8 inches for a single barreled siphon, the peak design velocity in the siphon would be 0.074 ft/s, a value much less than the minimum required scouring velocity of 3 ft/s for preventing solids deposition in the pipe. Pipes down to one inch in diameter would not provide adequate scouring velocity either.
2. Inadequate hydraulic head exists between the start and end manholes – The vertical difference between the start and end manhole inverts is approximately 0.15 feet. The required head to overcome entrance, exit and frictional losses in the pipe is approximately 3 feet at minimum scouring velocity.

4.7.15 Enfield Terrace Pump Station

The Enfield Terrace pump station is a suction lift packaged station constructed in 2004. The station is equipped with two suction-lift pumps and conveys wastewater approximately 700 feet through a 4-inch cast iron force main. The pumps are located inside an unheated above ground enclosure and are beginning to shows signs of wear. Access to the station is difficult, as operators must drive on the lawn to get near the pump station. This causes ruts to be formed in the grass.

Enfield Terrace Pump Station Wet Well

[9] Connecticut Public Health Code – "On-site Sewage Disposal Regulations, and Technical Standards for Subsurface Sewage Disposal Systems", January 2011.

The generator was installed in 2005. It is fed by an aboveground propane tank. The generator runs well.

4.7.15.1 Deficiencies

The following deficiencies exist at the Enfield Terrace Pump Station:

- The pumps may need to be rebuilt in the near future and the parts are available as a package from the manufacturer;
- The pump station is in need of an access driveway; and
- The pump enclosure is not insulation and lacks heat.

4.7.16 Simon Road Pump Station

The Simon Road pump station was constructed in 1978. The pump station is located off of Simon Road and is surrounded by conservation land. The pump station conveys wastewater approximately 4,600 feet through a 14-inch ductile iron force main.

The pump station is a brick and concrete structure with a wet well and dry well configuration. Dual wet wells are located on the east side of the building while the dry well is located on the west side of the building. A diesel generator on the ground floor supplies emergency power. Also at the ground level is a bathroom, HVAC equipment, MCC and the instrumentation controls. The pump motors are located one level below grade. The bottom level houses the pumps, valving, and piping. The east side of the building has two levels above the dual wet wells; the lower level which contains an influent channel equipped with a comminutor.

A 10" asbestos cement sewer main flows down the access road and takes two 90-degree bends and switches to 10" ductile iron before it enters the station. Flow also enters the station through a triple siphon; two barrels are 12" ductile iron and one barrel is 8' ductile iron. The triple siphon enters the inverted siphon chamber and exits as a 24" cast iron main. From here, it meets flow from the 10' ductile iron pipe in a manhole and enters the wet well through a 24" ductile iron line.

Simon Road Pump Station Pump in Dry Well

The bottom floor of the dry well has extra space for a third pump, there is currently a blind flange on the header. At this time, the third pump is not needed. The two operating pumps are leaking and need to be replaced. The columns next to the pumps are showing signs of corrosion from the pump leaks. The columns need to be repainted. A new burner was installed in the boiler in 2013. The roof hatch is leaking and needs to be replaced. Table 4-18 summarizes the pump station specifications.

The main electrical service originates from a pad-mounted utility transformer adjacent to the pump station. The service is fed underground to a 480V, 3-pole main circuit breaker enclosed in a Sylvania motor control center (MCC). The MCC is in fair condition with no apparent rusting of the enclosure, the MCC feeds the pumps in the station along with a 100A, 120/208 volt, 3-phase panelboard that powers lights, receptacles and various loads for the station and has various spare buckets available.

A 155KW, 193.75KVA, 480V diesel fueled CAT generator provides emergency power to the entire station. The generator is from the 1980's vintage, is skid mounted with an adjacent day tank, which pumps fuel from an adjacent diesel fuel tank. The main circuit breaker on the generator feeds an Automatic Transfer Switch located inside the MCC.

The generator is original to the pump station. It has been rebuilt and runs when needed but is at the end of its useful life. The generator is serviced by Weld Power, Generator Service Company. The automatic transfer switch is not working well and needs replacement. The MCC is original to the pump station and it is becoming difficult to find spare parts. We recommend replacement of the MCC.

4.7.16.1 Deficiencies

The following deficiencies exist at the Simon Road Pump Station:

- Motor Control Center – The Sylvania MCC is from the 1980's vintage, replacement parts may have a long lead-time in the event of failures in the bucket motor starters or circuit breakers;
- The generator is original to the pump station and is at the end of its useful life;
- Working Clearance for the Panelboard and Transformer– There is inadequate National Electrical Code working clearances between the existing panelboard and transformer located behind the Sylvania MCC;
- The pumps are original to the station and have reached the end of their useful life;
- There is a leaking roof hatch; and
- Working Clearance for the Panelboard and Transformer – There is inadequate National Electrical Code working clearances between the existing panelboard and transformer located behind the Sylvania MCC.

Table 4-18: Simon Road Pump Station Specifications

Equipment	Design
Inlet Pipe Diameter	24-inch
Force Main Diameter	16-inch
Wet Well Dimensions	20.5' x 13.0' x 11.5', 12.0' x 13.0' x 16.5' with sloped floors
Total Wet Well Volume	
Duty Pumps	
Number of Pumps	2
Pump Model	Aurora
Pump Design Capacity	800 GPM @ 77 FEET
Year	1978
Pump Motor	40HP
Generator	
Manufacturer	Caterpillar
Year	1978
Fuel	Diesel
Power	155 kW

4.7.17 Sparkle Street Pump Station

Sparkle Street Pump Station

The Sparkle Street pump station serves approximately 70 homes located on Sparkle Street, Diamond Drive, Luster Lane, Gem Grove, Campsite Road, and Crystal Corners. The station was constructed in 1970 and includes two pneumatic ejectors that are capable of transporting approximately 125 gpm. Most of the equipment and electrical controls are original to the station, and operators reported having several issues with the controls and compressors. The ejector is pressurized between 500 and 800 times each day, which is an indication that it is undersized.

The two pneumatic ejectors were installed in 1973. The ejector type station is an antiquated technology. A 20 kW natural gas fueled generator, installed in 2002 provides backup power. The dry well and sewage pot ejectors are located in an underground steel "can" type structure. The generator and controls are outside. The pump station specifications are summarized in Table 4-19.

The main electrical service enters the pump station underground from a wooden riser pole and terminates at a main circuit breaker. The main circuit breaker was originally installed in 1973 and was manufactured by General Electric. The main circuit breaker feeds a 277/480 volt, 100 amp, 3 pole ATS which then feeds into a sheet metal wireway which has several splices or taps.

Table 4-19: Sparkle Street Pump Station

Equipment	Design
Inlet Pipe Diameter	8-inch
Force Main Diameter	6-inch
Dry Well Diameter	8 FT
Pneumatic Ejectors	
Number of Pneumatic Ejectors	2
Ejector Design Capacity	125 GPM @ 50 FT TDH
Sewage Pot Volume	140 GAL
Sewage Pot Working Pressure	100 psi
Year	1973
Air Compressors	
Model	QR-25 Series Model 270
Year	1973
Motor	5 HP
Generator	
Manufacturer	Onan
Year	2002
Fuel	Natural Gas
Power	20 kW

The taps off the main service wires include the following:

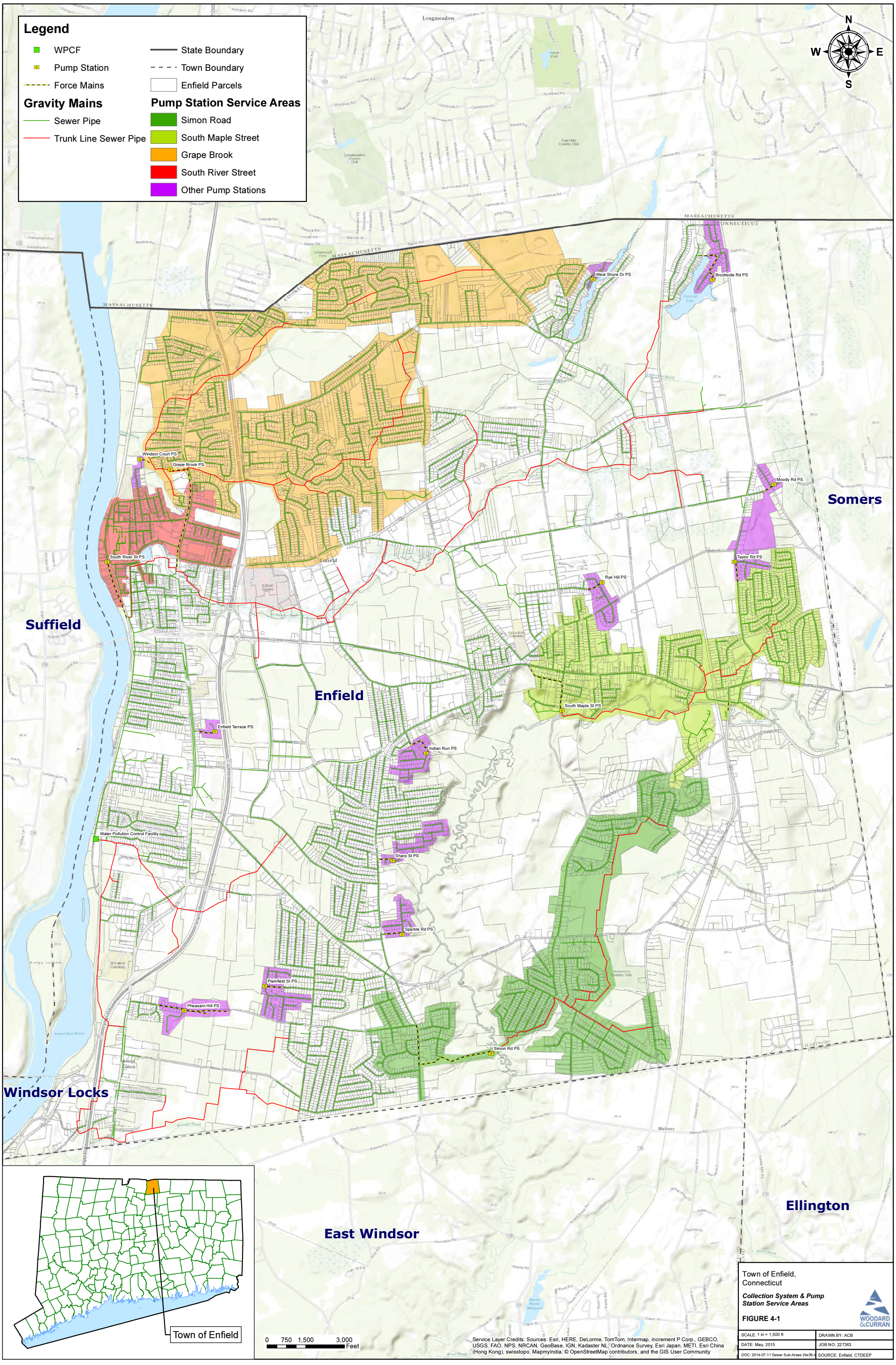
- A Feeder to the Pump Control Panel;
- A Feeder to a 50 amp disconnect switch for the Ejector Pump; and
- A Feeder to a small transformer, which serves a 120/240 volt load center for general receptacles and lighting in the pump station.

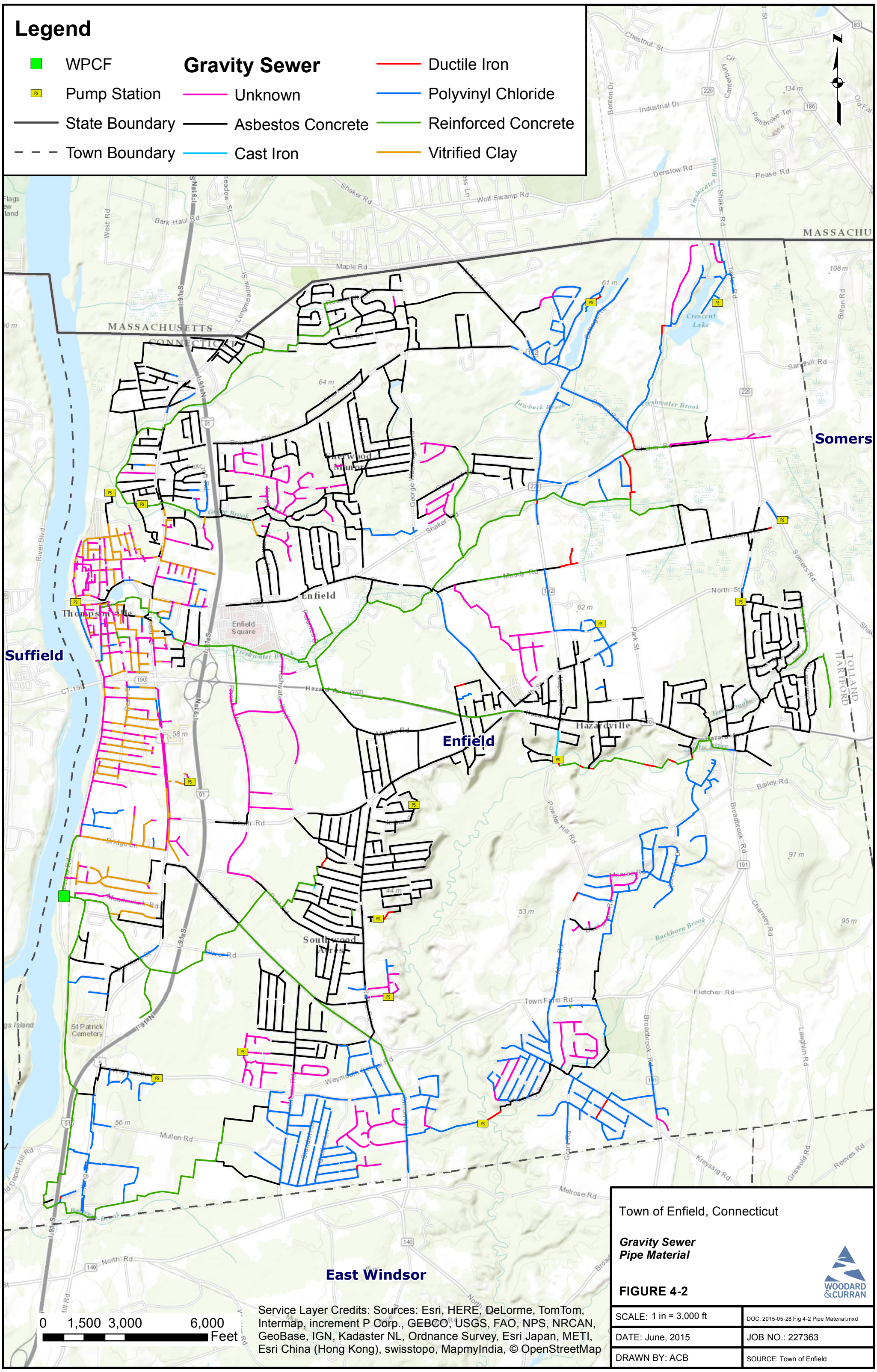
The existing Onan natural gas generator serves the entire pump station and is located outside. The generator is rated at 20kw and contains a Main Circuit Breaker. The generator was installed in the early 2000's along with the automatic transfer switch and appears to be in good working condition.

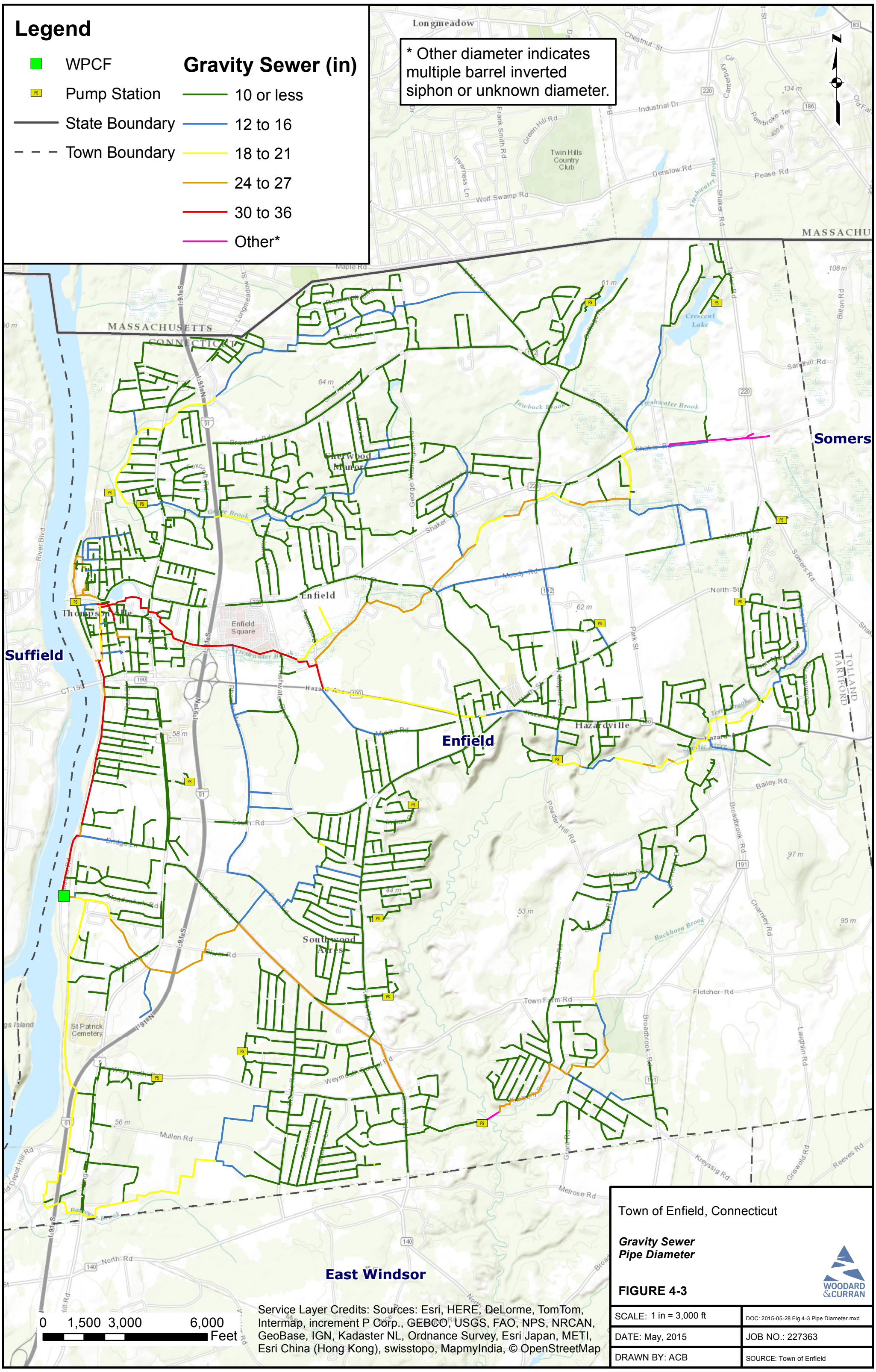
4.7.17.1 Deficiencies

The following deficiencies exist at the Sparkle Street Pump Station:

- Pneumatic Ejectors – The ejectors have surpassed their useful design life, are undersized, and are not as reliable as submersible pumps. The controls are located in the dry pit, which reaches very high temperatures during summer due to compressor operation; and
- The station is undersized.


Legend
WPCF
Pump Station
Force Mains
Gravity Mains
Sewer Pipe
Trunk Line Sewer Pipe
State Boundary
Town Boundary
Enfield Parcels
Pump Station Service Areas
Simon Road
South Maple Street
Grape Brook
South River Street
Other Pump Stations
N
W
E
S
Suffield
Enfield
Somers
Windsor Locks
East Windsor
Ellington
West Shore Dr PS
Brookside Rd PS
Windsor Court PS
Grape Brook PS
South River St PS
Moody Rd PS
Taylor Rd PS
Rye Hill PS
South Maple St PS
Enfield Terrace PS
Indian Run PS
Water Pollution Control Facility
Sharp St PS
Sparkle Rd PS
Plainfield St PS
Pheasant Hill PS
Simon Rd PS
Town of Enfield
0 750 1,500 3,000 Feet
Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Town of Enfield, Connecticut
Collection System & Pump Station Service Areas
FIGURE 4-1
WOODARD & CURRAN
SCALE: 1 in = 1,500 ft
DRAWN BY: ACB
DATE: May, 2015
JOB NO: 227363
DOC: 2014-07-11 Sewer Sub-Areas 24x36.m
SOURCE: Enfield, CTDEEP


Legend
WPCF
Pump Station
State Boundary
Town Boundary
Gravity Sewer
Unknown
Asbestos Concrete
Cast Iron
Ductile Iron
Polyvinyl Chloride
Reinforced Concrete
Vitrified Clay
Suffield
Enfield
Somers
East Windsor
MASSACHUSETTS
CONNECTICUT
Thompsonville
Hazardville
Southwood Acres
Enfield Square
Crescent Lake
Freshwater Brook
Shaker Rd
Hazard Ave
Somers Rd
Bailey Rd
Broadbrook Rd
Melrose Rd
Mullen Rd
Weymouth School Rd
Town Farm Rd
Fletcher Rd
North Rd
Powder Hill Rd
Buckhorn Brook
St Patrick Cemetery
0 1,500 3,000 6,000 Feet
Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap
Town of Enfield, Connecticut
Gravity Sewer
Pipe Material
FIGURE 4-2
WOODARD &CURRAN
SCALE: 1 in = 3,000 ft
DOC: 2015-05-28 Fig 4-2 Pipe Material.mxd
DATE: June, 2015
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Town of Enfield



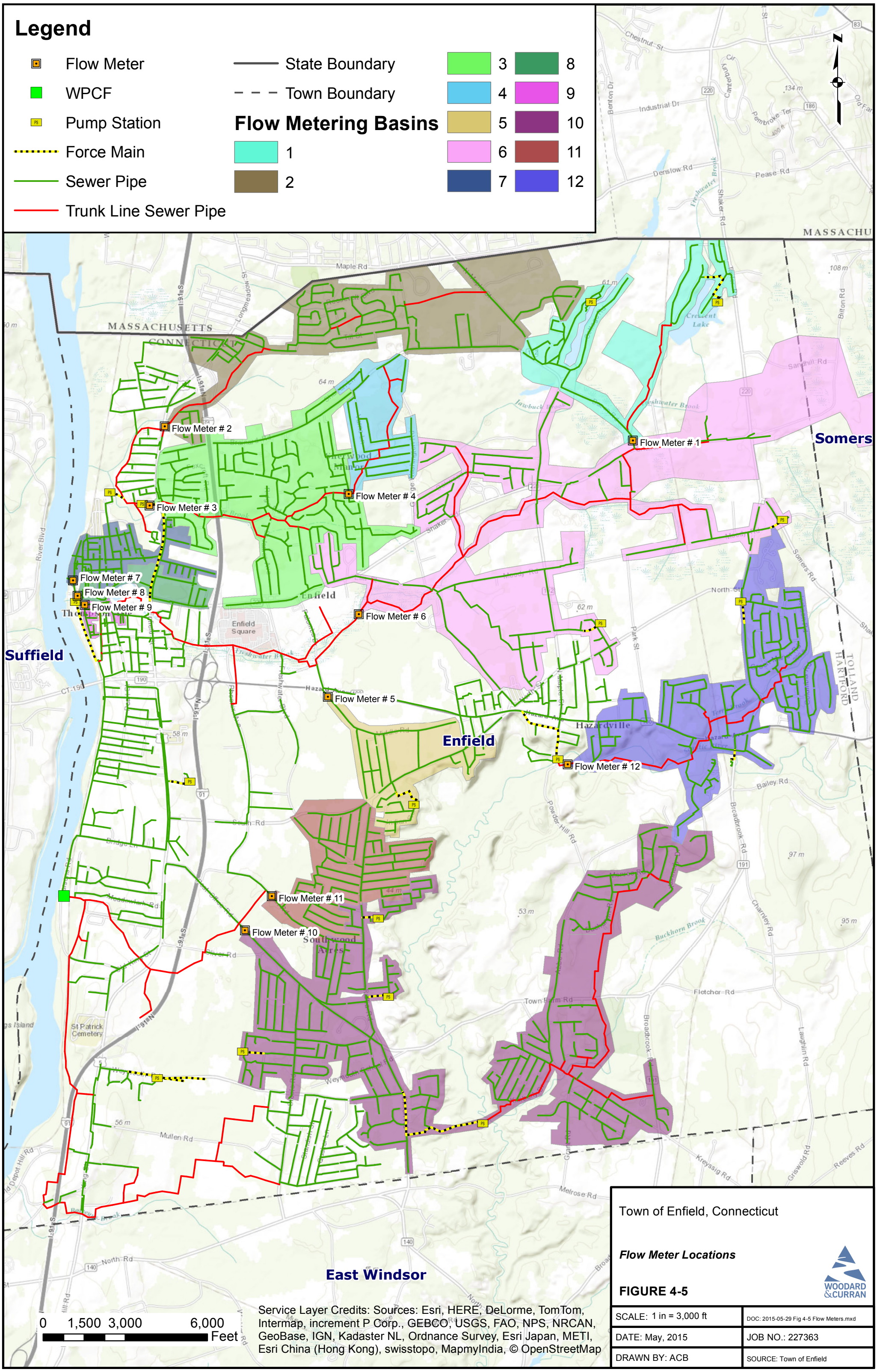
Town of Enfield, Connecticut

Gravity Sewer Pipe Diameter

FIGURE 4-3

WOODARD & CURRAN

SCALE: 1 in = 3,000 ft	DOC: 2015-05-28 Fig 4-3 Pipe Diameter.mxd
DATE: May, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield



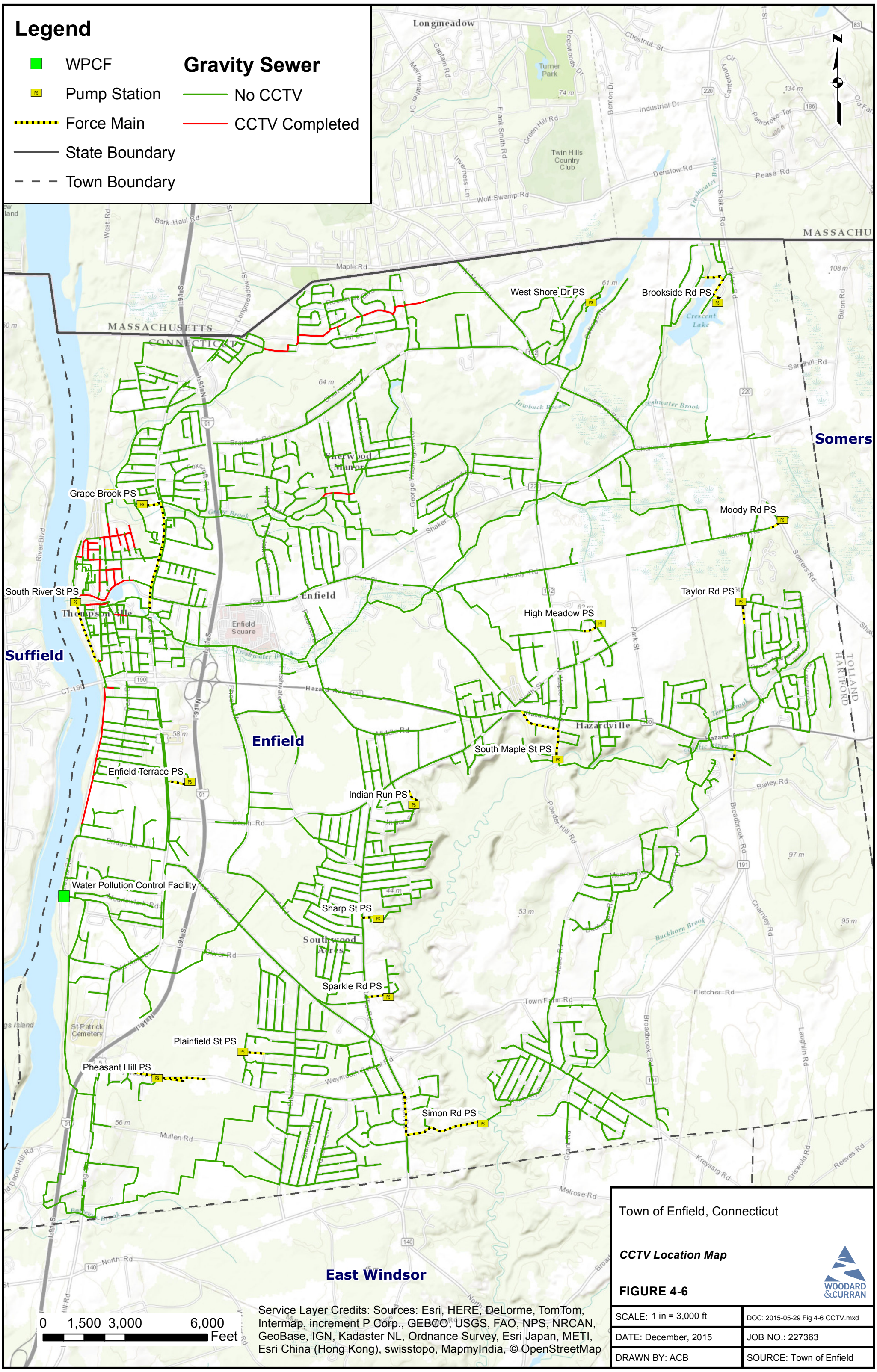
Town of Enfield, Connecticut

Flow Meter Locations

FIGURE 4-5

WOODARD & CURRAN

SCALE: 1 in = 3,000 ft	DOC: 2015-05-29 Fig 4-5 Flow Meters.mxd
DATE: May, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield



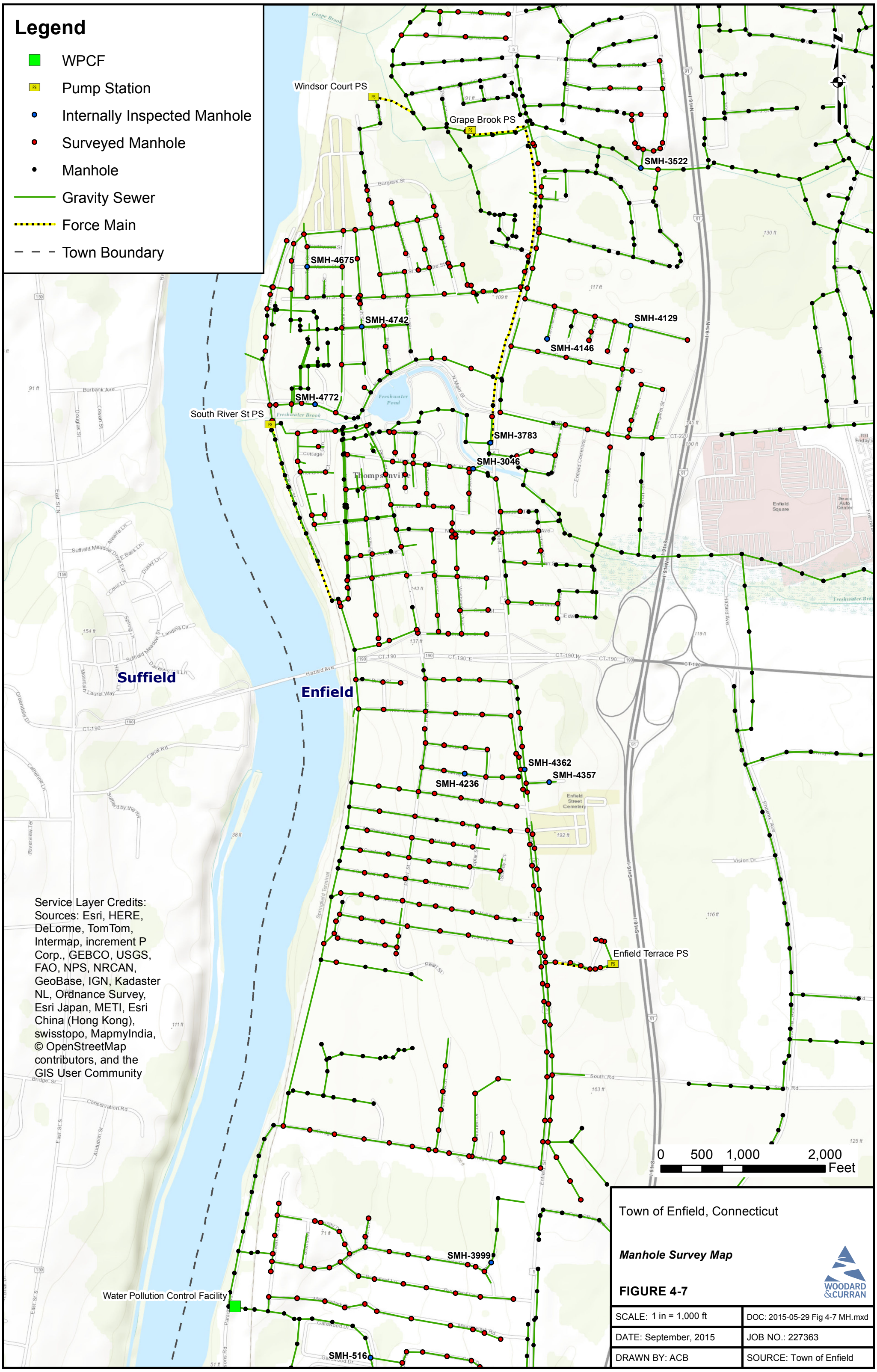
Town of Enfield, Connecticut

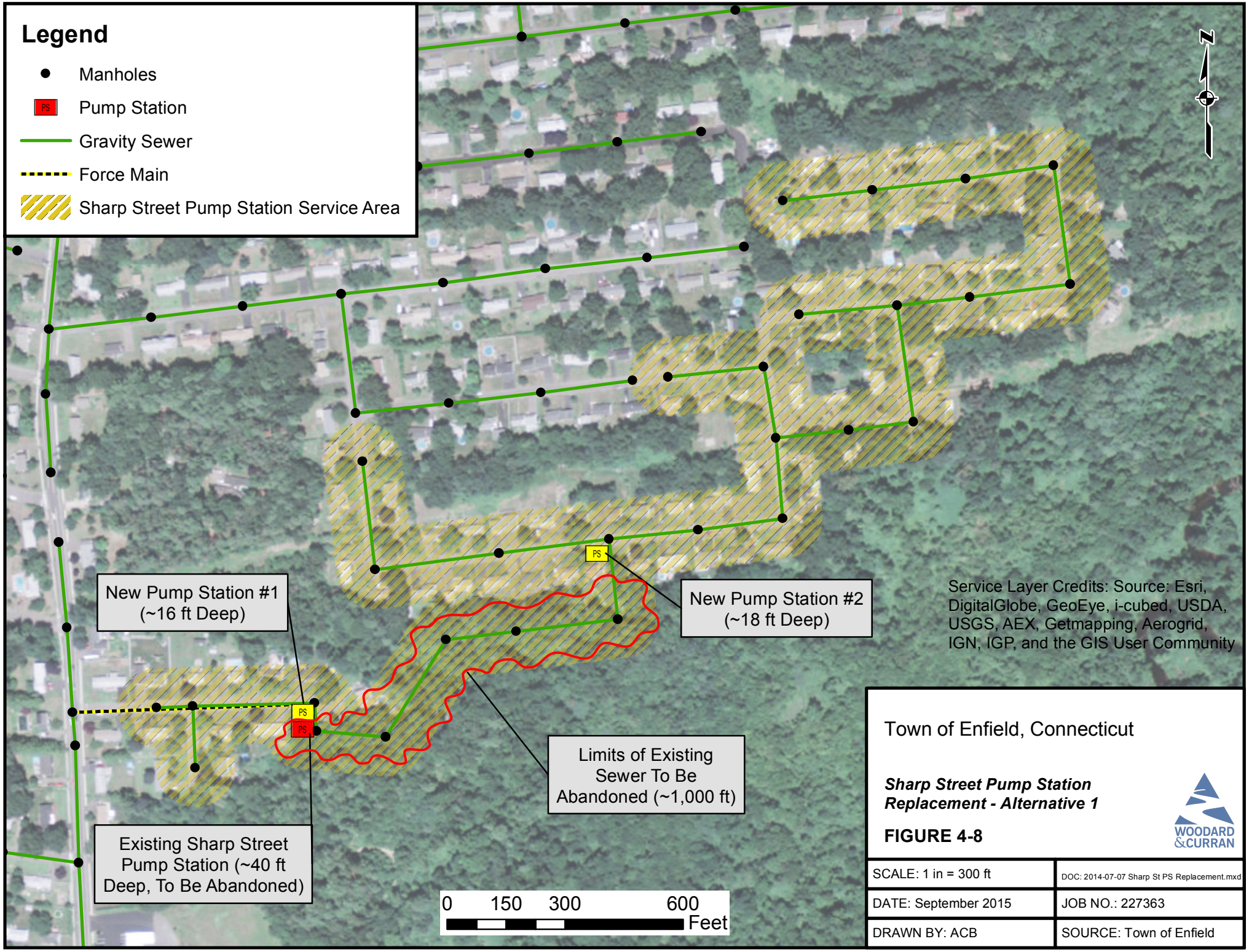
CCTV Location Map

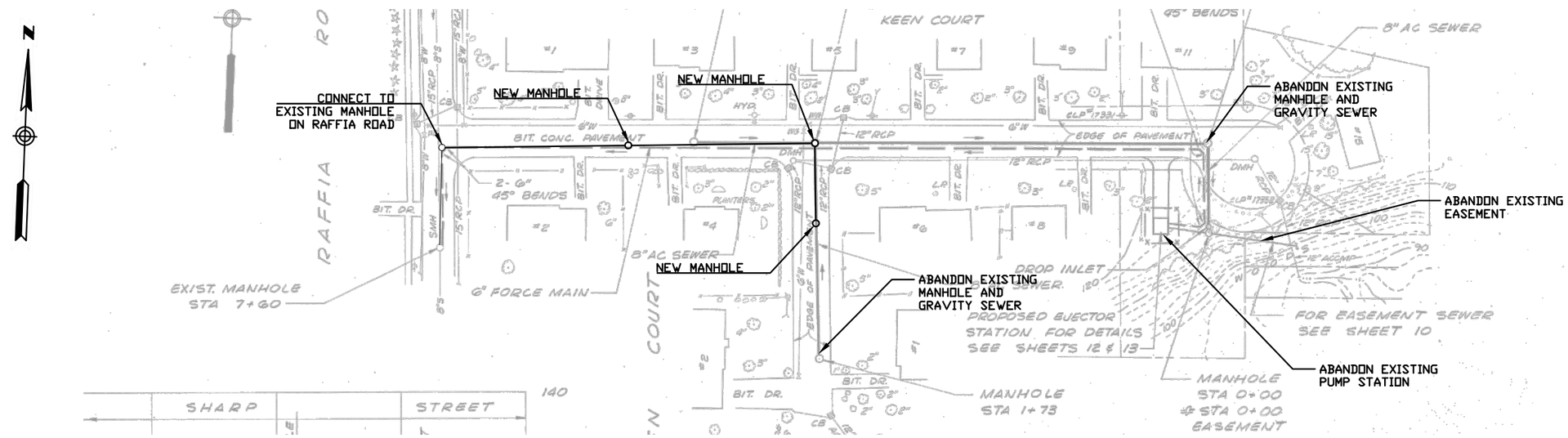
FIGURE 4-6

WOODARD &CURRAN

SCALE: 1 in = 3,000 ft	DOC: 2015-05-29 Fig 4-6 CCTV.mxd
DATE: December, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield


Legend
WPCF
Pump Station
Internally Inspected Manhole
Surveyed Manhole
Manhole
Gravity Sewer
Force Main
Town Boundary
Windsor Court PS
Grape Brook PS
South River St PS
Enfield Terrace PS
Water Pollution Control Facility
SMH-3522
SMH-4675
SMH-4742
SMH-4129
SMH-4146
SMH-4772
SMH-3783
SMH-3046
SMH-4362
SMH-4357
SMH-4236
SMH-3999
SMH-516
Suffield
Enfield
Thompsonville
Freshwater Pond
Freshwater Brook
Enfield Square
Enfield Street Cemetery
Springfield Terminal
Hazard Ave
CT-190
I-91 N
I-91 S
Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
0 500 1,000 2,000
Feet
Town of Enfield, Connecticut
Manhole Survey Map
FIGURE 4-7
WOODARD &CURRAN
SCALE: 1 in = 1,000 ft
DOC: 2015-05-29 Fig 4-7 MH.mxd
DATE: September, 2015
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Town of Enfield

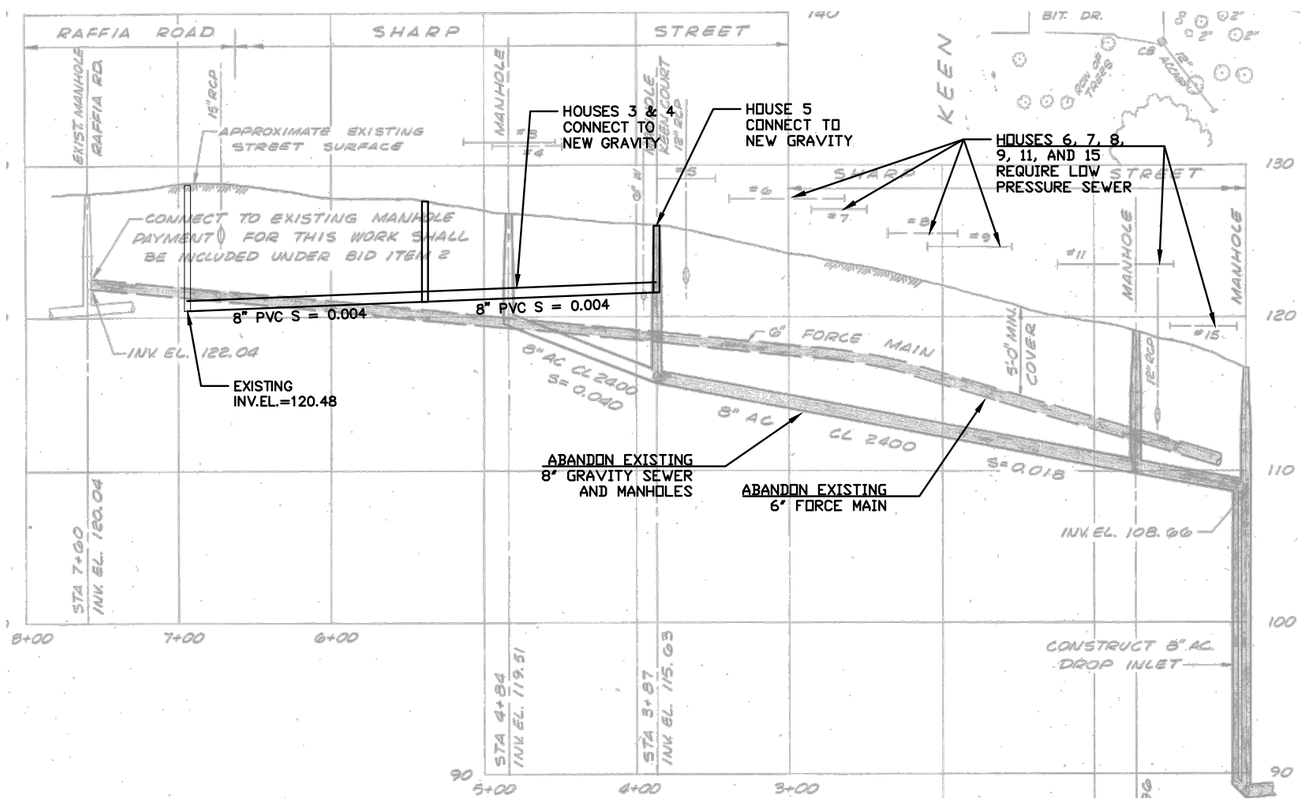

Legend
Manholes
Pump Station
Gravity Sewer
Force Main
Sharp Street Pump Station Service Area
N
New Pump Station #1 (~16 ft Deep)
New Pump Station #2 (~18 ft Deep)
Existing Sharp Street Pump Station (~40 ft Deep, To Be Abandoned)
Limits of Existing Sewer To Be Abandoned (~1,000 ft)
PS
0 150 300 600 Feet
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community
Town of Enfield, Connecticut
Sharp Street Pump Station Replacement - Alternative 1
FIGURE 4-8
WOODARD &CURRAN
SCALE: 1 in = 300 ft
DOC: 2014-07-07 Sharp St PS Replacement.mxd
DATE: September 2015
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Town of Enfield



SHARP STREET PLAN

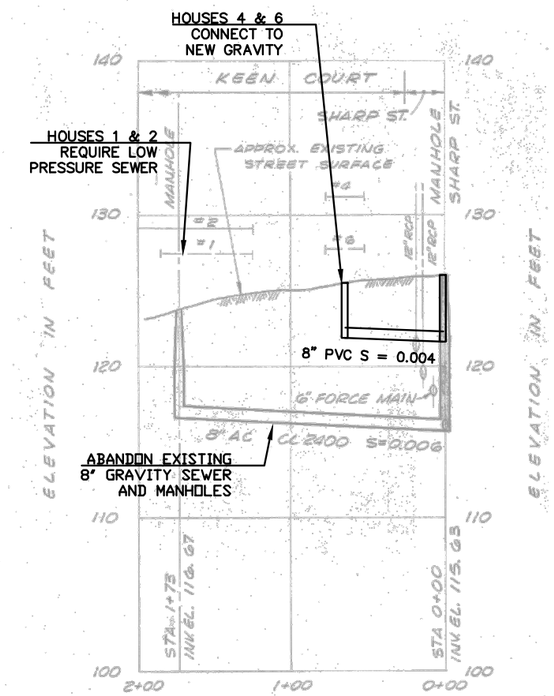
SCALE: 1" = 100'

NOTE: ALL SERVICE CONNECTION ELEVATIONS TO BE VERIFIED TO ENSURE CONNECTIVITY IS FEASIBLE. REMAINING EXISTING SHARP STREET PUMP STATION SERVICE AREA ASSUMED TO BE SERVED BY A NEW PUMP STATION TO BE CONSTRUCTED ON CLEAR STREET.



SHARP STREET PROFILE

SCALE: HOR. 1" = 100'
VER. 1" = 10'



KEEN COURT PROFILE

SCALE: HOR. 1" = 100'
VER. 1" = 10'

1699 King Street, Suite 406
Enfield, Connecticut 06082
855.347.6788 | www.woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN

ALTERNATIVE 2
NEW GRAVITY SEWER AND NEW PUMP STATION

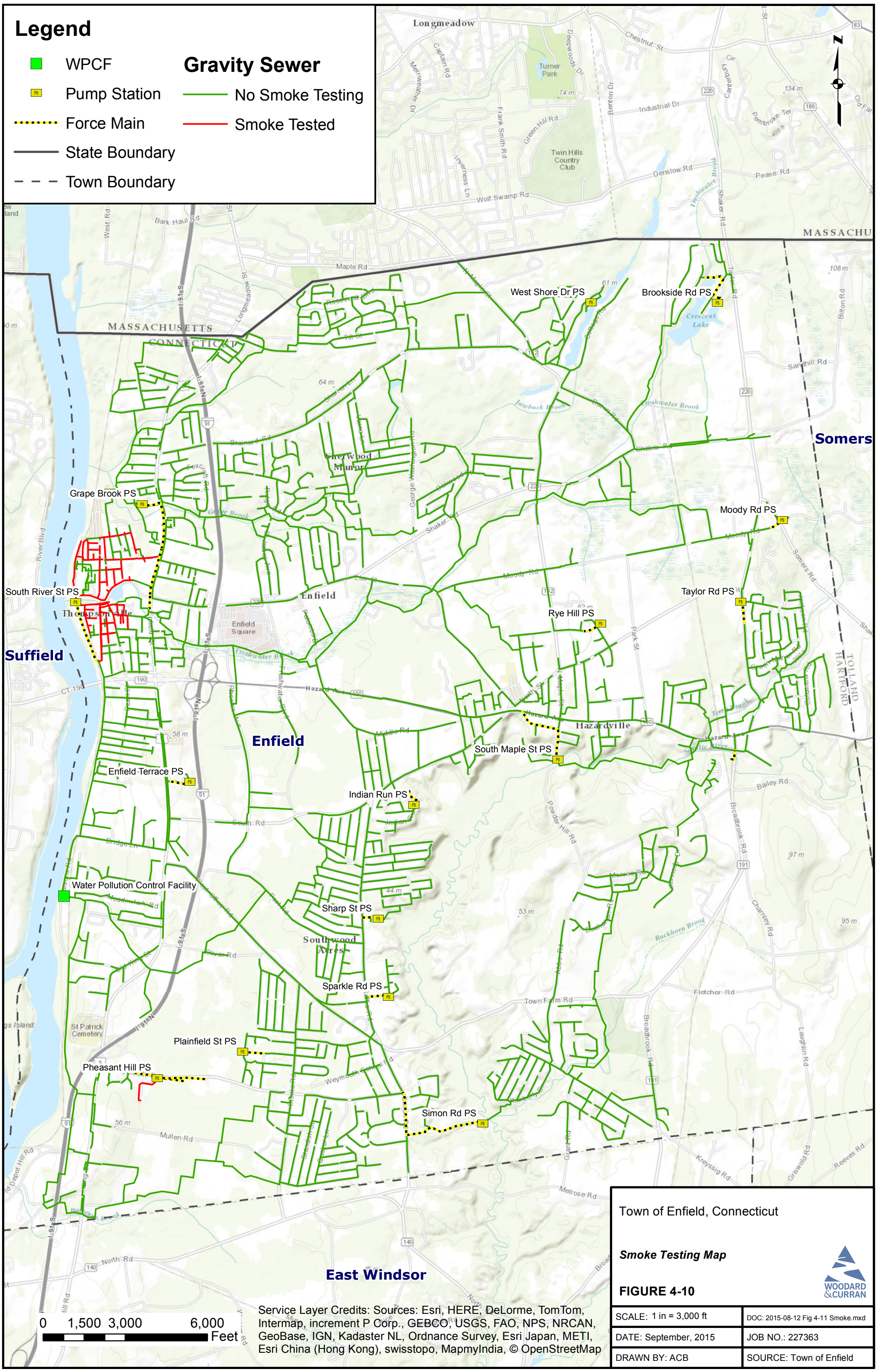
DESIGNED BY: ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.10 SHARP GRAVIT*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
SHARP STREET PUMP STATION
REPLACEMENT INVESTIGATION

JOB NO: 227363
DATE: MARCH 2015
SCALE: AS NOTED

FIGURE 4-9



Town of Enfield, Connecticut

Smoke Testing Map

FIGURE 4-10

WOODARD &CURRAN

SCALE: 1 in = 3,000 ft	DOC: 2015-08-12 Fig 4-11 Smoke.mxd
DATE: September, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield

Legend

- Manholes
- Pump Station
- Force Mains

Gravity Mains

- Not Smoke Tested
- Smoke Tested

Parcels with Confirmed Inflow Sources

- Parcels
- Roof Leaders
- Storm Drain
- Other
- Roof Leaders/Other
- Storm Drain/Other

Note: Other indicates positive inflow sources including foundation cracks, sidewalk cracks, or holes in the ground.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

Town of Enfield, Connecticut

Smoke Testing Confirmed Inflow Source Locations

FIGURE 4-11

WOODARD & CURRAN

SCALE: 1 in = 400 ft	DOC: 2015-08-28 Fig 4-12 Smoke.mxd
DATE: September 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield

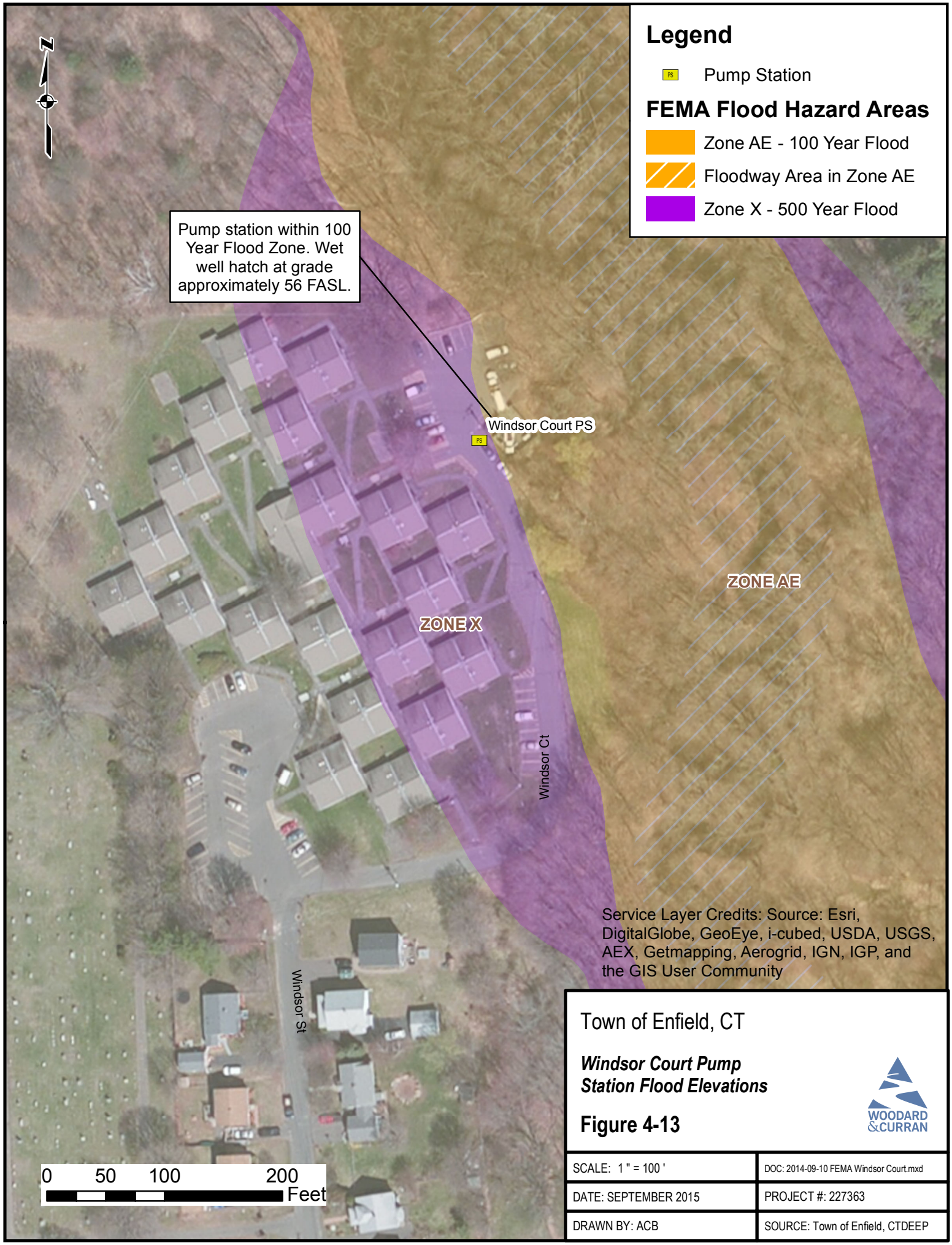
Town of Enfield, CT

South Maple Street Pump Station Flood Elevations

Figure 4-12

WOODARD & CURRAN

SCALE: 1 " = 100 '	DOC: 2014-09-10 FEMA South Maple.mxd
DATE: SEPTEMBER 2015	PROJECT #: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield, CTDEEP



Town of Enfield, CT

Windsor Court Pump Station Flood Elevations

Figure 4-13

WOODARD & CURRAN

SCALE: 1 " = 100 '	DOC: 2014-09-10 FEMA Windsor Court.mxd
DATE: SEPTEMBER 2015	PROJECT #: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield, CTDEEP

5. WATER POLLUTION CONTROL FACILITY

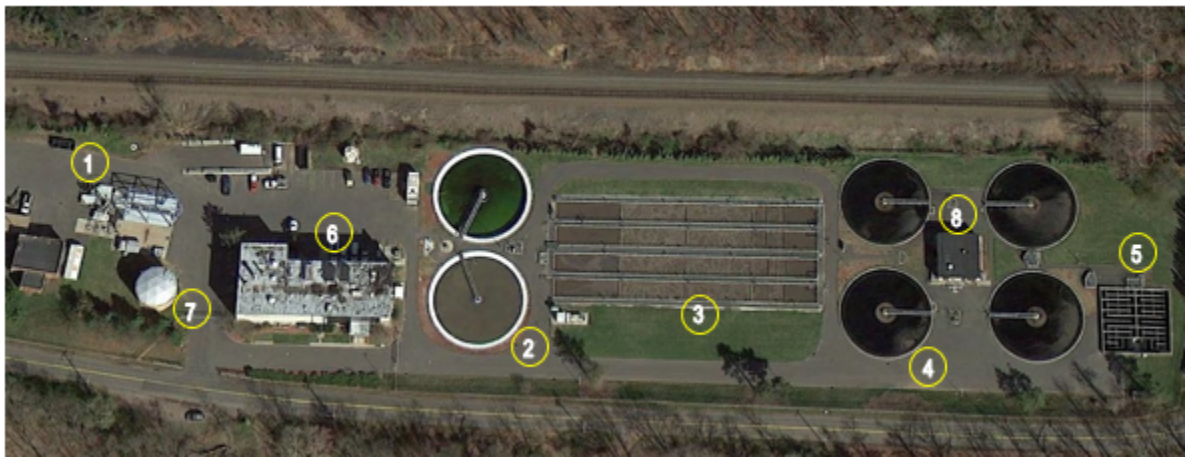
5.1 EVALUATION OF EXISTING WPCF AND CAPACITY ANALYSIS

The existing WPCF was reviewed to provide a basis for the evaluation of treatment alternatives. A description of the existing treatment systems, including their mechanical condition, design criteria, and operational status is provided in this section.

5.1.1 Overview

The Enfield WPCF was originally constructed as a primary treatment facility in 1938. The facility received a major upgrade in 1972 when it was converted to secondary treatment to meet Clean Water Act Requirements. The sludge processing system was upgraded in 1996 to include: (1) two belt filter presses for sludge dewatering, (2) a sludge storage tank adjacent to the headworks, and (3) an odor control equipment inside the Operations Building to treat odorous air generated in the belt filter press room. In 2004, an interim nitrogen removal retrofit was completed when the aeration tanks were reconfigured using wooden baffles and equipment was added in the existing aeration tanks to convert to the four stage Bardenpho process. Other minor improvements have occurred over the years, but the majority of the equipment at the plant has been in service for over 40 years and has surpassed its intended design life.

Figure 5-1: Enfield WPCF Aerial View



1- Preliminary Treatment
2- Primary Clarifiers
3- Aeration Tanks
4- Secondary Clarifiers
5- Chlorine Contact Tanks
6- Operations Building
7- Sludge Storage Tank
8- Sludge Pumping Station

The WPCF treats all wastewater flow from the Enfield sanitary collection system. The collected wastewater is treated at the Enfield WPCF and is discharged to the Connecticut River. According to the existing O&M Manual, the WPCF was designed to serve a population of 66,500 resulting in an average daily flow of 10 mgd. The WPCF includes preliminary treatment consisting of a mechanical screen, comminutor, and grit removal; primary treatment consisting of two primary clarifiers; secondary treatment that includes four aeration tanks and four secondary clarifiers; disinfection with sodium hypochlorite; sludge processing consisting of two belt filter presses and polymer feed equipment; and an odor control system. An aerial view of the major components of the WPCF is shown in Figure 5-1.

The existing unit processes and systems were evaluated to determine both hydraulic and process capacities for each of the unit processes in the liquid treatment systems. The solids treatment systems were also evaluated to determine the impact on the liquid treatment capacity. A WPCF flow schematic and hydraulic profile are shown in Figures 5-2 and 5-3, respectively. Plant design criteria for the existing WPCF are summarized in Table 5-1 and Appendix H. A

Table 5-1: Existing Plant Design Criteria

(Based on January 2010 to December 2013 Plant Data)

PROCESS / DESCRIPTION	AVERAGE DAILY	DESIGN	PEAK HOURLY
RAW WASTEWATER DATA			
TOTAL FLOW (Q), MGD	5.25	10.0	16.2
BOD CONCENTRATION, MG/L	215	216	
BOD LOADING, LBS/D	9,414	18,014	
TSS CONC, MG/L	196	197	
TSS LOADING, LBS/D	8,582	16,430	
TN, MG/L	32	32	
TN, LBS/D	1,401	2,669	

detailed description of each WPCF unit operation and its design method of operation is included in the following sections.

The capacity and adequacy of the various systems and unit processes, based on current design standards, have been computed and evaluated and are described in the following sections. These systems include influent screening, grit removal, primary clarifiers, aeration basins, blowers, mixers, internal recycle pumps, secondary clarifiers, chlorine contact tanks, Return Activated Sludge (RAS) pumps, Waste Activated Sludge (WAS) pump, and the belt filter presses. Capacities for each unit process are estimated based on all units being in service, while pumping capacities are based on the largest unit being out of service. Appendix I includes a summary of the capacity for each of these processes.

5.1.2 Preliminary Treatment

The raw wastewater enters the WPCF through a 36-inch main trunk sewer servicing the north section of Enfield and a 30-inch trunk sewer from the south section of the Town at the headworks structure. This structure includes a mechanical coarse bar screen to remove materials from the wastewater that enters through the 36-inch pipe and used to include a comminutor for the wastewater that enters through the 30-inch pipe. The comminutor failed in 2015 and was removed by plant personnel. The screen is located outside and is not protected from the weather. The raw screenings from the bar screen are discharged into a dumpster.

Headworks Structure

The Headworks influent channels were covered with fiberglass panels in an attempt to reduce odors. One panel was removed at the north end to observe the condition of the concrete. The concrete above the water appeared to be in generally good condition, which was verified by scraping with a steel rod in the area of access. Visual inspection from the north end showed the exposed concrete throughout appeared to be in good condition; it does not appear that any concrete repairs and/or application of a protective coating are needed.

Wastewater from the headworks structure flows into one of two covered aerated grit chambers that are also located outside. The two grit chambers are rectangular tanks of the dimensions shown in Table 5-2, with a total volume of approximately 66,600 gallons. The tank bottoms are sloped to facilitate collection and removal of the grit. The bottoms of the hoppers contain 30-pound steel rails that were designed to protect the concrete from being damaged by the cleaning bucket.

The grit chambers include air piping and diffusers that were designed to keep the organic material in suspension as wastewater travels through the tanks. Air is supplied by the main aeration blowers located in the basement of the Operations Building. The operation of these blowers is discussed in the secondary treatment section of this report. Air is delivered to the grit chamber through a 6-inch supply header. Four 3-inch swing-type, knee-jointed, vertical-drop pipes tee into the supply header and have a lower horizontal diffusion header mounted at the bottom of each, with a row of non-clog coarse bubble diffusers on the upper side. The entire assembly is designed to swing out of the chamber through the use of a portable hoist, to permit maintenance of the assembly.

When the plant was originally constructed, grit was removed from the grit hoppers by a perforated clamshell bucket that was operated from an electric trolley and hoist mounted on a monorail located over each hopper. This clamshell is no longer operational, and operators currently remove grit from the tanks using an excavator. Table 5-2 includes the design criteria for the headworks structure and the grit chamber.

Table 5-2: Existing Preliminary Treatment Equipment Design Data

Equipment	Design
Mechanical Bar Screen	
Number of units	1
Manufacturer	IDI – Infilco Degremont
Model	CS Model I
Maximum flow rate (MGD)	20
Screen angle of incline (Degrees)	80
Channel dimensions	3’-0”W, 3’-0” SWD
Bar rack spacing	¾"
Bar rack Height	6’-8”
Maximum water level	6’-0”
Head loss through screen @ 30% blocked (in.)	2.82
Motor Horsepower (hp)	2
Power (Voltage / Phase / Frequency)	240-480 / 3 / 60
Year Installed	1996
Comminutor	
Number of units	1
Manufacturer	Smith & Loveless
Maximum flow rate (GPM)	900
Motor Horsepower (hp)	3
Power (Voltage / Phase / Frequency/ Amps)	240-480 / 3 / 60 / 8.8-4.4
Year Installed	1972

Equipment	Design
Aerated Grit Chamber	
Number of Chambers	2
Dimensions	40.0' L x 12.5' W x 8.9' DAH[1]
Unit Volume (Gallons)	33,000
Aeration system	Non-clog coarse bubble diffusers
Air supply range, cfm/lf	3 to 6
Detention Time[2]	3.0 minutes @ 16.2 MGD
Year Installed	1972

1. Depth Above Hopper
2. One unit in service

Primary Clarifiers

The primary clarifiers are 85 feet in diameter with sidewall water depth of 12 feet. Overflow rates and detention times are as indicated in Table 5-3. Each clarifier is a center feed style and the liquid flows radially toward the outside of the tank. Clarified effluent flows over a V-notch weir plate at the periphery of the tank. The effluent then discharges to a launder around the outside of the each tank and is conveyed to a distribution box that is referred to as Structure No.3.

The primary sludge is moved down the sloped bottom towards the center of the tank by means of scraper blades mounted on two rotating rake arms. Sludge is withdrawn from the hopper through a 10-inch line by the primary sludge pumps located in the basement of the Operations Building.

A revolving skimmer arm removes scum from the surface of each tank. Scum is discharged via a trough and connecting pipe to a scum pit located between the two tanks. Septage that is accepted separately at the WPCF is also discharged into the scum pit. Scum is withdrawn from the scum pit by the primary scum pump located in the basement of the Operations Building. A single speed mixer with two multi-bladed impellers is mounted on the top of the scum pit for use as necessary in producing a more homogenous mixture for subsequent withdrawal. Design criteria for the primary treatment equipment are shown in Table 5-3.

To minimize the release of odors at the WPCF and as part of the interim odor reduction measures implemented by the plant staff, FRP covers were installed over the primary effluent launders, grit chambers, primary clarifier distribution box (Structure No.2), and primary scum pit.

5.1.3 Secondary Treatment

Primary effluent flows from the primary settling tank launders to Structure No. 3 through short sections of 60-inch reinforced concrete pipe (RCP). Sluice gates are provided at this structure on the two primary effluent lines to allow the complete isolation of either or both tanks and to permit cleaning and complete dewatering of the launders.

The primary effluent normally flows to the aeration tanks via a 60-inch RCP. However, provisions have been made for bypassing the flow should it become hydraulically impossible to provide secondary treatment due to high river stage.

Table 5-3: Existing Primary Clarifiers Design Data

Equipment	Design
Number of units	2
Unit Diameter (ft.)	85
Side Water Depth (ft.)	12
Unit Surface Area (sf.)	5,700
Total Surface Area (sf.)	11,400
Total Volume (gal.)	1,018,600
Manufacturer	Dorr-Oliver
Detention Time[1]	2.4 hr @ 10.0 MGD
Surface Overflow Rate	880 gpd/sf @ 10.0 MGD
Total Weir Length (ft.)	534
Weir Overflow Rate (gpd/lf)	18,700

1. Detention time does not include recycle flows

The primary effluent can be diverted from Structure No. 3 to Structure No. 8 via Structures No. 9 and 10 through a 54-inch R.C.P. sewer. However, the bypass valve was sealed years ago.

The secondary treatment process at the Enfield WPCF is an activated sludge process known as the Four Stage Bardenpho Process. The Bardenpho process used at the Enfield plant is a single sludge, nitrification/denitrification process that includes a primary anoxic stage followed by an aerobic stage, followed by a secondary anoxic stage, followed by a reaeration stage. An internal recycle from the aerobic stage goes back to the primary anoxic stage. The secondary treatment system starts at the influent box (Structure No. 3), where flow is split to each of the four aeration basins, and where primary effluent is mixed with return activated sludge flow (RAS).

5.1.3.1 Aeration Tanks

Primary effluent from Structure No. 3 directs flow into any combination of the four aeration tanks. Each tank includes sluice gates to allow the flow to enter each tank at a series of different locations. The nominal dimensions and volumes of these tanks are shown in Table 5-4.

The primary effluent enters the aeration tanks main influent channel, located at the northern end of the aeration tanks, through a 60-inch R.C.P. and the main influent channel, conveys the flow to the east and west influent channels. The west influent channel controls the flow to aeration tanks 1 and 2, and the east influent channel serves aeration tanks 3 and 4.

Aeration Tanks

There are four treatment trains through the secondary process. Each train includes a primary anoxic zone, three aeration zones, a secondary anoxic zone and a reaeration zone. The wastewater flow recombines in Structure No. 4, which distributes flow to the four Secondary Clarifiers. The locations of the components of the Secondary Treatment system on the site are shown on Figures 5-1 and 5-2.

Flygt Submersible Mixer

Each primary anoxic zone is equipped with one 4 HP Flygt submersible mixer. The mixers keep solids in suspension and keep the anoxic zone contents mixed. From the primary anoxic basin, the wastewater flows to the three subsequent aeration zones through side openings into the concrete baffle walls as shown in photo. Fine bubble disc diffusers arranged in a tapered aeration pattern provide oxygen to the aeration zones. Four centrifugal blowers located in the basement of the Operations Building supply air to the aeration system, and an aeration control system manufactured by ESCOR controls the blowers and modulates butterfly valves at each aeration zone to balance air flow between the zones. Submersible propeller pumps located in each aeration tank return nitrate rich mixed liquor from the first aerated zones back to the primary anoxic zones. Mixed liquor flows to the secondary anoxic zone through side openings into the wooden baffle walls. Similar to the first anoxic zones, the secondary anoxic zones are equipped with Flygt submersible mixers. From the secondary anoxic zone, flow overflows a weir directly into the reaeration zone in the effluent channel. Air in the reaeration zone is supplied through plate diffusers from one of the four centrifugal blowers located in the Operations Building.

From the primary anoxic zones, the flow travels to the aeration zones, where the mixed liquor is aerated using ceramic diffusers. Internal recycle pumps pump flow from the end of each aerated zone back to the primary anoxic zones to provide denitrification. Mixed liquor flows from the aeration basins to the secondary anoxic zones. In the secondary anoxic zones, further denitrification takes place, utilizing any remaining carbon in the mixed liquor. Supplemental carbon in the form of Micro C, a proprietary external carbon source is added to the secondary anoxic zones to reduce total nitrogen to low levels. From the secondary anoxic zones, the mixed liquor travels to the reaeration zones (effluent channel); where fine bubble aeration purges any remaining nitrogen gas and raises the wastewater dissolved oxygen to levels acceptable for discharge to the receiving waters. The design data for the secondary treatment process is presented in the following Table 5-4.

Internal Recycle Submersible Propeller Pump

Table 5-4: Existing Secondary Treatment Process Design Criteria

Equipment	Design
Aeration Tanks	
Number of Units	4
Dimensions	24'W x 248'L x 16.1'SWD
Unit Volume (Gal. each tank)	717,000
Total Volume (Gal.)	2,868,000
BOD Loading Rate (lb BOD / 1000 ft^3.d)	32.8
Primary Anoxic Zones	
Number of Units	4
Dimensions	24'W x 61.2'L x 16.1'SWD
Unit Volume (Gal.)	177,000
Total Volume (Gal.)	708,000
Detention Time[1]	1.7 hr @ 10.0 MGD
Anoxic Zone Mixers	
Number of Units – Primary & Secondary Zones	8 (one mixer for each zone)
Type	Submersible mixer
Manufacturer	Flygt
Model	4640
Motor (hp.)	4.0
Power (volts/phase/hertz/amps)	460 / 3 / 60 / 6.7
Aerobic Zones No.1	
Number of Units	4
Dimensions	24'W x 61.2'L x 16.1'SWD
Unit Volume (Gal.)	177,000
Total Volume (Gal.)	708,000
Detention Time[1]	1.7 hr @ 10.0 MGD
Aerobic Zones No.2	
Number of Units	4
Dimensions	24'W x 61.2'L x 16.1'SWD
Unit Volume (Gal.)	177,000
Total Volume (Gal.)	708,000
Detention Time[1]	1.7 hr @ 10.0 MGD

Equipment	Design
Aerobic Zones No.3	
Number of Units	4
Dimensions	24'W x 30.2'L x 16.1'SWD
Unit Volume (Gal.)	88,000
Total Volume (Gal.)	352,000
Detention Time[1]	0.84 hr @ 10.0 MGD
Aeration System	
Type	Fine bubble ceramic disc
Manufacturer / Size	Sanitaire / 9-INCH DIA
No. of grids	12
Total Diffusers installed in all grids	5496
Diffuser submergence (ft)	15.29
Pressure at top of drop leg (psig)	6.9
Avg. SCFM per diffuser	0.94
Max SCFM per diffuser	2.42
Year Installed	2003
Aeration Blowers	
No. of units	4
Manufacturer / Type	Gardner Denver / Centrifugal
Model	1256-AD
Discharge header size	24-INCH
Unit Capacity	4500 SCFM @ 7.1 psi
Unit Capacity Range	2000 to 4500 SCFM
Motor Size (HP)	200
VFD	No
Year Installed	1972

Equipment	Design
DO Control System	
Manufacturer	ESCOR
Aeration Zone Local Control Panel (LCP)	2
Master Control Panel (MCP)	1
Year installed+	1998
DO probes	
No. of units	12
Manufacturer	ATI
Type	Galvanic Membrane
Bioprocess Control System	
Manufacturer	Myratek BIOS
Ammonium and Nitrate Analyzer	
No. of units	1
Manufacturer	Hach
Location	Secondary Anoxic Zone-Train 4
Ammonium Analyzer	
No. of units	1
Manufacturer	Hach
Location	Primary Anoxic Zone-Train 4
Supplemental Carbon System	
External Carbon Source	Micro C
Carbon Storage Tank Capacity (Gal.)	1000
Manufacturer	Convault United Concrete
Carbon Chemical Feed Pump	
Number of Units	1
Manufacturer	Milton Roy LMI
Pump Capacity (gph)	10
Maximum Pressure (psig)	80

Equipment	Design
Internal Recirculation Pump	
No. of units	4
Manufacturer	Wilo-EMU
Type	Submersible Propeller Pump
Model	RZP 50-2.58-4/16 K6
Capacity / head each unit	6,338 gpm @ 2 feet TDH
Horsepower	10
Power (volts/phase/hertz/amps)	460-230 / 3 / 60 / 10.3-45
Secondary Anoxic Zones	
Number of Units	4
Dimensions	24'W x 31'L x 16.1'SWD
Unit Volume (Gal.)	90,000
Total Volume (Gal.)	360,000
Detention Time[1]	0.86 hr @ 10.0 MGD
Re-aeration Zone (Effluent Channel)	
Number of Units	1
Dimensions	3'W x 96'L x 5.5'SWD
Unit Volume (Gal.)	12,000
Total Volume (Gal.)	12,000
Detention Time[1]	1.73 min @ 10.0 MGD

1. Detention time does not include forward and recycle flows

Carbon Addition System

During normal operation, return activated sludge from the secondary clarifiers is pumped through a 14-inch RCP to the splitter box at the northern end of the aeration tanks. Slide gates in the splitter box control the sludge flow to the aeration tanks via 10-inch lines. As an alternate method for returning sludge, a bypass and plug valve have been provided in the pipeline west of the splitter box to divert the flow around the splitter box and discharge it through a sluice gate into the main influent channel.

The aeration tank effluent is collected in an effluent channel containing a submerged 54-inch outlet pipe, which delivers the flow to Structure No. 4 ahead of the secondary clarifiers. Each aeration tank is provided with foam spray water piping along the outside walls of the east and west influent channel walls. Each tank foam spray water system is supplied from a 3-inch header pipe carrying effluent water and can be controlled by either an underground gate valve or a 3-inch gate valve inside the tank. A 1/4-inch drain hole at the bottom of the riser section of pipe in each tank is used to drain the foam spray piping when not in use, and to protect it from freezing during the winter. This foam spray system is not operational and was replaced by a PVC spray system located primarily at the top of the baffle walls.

5.1.3.2 Aeration System

The air requirements for the aeration tanks and the aerated grit chamber are supplied by four multistage centrifugal blowers with characteristics indicated in Table 5-4. The air flow delivered by these blowers is varied by modulating motorized inlet control valves that are controlled by ESCOR's aeration control system to supply the volume of air required to maintain the level of dissolved oxygen (DO) in each aeration zone set by the plant operators. Reducing the air flow through the blower reduces the amp draw of the blower and consequently reduces the power used.

Supply air to the blowers is via a 40- x 36-inch aluminum duct with the air intake through a penthouse-type, louvered hood, located on the roof. The intake hood is equipped with removable filters. In the blower room, individual supply ducts, from the supply header are connected to each blower intake.

Fine Bubble Diffusers

A manually operated splitter damper in each supply duct and a bypass duct with a manually operated louver-type damper are used to provide air to the blowers. The four blowers are connected in parallel to a 24-inch discharge header. After the discharge header, the air flows to the blowoff chamber through an underground 24-inch air main. At the blowoff chamber, a 3/4-inch drain line with a gate valve on the bottom of the air line provides a means for removing condensation in the air main. The operators do not use this drain line; instead they are using individual purge valves installed near to the airdrops at the aeration tanks to purge the system.

Multistage Centrifugal Blowers

The four blowers also provide air to the grit chambers through a 6-inch diameter air supply header. Four 3-inch diameter air lines connect the header to the fixed vertical drop pipes and the air distribution header mounted at the bottom of each grit chamber.

At the aeration tanks, the air lines are located in the channel of the center wall between the two center aeration tanks 2 and 3 and in the channels of the outside walls for the two outside tanks 1 and 4. The originally installed coarse bubble diffusers were replaced with fine bubble diffusers as part of the 2004 upgrade. The diffusers are 9" diameter ceramic disc diffusers. The header pipes are fed by a drop pipe, which is connected at the top of the air main. Each secondary treatment tank has an air main, which includes an air flow control valve and air flow meter. The ESCOR's control system is designed to modulate the air flow control valves on each tank to maintain the DO set points in each aeration zone and also to control the blower output to provide the required quantity of air to the system.

Each aeration zone includes one aeration grid. Each grid is fed by a single drop pipe and consists of a header pipe and several manifolds, each supporting numerous diffusers. The aeration system is tapered, with more diffusers at the head of the aeration basin to provide sufficient oxygen for the incoming loading and less at the downstream end.

5.1.3.3 Aeration Control System

ESCOR's aeration control system is designed to control the four aeration blowers and control air distribution to the four aeration basins to maintain an operator adjustable level of dissolved oxygen (DO) in each basin. The system includes a DO sensor, modulating air control valve and air flow meter at each aeration zone, aeration basin local control panels (LCP), the blower control panels; and a master control panel located in the electrical room of the Operations Building.

The air flow transmitters are installed in the main header for each zone. They are placed upstream of each zone drop pipe and measure the actual SCFM flow in the main header. The flow to each zone is calculated at the LCP by subtracting the main header air flow before and after the zone drop pipe.

Aeration Control Panel (ESCOR)

The aeration basin control panels receive inputs from the DO sensors and air flow meters at each aeration zone and transmit them to the master control panel. The master control panel processes this data and sends signals back to the aeration basin control panels to adjust the air control valves at each zone to maintain the correct level of DO. The master control panel also transmits control signals to the blower control panels to turn blowers on and off and modulate the blower inlet control valves to provide the correct quantity of air required to maintain the required DO. As an alternative, the aeration system can be operated on a scheduled operation to provide a set level of aeration to each basin depending on the time of day. The master control panel has a touch screen display for operator interface and is connected to the SCADA computer. Status of the system and alarms is available through the SCADA system. Volume of airflow and DO readings for each aeration zone are displayed on SCADA and are available for trending.

In addition to the ESCOR's aeration control system, the process control was upgraded during the 2004 interim nitrogen retrofit to include the Myratek Bioprocess Intelligent Optimization System (BIOS) in order to optimize the biological nitrogen removal process. The equipment installed included:

- One Myratek BIOS system;
- One Myratek AD-2000 (ammonium analyzer) in the primary anoxic zone of Train 4;
- One Myratek Sentry C-2 (ammonium and nitrate analyzer) in the secondary anoxic zone of Train 4; and
- One TSS meter located at the second anoxic zone of Train No. 2.

The BIOS system uses a customized feed-forward simulation and control algorithm to determine and adjust the real time DO set point and internal recycle flow (IRQ) ratio to meet treatment goals. It manages the supply of air to each zone of the aeration basin, and it controls the recycle flow in the tank to maximize the amount of nitrogen removed from the system.

In order to complete these real time process optimizations, the BIOS uses data from on-line ammonium and nitrate analyzers, influent and effluent flowmeters, on line DO probes, and the on-line TSS meter.

The main functions of the BIOS system include the following:

1. Collect data from plant instruments and Myratek nutrient analyzers.
2. Feed data into a customized computer model of the secondary treatment process.
3. Use the results of the model to calculate optimal DO, Internal Recycle Flow (IRQ) ratio, and Waste Activated Sludge (WAS) flow set points for the process based on the real time influent wastewater conditions.
4. Send the optimal set points to both ESCOR and SCADA systems for implementation.

The BIOS system is located in the electrical/SCADA room at the Operations Building. It consists of an IBM desktop computer, an Automation Direct PLC, and equipment for communication with the plant's SCADA.

5.1.3.4 Secondary Clarifiers

Aeration tank effluent flows from the aeration tank effluent channel via a 54-inch RCP to Structure No. 4, a distribution box that divides the flow to the Secondary Clarifiers. From Structure No. 4, two 36-inch RCPs convey the flow to either Structure No. 5 or 6. At Structure No. 5, the flow can be directed to Secondary Clarifier No. 1 or 3 using the appropriate sluice gates and at Structure No. 6, the flow can be directed to Secondary Clarifier No. 2 or 4 using the appropriate sluice gates. Scum wells for the final settling tanks are also located as part of Structures No. 5 and 6 and will be described in the subsequent process.

Secondary Clarifier

The four secondary clarifiers are 85 feet in diameter with side water depths of 12 feet, and provide the detention times and overflow rates shown in Table 5-5. The overall condition of the concrete appeared to be good, but the equipment itself needs to be replaced.

Scum from the scum troughs flows by gravity to the scum well in Structure No. 5 or 6. The scum pump is used to transfer the scum back to Structure No. 2, where the scum is either refloated and drawn off directly to the primary scum pit, or it is distributed to the primary tanks with the raw sewage.

The secondary clarifiers differ from the primary clarifiers in the method of sludge removal. Rather than moving the sludge towards the center of the tank, the scraper blades in the clarifiers direct the sludge to a series of eight 8-inch PVC sludge withdrawal or suction pipes, where sludge is forced up through the suction pipes and discharged to a sludge collection well at the center of the tank. From there, it flows by gravity from each tank to the return sludge wet wells at the sludge pumping station.

Table 5-5: Existing Secondary Clarifiers Design Criteria

Equipment	Design
Number of units	4
Unit Diameter (ft.)	85
Side Water Depth (ft.)	12
Unit Surface Area (sf.)	5,700
Total Surface Area (sf.)	22,800
Total Volume (gal.)	2,036,000
Manufacturer	Dorr-Oliver
Detention Time	4.9 hr @ 10.0 MGD
Surface Overflow Rate	440 gpd/sf @ 10.0 MGD
Solids Loading Rate (lb/sf/day)	15 @ 10.0 MGD
Year Constructed	1972

5.1.3.5 Return and Waste Activated Sludge

As previously mentioned, settled sludge is forced by water pressure up the suction pipes to sludge collection wells at the surface of each tank. The water pressure is created by the difference in elevation between the liquid level in the main body of the secondary clarifiers and the discharge heights of the suction pipes. Sludge flows by gravity from the collection wells of the final settling tanks to the return sludge wet wells located outside the sludge pump station. Sludge

from Secondary Clarifiers 1 and 2 discharges to the north return sludge wet well and sludge from Secondary Clarifiers 3 and 4 discharges to the south wet well as shown in the WPCF flow diagram (see Figure 5-2).

Sludge pipe connections from either tank can be isolated from the return sludge wet wells by the use of sluice gates located at the wet wells. Three identical horizontal non-clog centrifugal pumps take suction from the return sludge wet wells and discharge either to the splitter box or influent channel at the aeration tanks (return sludge) or by a separate line to Structure No. 2 before the primary clarifiers (waste sludge). The pumps are directly connected to variable-speed drives and have manual controls, which permit a range of pumping rates up to 1,800 gpm each. A Cornell horizontal non-clog slurry pump was installed in 2005 to convey waste activated sludge. The pump is equipped with an explosion proof 5 hp. motor and an adjustable frequency drive. The Return Activated Sludge (RAS) and Waste Activated Sludge (WAS) pumps characteristics are shown in Table 5-6.

RAS and WAS Pumps

Metering of flow rate on the return sludge line is achieved by Type PMT-S flow tubes located in the basement of the sludge pumping station. The return sludge line uses a 14-inch flow tube equipped with a continuous flushing system for the piezometer lines, consisting of a pair of rotometers, constant differential regulators, and check valves with air vents. Metering of the WAS flow rate is achieved by an strap-on Doppler style flowmeter, which is also located at the waste sludge line in the basement of the sludge pumping station.

5.1.4 Disinfection System

The effluent from the Secondary Clarifiers flows via four 42-inch RCP pipes to Structure 7, located between Secondary Clarifiers 3 and 4 south of the sludge pumping station. The discharge from each Secondary Clarifier can be isolated by a sluice gate with a crank-operated floor stand. The final effluent flows to Structure No. 8 where chlorine is added. A sluice gate on the 54-inch bypass line controls the bypass flow to the structure.

Chlorination System

A chlorination system is used to disinfect the treated effluent before it is discharged to the Connecticut River. The original chlorine gas storage and feed system was replaced with a liquid hypochlorite system in 1994. Sodium Hypochlorite is stored inside three 2,000-gallon storage tanks located on the first floor of the Sludge Pumping Station (chlorination room). Chemical metering pumps are used to pump the chemical to the tanks. Carrying water is used to improve the control and performance of the sodium hypochlorite delivery system. There are no requirements for effluent dechlorination.

Sodium Hypochlorite is conveyed to Structure No. 8 through a 2-inch PVC pipe. The solution pipe is connected to a diffuser assembly located on the east wall and dispenses the disinfectant directly into the effluent flow as it exists from the structure. Design criteria for the disinfection system are shown in Table 5-7.

Table 5-6: Existing RAS, WAS, and Scum Pumps Design Data

Equipment	Design
RAS pumps	
Number of units	3
Manufacturer	Worthington Corp.
Model	8FN16
Type	Horizontal non-clog centrifugal pump
Size (suction x discharge)	8” x 8”
Capacity	1800 gpm @ 20 feet TDH
Motor	
Manufacturer	US Electric Motors
Type	VEUJVGH
Motor Size (hp)	20
Power (volts/ phase/ hertz/Amps)	480/ 3/ 60/22.5
VFD	Yes
Year Installed	1972
WAS pump	
Number of units	1
Manufacturer	Cornell Pump
Model	2.5YM-F16
Type	Screw centrifugal pump
Size (suction x discharge)	4” x 2.5”
Estimated Capacity	231 gpm @ 34 feet TDH
Motor	
Manufacturer	Baldor
Frame	215T
Motor Size (hp)	5
Power (volts/ phase/ hertz/Amps)	460/ 3/ 60/8.1
VFD	GE Fuji
Year Installed	2005

Equipment	Design
Scum Pump	
Number of units	1
Manufacturer	Vaughan
Model	H3F6S
Type	Horizontal centrifugal pump
Estimated Capacity	160 gpm @ 21 feet TDH
Motor size (hp)	5

Table 5-7: Existing Chlorination System Design Criteria

Equipment	Design
Chlorine Contact Tanks	
Number of units	2
Dimensions	30'W, 58' L, 12.4' D
Total Reactor Capacity, GAL	323,000
Length-to-width ratio	2
Detention Time	29 min @ PHF
Year Installed	1972
Chemical Feed Pump No.1	
Manufacturer	Milton Roy
Pump Capacity (gph)	57
Maximum Pressure (psig)	100
Motor size (hp)	0.5
Power (volts/ phase/ hertz/amps)	90/ 3/ 60/ 4.8
Chemical Feed Pump No.2	
Manufacturer	Milton Roy
Pump Capacity (gph)	53
Maximum Pressure (psig)	150
Motor size (hp)	1
Power (volts/ phase/ hertz)	90/ 3/ 60/ 9.8

Equipment	Design
Chemical Storage Tanks	
Number of units	3
Manufacturer	PolyProcessing
Contents	15% solution of sodium hypochlorite
Capacity (GAL)	2000
Material	HDPE
Design Pressure / Temp.	Atmospheric / Ambient
Year Installed	1996

Water for various plant needs can also be chlorinated by a plastic tube, inserted in the pipeline between the duplex strainer and the flexible coupling on the suction header to the effluent water and foam spray water pumps. PVC piping was added in the basement of the sludge pumping station to allow the chlorination of both the return sludge and the waste sludge lines using the existing chemical metering pump in the chlorination room.

The chlorinated effluent from Structure No. 8 flows, via a 60-inch pipe, to an influent box at the head of the chlorine contact tanks. This box contains slide gates that control the flow to one or both contact tanks. Each of the two tanks has a volume of about 160,000 gallons and uses three "end-around" concrete baffles to provide maximum detention time by preventing short-circuiting through the tank. The overall condition of the concrete appeared to be good. An open channel flow measurement system composed of two ultrasonic transmitters installed at the top of the effluent weir plates is used to measure the WPCF effluent flow.

Chlorine Contact Tank

The chlorinated effluent exits the contact tanks at the effluent box and flows on to Structure No. 11 where it is combined with plant site storm drainage prior to discharge to the Connecticut River. The final effluent, combined with any site drainage, leaves Structure No. 11 through a 60-inch outfall sewer. The outfall sewer extends approximately 175-feet out into the Connecticut River and terminates as an open-ended pipe on a riprap outlet apron.

5.1.5 Plant Water System

The plant water system is located in the basement of the Sludge Pumping Station and uses effluent water as flushing water, foam spray water, carrying water for the disinfection system, and other uses throughout the plant. Effluent water is withdrawn via a 10-inch, cast-iron pipe from Structure No. 7, at approximately 3 feet below the water surface, to the sludge pumping station.

A duplex basket strainer with 1/8-inch perforations is used to screen debris from the effluent water prior to use. By means of switching valves, flow may he directed through either side of the strainer, so that one side may be cleaned or inspected, while the other side is being used. Each side of the strainer is provided with a drain line and valve to permit dewatering of the unit for servicing.

The remainder of the effluent water system consists of a common header from which a battery of five pumps take suction, and the attendant piping, valves, equipment, and controls. In addition to the four vertical, double-suction centrifugal pumps, manufactured by Aurora Pump Co., and used for flushing water and foam spray water, there is a jockey horizontal pump used to supply carrying water for chemicals. The characteristics of all these pumps are shown in Table 5-8.

Plant Water System

The two effluent flushing water pumps discharge directly to the flushing water distribution system. The distribution system consists of various yard hydrants strategically located around the plant site, hose bibbs inside the buildings, and connections to the sludge processing facilities. Currently, the operators are using only these two pumps for all their effluent water uses around the plant, including supplying water to the temporary foam spray system and providing carrying water for chemicals.

The two foam spray water pumps discharge to a common line heading to the aeration tanks for intermittent use in suppressing foam accumulations on the surface of these tanks. Refer to Section 5.1.4.1 for a description of this system.

5.1.6 Potable Water System

A 4-inch potable water line enters the basement of the Operations Building. After metering, a portion of the potable water passes through two backflow assemblies in series to supply the service water system. The remainder passes through a 2-1/2-inch line and becomes the potable water system. The potable water is extended to the various plumbing fixtures, water coolers, sinks, and hot water heater.

Table 5-8: Existing Plant Water System Design Criteria

Equipment	Design
Effluent Flushing Water Pumps	
Number of pumps	2
Manufacturer	Aurora Pump
Model	413-BF
Type	Vertical double section centrifugal
Capacity	550 gpm @ 150 feet TDH
Size	3x4x14
Motor	
Manufacturer	Marathon Electric
Model	8-324TTDR7332AAW
Horsepower (hp)	40
Power (Volts/ phase/ hertz/Amps)	240-480 / 3 / 60 / 96-48
Year Installed	1972

Equipment	Design
Foam Spray Water Pumps (not operational)	
Number of pumps	2
Manufacturer	Aurora Pump
Type	Vertical double section centrifugal
Model	413-BF
Capacity	400 gpm @ 40 feet TDH
Size	3x4x10
Motor	
Manufacturer	Marathon Electric
Model	8N-213TTDR7374AAW
Horsepower (hp)	7.5
Power (volts/ phase/ hertz/Amps)	240-480 / 3 / 60 / 21.0-10.5
Year Installed	1972
Jockey Pump (not used)	
Number of pump	1
Manufacturer	A.W. Chesterton Co.
Type	Horizontal Centrifugal
Capacity	40 gpm @ 80 feet TDH
Size	1x1.5 x6
Motor	
Manufacturer	Reliance Electric
Horsepower (hp)	2.0
Power (volts/ phase/ hertz/Amps)	240-480 / 3 / 60 / 21.0-10.5

5.1.7 Solids Handling

The solids handling system in Enfield WPCF includes four major processes: (1) sludge conditioning (polymer feed system), (2) sludge dewatering (belt filter presses), (3) sludge storage (abandoned sludge storage tank), and (4) sludge incineration (abandoned incinerator). Each of these processes, along with applicable support systems, is discussed here.

Polymer Feed System

5.1.7.1 Sludge Conditioning

Prior to dewatering, sludge-conditioning chemical in the form of wet polymer is added to the flow stream. The polymer is used as a coagulant aid to tighten the bonds between the solids portion of the sludge, improving its dewatering characteristics.

In order to apply the polymer to the sludge stream, it must be fed into and mixed with water to form a polymer solution. The polymer feed and mixing system is located in the basement of the Operations Building. Neat polymer is fed by operating personnel into the refurbish tank for bulk polymer storage. From the refurbish tank and using the polymer transfer pumps, neat polymer is fed into two mixing tanks, where the solution is slowly mixed with water, facilitating complete dissolution of the polymer chemical. Level control instrumentation automatically controls the level of polymer solution in the mixing tank. From the mixing tanks, the polymer solution is pumped upstairs onto the filter press belt for dewatering. Details related to the polymer feed system are presented in Table 5-9.

Table 5-9: Existing Polymer Feed System Design Data

Equipment	Design
Polymer Preparation System	
Type of System	Liquid
Year Installed	1996
Neat Polymer Storage (refurbishment of lime tank to use as polymer storage tank)	
Number of Tanks	1
Type of tank	flat bottom steel tank
Diameter, inches	144
Height, inch	96
Polymer Mixing Tanks	
Number of tanks	2
Year Installed	1972
Capacity, Gal.	800
Size	5’-0” O.D. by 5’-6” Sidewall Height
Design Pressure/ Temperature	Atmospheric/ Ambient
Material	FRP
Polymer Transfer Pumps	
Number of units	2
Manufacturer	Netzsch Incorporated
Model	2NE40A
Type	Progressing Cavity
Pump Capacity	15 gpm @ 220 ft.
Size (suction/discharge)	4”x4”
Motor size (hp)	5
Power (volts/ phase/ hertz)	230-460 / 3 / 60
Polymer Feed Pumps	
Number of units	3
Manufacturer	Netzsch Incorporated
Model	NE40A

Equipment	Design
Type	Progressing Cavity
Pump Capacity	15 gpm @ 139 ft.
Size (suction/discharge)	3”x3”
Motor size (hp)	3
Power (volts/ phase/ hertz)	230-460 / 3 / 60
Year Installed	1996

5.1.7.2 Sludge Dewatering

Belt Filter Press

Sludge produced at the Enfield WPCF includes primary and secondary sludge. The sludge processing system was upgraded in 1996 to include:

- Two belt-filter presses (BFPs) to replace the originally installed two rotary drum filters. At the time they were installed, one of the belt filter presses was new and the other had been used for approximately 20 years. The two presses are used to dewater the sludge, which is then conveyed into roll-off container and hauled offsite. The sludge flowrate to the BFPs is measured by an in-line Venturi-type flow tube located upstream of each filter press unit. Polymer is added to the sludge before it is pressed. Each BFP is capable of dewatering the sludge from approximately 3% solids to a range of about 18 to 20% solids. The belt presses are operated five days per week, for approximately 10 to 12 hours on Mondays and Tuesdays and 5 to 6 hours a day for the rest of the week. The dewatered sludge filtrate is collected in the building drainage system and is returned to Structure No.2 before the primary clarifiers.
- Sludge and scum feed pumps: One original 4-inch plunger pump and three new Penn Valley diaphragm pumps (two 4” pumps and one 6” pump) are driven through variable speed drives and pump sludge from the primary settling tanks or abandoned sludge storage tank to the BFPs. Primary scum, after a portion of the primary sludge has been pumped to the scum pit and thoroughly mixed to form a homogenous mixture, is pumped to the BFP using one of the Penn Valley pumps, which is usually the 6” diaphragm pump with an output rating of 150 gpm at 69 feet of total head driven through a variable drive by 10 HP motor.
- Sludge belt conveyor: After discharge from the BFPs, the sludge cake is picked up by a 24-inch wide by 75-foot long horizontal belt conveyor, and discharged by a plow to a 3- x 3-foot chute where cake will drop into a container for disposal. The conveyor is equipped with a full-length drip pan, skirt boards at filters, screw-type takeup of 2 percent of the distance between the drive and tail pulleys, grease fittings all piped to one side, and adjustable belt scraper.
- Sludge storage tank: Other sludge handling equipment was installed in 1996 but is no longer used. This includes 170,000 gal. sludge storage tank and sludge mixing pumps. The sludge storage tank is a glass coated, bolted

Sludge Storage Tank

steel tank located adjacent to the headworks and provided with two rotatable mixing nozzles. This tank was taken offline after the Town received complaints about odors. The sludge mixing pumps were designed to draw raw sludge (consisting of raw domestic co-settled primary and waste activated sludge) from the storage tank and discharge it back into the same tank. Since the tank has not been in service for a number of years, it is not known if the pumps are still operational.

Details related to the sludge processing system are shown in Table 5-10.

5.1.7.3 Sludge Incineration

When the WPCF was constructed in 1972, an incinerator was built to burn the sludge that is produced. This incinerator was abandoned soon after it was commissioned, and it has not been used since then. The sludge incinerator is a vertical, cylindrical insulated, multiple hearth furnace designed to burn sludge cake. A series of six hearths are located within the furnace and the dewatered sludge cake is fed onto the top hearth by means of a belt conveyer system, discharge plow, and a feed hopper. Rotating rakes or rabble arms, with teeth, were installed to move the sludge cake successively from one hearth to the next below and it emerges from the bottom hearth in the form of ash.

5.1.8 Septage Receiving Station

The septage receiving station consists of a combined wet well and pump room structure located underground west of the headworks structure. Access to the wet well is obtained through a square aluminum hatch cover directly over the wet well sump and access to the pump room is obtained through a rectangular watertight aluminum hatch. The function of the station is to receive Fats, oils, grease (FOG), and septage and introduce these wastes into the treatment process in such a way as to reduce the effects of sudden shock loads of BOD and solids to the plant. As of January 2014, the plant stopped receiving FOG and began charging haulers to discharge septage at the WPCF. Since that time, the amount of septage discharged at the WPCF has been greatly reduced.

Septage Receiving Station

Wastes are discharged to the wet well through an 8-inch fill pipe located in the wet well roof section. This section of the roof is pitched to the fill pipe for ease in cleanup. A diaphragm transfer pump located in the pump room and taking suction from the bottom of the wet well, pumps the wastes via a 4-inch underground line to the headworks and bypass channel where it is mixed with the main incoming plant flow. Design criteria of the septage receiving station are presented is Table 5-11.

An effluent flushing water line enters the station through the east wall of the pump room and connects to a header fitted with spring nozzles locked around the periphery of the wet well. This header supplies wash drain water to all areas of the well and flow is controlled manually by a valve in the pump room.

A limited structural evaluation was performed on the wet well and dry well of the septage receiving tanks. The surface of the riser appeared to be in good condition, and the lower concrete surfaces were covered with residue and possibly a bitumastic coating. Visually, the concrete appeared to be in good condition, however we weren't able to reach the surface with the steel rod.

Table 5-10: Existing Sludge Dewatering System Design Data

Equipment	Design
Sludge Holding Tank (Abandoned)	
Number of Tanks	1
Capacity (Gal.)	170,000
Belt Filter Press	
Number of units	2
Manufacturer	Komline-Sanderson
Size, Meters (M)	2
Type	Three Belt
Operation, days/week	5
Model	Kompress GRS-SE-2
Design loading, lbs/hr	1500
Design Feed Concentration (% solids)	2-3%
Type of Sludge (Primary/WAS)	40/60
Min. Sludge cake concentration (% solids)	18
Min. Solids capture rate (% solids)	90
Year Installed	1996
Primary Sludge and Scum pumps	
Plunger Pump	
Number of units (ea.)	1
Manufacturer / Model	Komline-Sanderson Co. / KSS-11
Type	Simplex Plunger Pump
Size (suction x discharge)	4”x4”
Capacity	90 gpm @ 100 feet TDH?
Motor	
Manufacturer	Baldor
Motor Size (hp)	5
Power (volts/ phase/ hertz)	230-460/ 3 / 60
Year Installed	1994
4” Diaphragm Pumps	
Number of units (ea.)	2
Manufacturer / Model	Penn Valley
Type	Diaphragm Double Disc
Model	4DDSX30CNU-MK1
Size (suction x discharge)	4”x4”
Capacity	50-90 gpm @ 25 feet TDH

Equipment	Design
Motor	
Manufacturer	WEG
Horsepower (hp)	5
Power (volts/ phase/ hertz/Amps)	230-460/ 3 / 60
Year Installed	2012-2013
6" Diaphragm Pump	
Number of units (ea.)	1
Manufacturer / Model	Penn Valley
Type	Diaphragm Double Disc
Model	4DDSX76CNU-MK1
Size (suction x discharge)	6"x6"
Capacity	150 gpm @ 69 feet TDH
Motor	
Manufacturer	Toshiba
Horsepower (hp)	10
Power (volts/ phase/ hertz/Amps)	230-460/ 3 / 60
Year Installed	2012-2013
Sludge Mixing Pumps (not operational)	
Number of units (ea.)	2
Manufacturer	Vaughan
Type	Vertical dry-pit centrifugal chopper
Size (suction x discharge x Impeller)	4"x 4"
Capacity	400 gpm @ 55 feet TDH
Motor Power (hp)	15
Year Installed	1996
Odor Control Blower	
No. of units	1
Manufacturer / Model	Universal Blower -Roots / F65-4
Type	Rotary Positive Displacement
Unit Capacity	160 SCFM @ 14.65 psi
Horsepower / speed	20 hp / 1770 rpm
Year Installed	1996

Table 5-11: Existing Septage Receiving Station Design Data

Equipment	Design
Wetwell	
Number of units	1
Dimensions	9'-0"W x 16'-0"L x 9'-6"SWD?
Volume (Gallons)	10,200
Septage Receiving Pump	
Number of units	1
Manufacturer	ITT Marlow
Model	405E
Type	Diaphragm transfer pump
Size (suction x discharge)	4" x 4"
Capacity	N/A
Motor	
Manufacturer	U.S. Motors
Horsepower (hp)	3
Power (volts/ phase/ hertz/Amps)	230-460 / 3 / 60 / 11-5.5
Year Installed	1972

5.1.9 Odor Control System

The sludge processing system was upgraded in 1996 to include the installation of odor control equipment manufactured by Ambi inside the Operations Building to treat odorous air generated in the belt filter press room. The odor control equipment is a two stage horizontal cross flow wet pack scrubber designed to treat up to 14,000 cubic feet per minute (CFM) of air. The equipment was designed to oxidize hydrogen sulfide by passing the odorous air through two consecutive stages of polypropylene structure packing and injecting sodium hypochlorite and sodium hydroxide to provide oxidation of the odorous compound.

The odor control equipment remained in service until May 2009, when a fire erupted in an electrical room located on the floor below the belt filter press room. This fire damaged the odor control equipment and it was subsequently taken out of service. On September 16, 2010, the WPCF received a Notice of Violation (NOV) from the State of Connecticut Department of Energy and Environmental Protection (DEEP) indicating that objectionable odors existed outside the facility boundaries while the belt filter presses were running. Subsequent inspections of the WPCF identified that the scrubber system was disabled and taken offline without notifying the DEEP. Correspondence from the DEEP requested that the chemical scrubber be fixed or replaced with a similar unit.

Treatment plant staff have implemented a number of interim odor reduction measures over the years to minimize the release of odors at the WPCF. These include:

- Taking the sludge storage tank offline. This tank was not adequately configured to handle sludge and the positive displacement blower that was installed to draw odorous air from the tank did not function as intended. Use of this tank has been discontinued and primary and secondary sludge is now blended in the primary clarifiers.

- Installing FRP covers over the headworks area, grit chamber, primary clarifier distribution box, and primary effluent launders to prevent the release of odorous air into the atmosphere.
- Increasing the frequency of disposal of screenings to minimize the odors emanating from the preliminary treatment area.
- Injecting sodium permanganate into the primary and secondary sludge before it is dewatered. Details related to this operation are below.

Chemical Feed System for Odor Control

The greatest potential for objectionable odors in the facility is associated with the headworks and sludge processing. As mentioned before, primary and secondary sludge is dewatered by two belt filter presses located in the Operations Building. The dewatered sludge cake is conveyed into containers and hauled offsite. After the odor control equipment was discontinued, the Town began injecting liquid sodium permanganate in the sludge to reduce odors in the belt filter press room. The sodium permanganate has been used to oxidize dissolved sulfides and reduce formation of odorous compounds, thereby preventing the release of hydrogen sulfide (H2S) into the vapor phase. Sodium permanganate is delivered to the WPCF in 150-gallon totes filled with liquid product at approximately 12.5 percent concentration. The totes are stored outside in heated sheds to prevent freezing. Two chemical metering pumps located in the basement of the Operations Building are used to inject sodium permanganate into the sludge when the belt filter presses are operating. The operators monitor hydrogen sulfide inside the belt filter press room every half hour, and the pump speed is increased if a reading is detected. Table 5-12 shows the design criteria for the interim odor control system.

Table 5-12: Existing Interim Odor Control System Design Data

Equipment	Design
Chemical Storage Totes	
Number of Totes	4
Contents	12.5% sodium permanganate solution
Capacity (each tote -GAL)	150
Mixing Tanks Capacity (gal.)	300
Chemical Feed Pumps	
Number of units	2
Type of Pump	Diaphragm
Model	C771-26S
Pump Capacity (gph)	10
Maximum Pressure (psi)	80
Power (volts/ phase/ hertz/amps)	120/ 3/ 60/ 6.3

5.1.10 Building Facilities

The WPCF site contains three (3) permanent outbuildings, herein referred to as the "Operations Building", the "Sludge Pumping Station" and the "Garage". All three buildings were reviewed as part of this facilities plan, including structural, mechanical (HVAC / plumbing), and electrical systems. A hazardous materials survey was also performed. Results from this analysis are included in Appendix J.

The Operations Building contains three floors. The basement of the Operations Building contains the centrifugal blowers, primary sludge and scum pumps, chemical room, boiler room, storage room, and incinerator area. The ground floor of the Operations Building contains the main office (main controls), laboratory, electrical room, storage room, employee lunchroom and locker room. The second floor of the Operations Building contains the chemical scrubber room, press room, storage room, dewatering office, and conference room.

The Sludge Pump Station contains two floors. The basement contains the sludge handling pumps including the RAS, WAS, and Scum pumps, and the effluent plant water system including the foam spray water pumps and the effluent flushing water pumps. The first floor contains the chlorination room, and the electrical room including an old emergency generator that is no longer operational.

Garage

The Garage is a single story structure at the north end of the site that was constructed in 1938 and originally served as the Operations Building. The structure is a load-bearing brick masonry building with steel roof beams supporting wood planks that is currently used to house maintenance vehicles. A "Pre-Renovation Hazardous Materials Inspection" was conducted at the WPCF by AMC Environmental of Stratford, CT in June of 2014. The intent of the inspection was to identify potentially hazardous materials such as Asbestos Containing Materials (ACM), Lead Based Paint, and Polychlorinated Biphenyls (PCBs).

Inspection included retrieving samples from various construction materials (caulking, cement, insulation, roofing, etc.) from all three buildings. The samples were then sent to a lab for testing for asbestos, PCB and lead. Sample results concluded that all buildings on the WPCF site contained evidence of all three constituents.

AMC summarized the results of the inspection in a report dated March 9, 2015 and attached in Appendix J. The report details the findings of each sample and where the positive samples were located. AMC ultimately recommended that all ACM's be removed by a State of Connecticut Licensed Abatement Contractor prior to any renovations of the facilities.

5.1.11 Miscellaneous Treatment Plant Unit Processes

Aside from the liquid and solids processes of the WPCF, there also exist several miscellaneous processes and equipment groupings that serve to support the treatment plant as a whole. These miscellaneous items include the emergency generator and fuel oil system, plant instrumentation and control system, heating/ventilation/air conditioning (HVAC) system, and the electrical service. Each of these systems is described below.

Emergency Generator

5.1.11.1 Emergency Power and Fuel Oil System

Standby emergency power is provided for essential loads from a 750-kw, 480-volt, 3-phase, 60-Hertz Caterpillar diesel engine generator that was installed in 2004. The generator has a 1200 amp main circuit breaker, sub-base diesel fuel tank and is housed in a walk-in enclosure. This generator is located adjacent to Primary Clarifier No.2. In the event of primary power supply loss from the electric utility company, the generator provides emergency power to the entire facility via a 1200 amp, 480 volt automatic transfer switch located on the exterior adjacent to the existing utility pad mounted transformer. From the transfer switch the generator feeds into the Operations Building to a 1200 amp main circuit breaker, which serves as the main service switch to the WPCF. The generator can supply emergency power to the primary clarifiers, aeration equipment, secondary treatment, chlorination, plant water, boiler, compressed air, instrumentation, critical ventilation systems, and lighting panelboards, as well as a few miscellaneous non-critical supplies.

Diesel and unleaded fuel are stored outside the garage building, in two underground 2,500-gallon storage tanks. Unleaded fuel is supplied to some of the WPCF's trucks and vehicles and diesel fuel is supplied to the generators located in the wastewater pump stations.

Home heating oil is stored in an on-site, underground 2000-gallon storage tank. Heating oil is supplied to the water heater and heating boilers located in the Operations Building by a 1/3 HP fuel oil pump.

5.1.11.2 Heating, Ventilation, and Air Conditioning (HVAC) System

The existing heating system in the Operations Building is a two-pipe, reverse-return, forced hot water system with an oil-fired boiler that supplies hot water to room unit ventilators, convectors, unit heaters, and air handling units. Local thermostats control the convectors, unit ventilators, unit heaters and air handling unit (AHU). There is no central Building Automation System (BAS). The boiler functions under the control of an immersion thermostat that starts the burner when the boiler water temperature falls below 180 degrees F and stops the burner when the boiler water temperature reaches 200 degrees F, so as to maintain an average water temperature of 190 degrees F in the heating system.

The incinerator area is ventilated by means of roof exhaust fans EF-1 and EF-3. Exhaust fans were originally installed to ventilate the chemical storage and pump room in basement, toilet and locker room, shop and lunchroom on the first floor, and toilet and dewatering room on the second floor. However, these fans are no longer operational.

The air conditioning of the office areas, laboratory, lunchroom, electrical room, and storage room on the second floor is accomplished by the room unit ventilators that are combination of heating and cooling units. The cooling function of these units is no longer operable, so window air conditioners have been installed to provide cooling.

Electric unit heaters, controlled by their respective thermostats, provide heating of the first floor and basement areas of the sludge pumping station. Roof-type exhaust fans, complete with ductwork, provide ventilation for the sludge pumping station. A dedicated oil fired hot air furnace heats the old plant / garage.

5.1.11.3 Plumbing System

All of the Reduced Pressure Zone (RPZ) backflow preventers in the plant are heavily corroded. Exposed copper piping for cold and hot water also show significant corrosion. Safety showers throughout the WPCF do not meet current code

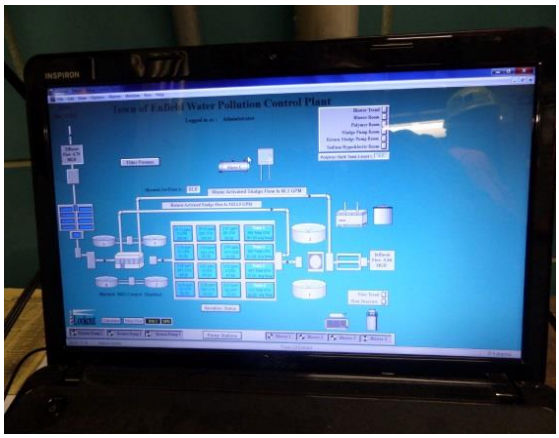
requirements for tepid water, and the existing hot water heater is too small to supply tepid water to the safety shower system. Operators reported that the water heaters require frequent replacement due to water quality issues.

5.1.11.4 Electrical Service

The main electrical service originates from a 480 volt, 3-phase pad mount transformer located on the south side of the Operations Building. The service is fed underground to a 1200 amp main circuit breaker and Automatic Transfer Switch located adjacent to the pad mount transformer. From the automatic transfer switch, the main service entrance is fed underground to a 1200 amp main circuit breaker located in the main electric room of the Operations Building. The main circuit breaker feeds Motor Control Center #1 (MMC #1), which houses the (3) three blower motor starters along with feeder breakers to the remaining Motor Control Center's at the WPCF.

5.1.11.5 SCADA System

The SCADA (Supervisory Control and Data Acquisition) system was added to the plant during the 1990's. The system is operated as two separate components. The first is monitoring the sixteen (16) remote pump stations and the second is monitoring the WPCF.



SCADA System Monitor

The remote sites are polled using TeleDesign TS 4000 radio's and the data collected by a central programmable logic controller (PLC). The data is displayed and trended on a single computer in the utility room located adjacent to the locker room at the first floor of the Operations Building.

The WPCF portion of the system has some connectivity to the central SCADA computer but this only allows operators to view unit processes, not control them. The communications within the plant is problematic due to infrastructure issues and the multiple PLC manufacturers.

The majority of the monitoring points included in the SCADA operator interface software are not wired to the associated equipment and instruments in the WPCF. There are several PLCs in the SCADA system's distributed control panels. The PLCs are Automation Direct, Allen Bradley and Modicom. Presently, the majority of the PLCs have not been fully commissioned and are therefore not properly automating the treatment system. In addition, the communication network between the PLCs and the SCADA system is slow and obsolete, creating an unstable monitoring environment.

5.1.12 Hydraulic Profile

A survey of the facility was performed to generate a hydraulic profile (see Figure 5-4) based on the aforementioned factors and current plant data. According to TR-16, wastewater treatment plants should provide uninterrupted operation under flood conditions of a 25-year frequency, and should be protected from damage under flood conditions of a 100-year frequency, both at the peak hourly flowrate. Hence, the assumed conditions for the hydraulic profile include low-mean river level, 25-year river level, and 100-year river level as shown in Table 5-13.

Table 5-13: Hydraulic Profile Assessment Conditions

Condition	Design Flow, Low River Level	Peak Hourly Flow, 25-Yr River Level	Peak Hourly Flow, 100-Yr River Level
Influent Flow	10 MGD	17.0 MGD	17.0 MGD
Return Activated Sludge Flow	10 MGD	10 MGD	10 MGD
Storm Water Inflow at Outfall	0 MGD	1.47 MGD	1.47 MGD
Number of Tanks Offline (i.e. CCTs, FSTs, ATs, etc.)	1 Offline At Each Treatment Stage	All Online	All Online
River Surface Water Elevation (ft ASL)	25.04 ft	39.00 ft	41.00 ft

With one exception within preliminary treatment, the process and hydraulic profile appear to have remained very similar to the original design. In the last 45 years, the facility has undergone only minor upgrades and modifications such as changes in chemical addition, aeration, baffling, recirculation rates, weir adjustments and preliminary screening. Hydraulics within preliminary treatment indicate that the grit chamber weir is approximately 2 feet lower than shown on the record drawings of the plant. However, the surface water elevations remain very similar during high flow periods due to other flow restrictions.

5.1.13 Vulnerability Assessment

The CT DEEP requested that a vulnerability assessment of the WPCF be performed as part of this Facilities Plan. Vulnerability assessments are used to help water and wastewater utilities evaluate susceptibility to potential threats such as natural hazards or vandalism and identify corrective actions that can reduce or mitigate the risk of serious consequences. The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (the Bioterrorism Act) required drinking water utilities serving populations greater than 3,300 to complete vulnerability assessments before June 2004. Water Pollution Control Facilities are not required by law to complete vulnerability assessments, but they must provide clean and safe water every day. Interruptions in wastewater treatment would have cascading effects, as many hospitals, schools, and commercial and industrial businesses may be forced to close.

Most WPCFs are located close to receiving waters and are usually at low points in the sewer service area. Therefore, one of the biggest vulnerabilities to many WPCFs is flooding. At the Enfield WPCF, the elevation of the top of walls of the primary clarifiers, aeration tanks, secondary clarifiers, distribution boxes, and chlorine contact tanks is at least 2-feet above the 100-year flood elevation. The first floor elevation of the Operations Building, Garage, and Sludge Pumping Station are also at least 2-feet above the 100-year flood elevation. In addition, the site is surrounded by a berm that is at least 10-feet higher than the 100-year flood elevation, so there is very little risk that water from the Connecticut River would enter any of the tanks. This berm also protects the facility from floodwater emanating from Beemans Brook located on the east perimeter of the property. Therefore, flooding is not generally a concern at the Enfield WPCF.

Water Pollution Control Facilities are dependent upon other national critical infrastructures such as energy to operate pumps and other equipment. Extended power outages resulting from storms, problems at the utility company, or trees falling on power lines that feed the WPCF are therefore another vulnerability. Fortunately, the Enfield WPCF includes an emergency generator that is capable of powering all of the equipment needed to convey and treat wastewater. The storage tank that provides fuel to the generator is sized to allow the generator to run for 48 hours.

Chemicals such as polymer, sodium permanganate, and sodium hypochlorite are used at the Enfield WPCF to process sludge, reduce odors, and disinfect the wastewater. These chemicals are delivered by tanker trucks so the roads leading to the Enfield WPCF must be accessible at all times. The roads must also be accessible to allow sludge to be hauled offsite. The WPCF is located close to Interstate 91 and Route 5 which are two major roads that are maintained by the State Department of Transportation. Also, the WPCF can be accessed from the north by following Route 5,

Bridge Lane, and Parsons Road or from the south by taking Route 5, Old King Street, and Parsons Road. In truly emergency situations, it would also be possible to access the WPCF by boat via the Connecticut River which is across the street from the WPCF.

Vandalism is another potential threat to treating wastewater at many WPCFs. The Enfield WPCF is surrounded by a 6-foot high chain link fence with barbed wire at the top around the entire perimeter. Access to the WPCF is provided by a motorized gate that is activated by a card reader. The door to the Operations Building is locked at all times, and visitors must ring a bell for access. Vandalism sometimes occurs at some of the remote pumping station, even though they are also protected by chain link fences with locks. The Town has installed security cameras at a few of the remote stations, and the collection system staff visit the stations regularly.

5.2 WPCF EXISTING LIMITATIONS AND DEFICIENCIES

A review of the WPCF operational characteristics and system deficiencies was undertaken as part of the facilities planning process. Major unit processes and pertinent operating conditions and criteria were presented earlier in this Chapter. In this section, known process and equipment deficiencies experienced under current operations of the plant will be identified. A summary of needs and opportunities for existing facilities is presented in Table 5-13.

5.2.1 Preliminary Treatment Systems

The preliminary treatment systems of the WPCF include the headworks structure and the aerated grit chambers. Generally, most of the equipment in these systems have surpassed their useful lives and should be replaced. The following deficiencies are noted:

- The Infilco Degrement mechanically cleaned bar screen is located outside and is subject to freezing conditions in the winter. The screenings do not pass through a grinder as required to avoid classifying it as a special waste. Also, the raw screenings are discharged into a dumpster which attracts vectors and causes excessive odors, especially during warmer months.
- The comminutor that was original to the plant failed and has not been replaced.
- At the grit chamber, when the WPCF was originally constructed, grit was removed using a motorized clamshell hoist suspended from a monorail structure above the grit chamber. This clamshell is no longer operational, so operators currently remove grit from the tanks using an excavator. This practice is very labor intensive and does not effectively remove all of the grit from the tanks. The grit chamber was covered recently to contain objectionable odors, however there is no means to collect and treat the odors separately, which can lead to equipment deterioration due to high hydrogen sulfide (H_2S) concentration inside the chamber.
- The Aerated Grit Chambers are covered with fiberglass panels. Cover panels were removed near the center of the west chamber and at both the north and south ends of the east chamber. Visually, the concrete above the water appeared to be in fair to good condition, with some areas of exposed aggregate. However, scraping the concrete in these three areas with a steel rod indicated that the surface was relatively easy to remove in powder form to a depth of approximately 1/4” to 1/2”. Unlike at the influent channels, the agitation of the wastewater in these chambers is probably conducive to the presence of hydrogen sulfide, leading to the creation of sulfuric acid, and causing the concrete corrosion that is evident. We recommend hydro-blasting the tank walls to remove corroded concrete, and providing an epoxy coating system that is resistant to sulfuric acid to protect the concrete against further deterioration.
- The steel framing around the Headworks that supports a clamshell appeared to be in good condition. However, portions of the diagonal cross bracing appears to have been modified without being repaired to its original construction.
- The railings that surround the elevated platform at the headworks structure are less than 42-inches high and do not meet code. These will have to be replaced.

5.2.2 Primary Treatment Systems

The primary treatment systems of the WPCF include Structure No. 2 (distribution box), the primary clarifiers, and primary sludge pumps. Generally, the existing equipment is aging, in poor condition, and needs to be upgraded. The following deficiencies are noted:

- Structure No. 2 includes two sluice gates used to control the flow to the primary clarifiers. These gates and their operating stems have been problematic and cannot be used to reliably isolate flow to either of the two primary clarifiers. Replacing these gates will require the flows to the primary clarifiers to be bypassed.
- Structure No. 2 is covered with hinged fiberglass panels. Two panels were lifted to inspect the concrete above the water surface. This concrete showed exposed aggregate, a likely indication of concrete surface corrosion. We recommend removing the corroded concrete by hydro-blasting to sound concrete, and providing an epoxy coating system that is resistant to sulfuric acid to protect the concrete against further deterioration.
- A 12-inch scum draw-off line is used to convey scum from Structure No.2 to the scum pit. This scum pipe is located at the operating water level of Structure No. 2. Flow through the line was manually controlled by operation of a weir gate at the structure, and the line discharged scum into the primary scum pit. However, Structure No.2 was covered using FRP covers to prevent the release of odors into the atmosphere, and the gate operator was removed. As such, there is no way to operate the gate so scum must be removed using a vac truck. These limitations, along with the nature of the materials that are inside the structure, result in the generation of hydrogen sulfide and are a significant source of odors. The cover should be modified to allow the gate operator to be replaced so scum can be removed.
- The equipment inside the primary clarifiers has been in service for over 40 years and should be replaced. This equipment includes the drives, weirs, scum baffles, sludge collection mechanisms, scum skimmers, influent column, walkway, and handrails.
- The effluent launders for the primary clarifiers have fiberglass covers that are hinged on the outer edge. The exterior concrete wall of the launder extends approximately 7" above the top of the fiberglass cover, and is in good condition. We were able to lift the covers in proximity to the walkways of each tank, from where we could observe the condition of the concrete wall above the water level. The concrete consistently showed exposed aggregate, a likely indication of concrete surface corrosion. We were not able to probe the surface. Recommendation is to remove corroded concrete by hydro-blasting to sound concrete, and providing an epoxy coating system that is resistant to sulfuric acid. This will protect the concrete against further deterioration. The surface of the concrete above the water level was visible via a hatch at the distribution box to the Primary Clarifiers. It appeared to be in good condition, and probing of the surface showed that it was hard, and it does not appear that any concrete repairs and/or application of a coating are necessary in the box.
- Effluent leaving the primary clarifiers flows into Structure No. 3, which contains sluice gates to control flow to the aeration tanks. These gates are leaking and should be rebuilt or replaced.
- The scum pit is equipped with a mixer used to produce a homogenous mixture for later removal. This mixer is over forty years old and has reached the end of its useful design life and should be replaced.
- Wasted activated sludge is co-settled with influent wastewater in the primary clarifiers. A separate sludge holding tank or gravity thickener is needed to increase the removal efficiency of the primary clarifiers and reduce odors.
- Primary clarifiers bypass should be provided to divert a portion of the pretreated wastewater flow directly to the aeration tanks when supplemental carbon source is required to improve nitrogen removal.
- The existing railings around the primary clarifiers are only 36-inches from the walking surface, which does not meet code. These railings will need to be replaced with 42-inch high railings with toe plates.

5.2.3 Secondary Treatment

The secondary treatment systems of the plant include the aeration tanks, the aeration blower equipment, the aeration control system, and chemical feed equipment. In general, the majority of the existing equipment and instrumentation system is either surpassed it's intended design life or in need of replacement. The following deficiencies are noted:

- Fine bubble air diffusers are ceramic disc style, dating back to 2004 installation. Based upon the observed bubble pattern in each tank, the condition of the diffusers appears to be adequate. However, cleaning these diffusers requires the use of an acid and is a very labor-intensive task. As a result, they have only been cleaned once since they were installed. Replacing the ceramic diffusers with membrane diffusers that do not need to be cleaned frequently will reduce the amount of energy consumed and eliminate the challenging cleaning requirements.
- Operators indicated that in-tank repairs to concrete and wooden baffle walls are needed.
- The overall condition of the concrete at the aeration tanks appeared to be good. Some areas around the walkways are spalling, primarily at conduit penetrations near the effluent end and the embedded gate components, and require repair.
- Each aeration tank includes sluice gates to allow the flow to enter each tank at a series of different locations. These gates are no longer operational, which limits operational flexibility and may adversely impact plant performance, especially during high flow periods. These gates should be replaced.
- Four centrifugal blowers are used to provide air to the wastewater. Each blower is powered by a constant speed motor, with air flow controlled by modulating motorized inlet control valve. These blowers are oversized and inefficient and result in excessive energy consumption. In addition, they have reached the end of their useful design life. Newer blowers equipped with VFDs are available that are much more efficient and can be properly sized to meet process demands.
- Dissolved oxygen probes are used to measure the amount of oxygen in the wastewater in the aeration tanks and can also be used to control the centrifugal blowers through the Escor system. Nitrogen analyzers and TSS probe are also installed in the tanks to measure the amounts of ammonia, nitrate and TSS present in the wastewater and are used to control the recirculation rate and the WAS flow through the BIOS system. A portion of these probes and analyzers including both control systems, Escor and BIOS, are outdated, do not function properly and should be replaced with an updated instrumentation and control system. In addition, the types of analyzers and their configuration within the aeration tanks should be evaluated to optimize plant performance.
- The existing foam spray system, including the pipes and nozzles, is original to the plant and is no longer functional. The piping and nozzles should be replaced to reduce the amount of foam that accumulates on the surface of the aeration tanks.
- The submersible mixers in the anoxic zones do not have adequate capacity (see Appendix I), and require a frequent amount of maintenance. A variety of low-energy mixing solutions are available that are proven to provide effective mixing and can be properly sized for each anoxic zone.
- The internal recirculation pumps are located in the secondary anoxic zone of each tank with a suction pipe that goes all the way down to the end of the first aerobic zone. These pumps should be installed at the end of the last aerobic zone in order to effectively return the nitrate rich mixed liquor to the primary anoxic zone. In addition, these pumps are difficult to maintain because of the rusted guide rail system. The new guide rail arrangement should permit easy removal of pump for maintenance without the need for personnel entering the tank. The installation should be equipped with stainless steel guide pipes.
- The main air pipes feeding the aeration tanks have evidence of leaking and their structural integrity is unknown. The pipes appear to be constructed from ductile iron, and should be replaced with a stainless steel that is corrosion resistant.

- Supplemental carbon in the form of Micro C is added to the secondary anoxic zone using a temporary carbon feed system. The type of carbon, and the configuration, location and necessity of the carbon system should be evaluated to optimize plant performance. In addition, there is another abandoned carbon feed system that was designed to add methanol to the BNR system, but never used. This system including the chemical pumps and the PLCs designed to control the pumps should be evaluated by a factory technician for overhaul or reuse for other purposes.
- All of the railings at the aeration tanks are only 36-inches high which does not meet code. These will need to be replaced with railings that are 42-inches high and have 4-inch high kickplates. In addition, there are no railings on the south side of the aeration tanks elevated platform, but they are required.

5.2.4 Secondary Clarifiers

We noted the following limitations within the Secondary Clarifiers:

- Effluent from the aeration tanks flows into Structure No. 4 and then into either Structure No. 5 or No. 6 before it enters either of the Secondary Clarifiers. These concrete structures contain sluice gates that provide flow control and isolation for each of the Secondary Clarifiers. These gates have been problematic and should be refurbished or replaced to allow a clarifier to be isolated.
- The Secondary Clarifiers have enough capacity (see Appendix I), but lack density current baffles and energy-dissipating inlets (EDIs) which are commonly used to increase hydraulic capacity and improve performance.
- Excessive algae growths occur on the effluent weirs and launders. The installation of a system to limit algae growth should be investigated. Such systems include covering the launders with fiberglass covers, installing brushes at the end of the skimmer arm to remove algae, or installing a weir washing system that uses effluent water to remove algae.
- If one clarifier is taken offline, it is challenging for the operators to balance the flow between the rest of the three clarifiers. The flow balance between all four clarifiers should be investigated to secure an even flow distribution.
- Effluent leaving the clarifiers flows into Structure No. 7, which includes sluice gates to control the flow to the chlorine contact tanks. The condition of these gates is similar to those that are installed in Structure No.4 and should be refurbished or replaced.
- The equipment inside the Secondary Clarifiers has been in service since 1972 and needs to be replaced. This equipment includes the drives, weirs, scum baffles, sludge collection mechanisms, scum skimmers, influent column, walkway, and handrails.
- The scum mixer installed at Structure No. 7, which is located between Clarifiers 3 and 4 as shown in the flow diagram (see Figure 5-2), has been in service since 1972 and should be replaced.
- The railings that surround the secondary clarifiers and at the distribution boxes are less than 42-inches high and do not meet code and must be replaced.

5.2.5 Sludge Pumping Station

The sludge pumping station of the WPCF include the RAS, WAS and scum pumps, and the plant water system. Generally, the existing equipment is aging, in poor condition, and needs to be upgraded. The following deficiencies are noted:

5.2.5.1 Sludge Pumps

- The sludge that settles in the Secondary Clarifiers is either returned to the head of the aeration tanks or wasted to the primary clarifiers. Co-settling of the waste activated sludge should be investigated in the context

of the plant upgrade. Additional primary clarifier capacity can be realized and less odors would be produced if secondary sludge is handled in a different manner.

- The RAS pumps have been in service for 40 years. These pumps are not adequately sized for the flows treated at the WPCF (see Appendix I) and should be replaced.
- The waste activated sludge flowrate is measured by flowmeter that was installed in 1972. This flowmeter is not as accurate as newer technologies that are available, so it should be replaced.
- Only one WAS pump and one scum pump are dedicated to waste sludge and scum from the four clarifiers. According to the process capacity analysis results summarized in Appendix I, the WAS pump does not have the adequate capacity to handle the existing flows and the necessity to replace the existing pumps or add another WAS and/or scum pumps should be investigated.

5.2.5.2 Plant Water System

- The plant water leaving Structure No. 7 passes through an 8-inch dual basket strainer. This piece of equipment removes larger materials from the water before it is sent to the pumps and fixtures such as hoses, and spray nozzles. This unit is rusted and exceeded its useful life, making removal of the baskets extremely difficult. We recommended that it be replaced with an automatic backwashing strainer. The valve used to isolate the strainer from Structure No. 7 does not function and must be replaced.
- The plant water system consists of two operational effluent flushing water pumps, two non-operational foam spray water pumps, and one failed horizontal pump used to supply carrying water for chemicals. These pumps are original to the plant, undersized, outdated and need to be replaced by a new packaged plant water pumping system that is sized to handle the WPCF future flow demands.
- The original foam spray system including pipes, valves and nozzles is rusted, at the end of its useful life, and needs to be replaced.

5.2.6 Disinfection System

The plant's disinfection system includes the sodium hypochlorite storage and feed system, chlorine injection system, and chlorine contact tanks. Generally, these systems are functioning well, but the following limitations are noted:

- Chemical metering pumps are used to pump sodium hypochlorite to the contact chlorination tanks. The speed of these pumps is manually set by operators, and no alarms are in place to monitor the pump run status. The alarms and automatic control of the pumps are required to meet the NPDES permit and need to be installed. In addition, the second Milton Roy metering pump was rebuilt multiple times and needs to be replaced.
- Carrying water is commonly used to improve the control and performance of the sodium hypochlorite delivery system. Originally, carrying water was provided by a dedicated pump, which has failed. Carrying water is now temporarily provided by the plant water system.
- The third chemical storage tank has surpassed its useful life and needs to be replaced.
- PVC piping was provided in the basement of the sludge pumping station to inject sodium hypochlorite into the return sludge, the waste sludge, and the effluent water lines. Some sections of this piping is broken and need to be fixed. In addition, flowmeters should be installed before each injection point to monitor the amount of chemical used for each application.
- The existing railings around the chlorine contact tanks are only 36-inches from the walking surface, which does not meet code. These railings should be replaced with 42-inch high railings and a toeplate.

5.2.7 Solids Handling Systems

The WPCF's solids handling systems include the sludge transfer pumps, scum handling system, septage receiving facility, sludge conditioning systems (polymer feed system), and sludge dewatering systems. Generally, some of these

systems are functioning well, while others no longer function at all. Overall, most of the equipment is aging and in need of replacement. The following deficiencies are noted:

- Septage is accepted at the WPCF and is pumped by a single transfer pump from the holding tank to the headworks. This pump is located in a confined space and has been in service for over 40 years and is difficult to access.
- Secondary sludge collected from the Secondary Clarifiers is co-settled with influent wastewater in the primary clarifiers. This practice negatively impacts plant performance and may also result in odors. Alternatives should be considered to handle primary and secondary sludge independent of the liquid treatment process.
- There are four sludge pumps that are used to pump scum and sludge from the primary clarifiers to the belt filter presses. Three of these pumps are relatively new, but the fourth old plunger pump has surpassed its useful design life and should be replaced.
- The belt filter presses were both built by the same manufacturer, but one press is 20-years older than the other, so parts are not interchangeable. As such, two sets of spare parts must be kept in inventory. Belt filter presses are an older technology that is used to process sludge. This type of equipment is very labor intensive to operate, requires a significant quantity of water to function, is not enclosed which leads to excessive moisture and odors, and should be replaced by latest technology. These issues not only create a very unpleasant work environment, but also have caused the structural steel to rust. Further replacements of the belt filter presses and the dewatering technology has the potential to significantly decrease the airflow requirements for this space.
- Odors are an issue at the WPCF, and the existing odor control system (chemical scrubber system) is no longer functioning. Ventilation and odor control system configuration results in uncomfortably low temperatures within the filter press room during winter months. An alternate configuration for feeding fresh makeup air to the room, and an upgrade to the odor control system will be provided during final design.
- The existing polymer feed system has a large footprint and requires a lot of maintenance, the neat polymer storage tank is leaking and is on the verge of collapsing, and the controls and instrumentation for the polymer mixing tanks are not functioning properly. The polymer system should be replaced by a new compact system that requires less maintenance and matches the selected new technology for sludge dewatering.

5.2.8 Miscellaneous Plant Systems

Most of the equipment in the WPCF's miscellaneous support systems are either aging or not functioning properly and should be replaced or removed. Of particular concern are the following items:

5.2.8.1 Incinerator

The incinerator was abandoned soon after it was commissioned and has not been used in over 40 years. Plant staff reported that hazardous materials have been removed. This was confirmed by the hazardous materials survey that was performed as part of this facilities plan.

5.2.8.2 Building Facilities Improvements

Building facilities include the Operations Building, the Sludge Pumping Station, and the Garage Building. The following limitations are noted:

- The Operations Building includes office space, a laboratory that is used to analyze wastewater, a conference room, restrooms, the sludge processing equipment, and other items. Office space is limited, the laboratory is undersized, and the equipment used to analyze the wastewater is outdated. In addition, the heating, ventilation, and air conditioning equipment, as well as the electrical infrastructure, needs to be upgraded.

- The Operations Building also includes the dewatering and odor control rooms. In these rooms, the paint on the steel framing and metal roof deck is failing, however significant member corrosion was not observed during the walk-through, and the steel otherwise appeared to be in good condition. The framing and deck should be abrasive-blasted to remove the existing paint, followed by repainting. The floor coating has failed throughout this area, and some areas of the structural glazed facing tile (SGFT) are cracked and spalled. A more detailed analysis of the roof and the second floor should be performed during design to be sure that more extensive repairs are not needed.
- It is our understanding that the belt filter presses were installed by removing portions of the wall panels and framing. To remove the existing presses and install new equipment, we recommend that a similar procedure be used.
- The Operations Building roofing system is comprised of bands of adhered membrane and a reflective silver coating that has largely worn away. The presence of air handling equipment in proximity to roof edges will require determination of the need for roof railings unless the units can be relocated, or new units located at the required distance from the roof edge. The Building Code requires a railing when serviceable equipment is within 10' of a roof edge.
- At the Operations Building, metal grating floors supported by steel beams are constructed around the incinerator at two levels. The top floor is similarly constructed, although it extends over the top of the incinerator. The framing for these grating floors is not capable of carrying the anticipated load of a composite concrete-steel deck floor that is expected to be required for a different use. Any structural modifications will require the entire building to be upgraded to meeting current code loading and detailing requirements, including seismic loads. This is expected to be a difficult and costly undertaking. One potential alternative might be a structurally independent framework and foundation, constructed inside the existing building.
- The exterior concrete walkway along the east side of the Operations Building shows some cracking and deterioration and should be repaired.
- Record Drawings of the Garage Building were not found. However, this structure dates back to 1938 so it is likely that the masonry walls are unreinforced. Such construction does not meet the requirements of the current building code that includes seismic considerations. The masonry walls show significant structural cracks at locations that include beneath roof beam bearing locations. The exterior brick face is severely weathered with significant section loss in many locations. Modifications have been made to the building through the years that include blocking in of window openings with concrete block. The roof was not accessed, but it appears to include a parapet. The cost to renovate the building and to bring it up to current building code standards would be complicated, difficult, and economically imprudent. It would be necessary to design and construct within the building a new structural framework that would support the existing brick walls and roof. However, the brick walls will continue to deteriorate because of weathering. If no significant modifications are made to the Garage, it does not need to meet the current building code. We suggest that the WPCA continue to utilize the building to store their vacuum / jet truck without modifying the building to avoid

5.2.8.3 Electrical Service

Significant components of the electrical infrastructure at the WPCF are outdated, in poor condition and in need of a major upgrade. The following limitations are noted:

- The current exterior service distribution equipment, Main Service Entrance Switch and Automatic Transfer Switch are in fair condition and were installed in the early 2000's and are housed in weatherproof enclosures.
- There are four existing Motor Control Centers (MCC's) located throughout the WPCF, all MCC's were installed when the plant was constructed in 1972 and are rated 480 volt, 3-phase, 3-wire and are located in the following areas:
  - MCC#1: Operations Building Main Electric Room - This MCC is in poor condition with signs of a fire or excessive heat occurring inside the enclosure causing the exterior panels to be charred and burnt from

the heat. The ITE Company manufactured the MCC with multiple sections containing the blower motor starters and feeder breakers to the remaining plant Motor Control Centers. This MCC should be replaced.

- MCC#2: Operations Building Main Electric Room - This MCC was manufactured by the ITE company and is rated for 600 amps. The MCC contains multiple buckets located on each side that contain motor starters and feeder circuit breakers to various pieces of equipment. The MCC is outdated, has minimal spare capacity, and should be replaced.
- MCC#3: Operations Building Dewatering Office – This MCC is a Freedom 2100 Series manufactured by the Cutler Hammer Company with an amperage rating of 600. The MCC appears to have been installed after the Main Electrical Room MCC's and is in fair condition. The MCC houses various motor starters and feeder breakers for exhaust fans, Air Handling Units and transformers for Lighting and receptacle panelboards.
- MCC#4: Sludge Pumping Station – This MCC was manufactured by the ITE company and has an amperage rating of 600 amp. The MCC contains multiple motor starter and feeder buckets for the sludge processing equipment and is in poor condition.

It should be noted that original replacement parts are no longer available for the older ITE MCC's including any new parts for the existing buckets.

5.2.8.4 HVAC and Plumbing Systems

The HVAC system is at the end of its design life and has significant inoperative components. The system is in need of a major upgrade. The Unit Ventilators are in various states of disrepair. Most of the thermostats are inoperative. The boiler is of an older design and has about 20-25% lower efficiency than more modern equipment. We observed substantial corrosion throughout the heating system, which should be replaced.

5.2.8.5 Fuel Oil System

Diesel fuel that is used for Town vehicles and home heating oil that is used to heat some of the buildings are stored in buried storage tanks. These tanks are constructed from fiberglass, but are likely no longer covered by their warranty and therefore must be replaced.

The diesel fuel that is used for the Town's vehicles is pumped by electric pumps that are not connected to the standby power system and the plant generator. New conduit and wiring should be provided to connect the pumps to the standby power system.

5.2.8.6 Vehicle Wash Station

The WPCA spends considerable amount of money in washing their vehicles externally and expressed the need to construct their own vehicle wash station at the back of the WPCF near the headworks structure to save in O&M costs related to the Town vehicles. In addition to the high pressure pumps required for this system, drainage will need to go through a new oil-water separator before the flow is sent to the headworks.

5.2.8.7 SCADA System

The SCADA system is operated as two systems. The first being the monitoring of sixteen (16) remote pump stations (PS) and the second is monitoring the WPCF. The following limitations for both systems are noted:

- While the remote PS's report back to the central SCADA computer, there are no alarm notification functions available thru this system. Alarming is currently done with Auto Dialers at each station. While this was a common practice when the system was updated, advances in technology have allowed complete and seamless integration of monitored sites into the SCADA computer for advanced alarm notification. The upgraded alarming functionality would eliminate the need and extra cost of phone lines at each PS's and

would allow more alarms and notifications of communication issues between the sites and the WPCF. We recommend that a package such as WIN911 be used to enhance the alarming capability.

- The WPCF wide controls and SCADA system consist of multiple brands of programmable logic controllers (PLC's). This type of system poses several issues from an integration and maintenance perspective. The PLC's are manufactured by multiple vendors and have differing communications protocols and functionality. Added to this complexity is the expense and logistics of trying to maintain a spare parts inventory for all these PLC's. We recommended that all PLC's be upgraded and standardized to a common open architecture platform.
- The WPCF SCADA computer is running on an outdated operating system using an aging computer. The single computer is located in a small utility closet with tight access. The Lookout Express HMI software is functional but lacks good aftermarket support. We recommended that a new SCADA computer with a current operating system be installed in an open area that will allow full situational awareness by all key personnel. We also recommend that as the SCADA system is expanded plant wide and the operators become more dependent on the SCADA functionality, that a second backup computer be installed in case of failure to improve reliability.
- An important piece of a stable plant wide SCADA system is communications. There have been some issues with reliable communications both within the plant and from the remote sites. We recommend that a radio path study be completed as part of any upgrade. This will revisit the antenna heights, radio frequency and hardware selection. For the WPCF, we would recommend a plant wide industrial wireless Ethernet network. The advantage of this type of communications is security and the ability to connect all out building without excavation.
- Presently, the plant collects data for mandated reporting using a combination of screen shots that are printed from the SCADA computer and grab sample entries from the lab. The process of transferring data from SCADA to a spreadsheet is time consuming and needs constant checking to assure accuracy. To greatly reduce the time required to gather this data and ensure better accuracy, we recommend the installation of an automated reporting package such as XL Reporter. This is an Excel base program that automatically extracts data from the SCADA system at pre-determined intervals. For instance, effluent pH can be collected every 15 minutes, recorded for the day and minimum / maximum values documented. The report can reset at midnight and print automatically. A new page is created each day and a new month created when needed. All of these files are stored for easy retrieval. As this is Excel based, the forms are created to match any state or local reports that are required.

5.3 SUMMARY OF WPCF NEEDS

The general findings of the existing WPCF evaluation are that much of the WPCF unit processes and equipment are nearing the end of their useful lives and should be considered for replacement or major rehabilitation. A summary of the major findings and replacement needs are shown in Table 5-14.

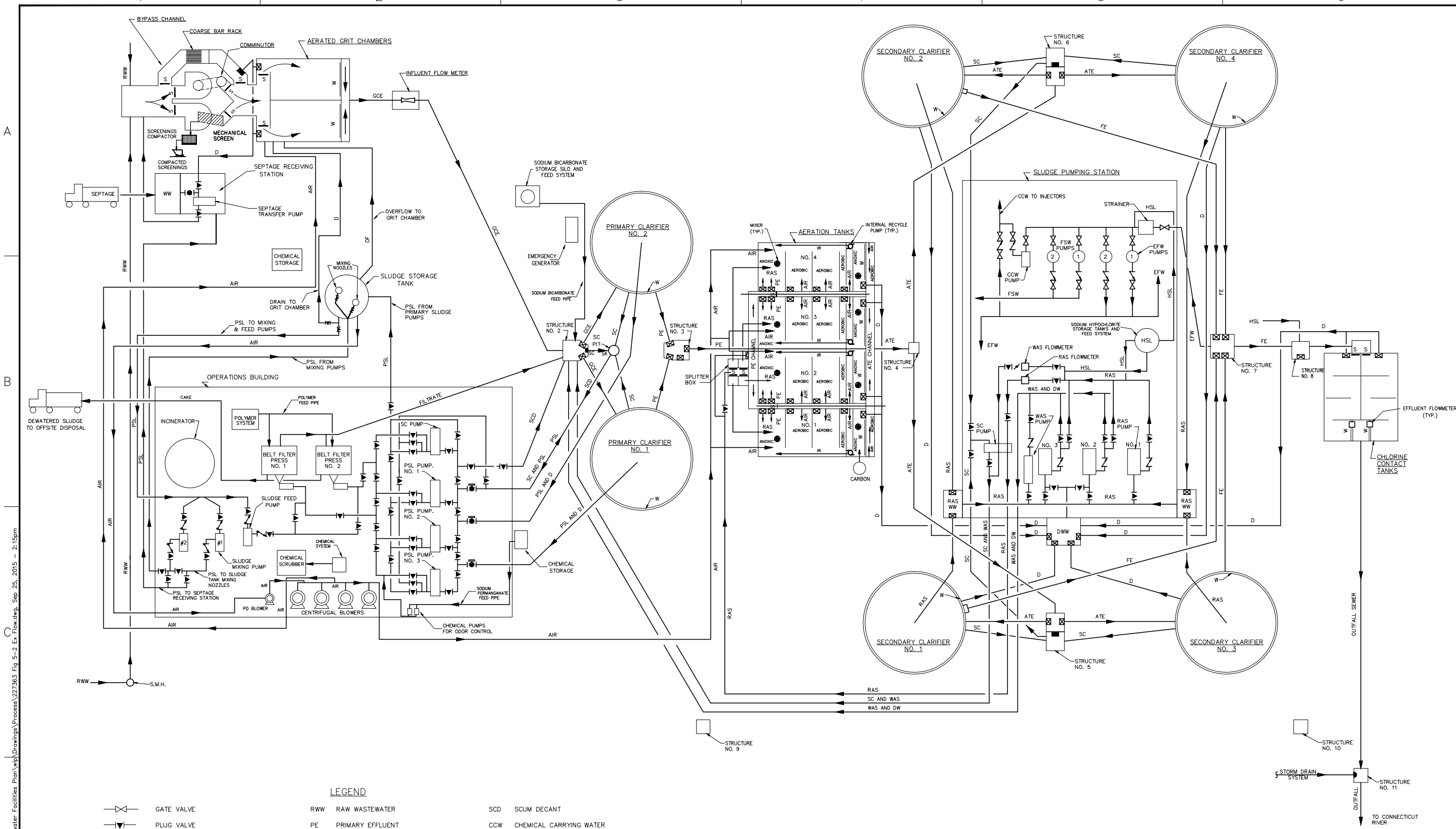
Table 5-14: Summary of Needs and Opportunities for Existing Facilities

Driver	Process	Need/Opportunity	Reason
Operations and/or Capacity	Carbon Addition System	Investigate type, capacity, configuration and necessity of the system	Optimize plant performance, high operations cost
	Sludge Processing	Evaluate raw sludge management alternatives and needed capacity	Avoid co-settling in primary clarifier

Driver	Process	Need/Opportunity	Reason
	Plant Water System	New effluent plant water system	Limited capacity, aging infrastructure, and difficult to operate
Replacement, Rehabilitation, and/or Reliability	Preliminary Treatment	New headworks building to enclose the new screens New motorized clamshell hoist and aeration system or other grit removal equipment for the grit chamber Repair concrete for grit chambers	End of useful life. Existing system outdoor, difficult to maintain, inefficient and generate odors
	Primary Treatment	New sluice gates and primary clarifier equipment New mixer for scum pit Repair concrete for primary clarifiers & Structure No.2 Provide primary clarifiers bypass Replace handrails Replace scum shear gate	Operational issues and end of useful life Internal carbon source to improve nitrogen removal
	Aeration Tanks	New aeration blowers New aeration control system Tanks improvements and modifications including minor concrete repairs; and new baffles, diffusers, froth spray system, influent gates, internal recycle pumps, instrumentation, handrails, and mixing system	Existing blowers oversized and inefficient Existing aeration system outdated and does not function properly Accommodate for better nutrient removal and operational flexibility Energy savings
	Secondary Clarifiers	New mechanisms, weirs, and baffles New mixers at Structures 5, 6, and 7 New influent and effluent gates Replace handrails	Near end of useful life Operational issues Regulatory requirement
	RAS/WAS Pump Station	New RAS, WAS and secondary scum pumps New flowmeters	End of useful life. Need new equipment Improve sludge management

Driver	Process	Need/Opportunity	Reason
		Roof replacement	
	Sludge Processing	New primary sludge pump	End of useful life
		New sludge dewatering system	Existing BFPs labor intensive and generate odors
		New odor control system	
		Discontinue co-settling	Odors, process upsets
	Septage Receiving Station	New transfer pump	End of useful life
	Polymer Feed System	New polymer system	End of useful life, large foot print and operational issues
	Disinfection system	New chemical storage tank and feed pump	Aging equipment
		New sodium hypochlorite carrying water pump	
		Repair PVC piping to inject sodium hypochlorite into RAS, WAS, and effluent water lines	Regulatory requirement and operational issues, odor control
		Update instrumentation and controls	
	Misc. buildings, power/electricity	In plant piping, update heating and ventilation equipment	End of useful life and operational issues
		Upgrade electrical infrastructure	O&M cost savings
		New vehicle wash station	
		Upgrade SCADA system	
	Support Facilities	Demolish Incinerator and Rehab Building	Need for better utilization existing space, need additional space for staff, and outdated lab
		Demolish or remodel Operations Building including upgrade of heating system and electrical components, and provide new laboratory and office space	End of useful life
		Provide emergency power to diesel fuel pumps	

22x34 SHEET
1:1



LEGEND

	GATE VALVE	RWW	RAW WASTEWATER	SCD	SCUM DECANT
	PLUG VALVE	PE	PRIMARY EFFLUENT	CCW	CHEMICAL CARRYING WATER
	BALL VALVE	ATE	AERATION TANK EFFLUENT	EFW	EFFLUENT FLUSHING WATER
	CYLINDER OPERATED BALL VALVE	B	BYPASS	FSW	FOAM SPRAY WATER
	CHECK VALVE	PSL	PRIMARY SLUDGE	DW	DEWATERING
	BUTTERFLY VALVE	RAS	RETURN ACTIVATED SLUDGE	D	DRAIN
S	SLIDE GATE	WAS	WASTE ACTIVATED SLUDGE	WW	WET WELL
	SLUICE GATE	FSL	FILTERED SLUDGE	DWW	DEWATERING WET WELL
W	WEIR	AS	ASH SLURRY	FE	FINAL EFFLUENT
	FLAP VALVE	SC	SCUM	SK	SKIMMER
SMH	SEWER MANHOLE	GCE	GRIT CHAMBER EFFLUENT	HSL	SODIUM HYPOCHLORITE SOLUTION
	SHEAR GATE	IR	INTERNAL RECYCLE	OF	OVERFLOW

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DESIGNED BY: AH
DRAWN BY: AH
CHECKED BY: MJB/PAD
227363 FIG 5-2 EX FLOW.DWG

EXISTING PROCESS FLOW DIAGRAM

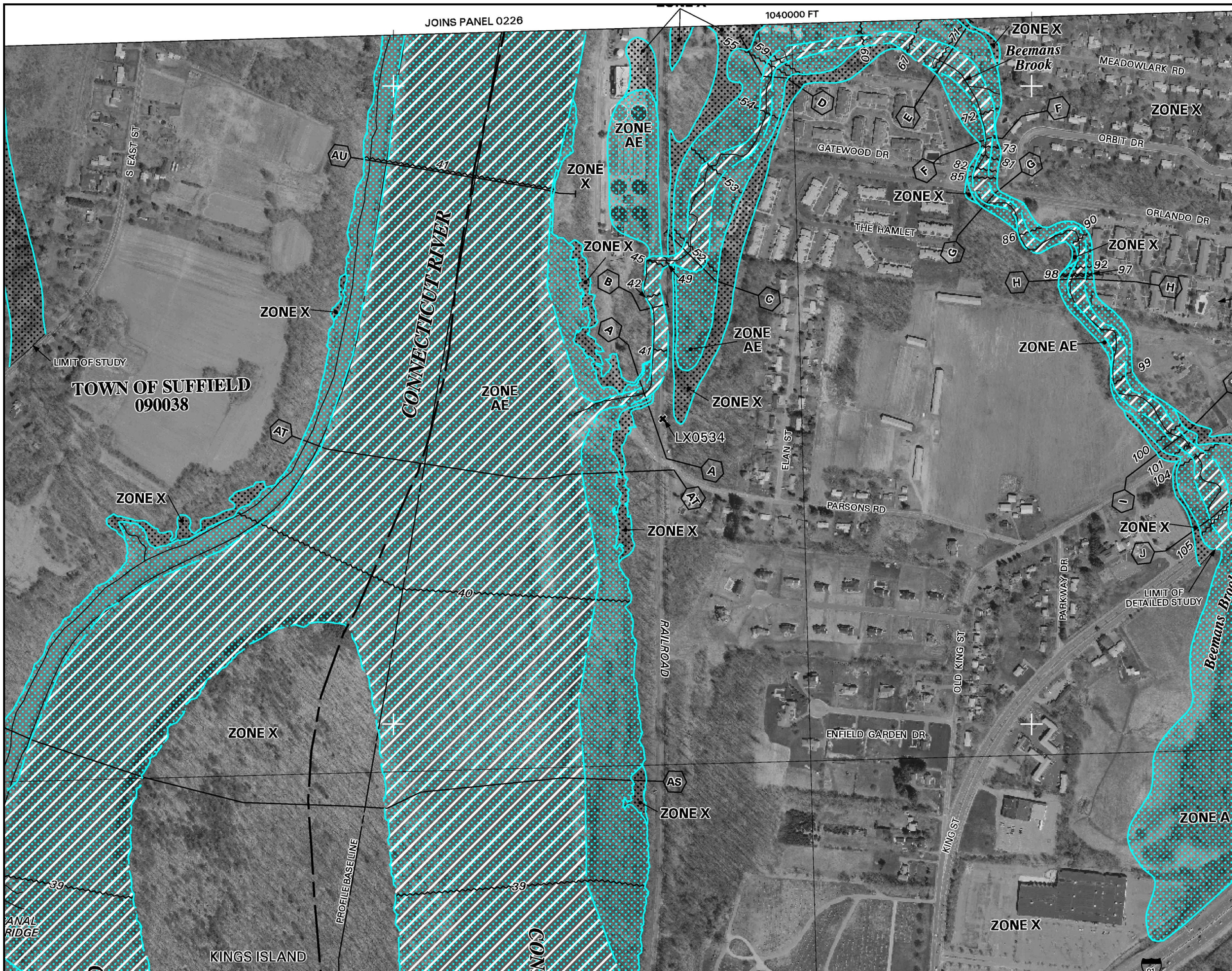
TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO.: 227363
DATE: SEPTEMBER 2015
SCALE: NONE
SHEET: 1 OF 1

FIG 5-2

\\wc\shared\Projects\227363 Town of Enfield CT-Wastewater Facilities Plan\wip\Drawings\Process\227363 Fig 5-2 Ex Flow.dwg, Sep 25, 2015 - 2:15pm



od Insurance is available in this community, contact you
nal Flood Insurance Program at (800) 638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0228F

FIRM

FLOOD INSURANCE RATE MAP

HARTFORD COUNTY,
CONNECTICUT
(ALL JURISDICTIONS)

PANEL 228 OF 675

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ENFIELD, TOWN OF	090028	0228	F
SUFFIELD, TOWN OF	090038	0228	F
WINDSOR LOCKS, TOWN OF	090042	0228	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

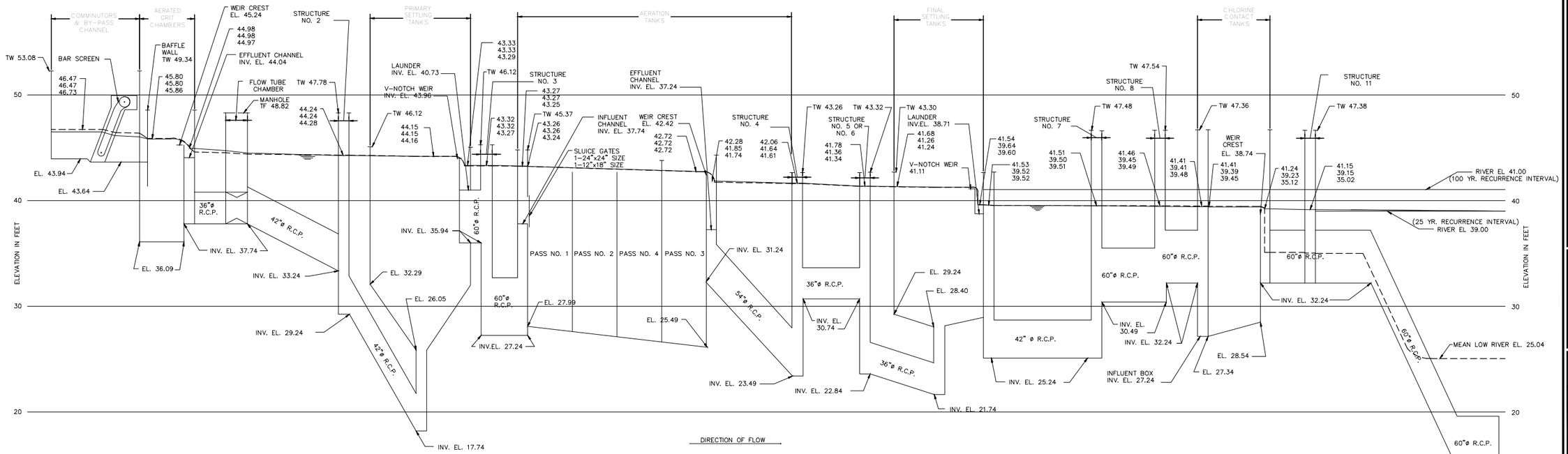
MAP NUMBER
09003C0228F

EFFECTIVE DATE:
SEPTEMBER 26, 2008

Federal Emergency Management Agency

FIG 5.3

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



HYDRAULIC PROFILE

SCALE: HOR. NO SCALE
VER. 1" = 5'

BASIS OF HYDRAULIC PROFILES

FLOW DESCRIPTION	SEWAGE FLOW	*PERCENT RETURN SLUDGE	RETURN SLUDGE FLOW	NUMBER OF TANKS IN SERVICE
FUTURE PEAK HOURLY	17 MGD	100	10 MGD	2 CHLORINE CONTACT TANKS 4 FINAL SETTLING TANKS 4 AERATION TANKS 2 PRIMARY SETTLING TANKS 2 AERATED GRIT CHAMBERS 2 SCREENS/COMMINUTORS
DESIGN AVERAGE	10 MGD	100	10 MGD	1 CHLORINE CONTACT TANK 3 FINAL SETTLING TANKS 3 AERATION TANKS 1 PRIMARY SETTLING TANK 1 AERATED GRIT CHAMBER 1 SCREEN/COMMINUTOR

* BASED ON DESIGN AVERAGE FLOW

ELEVATION LEGEND

46.11 — WATER SURFACE ELEVATION AT FUTURE PEAK HOURLY FLOW, 100-YR RIVER LEVEL

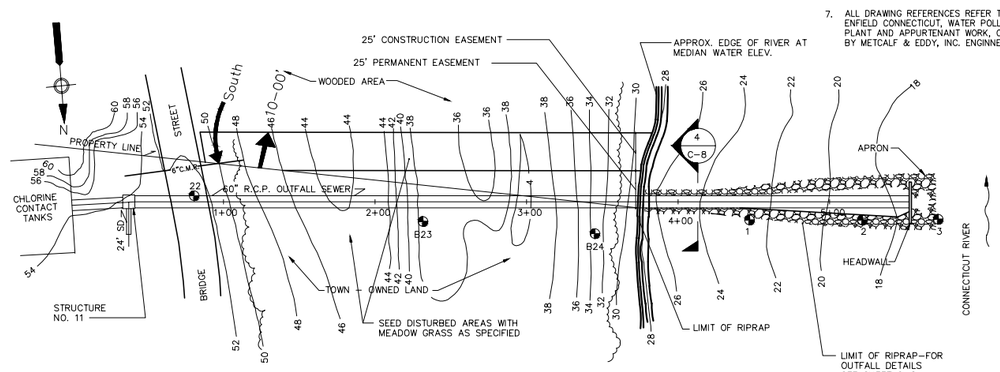
45.10 — WATER SURFACE ELEVATION AT FUTURE PEAK HOURLY FLOW, 25-YR RIVER LEVEL

44.99 — WATER SURFACE ELEVATION AT DESIGN AVERAGE FLOW, MEAN RIVER LEVEL

TW — TOP OF EXTERIOR WALL

NOTES:

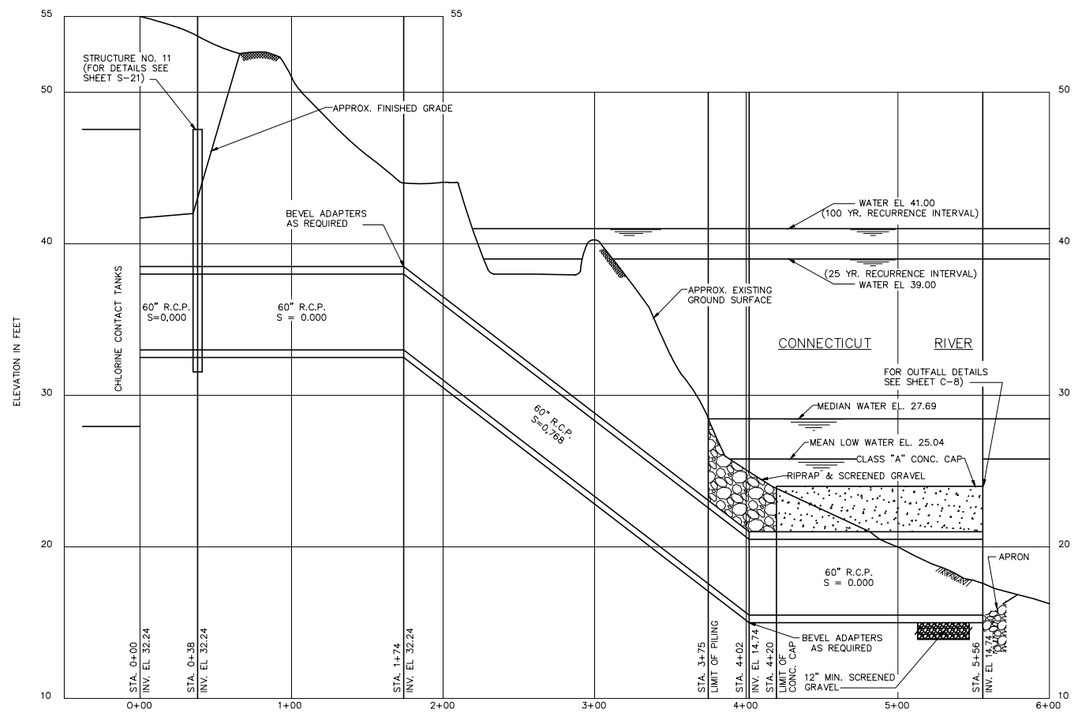
1. ADDITIONAL FLOW RESULTING FROM THE PLANTS WASTEWATER SYSTEM, PROCESS WATER AND RECYCLED FLOWS OTHER THAN RETURN SLUDGE FLOWS HAVE BEEN INTENTIONALLY NEGLECTED.
2. THE HYDRAULIC PROFILE FOR 17 MGD IS BASED ON CONNECTICUT RIVER ELEVATIONS OF 39.0 AND 41.0 FEET, WHICH HAVE 25 AND 100 YEAR RECURRENCE INTERVALS, AND INCLUDES STORMWATER DISCHARGE INTO STRUCTURE NO. 11.
3. ELEVATIONS INDICATED REFER TO USGS MEAN SEA LEVEL DATUM, NAVD88, UNLESS NOTED OTHERWISE.
4. ORIGINAL PIPE INVERT ELEVATIONS AND MEAN/MEDIAN SURFACE WATER ELEVATIONS WERE CONVERTED FROM NGVD29 TO NAVD88 WITH A -0.76' CORRECTION. ALL ABOVE GRADE ELEVATIONS WERE RESURVEYED IN 2015 BY PEREIRA ENGINEERING, LLC.
5. FLOOD ELEVATIONS PROVIDED BY FEMA FLOOD INSURANCE STUDY NUMBER 09001CV003B, REVISED SEPTEMBER 16, 2011. PROCESS SURCHARGE ELEVATIONS ARE BASED ON CONNECTICUT RIVER SURFACE ELEVATIONS, HOWEVER, THE SURROUNDING LAND WILL BE FLOODED BY BEEMAN'S BROOK.
6. ACCORDING TO TR-16, 2011 EDITION, TREATMENT FACILITIES SHOULD PROVIDE UNINTERUPTED SERVICE UNDER 25-YR FLOOD CONDITIONS, AND SHOULD BE PROTECTED AGAINST DAMAGE UNDER 100-YR FLOOD CONDITIONS.
7. ALL DRAWING REFERENCES REFER TO "TOWN OF ENFIELD CONNECTICUT, WATER POLLUTION CONTROL PLANT AND APPURTENANT WORK, CONTRACT 1969-1" BY METCALF & EDDY, INC. ENGINNEERS.



OUTFALL PLAN

SCALE: 1" = 50'-0"

NOTE: STEEL SHEET PILING SHALL BE INSTALLED FROM STA. 3+75 TO THE END OF THE OUTFALL.
ALL CONTOURS SHOWN RELATIVE TO USGS MEAN SEA LEVEL DATUM NGVD29.



OUTFALL PROFILE

SCALE: HOR. 1" = 50'-0"
VER. 1" = 5'-0"

BAR SCALE
1" = 50'-0"
CHECK GRAPHIC SCALE BEFORE USING

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DESIGNED BY: CCK
DRAWN BY: CCK
CHECKED BY: MJB/PAD
2015.09.24_HYDRAULIC_PRF.dwg

EXISTING HYDRAULIC PROFILE

TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO.: 227363
DATE: JULY 2015
SCALE: AS NOTED
SHEET: 1 OF 1

FIG 5.4

22x34 SHEET
1:1

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6. ALTERNATIVES ANALYSIS

6.1 PURPOSE AND OVERVIEW

The purpose of this section is to document the evaluation of alternatives considered for a number of key collection system and WPCF upgrade alternatives.

6.2 EVALUATION OF BIOLOGICAL TREATMENT ALTERNATIVES

6.2.1 Development of Alternatives

Consistently achieving very low nitrogen levels in treated wastewater will require some modifications to the biological treatment process. A number of processes have the potential to meet future loading conditions and effluent permit requirements. However, there are many factors that may influence the level of treatment and reliability possible from such systems. These factors include the potential for shock and toxic loads, the impacts of wet weather flows, and other conditions that impact plant performance.

To enhance nitrogen removal capabilities and improve wet weather flow management, several biological treatment processes were evaluated with respect to capital, operation and maintenance (O&M), site layout, process control flexibility, as well as other non-economic factors. All alternatives were developed based on the 20-year projection of flows and loads established in Section 3. Each alternative is capable of meeting the anticipated effluent criteria.

Four wastewater treatment configuration alternatives were evaluated including: (1) ballasted biological treatment process for enhanced secondary treatment (Biomag); (2) modifications for a conventional four-stage Biological Nutrient Removal (BNR) process for nitrogen removal; (3) modifications for a Variable Operating Mode (VOM) BNR process with multistage zones for nitrification / denitrification and wet weather flow management; and (4) Integrated Fixed-Film Activated Sludge (IFAS).

Each of these alternatives will be discussed in the following sections including economic and non-economic evaluations of each alternative.

6.2.2 Common Facilities

The four (4) treatment alternatives evaluated address the permit requirements and improve nitrogen removal capabilities. Common to each alternative is the general upgrade of the wastewater facility to correct deficiencies identified in Section 5, including, but not limited to, the installation of headworks upgrades, sludge pumping station upgrades including new return activated sludge (RAS), waste activated sludge (WAS), and scum pumps, new equipment for the primary and secondary clarifiers, new chlorination system, and new plant water system.

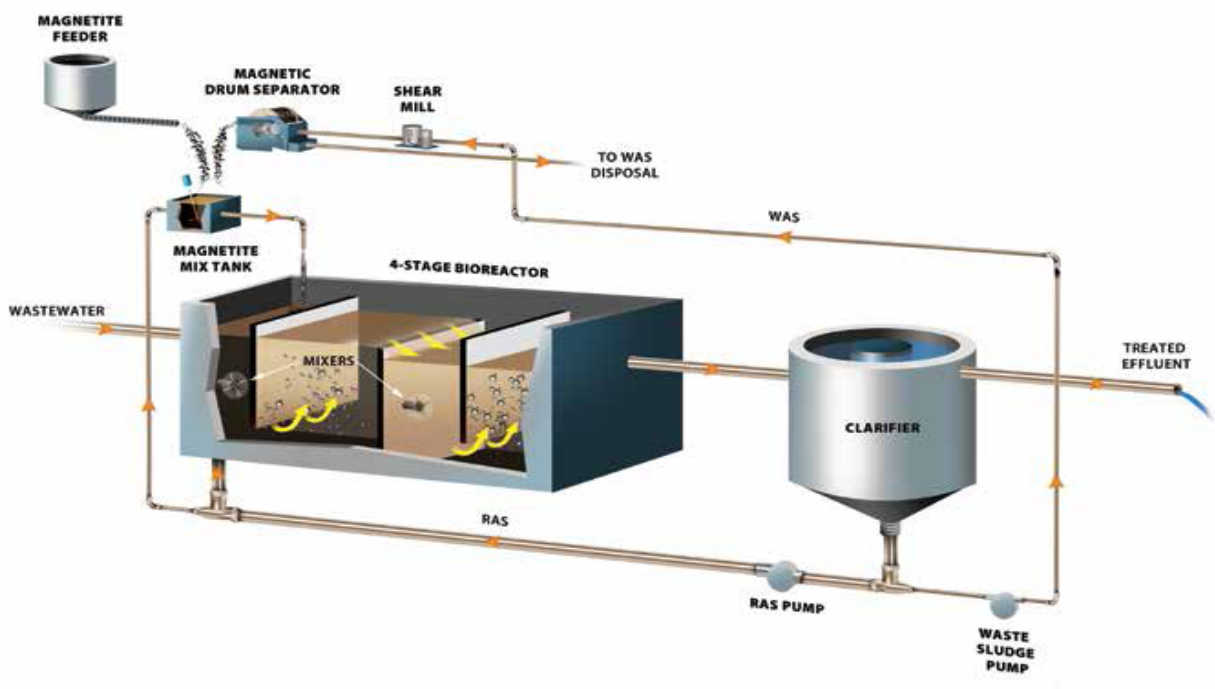
6.2.3 Do Nothing Alternative

Before investigating each of the processes mentioned earlier, the "do nothing" alternative must be considered. This alternative essentially includes leaving the WPCF in its existing condition, with no upgrades to replace aged equipment, improve performance during wet weather flows, address odors, or improve nitrogen removal. The do nothing alternative is not feasible at the Enfield WPCF for several reasons: because it does not have the capacity to control objectionable odors reliably and address the nitrogen removal goals. Without a reconfiguration of the existing process, the plant will not be able to consistently treat the estimated future flows and loads and meet the permit requirements. Failure to modernize the WPCF will result in effluent permit violations, with potential penalties and fines imposed on the Town. The only way to achieve the required treatment is to upgrade the WPCF. Therefore, the "do nothing" alternative will not be investigated further.

6.2.4 Alternative 1 – BIOMAG Process

The BioMag process differs from a conventional activated sludge process in that it introduces the ballasting agent, magnetite, to the activated sludge, thereby increasing the specific gravity of the sludge and subsequently the settling rate. The BioMag system uses a side stream process split off from the normal return activated sludge (RAS) flow. This side stream is directed to a small ballast mix tank where new and recovered magnetite is blended with the mixed liquor and embedded into the biological floc. The ballasted biosolids are then conveyed back to the biological process to enhance settling in the secondary clarifiers. Similar to any other activated sludge process, a portion of the settled solids are removed from the process as waste activated solids (WAS). With the BioMag process, the WAS is first sent through a magnetite recovery process where the ballast is recovered from the floc for reuse in the process as shown in Figure 6-1.

Figure 6-1: BIOMAG Process Configuration
(Evoqua conceptual proposal, February 2015)



Evoqua's Biomag technology was evaluated. The required reactor volumes and equipment needed for the BioMag Alternative were based on a technical proposal provided by Evoqua. Process calculations and industry literature was

reviewed to confirm the adequacy of the Evoqua proposal. The BioMag process consists of anoxic zones, aeration zones, post anoxic zones, and reaeration zones (4-stage Bardenpho configuration). The conceptual design consists of the following modifications:

- No additional reactor volume is required to meet the effluent permit limits. This process will utilize the existing four aeration tanks, which will be fitted with partition walls to form anoxic and aerobic zones.
- Aeration blowers will be required to supply air to the aerated zones of BioMag system. The existing centrifugal blowers are oversized, inefficient and have reached the end of their useful design life. Evoqua recommended four new Positive Displacement (PD) blowers (3 duty/1 standby).
- Fine-bubble diffusers will be necessary to supply air to the aerated zones of the reactors.
- Mixing system will be required in the anoxic zones. Mixer types such as submersible mixers, hyperbolic mixers, floating mixers, and compressed gas mixing were evaluated in section 6.5 to determine which type is most efficient and cost-effective. The compressed gas mixing system was selected based on this preliminary evaluation.
- A new building will be required to house the magnetite recovery equipment. This building will be located west of the existing aeration tanks.
- A silo is required for onsite storage of magnetite to allow for periodic bulk delivery. Virgin magnetite is fed from the storage silo to a ballast mix tank using a pneumatic conveyance system.
- A mechanical in-line shear mill is required to condition the waste sludge to enhance separation of the magnetite from the floc.
- Magnetite is recovered from the waste sludge using a magnetic drum separator. Ballasted waste sludge flows through the drum sump where magnetic forces created by a stationary array of magnets located behind the rotating drum attract the magnetite to the drum. The drum rotates in the opposite direction of the sludge flow and lifts magnetite up out of the sump to be scraped off for re-use in the ballast mix tank.
- Internal Mixed Liquor Recycle (IMLR) pumps will be required to recycle mixed liquor and nitrate from the aeration zones to the anoxic zones on the upstream end of the reactors.
- The existing return activated sludge (RAS) pumps are undersized and in need of replacement. The recommended RAS pumping system will consist of three pumps (2 duty/1 standby), rated to pump 80% of summer maximum day influent flow based on TR-16 recommendations.
- The existing waste activated sludge (WAS) pumps are undersized and in need of replacement. The recommended WAS pumping system consists of two pumps (1 duty/1 standby).
- An external carbon source is required to accelerate the denitrification process. It is anticipated that Micro-C will be used to provide carbon addition.
- An alkalinity feed system is required to restore alkalinity which has been lost due to the nitrification process. It is anticipated that Sodium Hydroxide (NaOH at 25%) will be used to provide alkalinity. The feed system will require chemical feed pumps and chemical storage totes/tanks.

Tables 6-1 and 6-2 summarize the conceptual design criteria and the proposed configuration for the BioMag Alternative, respectively. For more details, refer to Appendix K-1 for Evoqua's conceptual proposal.

Table 6-1: BioMag Alternative – Conceptual Design Summary

Parameter	Quantity	Design Criteria
Number of Biological Treatment Trains	4	Existing
Biological Treatment Volume (MG)	2.83	Existing
Aeration System	1	Fine bubble aeration
Aeration Blowers	4	PD blowers
Mixing system	1	Compressible gas mixing with screw compressor and nozzles
IMLR pumps	4	Submersible Propellers with VFDs
BioMag Building	1	28'W x 30'L
Ballast Storage & Feed System		
Ballast Mix Tank Mixer	1	3 HP – Vertical Shaft
Magnetite Storage	1	25 Ton Storage Silo
Compressed Air System	1	10 HP air compressor, air receiver and desiccant dryer
Ballast Recovery System		
Magnetite Drum Separator	2	7.5 HP each
Shear Mill	2	40 HP each
Ballast Mix Tank Discharge Pump	2	Dry pit submersible – 200 gpm each
Magnetic Drum WAS Pump	2	Dry pit submersible – 150 gpm each

The BioMag Alternative does not have influent screening requirements for WPCFs with primary settling tanks. In addition to alkalinity and carbon addition, the process will also require the addition of magnetite and polymer, which will increase operation costs.

Table 6-2: BioMag Alternative – Aeration Tanks Proposed Configuration

Zone	No. of Zones	Dimensions (ft)	Volume (gal)	HRT @ MMF – 7.6 MGD (hours)	HRT @ Permitted Flow - 10 MGD (hours)
Winter Mode					
Anoxic	4	61.2 L x 24 W x 16.1 D	707,539	2.2	1.7
Aerobic	4	183.6 L x 24 W x 16.1 D	2,122,616	6.7	5.1
Winter Mode Total		**244.8 L x 24 W x 16.1 D**	**2,830,154**	**8.9**	**6.8**
Zone	**No. of Zones**	**Dimensions (ft)**	**Volume (gal)**	**HRT @ MMF – 7.6 MGD (hours)**	**HRT @ Permitted Flow - 10 MGD (hours)**
Summer Mode					

Zone	No. of Zones	Dimensions (ft)	Volume (gal)	HRT @ MMF – 7.6 MGD (hours)	HRT @ Permitted Flow - 10 MGD (hours)
Primary Anoxic	4	61.2 L x 24 W x 16.1 D	707,539	2.2	1.7
Primary Aerobic	4	122.4 L x 24 W x 16.1 D	1,415,077	4.5	3.4
Secondary Anoxic	4	49.2 L x 24 W x 16.1 D	568,806	1.8	1.4
Secondary Aerobic	4	12.0 L x 24 W x 16.1 D	138,733	0.4	0.3
Summer Mode Total		**244.8 L x 24 W x 16.1 D**	**2,830,155**	**8.9**	**6.8**

Notes:

MMF=Maximum Month flow
HRT=Hydraulic Retention Time
MGD=Million Gallons Per Day

6.2.5 Alternative 2 – Four-Stage BNR Process

The four stage BNR process is a continuous flow suspended growth process with alternating anoxic/aerobic/anoxic/aerobic stages. The activated sludge process can be briefly defined as a system in which microorganisms are continuously circulated and alternatively aerated so as to promote consumption of organic compounds and removal of nutrients from the wastewater. The chief purpose of the process is to reduce the quantity of organic material (as measured by the BOD) and nutrients (nitrogen) contained in the wastewater. The reduction of organic material is accomplished biologically by the bacteria and other microorganisms in the system, which utilize the organic matter as food for their growth and reproduction and, in so doing, reduce it to end products such as carbon dioxide and water. Fine bubble diffusers provide dissolved oxygen needed by the microorganisms and provide mixing of the aeration tanks. Mixing is required to maintain complete solids suspension and to ensure contact between the activated sludge microorganisms and the incoming wastewater.

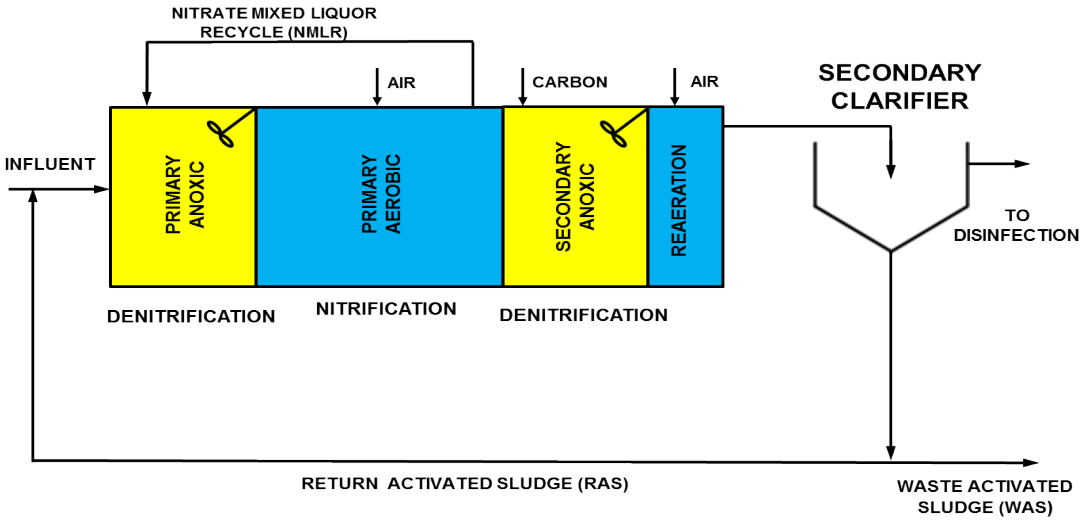
BNR processes for removal of nitrogen are typically accomplished in either a two-stage or a four-stage process. In either system, flow enters a primary anoxic zone where it is mixed with RAS and nitrified recycle from the downstream aerobic zone. The anoxic zone is devoid of free oxygen and is where some of the BOD is removed and used as a carbon source by the bacteria, and where most of the nitrates are reduced. The flow then proceeds to an aerobic zone where oxygen is added, the remaining BOD is oxidized, and the wastewater is nitrified, meaning that the ammonia nitrogen in the influent is oxidized to nitrate. Most of this nitrate formed in this zone is internally recycled back to the primary anoxic zone where the bacteria in this zone, in the absence of oxygen and in the presence of a carbon source, utilize the nitrate oxygen. This reduces the nitrate to nitrogen gas, which then leaves the process as a gas. The nitrogen removal at this point can typically exceed 80%. However, in some instances, this is insufficient to meet some of the more stringent total nitrogen requirements.

To achieve even greater nitrogen removal requires the addition of a secondary anoxic zone after the aerobic zone, followed by a secondary aerobic zone as shown in Figure 6-2. This second anoxic zone reduces the remaining nitrates that are generated in the aerobic zone and occasionally requires the addition of an external carbon source for the denitrifying bacteria. This carbon source is sometimes necessary to achieve the low levels of nutrient removal. An additional secondary aerobic zone is then added to strip the entrained nitrogen gas prior to clarification.

Settling in a final settling tank is required following the four-stage process to separate the biomass from the treated wastewater. A large portion of the settled sludge containing the bacteria is returned to the primary anoxic zone to maintain the correct amount of biomass in the tank. The remainder of the biomass, consisting of the day's sludge production, is wasted. Sludge wasting is controlled so that the required aerobic solids retention time (SRT) is maintained. This will insure that the nitrifier population will be present for wastewater treatment. Internal recycle, where

the nitrates are returned from the primary aerobic zone to the primary anoxic zone, is typically 200 - 400% of the influent flow.

Figure 6-2: Four-Stage BNR Process Configuration



Our conceptual design for this alternative consists of the following modifications:

- No additional reactor volume is required to meet the effluent total nitrogen permit limits. This process will utilize the existing four aeration tanks, which will be fitted with partition walls to form anoxic and aerobic zones.

- Aeration blowers will be required to supply air to the aeration zones of the activated sludge system. The existing centrifugal blowers are oversized, inefficient and they reached the end of their useful design life. New hybrid blowers have been chosen for the purposes of this evaluation. The recommended blower system consists of four blowers (3 duty/1 standby).
- Fine-bubble diffusers will be necessary to supply air to the aerated zones of the reactors.
- A mixing system will be required in all zones of the reactors with the exception of the first aerobic zones. Mixer types such as submersible mixers, hyperbolic mixers, floating mixers, and compressed gas mixing were evaluated in Section 6-5 to determine which type is most efficient and cost-effective. The compressed gas mixing system was selected based on this preliminary evaluation.
- The existing Internal Mixed Liquor Recycle (IMLR) pumps are oversized, installed in the wrong location, and need to be replaced. The new four submersible axial flow pumps will be installed at the downstream end of the aeration zones to recycle nitrate rich mixed liquor to the primary anoxic zones. Each pump will be rated for 75% of the max monthly flow (combined 300%).
- The existing return activated sludge (RAS) pumps are undersized and in need of replacement. The recommended RAS pumping system will consist of three pumps (2 duty/1 standby), rated to pump 100% of the maximum weekly flow based on a secondary clarifier state-point analysis.
- The existing waste activated sludge (WAS) pumps are undersized and in need of replacement. The recommended WAS pumping system shall consist of two pumps (1 duty/1 standby).

- An external carbon source may be required for denitrification in the post-anoxic zones. It is anticipated that Micro-C will be used to provide carbon addition. The feed system will require chemical feed pumps and chemical storage totes/tanks.
- An alkalinity feed system may be required to restore alkalinity which has been lost due to nitrification. It is anticipated that Sodium Hydroxide (NaOH at 25%) will be used to provide alkalinity.

Tables 6-3 and 6-4 summarize the conceptual design criteria and the proposed configuration for the four-stage BNR process alternative, respectively.

Table 6-3: 4-Stage BNR Process Alternative – Conceptual Design Summary

Parameter	Quantity	Design Criteria
Number of Biological Treatment Trains	4	Existing
Biological Treatment Volume (MG)	2.83	Existing
Fine Bubble Aeration	1	9-inch dia. membrane disc diffusers
Aeration Blowers	4	Hybrid blowers with VFDs
Mixing System	1	Compressible gas mixing with screw compressor and nozzles
IMLR Pumps	4	Submersible propeller with VFDs

The conventional 4-stage BNR process without a contact stabilization mode (as provided in the Variable Operating Mode Alternative) to handle storm flows would be unable to protect the process against secondary clarifiers overload. Limited flexibility will be provided to the operators and more carbon addition would be needed to achieve the nitrogen goal limits, which makes this process challenging and costly to operate and maintain.

Table 6-4: 4-Stage BNR Process – Aeration Tanks Proposed Configuration

Zone	No. of Zones	Dimensions (ft)	Volume (gal)	HRT @ MMF – 7.6 MGD (hours)	HRT @ Permitted Flow -10 MGD (hours)
Winter Mode					
Anoxic	4	61.2 L x 24 W x 16.1 D	707,539	2.2	1.7
Aerobic	4	183.6 L x 24 W x 16.1 D	2,122,616	6.7	5.1
Winter Mode Total		**244.8 L x 24 W x 16.1 D**	**2,830,154**	**8.9**	**6.8**
Summer Mode					
Primary Anoxic	4	61.2 L x 24 W x 16.1 D	707,539	2.2	1.7
Primary Aerobic	4	122.4 L x 24 W x 16.1 D	1,415,077	4.5	3.4
Secondary Anoxic	4	49.2 L x 24 W x 16.1 D	568,806	1.8	1.4
Secondary Aerobic	4	12.0 L x 24 W x 16.1 D	138,733	0.4	0.3
Summer Mode Total		**244.8 L x 24 W x 16.1 D**	**2,830,154**	**8.9**	**6.8**

Notes:
MMF=Maximum Month flow
HRT=Hydraulic Retention Time

6.2.6 Alternative 3 – Variable Operating Mode (VOM) – BNR Process

The Variable Operating Mode (VOM) process entails three configurations including: (1) VOM-1, 2-stage Modified Lutzack-Ettinger (MLE) process for winter mode BNR, (2) VOM-2, 4-Stage Bardenpho process for summer mode BNR, and (3) VOM-3, contact stabilization mode for wet weather operation. The following is a brief description of each mode of operation.

1. VOM-1: The 2-stage MLE mode of operation (anoxic and aerobic configuration) take advantage of the carbonaceous substrate available in the influent wastewater by placing the anoxic zone upstream of the nitrification reactor (aerobic zone). In this configuration, nitrates included in the RAS flow are mixed with influent wastewater and reduced to nitrogen gas in a predenitrification reactor upstream of the main aerobic zone. However, the total nitrogen removal efficiency of the MLE process is limited by the quantity of nitrate recycled back to the anoxic zone in the RAS flow and through the recirculation of mixed liquor recycle from the end of the aerobic stage to the beginning of the anoxic stage as illustrated in Figure 6-3.

   The MLE mode of operation provides the capability to reduce Total Nitrogen (TN) below the target level but requires a significant amount of aerated tank volume to accomplish consistent cold-weather nitrification. During lower loading and/or warmer weather conditions, less volume is required and allows use of a portion of the aerated volume to be used for other purposes.

2. VOM-2: The 4-stage Bardenpho process (Anoxic, Aerobic, Anoxic, and Aerobic configuration) will function in a similar fashion to alternative 2 but with less aerobic volume. Changing from the MLE process to a Bardenpho configuration will be possible when lower loads and / or higher temperatures allow consistent nitrification in the reactor volume provided in the aerobic zones.

3. VOM-3: Under extreme wet weather flow conditions, the process can operate in the contact stabilization mode to protect against secondary clarifier overload and potential washout. The general configuration of the contact stabilization mode involves re-distributing the inventory of MLSS in the aeration tanks by separating the influent from the RAS. The contact stabilization uses two separate compartments for the treatment of the wastewater and stabilization of the return activated sludge. The stabilized activated sludge is mixed with the influent wastewater in a contact zone. The MLSS concentration in the contact zone is substantially lower than in the stabilization zone. Rapid removal of soluble BOD occurs in the contact zone, and colloidal and particulate organics are captured in the activated sludge floc for degradation later in the stabilization zone. In the stabilization zone, RAS will be exposed to anoxic and aerobic conditions in the primary anoxic zone and the primary aerobic zone, respectively.

Process calculations were performed to determine the reactor volumes and equipment needed for the Variable Operating Mode Alternative. Figure 6-5 illustrates the VOM Alternative flow diagram. Our conceptual design for this alternative consists of the following modifications:

- No additional reactor volume is required to meet the effluent total nitrogen permit limits. This process will utilize the existing four aeration tanks, which will be fitted with partition walls to form anoxic selector zones, anoxic zones, swing zones, aerobic zones, post swing zones and post aerobic zones.
- Aeration blowers will be required to supply air to the aeration zones of the activated sludge system. The existing centrifugal blowers are oversized, inefficient and they reached the end of their useful design life. New hybrid blowers have been chosen for the purposes of this evaluation. The recommended blower system consists of four blowers (3 duty/1 standby).
- Fine-bubble diffusers will be necessary to supply air to the aerobic and swing zones of the reactors.
- Mixing system will be required in all zones of the reactors with the exception of the first aerobic zones. Mixer types such as submersible mixers, hyperbolic mixers, floating mixers, and compressed gas mixing were

evaluated in Section 6-5 to determine which type is most efficient and cost-effective. The compressed gas mixing system was selected based on this preliminary evaluation.

- The existing Internal Mixed Liquor Recycle (IMLR) pumps are oversized, installed at the wrong location, and in need of replacement. The new four submersible axial flow pumps will be installed at the downstream end of the aeration zones to recycle nitrate rich mixed liquor to the primary anoxic zones. Each pump will be rated for 75% of the maximum monthly flowrate (combined 300%).
- The existing return activated sludge (RAS) pumps are undersized and in need of replacement. The recommended RAS pumping system will consist of three pumps (2 duty/1 standby), rated to pump 100% of the maximum weekly flow of 10.3 MGD based on secondary clarifier state-point analysis.
- The existing waste activated sludge (WAS) pumps are undersized and in need of replacement. The recommended WAS pumping system shall consist of two pumps (1 duty/1 standby).
- An external carbon source may be required for denitrification in the post-anoxic zones. It is anticipated that Micro-C will be used to provide carbon addition. The feed system will require chemical feed pumps and chemical storage totes/tanks.
- An alkalinity feed system may be required to restore alkalinity which has been lost due to nitrification. It is anticipated that Sodium Hydroxide (NaOH at 25%) will be used to provide alkalinity.

Tables 6-5 and 6-6 summarize the conceptual design criteria and the proposed configuration for the VOM-BNR process alternative, respectively.

Table 6-5: VOM - BNR Process Alternative – Conceptual Design Summary

Parameter	Quantity	Design Criteria
Number of Biological Treatment Trains	4	Existing
Biological Treatment Volume (MG)	2.87	Existing
Fine Bubble Aeration	1	9-inch dia. membrane disc diffusers
Aeration Blowers	4	Hybrid blowers with VFDs
Mixing System	1	Compressible gas mixing with screw compressor and nozzles
IMLR Pumps	4	Submersible propeller

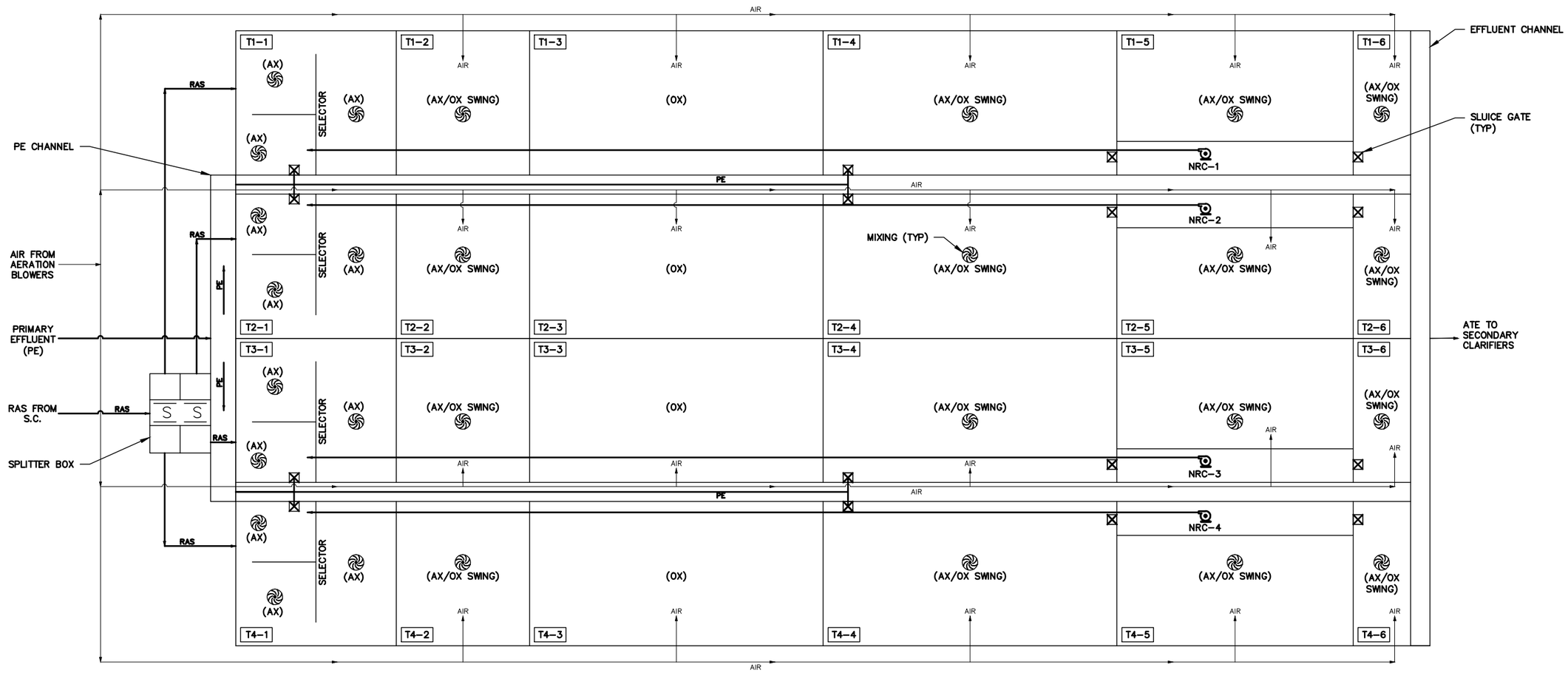
The Variable Operating Mode Alternative will give plant operators maximum flexibility to change the operating modes depending of the season and flow conditions without the use of proprietary equipment. This process is expected to require less carbon addition than the conventional 4-stage BNR process, which makes it less costly to operate and maintain. Also, better nitrogen removal can be expected when compared to other alternatives.

Table 6-6: VOM – BNR Process Alternative – Aeration Tanks Proposed Configuration

Zone	No. of Zones	Dimensions (ft)	Volume (gal)	HRT @ MMF – 7.6 MGD (hours)	HRT @ Permitted Flow -10 MGD (hours)
Winter Mode					
Anoxic	4	61.2 L x 24 W x 16.1 D	707,539	2.2	1.7
Aerobic	4	183.6 L x 24 W x 16.1 D	2,122,616	6.7	5.1
Winter Mode Total		**244.8 L x 24 W x 16.1 D**	**2,830,154**	**8.9**	**6.8**
Summer Mode					
Primary Anoxic	4	61.2 L x 24 W x 16.1 D	707,539	2.2	1.7
Primary Aerobic	4	122.4 L x 24 W x 16.1 D	1,415,077	4.5	3.4
Secondary Anoxic	4	49.2 L x 24 W x 16.1 D	568,806	1.8	1.4
Secondary Aerobic	4	12.0 L x 24 W x 16.1 D	138,733	0.4	0.3
Summer Mode Total		**244.8 L x 24 W x 16.1 D**	**2,830,154**	**8.9**	**6.8**
Wet Weather Mode					
Stabilization	4	122.4 L x 24 W x 16.1 D	1,415,077	4.5	3.4
Contact	4	122.4 L x 24 W x 16.1 D	1,415,077	4.5	3.4
Wet Weather Mode Total		**244.8 L x 24 W x 16.1 D**	**2,830,154**	**9.0**	**6.8**

Notes:

MMF=Maximum Month flow
HRT=Hydraulic Retention Time
MGD=Million Gallons Per Day



VARIABLE OPERATING MODE (VOM) ALTERNATIVE CONCEPTUAL PROCESS FLOW DIAGRAM

SCALE: N.T.S.

LEGEND

ABBREVIATIONS

ATE	AERATION TANK EFFLUENT
AX	ANOXIC ZONE
NRC	NITRIFIED RECYCLE PUMP
OX	OXIC (AEROBIC) ZONE
PE	PRIMARY EFFLUENT
RAS	RETURN ACTIVATED SLUDGE
S	SLIDE GATE
SC	SECONDARY CLARIFIER
T1-1	TRAIN 1, ZONE 1 (TYP FOR ALL ZONES)

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DATE: JULY 2015
SCALE: N.T.S.

FIGURE 6.3

6.2.7 Alternative 4 – IFAS Process

Integrated fixed-film activated sludge (IFAS) process includes any wastewater treatment system that incorporates biofilm support media (biofilm carrier particles) to activated sludge basins and operating the basins with a significant level of MLSS. The IFAS process can use three categories of biofilm: fixed bed, free-floating plastic media, and sponge-type media. The fixed-bed media is held in frames. The plastic media is held in place by screens within anoxic and aerobic cells. The sponge-type media are retained in bioreactors by screens, but unlike plastic media, must be recirculated within the basin due to their tendency to migrate to retention screens. The recirculation enhances biomass sloughing.

The principle of the IFAS system is to enhance BOD and nitrogen removal above the removal that could have been achieved using MLSS in a suspended growth only reactor of like volume. The interaction and exchange between the biofilm and the mixed liquor increases the design complexity relative to activated sludge and IFAS. Suspended growth activated sludge systems have no biofilms and therefore, do not need integrated biofilm and activated sludge models for their design.

For this alternative, the free-floating plastic media (which are the predominant type of media in IFAS systems) was considered. With a specific density slightly less than that of water, the free-floating plastic media is distributed throughout the mixed liquor with the aid of aeration in the aerobic sections or with mixers in anoxic sections. The media are added to reactor tanks with fill ratios ranging from 25 to 67 percent of the tanks' volume, depending on process requirements. These media types work with both coarse and fine bubble aeration. The HDPE media material will not, under normal operation, degrade or require regular replacement, especially if media is manufactured with inclusion of UV inhibitors.

This type of media requires a retaining screen typically 1 mm smaller than the media's smallest significant dimension. Screen types can be of the flat–panel type or flanged-cylindrical type. The screen design should incorporate sufficient screen area to minimize headloss. An air knife may be required to continuously scour the screen.

This alternative will require the existing aeration basins to be converted to IFAS reactors to accommodate the media and equipment. The required reactor volumes and equipment needed for the IFAS Alternative were based on the technical proposal that was provided by Kruger, Inc. Process calculations were prepared and industry literature was reviewed to confirm the adequacy of the IFAS technical proposal. Figure 6-4 illustrate the IFAS conceptual process flow configuration. The conceptual design consists of the following modifications:

- Kruger proposed to retrofit three of the four existing aeration trains into three (3) new process trains, each train comprised of one (1) 2-stage pre-anoxic reactor for denitrification followed by one (1) aerobic IFAS reactor with media for BOD removal and nitrification, one (1) aerobic non-media reactor for polishing and deoxygenation, one (1) 2-stage post anoxic reactor for additional denitrification and (1) re-aeration reactor.
- IFAS media will be inserted into the IFAS zones of the activated sludge system. The media can be made of different shapes and sizes depending on the wastewater characteristics and the selected manufacturer. Most media is made of polyethylene and has a density less than water. The media will be supplied as a part of the IFAS vendor package, and will not require replacement for many years after it is installed.
- Cylindrical screen assemblies will be required and provided by the IFAS manufacturer to keep the media contained in the IFAS reactors. The screens will be made of stainless steel and mounted directly to the tank wall of each IFAS reactor.
- Blowers will be required to air-scour the screen assemblies to prevent excessive growth on the screens. The air scour system shall require two blowers (1 duty/1 standby).
- Aeration blowers will be required to supply air to the aeration and IFAS for aeration and mixing purposes. These blowers must impart enough energy to keep the IFAS reactors completely mixed at all times and to

slough growth from the media. For the purposes of this evaluation, the IFAS manufacturer has recommended four multistage centrifugal blowers (3 duty/1 standby). This process typically requires more energy to provide the scouring needed, and also because medium bubble diffusers are often used.

- The mixing of the media within the IFAS reactors is provided by a medium bubble aeration system supplied by the IFAS manufacturer. Fine-bubble diffusers will be necessary to supply air to the aerated zones of the activated sludge tanks.
- Manufacturer-supplied submersible mixers will be required in the anoxic zones to ensure the zones are completed mixed.
- Internal Mixed Liquor Recycle (IMLR) pumps will be required to recycle mixed liquor and nitrate from the aeration zones to the anoxic zones on the upstream end of the reactors. Pump sizing should be evaluated and confirmed during the project design phase.
- The existing return activated sludge (RAS) pumps are undersized and in need of replacement. The recommended RAS pumping system shall consist of three pumps (2 duty/1 standby), rated to pump 100% of the maximum weekly flow of 10.3 MGD based on TR-16 recommendations.
- The existing waste activated sludge (WAS) pumps are undersized and in need of replacement. The recommended WAS pumping system shall consist of two pumps (1 duty/1 standby).
- An external carbon source is required to accelerate the denitrification process. It is anticipated that Micro-C will be used to provide carbon addition.
- An alkalinity feed system is required to restore alkalinity which has been lost due to the nitrification process. It is anticipated that Sodium Hydroxide (NaOH at 25%) will be used to provide alkalinity. The feed system will require chemical feed pumps and chemical storage totes/tanks.

Tables 6-7 and 6-8 summarize the conceptual design criteria and the proposed configuration for the IFAS Alternative, respectively. For more details, refer to Appendix K-2 for Kruger conceptual proposal.

Figure 6-4: IFAS System Configuration

(Kruger conceptual proposal, March 2015)

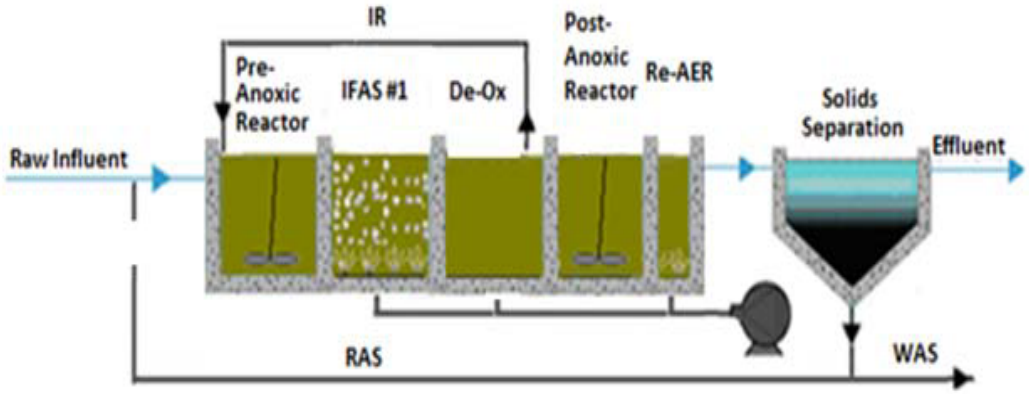


Table 6-7: IFAS Process Alternative – Conceptual Design Summary

Parameter	Quantity	Design Criteria
Number of Process Trains	3	Existing
Biological Treatment Volume (MG)	2.15	Existing
IFAS Media (ft^3)	32,309	High density PE carrier elements
Cylindrical Screen Assemblies	54	Eighteen (18) per reactor
Air Sparge System	1	304L Stainless Steel to scour the screens
Medium Bubble Aeration System	3	One (1) per IFAS reactor
Fine Bubble Aeration System	6	One (1) for each non-media aerobic reactor and each reaeration reactor
Submersible Mixer	12	One (1) for each pre-DN and post-DN reactor
IMLR Wall pumps	3	One (1) per train submersible propeller with VFD
Aeration Blowers	4	Multistage centrifugal blower with VFD
Regenerative Blowers	2	Supplied exclusively for air sparging

The IFAS Alternative requires additional equipment to the typical BNR system equipment including the IFAS media, retention screens and an air scour system for the screens. The IFAS alternative also requires fine screening pretreatment to protect the IFAS media and reactor basins (6mm screen or smaller). The IFAS system requires additional aeration as compared with other BNR systems, which increases the operations cost.

Table 6-8: IFAS Process Alternative – Aeration Tanks Configuration

Zone	No. of Zones	Dimensions (ft)	Volume (gal)	HRT @ MMF – 7.6 MGD (hours)	HRT @ Permitted Flow -10 MGD (hours)
Winter Mode					
Anoxic	3	61.2 L x 24 W x 16.1 D	530,654	1.7	1.3
Aerobic IFAS	3	61.2 L x 24 W x 16.1 D	530,654	1.7	1.3
Non-Media Aerobic	3	122.5 L x 24 W x 16.1 D	1,062,175	3.4	2.5
Winter Mode Total		**244.9 L x 24 W x 16.1 D**	**2,123,483**	**6.7**	**5.1**
Summer Mode					
Pre-Anoxic	3	61.2 L x 24 W x 16.1 D	530,654	1.7	1.3
IFAS Aerobic	3	61.2 L x 24 W x 16.1 D	530,654	1.7	1.3
Non-Media Aerobic	3	61.2 L x 24 W x 16.1 D	530,654	1.7	1.3
Post-Anoxic	3	47.0 L x 24 W x 16.1 D	407,528	1.3	1.0
Re-Aeration	3	14.3 L x 24 W x 16.1 D	123,993	0.4	0.3
Summer Mode Total		**244.9 L x 24 W x 16.1 D**	**2,123,483**	**6.7**	**5.1**

Notes:
MMF=Maximum Month flow
HRT=Hydraulic Retention Time
MGD=Million Gallons Per Day

6.2.8 Economic and Technical Evaluation of Alternatives

6.2.8.1 Evaluation and Selection Process

The preferred alternative will be identified based on an evaluation of costs among the viable alternatives as well as qualitative factors (non-monetary) that may influence the decision process. Cost comparisons are made by taking into account the capital costs to construct each process as well as the yearly operating and maintenance costs.

The proposed alternatives were evaluated based on future primary effluent flows and loads presented in Table 3-5 and according to the expected biological treatment process performance listed in Table 6-9. Each biological treatment process shall clearly demonstrate that the final effluent from the biological treatment process will meet the NPDES permit criteria summarized in Table 2-10 (excluding fecal coliform and chlorine limits), the final effluent requirements shown in Table 6-9, and the General Nitrogen permit requirements shown in Table 6-10.

6.2.8.2 Life Cycle Cost Analysis

6.2.8.2.1 Basis of Cost Estimates

The estimated capital cost of each alternative is based on 2015 costs and does not include escalation factors to account for projects constructed in the future, since the timing of these projects is currently unknown. Building costs include all building support systems such as plumbing, HVAC, and electrical. All costs assume the existing soils have sufficient structural bearing capacity to not require piles for supporting new structures such as buildings and tanks. The costs include the following markups:

Utility Relocation – 1% of Construction Base Cost
General Conditions – 7% of Construction Base Cost
Mobilization, Bond & Insurance – 4% of Construction Base Cost
Overhead – 7% of Construction Base Cost
Profit – 6% of Construction Base Cost
Construction Contingency – 20% of the Construction Cost
Design and Construction Phase Engineering – 20% of the Construction Cost

Capital costs were determined by the quotes received from the suppliers/manufacturers, in addition to estimates for excavation, concrete tanks, buildings, and other necessary equipment and processes.

The annual operation and maintenance (O&M) costs based on electricity and chemical usage for each alternative and assuming other O&M costs such as labor, sludge and equipment maintenance were developed. All costs were based on average flow conditions. Electricity costs were based on a unit cost of $0.12 per kilowatt-hour. The number of equipment units operating under average conditions was estimated, and average run time was approximated in order to develop an average annual electricity cost. Similarly, average annual chemical usage was approximated for sodium hydroxide (alkalinity adjustment), Micro-C (carbon addition), as well as the polymer and magnetite quantities required for the BioMag alternative.

6.2.8.2.2 Alternative Cost Comparison

Tables 6-12 and 6-13 provide the 20 year life cycle cost analysis for the four proposed alternatives. The analysis is important for comparing the alternatives on an equivalent basis over the project life. The life cycle cost analysis is based on estimated capital and present worth of annual costs for the four alternatives as follows:

- Present worth (PW) costs include the capital cost and the totalized 20-year O&M costs. O&M costs were assumed to increase at a rate equal to inflation and therefore the present worth was assumed to be the sum of the annual costs over the 20-year planning period.

- Equivalent Uniform Annual Cost (EUAC) considers the projects value over the expected life. The calculation allows comparison of non-uniform costs as a uniform annual expenditure. For this analysis the capital costs were assumed to be amortized at a rate of 2%, which is then added to the annual O&M costs.

A cost comparison of each alternative is presented in Table 6-11. The cost estimates shown, and any resulting conclusions on project financial or economic feasibility or funding requirements, have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, the final project costs will vary from estimates presented here.

Table 6-9: Proposed Biological System Effluent Requirements

Parameter	Unit	Monthly Average Limit
BOD	mg/L	≤ 20
TSS	mg/L	≤ 20

Table 6-10: Nitrogen General Permit Requirements[1] - 2015

Parameter	Unit	Limit

Parameter	Unit	Limit
TN[2]	lbs/day	≤ 278
TN[3]	mg/L	≤ 7.5
TN[4]	mg/L	≤ 5.0

1. TN projection limit applies to 2015 only and subject to change in the future by CT-DEEP
2. Based on annual average conditions
3. Based on future primary effluent maximum month conditions
4. Based on future primary effluent annual average conditions

Table 6-11: Comparative Costs – Biological System Alternatives Evaluation

Capital and O&M Conceptual Costs (2015 Costs)					
		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Item No.	Cost Item	BioMag Process	Four-Stage BNR Process	VOM/BNR Process	IFAS Process
1	CAPITAL COST SUMMARY				
1.1	Excavation / Backfill	$18,000	$ -	$ -	$ -
1.2	Concrete	$204,000	$333,000	$333,000	$249,000
1.3	Process Piping	$147,000	$147,000	$147,000	$104,000
1.4	Building Construction	$223,000	$ -	$ -	$ -
1.5	Equipment	$5,032,000	$2,258,000	$2,300,000	$4,999,000
1.6	Site / Miscellaneous	$253,000	$203,000	$203,000	$203,000
1.7	**CONSTRUCTION BASE COST**	**$5,877,000**	**$2,941,000**	**$2,983,000**	**$5,555,000**
1.8	Overhead, Insurance, & General Conditions (25%)	$1,469,200	$735,000	$745,000	$1,389,000
1.9	Contingency & Engineering (40%)	$2,938,000	$1,470,000	$1,491,000	$2,778,000
1.10	**TOTAL CAPITAL COST**	**$10,284,000**	**$5,146,000**	**$5,219,000**	**$9,722,000**
2	O&M COST SUMMARY				
2.1	Electrical	$113,000	$42,000	$42,000	$64,000
2.2	Chemical & Sludge Disposal	$151,000	$64,000	$47,000	$47,000
2.3	Operation	$39,000	$15,600	$15,600	$23,400
2.4	Maintenance	$88,100	$40,000	$40,900	$86,900
2.5	**TOTAL ANNUAL O&M COST**	**$391,000**	**$162,000**	**$146,000**	**$221,000**

Table 6-12: Equivalent Present Worth Cost (PWC)

Alternative	Total Capital Cost	Annual O&M	O&M PWC[1]	Total PWC
1 – BioMag Process	$10,284,000	$391,000	$6,393,000	$16,677,000
2 – Four-Stage BNR Process	$5,146,000	$162,000	$2,649,000	$7,795,000
3 - VOM/BNR Process	$5,219,000	$146,000	$2,387,000	$7,606,000
4 – IFAS Process	$9,722,000	$221,000	$3,614,000	$13,336,000

[1] 2% interest for 20 years - ENR 9681

Table 6-13: Equivalent Uniform Annual Cost (EUAC)

Alternative	Total Capital Cost	Capital EUAC[1]	Annual O&M	Total EUAC
1 – BioMag Process	$10,284,000	$629,000	$391,000	$1,020,000
2 – Four-Stage BNR Process	$5,146,000	$315,000	$162,000	$477,000
3 - VOM/BNR Process	$5,219,000	$319,000	$146,000	$465,000
4 – IFAS Process	$9,722,000	$595,000	$221,000	$816,000

[1] 2% interest for 20 years - ENR 9681

6.2.8.3 Technical Comparison

The BioMag, MLE / 4-Stage BNR, Variable Operating Mode, and IFAS alternatives are all expected to achieve the target limits included in the State of Connecticut Nitrogen General Permit for the Town of Enfield. However, there are various advantages and limitations to each alternative, which are summarized in Table 6-14.

6.2.8.4 Environmental Considerations

All four alternatives will have equivalent environmental impacts. The WPCF site and the location for the nitrogen removal technology is currently developed, therefore negative environmental impacts will be minimal. Section 6.9 provides additional information on our assessment of environmental impacts.

6.2.8.5 Recommended Alternative

The life cycle analysis results indicate that the Variable Operating Mode (VOM) Alternative (Alternative 3) is the lowest cost alternative, in terms of Equivalent Present Worth Cost (PWC). The BioMag Alternative (Alternative 1) is the highest in capital and O&M costs due to the large amount of equipment and labor required for the proper operation of this system and the additional building needed to house all of this required equipment. The IFAS Alternative (Alternative 4) has a high capital cost due to the additional media and a high-energy cost associated with the additional air requirements. The 4-stage BNR Alternative (Alternative 2) has a similar capital and O&M costs than the VOM alternative, however this alternative does not provide enough operational flexibility to the operators to deal with seasonal and extreme flow conditions (as provided by the VOM alternative).

Based on the cost and technical comparison between each alternative, Woodard & Curran recommends the Variable Operating Mode (VOM) Alternative for the Enfield WPCF.

Table 6-14: Summary of Advantages & Limitations of Alternatives Proposed

Process	Advantages	Limitations
Alternative 1 – BioMag Process	- Reliable control of clarifier effluent and sludge blanket due to the increased settling rate - Meets the permit requirements within the existing aeration basin volume - Ability to operate with significantly greater mixed liquor suspended solids (MLSS)	- Labor intensive process - Higher capital and O&M costs - More complex operation - Additional building required to house the ballast storage & recovery system - Requires magnetite and polymer addition - Power requirements higher than for conventional systems
Alternative 2 – Four-Stage BNR Process	- Uses existing tankage volume to achieve nutrient removal - Ease of construction - Lowest capital cost - Less equipment required	- Difficult to handle wet weather conditions - Limited operational flexibility - More carbon addition required to meet nitrogen goal limits
Alternative 3 – Variable Operating Mode (VOM) Process	- Lowest Present Worth cost (PWC) - Flexible operation - Relatively simple operation - Highly reliable process - Less chemicals required - Meets nutrient goal limits within existing tankage volume - Produces good settling sludge	- Training required of operators - Challenging to achieve stringent nutrient limits during big storm events (approx. 7 days a year)
Alternative 4 – IFAS Process	- Less tankage volume required to achieve nitrogen goal limits - Less mechanical equipment required	- High capital and O&M costs - High energy consumption due to additional air requirements - Fine screening required to protect IFAS media

6.3 EVALUATION OF BIOLOGICAL REACTOR MIXING SYSTEM ALTERNATIVES

6.3.1 Development of Alternatives

As discussed in the previous section, the recommended alternative for the biological system is the Variable Mode Operation (VOM) process. This process will utilize the existing four aeration tanks, which will be fitted with partition walls to form anoxic selector zones, anoxic zones, swing zones, aerobic zones, post swing zones and post aerobic zones. A mixing system will be required in most of these zones with the exception of the first aerobic zones.

The existing submersible mixers in the anoxic zones do not have adequate capacity and do not appear to provide efficient and uniform mixing to maintain complete solids suspension. These mixers are difficult to access, maintain, and require a frequent amount of maintenance. A variety of low-energy mixing solutions are available that are proven to provide effective mixing and can be properly sized for each zone.

To replace the inefficient submersible mixers, several mixing technologies were evaluated with respect to capital, operation and maintenance (O&M), as well as other non-economic factors. The three mixing system alternatives that were evaluated include: (1) surface floating mixing; (2) hyperbolic vertical shaft mixing; and (3) compressed gas mixing. In order to compare these technologies, information was obtained from several different manufacturers of these systems.

Each of these alternatives will be discussed in the following paragraphs including economic and non-economic evaluations of each alternative.

6.3.2 Alternative 1 – Surface Floating Mixing

The surface floating mixing system utilizes a series of fixed, floating surface mixers, which are mechanically similar to submersible propeller mixers. The floating design allows for vertical, top-to-bottom mixing, which creates higher mixing energy than standard horizontal submersible propeller mixers of the same size. This increased mixing energy would allow smaller mixers to be installed in each of the mixed zones at the Enfield WPCF. A typical installation for this system is shown in the Figure on the right.

(54) 7.5 HP AquaDDM Floating Mixers Installation in a 25 MGD Reclaimed Water Facility

Aqua-Aerobic's Direct Drive (DDM) floating mixer was evaluated. The required power requirement and equipment needed for the mixing system were based on a technical proposal provided by Aqua- Aerobics. Woodard & Curran performed process calculations and reviewed industry literature to confirm the adequacy of Aqua- Aerobics proposal. Aqua-Aerobics proposed two (2) – 2 HP floating mixers that would be installed in each of the 12 mixed zones, for a total of twenty-four (24) - 2 HP mixers. All information provided by the manufacturer is included in Appendix L-1.

6.3.3 Alternative 2 – Hyperbolic Vertical Shaft Mixing

The potential installation of vertical shaft hyperbolic mixers was also investigated. The Invent Hyperbolic vertical mixer is becoming a very common alternative to submersible mixers in activated sludge aeration systems. The mixer motor sits on a bridge suspended above the aeration tank, and rotates the mixer body via a long hollow shaft that extends to the bottom of the tank. The design of the mixer body allows for a hyperbolic mixing profile throughout the tank, which creates a more even dispersion of solids in the zone. This allows the capability to reduce the motor size as compared

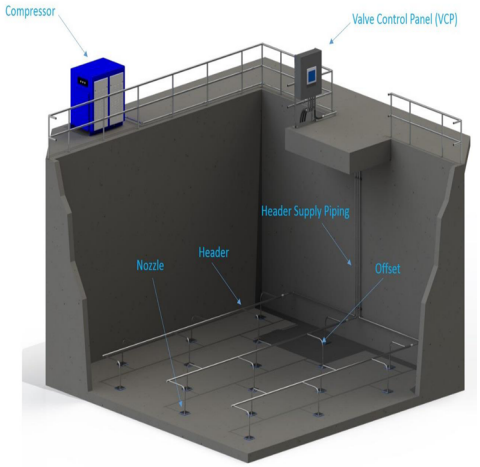
to a submersible propeller mixer in the same application. Additionally, submersible motors are mechanically less efficient than standard electric motors. Since the motor is not submerged in an Invent Hyperbolic mixer, the use of NEMA Premium Efficiency Motors further reduces the energy usage of the system. A typical installation for this system is shown in the Figure below.

Invent's hyperbolic mixers were evaluated. The required power requirement and equipment needed for the mixing system were based on a technical proposal provided by Invent. Process calculations were prepared and industry literature was reviewed to confirm the adequacy of Invent's proposal. Invent proposed one (1) – 3 HP hyperbolic mixer that would be installed in each of the 12 mixed zones, for a total of twelve (12) - 3 HP mixers. All information provided by the manufacturer is included in Appendix L-2.

While the Invent Hyperbolic mixers provide adequate mixing at a reduced energy demand, the mixers require the installation of structural supports for the motor and drive, as well as suspended walkways for maintenance. The Enfield WPCF does not currently have mixer bridges installed, and the cost of fabricating and installing a total of twelve bridges will increase the total project cost significantly.

Invent Hyperbolic Mixer Installation in Stratford, CT WPCF

6.3.4 Alternative 3 – Compressed Gas Mixing



Typical Biomix Compressed Gas Mixing Layout

One of the energy-efficient mixing options that we considered for the Enfield WPCF is the compressed gas mixing system. This system consists of a single air compressor, which runs continuously to provide air to pipe headers located at the bottom of each zone. Each pipe header contains nozzles that modulate automatically to deliver small bursts of compressed air bubbles to provide mixing in the zone as shown in the Figure on the left. These nozzles do not require any electricity to operate, so the only power demand of the mixing system is from the one compressor.

Biomix compressed gas mixing was evaluated. The required power requirement and equipment needed for the mixing system were based on a technical proposal provided by Enviromix. Process calculations were performed and industry literature was reviewed to confirm the adequacy of Enviromix proposal. Enviromix stated in their proposal that a 20-horsepower compressor would be required to provide mixing to the four aeration tanks. All information provided by the manufacturer is included in Appendix L-3.

6.3.5 Economic Evaluation of Alternatives

6.3.5.1 Life Cycle Cost Analysis

Using the capital and annual operating cost of the different technologies, a life cycle cost comparison was performed to determine the cost of operating the mixing systems for a 20-year period. The basis of cost estimates is similar to the basis used for the wastewater treatment alternatives evaluation. Refer to section 6.2.8 for more details.

A cost comparison of each alternative is presented in Tables 6-15, 6-16, and 6-17. The cost estimates shown, and any resulting conclusions on project financial or economic feasibility or funding requirements, have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, the final project costs will vary from estimates presented here.

6.3.5.2 Technical Comparison

The advantages and disadvantages of each technology are summarized in Table 6-18. This table is based on a comparison of manufacturer information.

Table 6-15: Comparative Costs - Aeration Tank Mixing System Alternatives Evaluation

Capital and O&M Conceptual Costs (2015 Costs)					
		Alternative 1	Alternative 2	Alternative 3	
Item No.	Cost Item	Surface Floating Mixing	Hyperbolic Mixing	Compressed Gas Mixing	
1		CAPITAL COST SUMMARY			
1.1	Equipment	$ 280,000	$ 530,000	$ 497,000	
1.2	Electrical	$108,000	$ 101,000	$ 75,000	
1.3	Installation	$ 112,000	$ 212,000	$ 199,000	
1.4	**CAPITAL BASE COST**	**$ 500,000**	**$ 843,000**	**$ 771,000**	
1.6		Contingency & Engineering (40%)	$ 200,000	$ 337,000	$ 308,000
1.7	**TOTAL CAPITAL COST**	**$ 700,000**	**$ 1,180,000**	**$ 1,079,000**	
2		O&M COST SUMMARY			
2.1	Electricity	$ 29,000	$ 22,000	$ 14,000	
2.4	Operation	$ 3,100	$ 1,600	$ 1,200	
2.5	Maintenance	$ 16,800	$ 10,600	$ 5,000	
2.6	**TOTAL ANNUAL O&M COST**	**$ 49,000**	**$ 34,000**	**$ 20,000**	

Table 6-16: Equivalent Uniform Annual Cost (EUAC)

Alternative	Total Capital Cost	Capital EUAC[1]	O&M	Total EUAC
1 - Surface Floating Mixing	$ 700,000	$ 43,000	$ 49,000	$ 92,000
2 - Hyperbolic Mixing	$ 1,180,000	$ 72,000	$ 34,000	$ 106,000
3 - Compressed Gas Mixing	$ 1,079,000	$ 66,000	$ 20,000	$ 86,000

[1] 2% interest for 20 years - ENR 9681

Table 6-17: Equivalent Present Worth Cost (PWC)

Alternative	Total Capital Cost	Total O&M	O&M PWC[1]	Total PWC
1 - Surface Floating Mixing	$700,000	$49,000	$801,000	$1,501,000
2 - Hyperbolic Mixing	$1,180,000	$34,000	$556,000	$1,736,000
3 - Compressed Gas Mixing	$1,079,000	$20,000	$327,000	$1,406,000

[1] 2% interest for 20 years - ENR 9681

Table 6-18: Advantages and Limitations of Mixing System Alternatives

Technology	Advantages	Limitations
Alternative 1 – Surface Floating Mixing	• Low initial cost • No couplings or submerged bearings • Submerged intake volute eliminates air entrainment	• Requires more mechanical and electrical equipment • Higher O&M costs • Requires more maintenance • May require cranes or access platforms for maintenance
Alternative 2 – Hyperbolic Mixing	• Uniform mixing of the entire tank contents • Low maintenance compared to submersible and floating mixing due to dry mounted drive • Use of non-submerged premium efficiency motor reduces energy usage compared to submersible mixing	• Requires installation of structural supports and walkways for maintenance • Higher capital and energy costs
Alternative 3 – Compressed Gas Mixing	• Lowest life cycle cost • Lowest energy consumption • No mechanical or electrical parts in the wastewater • No bridges or platforms required • Less maintenance • Homogenous mixing	• High initial cost • Limited number of installations in New England

6.3.6 Recommended Alternative

The life cycle analysis suggest that the compressed gas mixing is the lowest cost alternative, in terms of Present Worth Cost (PWC). The Hyperbolic mixing is the highest in capital and energy costs, essentially because of the platforms and walkways required for maintenance. The surface floating mixing is the highest in O&M costs due to the large number of mixers required to insure adequate mixing of the tanks.

Based on the economic evaluation and the technical comparison, the compressed gas mixing system is recommended to mix the aeration tanks for the Enfield WPCF.

The compressed gas mixing system was selected because of its key advantages compared to other mixing technologies including: (1) reduced power consumption, (2) no mechanical or electrical components in the wastewater, (3) no bridges or platforms required, and (4) less maintenance.

6.4 EVALUATION OF SLUDGE PROCESSING ALTERNATIVES

6.4.1 Development of Alternatives

Typically, some of the most costly items in the treatment of municipal sewage are the processing and disposal of the biosolids (sludge) produced. Treatment and disposal may include any number of different processes, ranging from disposal of waste sludge in an untreated liquid form, thickening sludge, and dewatering sludge.

6.4.1.1 Sludge Storage

Sludge storage should be provided to smooth out fluctuations in the rate of biosolids production and to allow solids to accumulate during periods when subsequent processing facilities are not operating, such as night shifts, weekends, and periods of unscheduled equipment downtime. Storage is particularly important in providing uniform feed rate ahead of mechanical dewatering processes.

Storage options include in-process storage such as gravity thickening, and storage tanks. As mentioned in Section 5, the existing 170,000 gallon sludge storage tank has insufficient capacity to handle the quantities of sludge produced and was taken out of service due to odor complaints. Therefore, waste activated sludge is currently co-settled with influent wastewater in the primary clarifiers. Excessive retention of solids in the primary clarifiers can cause septic conditions and gasification, and reduce the levels of TSS and BOD removal. A separate sludge holding tank with enough capacity or gravity thickening is needed to increase the removal efficiency of the primary clarifiers and reduce odors.

To evaluate the sludge storage capacity, we estimated and summarized the projected sludge quantities in Table 6-19 based on future flows and loads established in section 3 – Table 3-5. Based on the sludge production illustrated in Table 6-19, sludge storage can be accommodated by either using two (2) sludge holding tanks with a capacity of approximately 310,000 gallons each, or (2) two 35-feet diameter gravity thickeners for combined primary and waste activated sludge (WAS). Both storage options have sufficient capacity for approximately 3 ½ days storage under maximum week flow and loadings.

Sludge storage tank and gravity thickening will both provide reliable sludge storage for the Enfield WPCF. However, there are various advantages and limitations associated with each option, which are summarized in Table 6-20. Based on the technical comparison between the two options, Woodard and Curran recommends using the gravity thickeners for sludge storage and thickening. Of the factors that contribute to this outcome, some of the most significant are:

- The gravity thickener can achieve better performance than the sludge storage (3 to 6% solids concentrations for the gravity thickener vs. 2 to 3% for sludge tank).
- The gravity thickener can provide more consistent and uniform sludge feed rate ahead of the dewatering system.
- The need of less operation time to operate the dewatering system with the use of gravity thickeners upstream.
- The two storage tanks will require more capital and O&M costs than the gravity thickeners.

The recommended gravity thickeners should be 35-feet in diameter with a side water depth of at least 14 feet. The conceptual design criteria for the proposed gravity thickener are summarized in Appendix M.

Table 6-19: Future Sludge Quantities

	Peaking Factor	Primary Sludge	Waste Activated Sludge	Thickened Sludge
Solids Loadings (lbs/day)				
Average Annual		6,078	4,033	9,099
Maximum Week	2.0	12,156	8,066	18,198
Maximum Day	3.2	19,448	12,905	29,117
Flows (gpd)				
Average Annual		23,134	59,846	21,821
Maximum Week	2.0	46,268	119,691	43,642
Maximum Day	3.2	74,030	191,506	69,827

Table 6-20: Advantages & Limitation of Sludge Storage Alternatives

Technology	Advantages	Limitations
Sludge Holding Tank	• No special skills required for maintenance • Less training required for the operators	• Odor control system required • Higher capital and O&M costs • Poor solids concentration (2 to 3%) • Limited operational flexibility • More operation time required for the dewatering equipment
Gravity Thickening	• Ease of operation • Better performance (3 to 6% solids concentration) • Lower capital and O&M costs • Consistent and uniform feed rate ahead of the dewatering system • Less operating time for needed to dewater the thickened sludge • Resilient and highly reliable process	• High hydraulic loadings can cause excessive solids carryover • Low hydraulic loadings can cause septic conditions and floating sludge • Odor control system recommended

6.4.1.2 Sludge Dewatering

As discussed in Section 5, the Enfield WPCF currently dewaters its sludge through the use of a pair of belt filter presses (BFPs) located in the Operations Building. These BFPs are in operation five days per week, for approximately 10 to 12 hours on Mondays and Tuesdays and 5 to 6 hours a day for the rest of the week. The sludge cake produced is hauled from the site and disposed of at the Metropolitan District Commission (MDC) WPCF in Hartford for incineration.

There are several process issues associated with the operation of the existing BFPs, which are the driving force to upgrade the system:

- The BFP room is a major source of odors at the plant. BFP equipment requires a significant quantity of water to function and is not enclosed, which leads to excessive moisture and odors. These issues not only create a very unpleasant work environment, but also have caused the structural steel to rust;
- The BFPs were both built by the same manufacturer, but one press is 20-years older than the other, so parts are not interchangeable. As such, two sets of spare parts must be kept in inventory;
- The BPFs require considerable ongoing maintenance. The mechanical systems on the presses (hydraulic power packs, tracking systems, bearings) are at the end of their useful lives and would need to be replaced if these units are retained;
- The BFP equipment is very labor intensive to operate. The throughput of the existing BFPs in combination with the limitations on sludge trailer hauling and the lack of operational sludge storage requires dewatering sludge for two shifts during Mondays and Tuesdays (10 to12 hours); and
- Enfield WPCF desires to be able to dewater sludge in 5 days per week and within one shift each day of operation. This will reduce the labor required to process the sludge.

Having determined that it will be more efficient to store and thicken sludge using gravity thickening than storage tanks, it is necessary to determine the most cost effective dewatering technology to replace the old BFP technology. For this evaluation of solids processing alternatives, Woodard and Curran evaluated several technologies for sludge dewatering with respect to capital, Operation and Maintenance (O&M), site layout as well as other non-economic factors. All alternatives were developed based on the pilot and/or laboratory testing and the design flows and loads established in Section 3.

Three solids processing alternatives that were evaluated include: (1) Screw Press, (2) Rotary Press, and (3) Centrifuge. In order to compare these technologies, W&C contacted suppliers/manufacturers to obtain further information and run pilot and/or lab tests on site.

The following paragraphs describe the different dewatering technologies evaluated and summarize the piloting and laboratory testing that has occurred to date. Economic and non-economic evaluations are also included in the following sections.

6.4.2 Alternative 1 – Screw Press

6.4.2.1 Technology Description

Polymer is blended with the sludge prior to entering the screw press. Dewatering is continuous and is accomplished by gravity drainage at the inlet end of the screw and then pressure imparted by reducing the volume as the material is conveyed by the internal auger with narrowing flights. The internal auger is housed within a screen that allows the filtrate to drain from the sludge as it is dewatered. Screw design is important, as different materials require different screw speeds, screw configurations, and screens in order to dewater to a high outlet consistency while maintaining a desired capture rate[10]. Appendix N contains a conceptual drawing showing the general layout of the dewatering system in the press room located at the second floor of the existing Operations Building.

[10] Screw Press Introduction. http://www.fkcscrewpress.com/spintro.html (May, 2015)

6.4.2.2 Huber Press Piloting Results

Huber Screw Press Pilot Unit

Huber was onsite May 04 through May 08, 2015 to pilot the screw press. Appendix N contains the piloting summary report. Sludge was pumped out of the primary clarifiers via a hose to the screw press. Polymer blending occurred inline through the use of a weighted check valve. The polymer was made down in a separate polymer makedown tank.

Before the pilot test, bench tests were conducted to determine which polymers are suitable for the sludge generated at the Enfield WPCF. The bench tests were performed using three polymers from the manufacturers Ashland (K) and Fort Bend Services (FBS) including FBS 6750, FBS 6804, and FBS 7802.

The most effective polymer and sludge reaction occurred with the FBS 7802 polymer, which released 43% of the liquid from the sludge within 30 seconds; therefore, the polymer was used for piloting.

The pilot test results and sludge test conclusions are summarized in Tables 6-21 and 6-22, respectively. For the blended primary and secondary sludge, the test results suggest that cake can be expected in the range of 28% to 33% during dewatering mode, when using between 22 and 36 lbs. active / dry ton of the FBS 7802 polymer. The average solids capture rate during the pilot demonstration was 99.4 %.

Table 6-21: Huber Screw Press Piloting Results

Sludge Parameters	Unit	Minimum	Maximum	Average
Screw Press Speed	rpm	0.8	1.4	1
Pressure at Screw Press Inlet	psi	0	6.3	2
Pressure at Dewatering Cone	psi	20	20	20
Feed Sludge Solid Content	% DS	2	3.8	2.7
Cake Solids	% DS	20.9	33.2	29
Solid Loading Rate	lbs/hr	53	136	94
Flow Rate	gpm	4.8	10	7
Polymer Consumption	lbs/dry ton	15	48	30
Capture Rate	%	98.2	100	99.4

Table 6-22: Huber Sludge Test Conclusions

Sludge Parameters	Unit	Best Result Settings	Results at Low Polymer Consumption
Screw Speed	% of max. 2.1 rpm	62	57
Cake Produced	% DS	30 - 34	28 - 30
Solid Loading at % Feed Solids	lbs/hr	136 at 2.72 %	123 at 2.46 %
Flow Rate	gpm	10	10
Polymer Consumption	lbs/dry ton	32 - 36	22 - 26
Capture Rate	%	98	98

6.4.3 Alternative 2 – Rotary Press

6.4.3.1 Technology Description

The influent sludge is dosed with polymer, fed into a channel, and rotated between two parallel revolving screens, one of which is stationary. The filtrate passes through the screens as the flocculated sludge advances within the channel. The sludge continues to dewater as it travels around the channel, eventually forming a cake near the outlet side of the press. The frictional force of the slow moving screens, coupled with the controlled outlet restriction, results in the extrusion of a dry cake. Appendix O contains a conceptual drawing, which shows the general arrangement of the rotary press within the press room located at the second floor of the existing Operations Building.

Fournier Rotary Press Pilot Unit

6.4.3.2 Fournier Press Piloting Results

Fournier was onsite from April 27 through May 01, 2015 to pilot the rotary press. Appendix O contains the pilot test summary report and a drawing that shows the layout of the pilot dewatering system. Dewatering trials were performed on sludge from the primary clarifiers via a hose that connected to the rotary press holding tank. The sludge was pumped from the holding tank to the flocculation tank located before the rotary press. The polymer, which was made down in the polymer tank, was pumped and blended with sludge prior to entering the flocculation tank.

Two type of polymer and the facilities current polymer were selected to produce the best flocculation for the sludge. The emulsion polymer Ashland Praestol K-274 FLX, dry polymer Ashland Praestol 858 BS, the facilities manic polymer ACP 07A, were used.

The average three results of the pilot testing for each day are summarized in Table 6-23. The rotary press obtained cake dryness ranging between 20% and 33%, a capture rate averaging 98%, and a production as high as 393 dry lbs / hour. Looking at the results it appears that the best results were accomplished using actual WPCF Manich polymer ACP-07A. In this sense, it is important to consider the production associated with the achieved cake dryness. It is obvious that should the production been lowered to 205 dry lbs/hr/channel using Manich ACP-07A, the cake dryness would have been increased to 26.3 %. In conclusion, we can state that WPCF Manich polymer is at minimum equivalent to the Ashland polymer K274 FLX, if not superior. The polymer dosage to adequately flocculate the sludge was averaging 11.3 active lbs of polymer per dry ton of solid.

Table 6-23: Fournier Rotary Press Piloting Results

Sludge Parameters	Unit	Date		
		04/28/15	04/29/15	04/30/15
Polymer Used		Praestol K 274 FLX	Praestol 858 BS	ACP-07A
Average Polymer Dose	lbs/dry ton	10.5	8.5	15
Average Speed	rpm	0.35	0.42	0.44
Avg. Production per Channel	dry lbs/hr	205	198	239
Average Feed Sludge	% DS	3.47	3.23	3.67
Average Cake Solids	% DS	26.32	22.49	25.62
Average Capture Rate	%	97.7	97.7	98.3

6.4.4 Alternative 3 – Centrifuge

6.4.4.1 Technology Description

A centrifuge is a rotating assembly that uses centrifugal force to separate solids from liquids. The polymer is added inline prior to the sludge entering the centrifuge. As the assembly rotates, the solids separate out and are forced to the outer wall while the liquids remain (pond) at the core. The centrifuge has an internal conveyor that moves the sludge material towards a discharge outlet.

GEA Westfalia Centrifuge Model CF 8000

6.4.4.2 Westfalia Centrifuge Bench Testing Results

The Westfalia machine was not piloted. A sludge sample was sent to the Westfalia laboratory for testing. The Westfalia laboratory testing report and a drawing of the general arrangement of the dewatering system are contained in Appendix P. The laboratory results have been summarized in Table 6-24. During the laboratory testing, a maximum cake total solids of 30±1 percent was achieved. The most effective polymer was the cationic polymer SNF Polydyne Clarifloc C-6262 at an active dose of 25 lbs/ dry ton.

Table 6-24: Westfalia Centrifuge Lab Results

Sludge Parameter	Unit	Date: 06/11/15
Polymer Used		SNF Polydyne Clarifloc C 6262
Average Polymer Dose	lbs/dry ton	25
Feed Sludge	% DS	2.62
Average Cake Solids	% DS	30
Average Capture Rate	%	95

6.4.5 Throughput and Performance Comparisons

Table 6-25 compares the potential throughput and performance of each dewatering technology for average and peak design conditions based on sludge quantities established in Table 6-19 and the results of pilot and lab testing for each technology. The table also shows the number of unit required to meet throughput requirements and to accomplish dewatering in 5 days per week and within one shift each day of operation.

Table 6-25 illustrates that during maximum week conditions, at least three Huber screw presses are needed to meet the throughput requirements of an 8-hour day and 5 days per week. In order to process the solids loading during a peak flow week, two Huber units would need to operate for approximately 13 hours per day and 5 days a week. Fournier rotary press and Westfalia centrifuge can meet the throughput requirements during peak conditions with only two units.

6.4.6 Economic Evaluation of Alternatives

6.4.6.1 Life Cycle Cost Analysis

Using the capital and annual operating cost of the different technologies, a life cycle cost comparison was performed to determine the cost of operating the units for a 20-year period.

We made the following assumptions in order to conduct the life cycle analysis:

- Life cycle costs include the capital and annual operating costs;
- O&M costs were based on average flow and loadings;
- The basis of cost estimates is similar to the basis used for the wastewater treatment alternatives evaluation. Refer to section 6.2.8 for more details;
- The pilot results are a good indicator of the full scale operations; and
- Future costs of polymer, electricity, and disposal may be higher than present day costs; however, an increase in any of these costs would have a similar effect on all of the dewatering alternatives and therefore a constant price for polymer and electricity can be assumed.

Table 6-25: Comparison of Throughput and Performance

Item No.	Design Criteria of Comparison	Alternative 1	Alternative 2	Alternative 3
		Screw Press	Rotary Press	Centrifuge
1	Vendor / Model	Huber RoS3-Q800	Fournier 6-900/6000CV	Westfalia CF 8000
2	Thickened Sludge to Dewatering (dry lbs/day)	9099	9099	9099
3	Dewatered Sludge to Disposal (dry lbs/day)	8917	8826	8644
4	Throughput per unit (dry lbs/hr/unit)	980	1800	3300
5	Number of Units Required	3	2	2
6	Average Capture Rate (%)	98%	97%	95%
7	Average Sludge Cake Solids (%)	28%	26%	30%
8	Average Polymer Feed Rate (lbs/dry ton)	22	12	25
9	Connected Power per unit	5	20	125
10	**Average Conditions**			
10.1	Hours of operation (hours/day)	7.2	5.9	4.8
10.2	Days of operation (days/week)	3	3	2
11	**Maximum Week Conditions**			
11.1	Hours of operation (hours/day)	8.7	7.1	3.9
11.2	Days of operation (days/week)	5	5	5

A cost comparison of each alternative is presented in Tables 6-26, 6-27, and 6-28. The cost estimates shown, and any resulting conclusions on project financial or economic feasibility or funding requirements, have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, the final project costs will vary from estimates presented here.

6.4.6.2 Technical Comparison

The advantages and disadvantages of each technology are summarized in Table 6-25. This table is based on a comparison of manufacturer information.

Table 6-26: Comparative Costs - Solids Processing Alternatives Evaluation

Capital and O&M Conceptual Costs (2015 Costs)				
		Alternative 1	Alternative 2	Alternative 3
Item No.	Cost Item	Screw Press	Rotary Press	Centrifuge
1	DESIGN SPECIFICATIONS[1]			
1.1	Sludge Production (dry lbs/day)	9,099	9,099	9,099
1.2	Unit Solids Loading Rate (lbs/hr/unit)	980	1800	3300
1.3	Unit Hydraulic Loading Rate (gpm/unit)	39	72	132
1.4	Number of Units Required	3	2	2
1.5	Average Capture Rate (%)	98%	97%	95%
1.6	Average Sludge Cake Solids (%)	28%	26%	30%
1.7	Hours of Operation (hours/day)	7.2	5.9	4.8
1.8	Days of Operation (days/week)	3	3	2
1.9	Average Polymer Feed Rate (lbs/dry ton)	22	12	25
1.10	Connected Power per unit (hp)	5	20	125
2	CAPITAL COST SUMMARY			
2.1	Equipment	$867,000	$620,000	$1,236,000
2.2	Electrical	$303,000	$217,000	$433,000
2.3	Plumbing	$43,000	$30,000	$60,000
2.4	Installation	$347,000	$248,000	$494,000
2.5	CAPITAL BASE COST	$1,560,000	$1,115,000	$2,223,000
2.6	Overhead, Insurance, & General Conditions (25%)	$390,000	$279,000	$556,000
2.7	Contingency & Engineering (40%)	$780,000	$558,000	$1,112,000
2.8	TOTAL CAPITAL COST	$2,730,000	$1,952,000	$3,891,000
3	O&M COST SUMMARY			
3.1	Electricity	$2,000	$4,000	$12,000
3.2	Polymer Use	$90,000	$48,000	$99,000
3.3	Sludge Disposal	$375,000	$371,000	$363,000
3.4	Operation	$34,000	$28,000	$15,000
3.5	Maintenance	$26,000	$19,000	$37,000
3.6	TOTAL ANNUAL O&M COST	$527,000	$470,000	$526,000

1. Design criteria are based on average conditions

Table 6-27: Equivalent Uniform Annual Cost (EUAC)

Alternative	Total Capital Cost	Capital EUAC[1]	O&M	Total EUAC
1 – Screw Press	$2,730,000	$167,000	$527,000	$694,000
2 – Rotary Press	$1,952,000	$119,000	$470,000	$589,000
3 - Centrifuge	$3,891,000	$238,000	$526,000	$764,000

[1] 2% interest for 20 years - ENR 9681

Table 6-28: Equivalent Present Worth Cost (PWC)

Alternative	Total Capital Cost	Total O&M	O&M PWC[1]	Total PWC
1 – Screw Press	$2,730,000	$527,000	$8,617,000	$11,347,000
2 – Rotary Press	$1,952,000	$470,000	$7,685,000	$9,637,000
3 - Centrifuge	$3,891,000	$526,000	$8,601,000	$12,492,000

[1] 2% interest for 20 years - ENR 9681

Table 6-29: Advantages & Limitations of Sludge Processing Alternatives

Technology	Advantages	Limitations
Alternative 1 - Screw Press	• Contained for better odor control • Can run without continuous supervision • Can handle variable sludge feed • Low power consumption	• Can require frequent maintenance • Large footprint
Alternative 2 - Rotary Press	• Low maintenance • Contained for better odor control • Small footprint • Can handle variable sludge feed • Easy to expand	• Requires fibrous material (high percentage of primary sludge) to achieve good results.
Alternative 3 - Centrifuge	• High throughput • Contained for odor control • Can run without continuous supervision • Small footprint • Can handle variable sludge feed	• Preventative maintenance required • Vibration on startup/shutdown and as machine ages can be transmitted through building • High grit sludge can damage the machine • Higher capital and energy costs

6.4.6.3 Evaluation Criteria

In addition to quantitative evaluation of capital and O&M costs, the following criteria were used for evaluating solids processing alternatives. Except for the cost, these criteria were applied on a weighted, qualitative basis.

Operational Flexibility

Operational flexibility refers to the ability of the dewatering equipment to produce a consistent cake if the feed sludge solids concentration and flow is varied. The rotary press and screw press are able to handle a sludge with a varying solids concentration due to the low speeds at which the unit operates. The centrifuge operates at a much higher speed. Therefore, there is a noticeable change in sludge cake if the solids concentration of feed sludge is not constant. This difference will be more apparent the longer the duration of varied solids concentration.

Operational Reliability

Operational reliability refers to the ability of the dewatering equipment to achieve a consistent sludge. Though the polymer dose and feed sludge will change, if the operating speed and operating pressure remain constant and the solids concentration of the dewatered sludge remains constant as well, all three technologies have an average operational reliability.

Expandability

Expandability refers to the ability of the dewatering system to increase in size and volume. The rotary press can easily expand by adding other channels to the unit in order to accommodate future increases in sludge production. However, it is more challenging to add an extra screw press or centrifuge due to space restraints.

Cake Total Solids

The rankings for the total solids are based on the results of the onsite pilot and lab testing. The Huber screw press achieved the highest percent solids during the onsite pilot testing.

Capacity – Throughput

Throughput refers to the solids loading rate in dry lbs per hour that can be achieved by each dewatering unit. Table 6-25 shows that the tested centrifuge has a much higher dewatering capacity that the rotary and screw presses.

Footprint

Footprint evaluates the space occupied by the dewatering equipment. The screw press and centrifuge have a larger footprint than the rotary press.

The space required to access the machines for maintenance also needs to be considered. The Westfalia centrifuges require a minimum clearance of three feet around all sides of the equipment for proper maintenance. The Huber screw press and Fournier rotary press require approximately four foot clearance for maintenance.

Ease of Maintenance

Routine maintenance will be required for all pieces of dewatering equipment. The screw press and centrifuge require more maintenance, based on information received from the manufacturer and past experience.

Maintenance of the Huber screw press requires removing the screw. The space needed to do this is equivalent to the length of the machine.

Supervision Required

All three dewatering technologies are designed to operate without constant supervision. Alarm conditions can be programmed and monitored using the SCADA system. As a result, plan personnel do not need to continuously monitor the dewatering equipment.

Polymer Usage

There are many options for dewatering polymers. Each onsite dewatering pilot selected several polymers and reported the polymers that worked the best. Based on the pilot and lab results and assuming that the results of the pilot were applicable to a full size unit, W&C determined the amount of polymer required for each dewatering technology. The centrifuge required the largest polymer dose.

Operator Safety

Operator safety evaluates the potential of personnel being physically harmed by the dewatering equipment. The centrifuge was assigned the lowest score due to the high speed (3,250 rpm) at which the bowl rotates.

Energy Use

The energy use is based on the nominal horsepower of the dewatering equipment. The centrifuge is designed to operate with a main drive motor and a hydraulic back drive motor. Compared to the screw press and rotary press, a larger nominal horsepower is required to maintain the operating speed of the centrifuge. The Huber screw press ranked the best because it has the lowest nominal horsepower, and therefore the lowest annual electrical cost. Operation hours and the number of units required were also taken into consideration to determine the electrical operating cost.

To qualitatively evaluate the three selected alternatives and finalize the process selection, a rating/decision matrix was created based on the evaluation criteria described above. A weighting factor was included to indicate the relative importance of each criterion being considered. In Table 6-26, the alternatives are assigned values from 1 to 3 (there are three alternatives), with 1 corresponding to the most favored alternative for the given criteria. The weighting factor for each criterion varies between 1 and 3, with 1 assigned to the most favored criterion. Totals are determined by summing the score of each criterion times the weighting factor. Therefore, the most favored alternative is the one with the lowest number at the bottom of the table.

This evaluation shows that, the highest ranked alternative is the Rotary Press, followed by the Screw Press and the Centrifuge.

6.4.6.4 Recommended Alternative

The life cycle analysis suggest that the Rotary Press Alternative (Alternative 2) is the lowest cost alternative, in terms of capital and O&M costs. The Centrifuge (Alternative 3) is the highest in capital and energy costs, essentially because of the high dewatering capacity. The Screw Press (Alternative 1) is the highest in operation cost due to the number of units required to meet the throughput requirements and the high polymer dose expected during dewatering mode.

Based on the economic evaluation, the technical comparison, and the non-economic evaluation, the Rotary Press Alternative is recommended for sludge dewatering at the Enfield WPCF.

Table 6-30: Rating Matrix – Solids Processing Evaluation

Item No.	Criteria for Comparison	Weighting Factor	Alternative 1	Alternative 2	Alternative 3
			Screw Press	Rotary Press	Centrifuge
1	**Costs (capital and O&M)**				
1.1	Capital	1	2	1	3
1.2	O&M	1	3	1	2
2	**Desirable Performance and Operational Requirements**				
2.1	Operational Flexibility	2	1	1	2
2.2	Operational Reliability	1	1	1	2
2.3	Expandability	3	3	1	2
2.4	Cake Total Solids	1	1	3	2
2.5	Capacity - Throughput	1	3	2	1
2.6	Footprint	2	3	1	2
2.7	Ease of Maintenance	1	2	1	3
2.8	Supervision Required	2	1	1	1
3	**Environmental and Health Impact**				
3.1	Chemical use	1	2	1	3
3.2	Energy use	2	1	2	3
3.3	Employee safety	1	1	1	2
4	**Total points**		**36**	**24**	**40**
5	**Rank**		**2**	**1**	**3**

Scoring: - The rating score is 1 to 3. Smaller numbers represent a more favorable alternative.
- Totals are determined by summing the score of each criterion times the weighting factor
- The alternative with the lowest total is the best alternative by this measure

6.5 ODOR CONTROL EVALUATION

In addition to wastewater treatment and solids handling process upgrades, the Town of Enfield needs to address odors at the facility. The WPCF is equipped with a 14,000 cfm cross-flow chemical scrubber, but the system has been out of service for several years, resulting in a Notice of Violation from CT DEEP. Woodard & Curran has contracted Bowker & Associates as a sub-consultant for evaluating and recommending odor control improvements at the Enfield WPCF.

Bowker conducted limited sampling and monitoring at the Enfield WPCF to serve as a basis for evaluating appropriate technology to control odors. Bowker summarized the results of the sampling in a report dated May 26, 2015 and attached as Appendix Q. The report details the findings of the sampling program, describes the odor sources recommended for control and summarizes air flows and loadings by source as shown in Table 6-27.

6.5.1 Economic Evaluation of Alternatives

There are many options for treating odorous air, from traditional chemical scrubbers to novel photo-catalytic systems. Table 6-28 summarizes the commonly used treatment technologies for odorous air. Assuming use of a single odor control system to treat the estimated 9,100 cfm of foul air, Bowker evaluated several technologies and performed the life cycle analysis of the evaluated alternatives. The results of the life cycle analysis are summarized in Tables 6-29, 6-30, and 6-31. Woodard & Curran performed process calculations and reviewed industry literature to confirm the adequacy of Bowker's technical and economic evaluation. Because the proposed carbon adsorber has lower estimated capital cost, lower life-cycle costs, and reduced footprint, it is the recommended odor control technology for the Enfield WPCF. The proposed biofilter has a larger footprint than the carbon adsorber, does not fit within the existing Operations Building, and requires more excavation, concrete, and site work. Vendor proposals and brochures are attached in Appendix Q.

Table 6-31: Summary of Air Flows and Loadings

	Source	Air Flow Rate - cfm	H_2S Conc. ppm
1.	Proposed Headworks Building	4,100	1
2.	Aerated Grit Chamber	1,400	5
3.	Primary Distribution box	100	5
4.	Proposed Gravity Thickeners	1,600	2
5.	Dewatered Sludge Conveyor and Truck Bay	1,900	1
	TOTAL	**9,100**	**1.8**

ESC Carbon Adsorber Installation

Biorem Biofilter Installation

Table 6-32: Summary of Odorous Air Treatment Alternatives
(Bowker & Associates, Inc.)

Technique	Frequency of Use	Cost Factors	Advantages	Disadvantages
Packed tower wet scrubbers	High	Moderate capital, high O&M cost	Effective and reliable; long track record; small footprint	High chemical consumption, high O&M
Activated carbon adsorbers	High	Cost-effectiveness depends on carbon replacement frequency	Simple; few moving parts; effective; several media options	Applicable to relatively dilute air streams in order to ensure long carbon life
In-ground biofilters	High	Low to moderate capital; low O&M costs	Simple; low O&M; effective; no chemicals	Large footprint; design criteria varies; some failures due to short-circuiting, overloading
Pre-engineered biofilters	Medium	Moderate to high capital; low O&M	Low O&M, no chemicals; longer media life and smaller footprint than in-ground systems	Higher capital costs than in-ground biofilters
Bioscrubbers, Biotrickling filters	Medium	Moderate capital; low O&M	Smaller footprint than biofilters, high H_2S loadings possible; little or no chemicals	Reduced performance at low temperatures; not as effective for non-H_2S odors
Thermal oxidizers	Low	Very high capital and O&M (energy) costs	Effective for wide spectrum of odors and VOCs	Only economical for high-strength, difficult to treat air streams
Diffusion into activated sludge basins	Low	Economical if use existing blowers or diffusers	Simple; low O&M; effective, reliable	Potential for corrosion of blower inlet components; add'l air filtration required
Odor counteractants	High	Operating cost dependent on chemical usage	Low capital cost	Limited odor removal efficiency (<40%); only applicable for dilute air streams

Table 6-33: Comparative Costs - Odor Control System Alternatives Evaluation

Capital & O&M Conceptual Costs (2015 Costs)			
		Alternative 1	Alternative 2
Item No.	Cost Item	Biofiltration	Activated Carbon
1	Capital Cost Summary		
1.1	Mobilization	$10,000	$10,000
1.2	Site work	$35,000	$3,000
1.3	Concrete	$151,000	$5,000
1.4	Equipment	$218,000	$175,000
1.5	Installation	$109,000	$53,000
1.6	Plumbing	$11,000	$4,000
1.7	Electrical	$44,000	$35,000
1.8	**CAPITAL BASE COST**	**$578,000**	**$285,000**
1.10	Contingency & Engineering (40%)	$231,000	$114,000
1.11	**TOTAL CAPITAL COST**	**$809,000**	**$399,000**
2	O&M Cost Summary		
2.1	Electricity	$17,000	$17,000
2.2	Media Replacement	$2,500	$17,200
2.3	Routine O&M	$6,500	$5,300
2.4	**TOTAL ANNUAL O&M COST**	**$31,000**	**$43,000**

1. Capital cost does not include ductwork

Table 6-34: Equivalent Uniform Annual Cost

Alternative	Total Capital Cost	Capital EUAC[1]	O&M	Total EUAC
1 – Biofiltration	$809,000	$49,000	$31,000	$80,000
2 – Activated Carbon	$399,000	$24,000	$43,000	$67,000

[1] 2% interest for 20 years - ENR 9681

Table 6-35: Equivalent Present Worth Cost (PWC)

Alternative	Total Capital Cost	Total O&M	O&M PWC[1]	Total PWC
1 – Biofiltration	$809,000	$31,000	$507,000	$1,316,000
2 – Activated Carbon	$399,000	$43,000	$703,000	$1,102,000

[1] 2% interest for 20 years - ENR 9681

6.6 SUMMARY OF EXISTING TREATMENT FACILITIES AND FUTURE NEEDS

In addition to those treatment items discussed in detail above, several treatment processes and facilities that may be considered peripheral to the main process must also be examined and evaluated to verify their capacity and suitability for use along with the recommended alternatives. These may include such processes as the headworks, septage handling, primary settling, and chemical feed systems. Administration space allocation will be discussed in Section 6-9, as it relates to building configurations alternatives.

6.6.1 Preliminary Treatment

The preliminary treatment system includes the headworks structure and the aerated grit chambers. As discussed in Chapter 5, the useful life of the headworks structure is exceeded and the existing equipment is outdoor, difficult to maintain, inefficient, and generate odors. For the purpose of the Facilities Plan, we recommend the construction of new headworks building around the existing headworks facility that would include the two new mechanical bar screens to replace the existing screen and failed comminutor.

As mentioned in Chapter 5, the aerated grit chambers are covered with fiberglass panels to contain objectionable odors, but there is no means to collect and treat the odors separately, which can lead to equipment deterioration and concrete corrosion. Therefore, we recommend concrete repair and the installation of odor ducts to collect and treat the odorous air using the proposed odor control system. In addition, the motorized clamshell and aeration system need to be replaced due to the end of their useful life.

A preliminary design is required for a more detailed evaluation of the grit and screening options. For the purposes of estimating costs, an aerated grit removal chamber and ¼ inch mechanical bar screening was assumed. Refer to Figure 7-3 in Chapter 7 for a conceptual layout of the proposed headworks building.

6.6.2 Primary Treatment

The existing primary treatment equipment, as discussed earlier, is aging, in poor condition, and needs to be upgraded. We recommend equipment replacement and concrete repair for primary clarifiers and structure No.2. This equipment includes the drives, weirs, scum baffles, sludge collection mechanisms, scum skimmers, influent column, walkway, handrails, as well as a new mixer for the scum pit, sluice gates and scum shear gate.

Primary clarifiers bypass will be provided to divert a portion of the pretreated wastewater flow to the aeration tanks when internal carbon source is needed to enhance denitrification and improve nitrogen removal.

6.6.3 Aeration Tanks

The majority of the equipment and instrumentation for the existing aeration tanks is either aging, improperly sized, or in need of replacement. The aeration tanks will need to be modified to accommodate for better nutrient removal and operational flexibility and to manage wet weather conditions. Major tanks improvements and modifications will include minor concrete repairs, new baffles, diffusers, new foam spray system, new influent gates, instrumentation upgrade, new mixing system, new IR pumps, and new handrails.

6.6.4 Secondary Clarifiers

While the existing four (4) secondary clarifiers have adequate capacity to provide sufficient treatment, they need major rehabilitation including the installation of new mechanisms, weirs, baffles, influent and effluent gates, mixers at flow distribution structures, handrails, as well as covering the launders with fiberglass covers or the installation of a weir washing system to limit algae growth.

6.6.5 Sludge Pump Station and Disinfection System

The Sludge Pumping Station includes the sludge pumps and the plant water system located at the basement. The building also includes the disinfection system located at the ground floor. Due to the need to replace the aging facilities, improve sludge management and provide adequate capacity, we recommend replacing the RAS, WAS, secondary scum pumps, pump controls, as well as the building roof. Some of the valves on the RAS and WAS piping may need to be replaced as well.

The existing plant water system has insufficient capacity and is aging. We recommend the installation of a new packaged plant water pumping system designed to maintain a constant system discharge pressure at variable flow demands and will supply water throughout the WPCF.

As described in Chapter 5, the improvements needed for the disinfection system include the replacement of the third chemical storage tank and the chemical feed pump, new sodium hypochlorite carrying water pumps, repair PVC piping to inject the disinfectant into RAS, WAS, or effluent water lines, replace some of the valves, as well as the update of instrumentation and controls.

6.6.6 Miscellaneous Items

Additional improvements are needed at the WPCF including the installation of a new load bank for the purpose of automatic load bank testing of the existing generator, updating the existing SCADA system to efficiently integrate and monitor all the critical plant equipment, replacing the aging septage receiving pump, construction of a new vehicle wash station near the headworks building, as well as providing emergency power to diesel fuel pumps.

6.6.7 Summary of Recommendations for Common Facilities

The recommended projects and costs for the common treatment elements discussed in the earlier part of this section are presented in Table 6-32 and in Appendix R.

Table 6-36: Summary of Recommended Project Costs for Common Facilities

Project	Elements Included	Reason/Driver	Project Cost
Preliminary Treatment Upgrades	• New headworks building for screens • Replace comminutor and existing screen with 2 mechanical bar screens and washer/compactor • Replace motorized clamshell hoist and aeration system for grit chamber • Repair concrete for grit chambers • New dedicated grit blowers	End of useful life. Existing system outdoor, difficult to maintain, inefficient and generate odors	$2,934,000
Primary Treatment Upgrades	• New primary clarifier equipment and sluice gates • New mixer for scum pit • Repair concrete for primary clarifiers & Structure No.2 • Provide primary clarifiers bypass • Replace handrails • Replace scum shear gate	Operational issues and end of useful life Supplemental carbon source to improve nitrogen removal	$1,485,000
Aeration Tanks Upgrades	• New aeration blowers • New aeration control system • Aeration Tanks improvements and modifications including minor concrete repairs; and new baffles, diffusers, froth spray system, influent gates, instrumentation, mixing system, IR pumps and handrails	Existing blowers oversized and inefficient Existing aeration system outdated and do not function properly Accommodate for better nutrient removal and operational flexibility	$5,221,000
Secondary Clarifiers Upgrades	• New mechanisms, weirs, and baffles • New influent and effluent gate • New mixers @ Structures No.5, 6 & 7 • Replace handrails	Operational issues and end of useful life	$2,867,000

Project	Elements Included	Reason/Driver	Project Cost
Sludge Pump Station & Disinfection System Upgrades	• New RAS, WAS and secondary scum pumps • New flowmeters • Roof replacement • New chemical storage tank and feed pump • New sodium hypochlorite carrying water pump • Repair PVC piping to inject sodium hypochlorite into RAS, WAS, and effluent water lines • Update instrumentation and controls • New effluent plant water system	End of useful life. Need new equipment. Improve sludge management Regulatory requirement and operational issues Aging equipment Limited capacity and aging infrastructure	$1,742,000
Misc. buildings, power/electricity	• Upgrade SCADA system • Provide emergency power to diesel fuel pumps • New septage receiving pump • New vehicle wash station • New load bank for existing generator	End of useful life and operational issues O&M cost savings	$631,000
		TOTAL:	**$14,881,000**

Notes:

(1) Cost estimates represent the values in 2015 dollars

(2) Project costs include estimated construction costs, engineering, design, administration, and construction management

6.7 EVALUATION OF BUILDING ALTERNATIVES

A meeting was held with Town staff to discuss the facility space deficiencies and develop an architectural program for the facility. The focus was on the 43 year old Operations Building and ways to rehabilitate that building and/or build a new Administration Building. After the meeting, we started investigating six (6) conceptual design alternatives to accommodate the facilities space and process requirements including:

1. Rehabilitation of the Operations Building (OB)
2. Rehabilitation of the Operations Building with new Gravity Thickeners (GTs)
3. New Administration Building (AB), new Sludge Handling Building (SHB), new Blower Building (BB), and new Gravity Thickeners
4. Rehabilitation of the Operations Building with new Sludge Handling Building and new Gravity Thickeners.
5. Rehabilitation of the Operations Building with new Blower Building and new Gravity Thickeners.
6. Rehabilitation of the Operations Building with new Administration Building and new Gravity Thickeners.

The purpose of this building alternatives evaluation is to investigate the feasibility of building a new Administration Building for office space only with partial rehabilitation or demolition of the Operations Building and compare it to the option of a complete rehabilitation of the Operations Building to improve office space and house all the required process equipment. Another driver of this building configurations analysis is to examine intermediate solutions such as the construction of a new Sludge Handling Building to decouple the solids and liquid processing trains, or build a new Blower Building adjacent to the aeration tanks to house the aeration equipment and to improve the operation of the biological system.

Each of these alternatives will be discussed in the following sections, as well as the structural evaluation of the Operations Building and the economic evaluation of all alternatives.

6.7.1 Structural Evaluation of the Operations Building

The Operations Building includes office space, a laboratory that is used to analyze wastewater, a conference room, restroom, the sludge processing equipment, the aeration blowers, the chemical systems, the abandoned incinerator and other items. The following describes the existing building construction and discusses issues pertaining to its potential renovation in the incinerator area.

The building façade varies, and is constructed of: precast concrete panels supported on 8” clay tile backup, insulated aluminum panels supported by steel girts, and insulated curtain walls. Drawing details do not indicate that the masonry backup walls contain steel reinforcement. The masonry walls are supported out of plane at the second floor and roof levels with steel strap anchors attached to the steel framing. There is no indication of vertical bracing on the drawings. The masonry walls do not meet current building code requirements as a means of providing lateral building support. The building was essentially designed with the steel framing supporting gravity loads, and the walls carrying lateral loads. It is unlikely there was much, if any thought, to seismic requirements at the time of its design.

The incinerator area is approximately 64’x40’ and includes a basement, first floor, and second floor. The foundation slab is 4’ thick, and in the area of the incinerator is recessed about 4.5’ below the basement floor. Approximately 75% of the first and second floors areas are steel grating supported by steel beams. The incinerator passes through the first floor. The second floor is at the elevation of the top of the incinerator. The remaining approximately 25% of the first and second floor areas is cast-in-place reinforced concrete slab supported on structural steel framing.

The rest of the building is approximately 100'x50' and also includes a basement, and first and second floors. The foundation slab is 4' thick, the first floor is constructed of reinforced cast-in-place beams and slabs, and the second floor is constructed of cast-in-place reinforced concrete slab supported on structural steel framing. The roof of the building is structural steel framing supporting a metal roof deck. A truckway on the east side of the building adjacent to the incinerator area is at a floor elevation approximately 4-feet below that of the rest of the first floor of the building.

The governing building code is the 2003 International Building Code (IBC) with the 2005 CT supplement and 2009 amendment. Chapter 34 of the IBC addresses "Existing Structures" and states: "Portions of the structure not altered and not affected by the alteration are not required to comply with the code requirements for a new structure." The goal for building alterations should be to limit the affected areas. Chapter 34 of the 2003 IBC doesn't specifically address lateral loads, whereas 2009 IBC does. It states: "Any existing lateral load-carrying structural element whose demand-capacity ratio with the alteration considered is no more than 10 percent greater than its demand-capacity ratio with the alteration ignored shall be permitted to remain unaltered."

The concept for renovating the incinerator area is to replace the grating floors with concrete floors. The first alternative is to use some existing columns and some new columns to support the new floors. This will increase the total dead load of the building floors considerably - certainly more than 10 percent. The seismic demand on the building will increase by the same percentage, so the building will require the addition of vertical lateral bracing. The existing steel beams along the exterior walls in the incinerator area support the walls out of plane. To avoid triggering additional code requirements, it is desirable not to alter or affect the existing wall support system. Hence, the new second floor would be constructed structurally independent of these existing beams.

The existing columns and interior floor support beams in the incinerator area were not designed for, and are not capable of carrying, the additional vertical load from new concrete floors. So, the interior beams would be replaced. The addition of interior columns will be necessary to reduce the tributary load areas supported by the columns. New perimeter columns will be required for the same reason, and to enable construction of the new floor independent of the existing perimeter beams. Existing columns will remain unaltered and continue to support the roof framing as per the original building design.

The second alternative is to provide new floors that are completely structurally independent of the existing structure, except at the foundation slab. This would have the additional benefit of not causing a seismic demand increase on the existing building, which would be considered to remain unaltered. An existing interior column supports the roof. This column requires lateral support at the first and second floors, which is currently provided by the original steel beams spanning to the columns at the exterior walls. In order to provide new floors that are completely structurally independent of the existing framing, the floors would be constructed with openings that allow the column to pass through freely and independently. The existing beams that provide lateral support for the column would be lowered to pass freely and independently below the new floor framing. Vertical bracing would then only be necessary in the incinerator area, rather than for the entire building.

It is possible that benefits of one alternative over the other may become clearer as more information about the future use of the area is known, and as some of the details are studied more closely during the design phase.

6.7.2 Alternative 1A – Rehab Operations Building

As mentioned in Section 5, there is not enough office space in the Operations Building. The laboratory is undersized, and the equipment used to analyze the wastewater is outdated. In addition, the heating, ventilation, and air conditioning equipment, as well as the electrical infrastructure, needs to be upgraded.

This alternative would focus on the rehabilitation of the Operation Building and would include the following:

- Demolition of the abandoned incinerator in the Operations Building;
- Removal of all the hazardous materials based on the abatement report (see Appendix I);
- Rehabilitation of the incineration area in the Operations Building as described in the structural evaluation to meet the current building code requirements and to house the new blowers and dewatering equipment;
- Heavy and light renovation in the admin and dewatering areas of the Operations Building including: relocated shop, relocated electrical, lunchroom/conference room, women's locker room, men's locker room, laundry area, expanded lab, new shared offices, and the installation of the proposed odor control system in the second floor at the current location of the belt filter presses;
- Light renovation in the basement of the Operations Building including the demolition of the existing blowers and chemical systems and the installation of the new chemical feed equipment. The primary sludge pumps will remain in the basement;
- Demolition/renovation of the Operations Building with a new handicap accessible entry ramp, replacing the glazed skin with mixture of metal panel and storefront, as well as new roofing;
- Upgrade the HVAC, plumbing, and electrical infrastructure in the Operations Building; and
- All the common items to each proposed alternative as described in Section 6-7 including, but not limited, the installation of headworks upgrades, sludge pumping station upgrades, new equipment for the primary and secondary clarifiers, aeration tanks upgrades, new chlorination system, and new plant water system.

Refer to Appendix S-1 for a conceptual layout of this alternative.

6.7.3 Alternative 1B – Rehab Operations Building and New Gravity Thickeners (GTs)

This alternative would include the construction of the proposed gravity thickeners in addition of the rehabilitation of the Operations Building. The following items are included:

- Demolition of the abandoned incinerator in the Operations Building;
- Demolition of the undersized Sludge Holding Tank and construction of two (2) 35-ft diameter gravity thickeners to store and thicken the combined primary and secondary sludge;
- Removal of all the hazardous materials based on the abatement report (see Appendix I);
- Rehabilitation of the incineration area in the Operation Building as described in the structural evaluation to meet the current building code requirements and to house the new blowers, the new dewatering equipment, as well as the new pumping equipment for the proposed gravity thickeners;
- Heavy and light renovation in the admin and dewatering areas of the Operations Building including: relocated shop, relocated electrical, lunchroom/conference room, women's locker room, men's locker room, laundry area, expanded lab, new shared offices, and the installation of the proposed odor control system in the second floor at the current location of the belt filter presses;
- Light renovation in the basement of the Operations Building including the demolition of the existing blowers and chemical systems and the installation of the new chemical feed equipment. The primary sludge pumps will remain in the basement;
- Envelope demolition/renovation including: new accessible entry ramp, replace glazed skin with mixture of metal panel and storefront, as well as new roofing;

- Upgrade the HVAC, plumbing, and electrical infrastructure; and
- All the common items to each proposed alternative as described in Section 6-7 including, but not limited, the installation of headworks upgrades, sludge pumping station upgrades, new equipment for the primary and secondary clarifiers, aeration tanks upgrades, new chlorination system, and new plant water system.

Refer to Appendix S-2 for a conceptual layout of this alternative.

6.7.4 Alternative 2 – New Admin Building, Sludge Handling Building, Blower Building, and GTs

This alternative would include the construction of an entirely new Administration Building, new Blower Building, new Sludge Handling Building, and new Gravity Thickeners. The following items are included:

- Demolition of the Operations Building and construction of a new Administration Building to separate office space from mechanical and chemical equipment. This building would contain essentially the conference room, laboratory, women's locker room, men's locker room, single and shared offices, lunchroom, and boiler room.
- Demolition of the undersized Sludge Holding Tank and construction of two (2) 35-ft diameter gravity thickeners and sludge pumping building to store, thicken, and pump the combined primary and secondary sludge to the new dewatering system.
- Removal of all the hazardous materials based on the abatement report (see Appendix I).
- Construction of a new Blower Building to house the proposed aeration blowers and chemical feed systems proximity to the bioreactors and to improve operation and maintenance of the biological system.
- Construction of a new two-story Sludge Handling Building to decouple liquid and solids processing trains. This building would house the proposed odor control system, the proposed grit blowers, the electrical equipment, the chemical systems, and the sludge hauling bay in the ground floor, as well as the new dewatering equipment in the second floor.
- All the common items to each proposed alternative as described in Section 6-7 including, but not limited, the installation of headworks upgrades, sludge pumping station upgrades, new equipment for the primary and secondary clarifiers, aeration tanks upgrades, new chlorination system, and new plant water system.

Refer to Appendix S-3 for a conceptual layout of this alternative.

6.7.5 Alternative 3A – Rehab Operations Building, New Sludge Handling Building and GTs

This alternative would include the construction of new Sludge Handling Building and new Gravity Thickeners, in addition of the rehabilitation of the Operations Building. The following items are included:

- Demolition of the abandoned incinerator in the Operations Building.
- Demolition of the undersized Sludge Holding Tank and construction of two (2) 35-ft diameter gravity thickeners and sludge pumping building to store, thicken, and pump the combined primary and secondary sludge to the new dewatering system.
- Removal of all the hazardous materials based on the abatement report (see Appendix I).
- Construction of a new two-story Sludge Handling Building to decouple liquid and solids processing trains. This building would house the proposed odor control system, the proposed grit blowers, the electrical equipment, the chemical systems, and the sludge hauling bay in the ground floor, as well as the new dewatering equipment in the second floor.

- Rehabilitation of the incineration area in the Operations Building as described in the structural evaluation to meet the current building code requirements and to house the new aeration blowers.
- Heavy and light renovation of the admin and dewatering areas in the Operations Building including: relocated shop, relocated electrical, conference/computer room, women's locker room, men's locker room, laundry area, expanded lab, new shared offices, and new lunchroom.
- Light renovation in the basement of the Operations Building including the demolition of the existing blowers and chemical systems. The primary sludge pumps will remain in the basement.
- Envelope demolition/renovation of the Operations Building including: new handicap accessible entry ramp, replace glazed skin with mixture of metal panel and storefront, as well as new roofing.
- Upgrade the HVAC, plumbing, and electrical infrastructure in the Operations Building.
- Construction of a new chemical building to house the chemical feed systems proximity of the aeration tanks and to improve operation and maintenance of the biological system.
- All the common items to each proposed alternative as described in Section 6-7 including, but not limited, the installation of headworks upgrades, sludge pumping station upgrades, new equipment for the primary and secondary clarifiers, aeration tanks upgrades, new chlorination system, and new plant water system.

Refer to Appendix S-4 for a conceptual layout of this alternative.

6.7.6 Alternative 3B – Rehab Operations Building, New Blower Building and GTs

This alternative would include the construction of new Blower Building and new Gravity Thickeners, in addition of the rehabilitation of the Operations Building. The following items are included:

- Demolition of the abandoned incinerator in the Operations Building.
- Demolition of the undersized Sludge Holding Tank and construction of two (2) 35-ft diameter gravity thickeners and sludge pumping building to store, thicken, and pump the combined primary and secondary sludge to the new dewatering system.
- Removal of all the hazardous materials based on the abatement report (see Appendix I).
- Construction of a new Blower Building to house the proposed aeration blowers and chemical feed systems proximity to the bioreactors and to improve operation and maintenance of the biological system.
- Rehabilitation of the incineration area in the Operations Building as described in the structural evaluation to meet the current building code requirements and to house the new grit blowers and chemical feed systems.
- Heavy and light renovation of the admin and dewatering areas in the Operations Building including: relocated shop, relocated electrical, lunchroom/conference room, women's locker room, men's locker room, laundry area, expanded lab, new shared offices, and the installation of the proposed odor control system in the second floor at the current location of the belt filter presses.
- Light renovation in the basement of the Operations Building including the demolition of the existing blowers and chemical systems. The primary sludge pumps will remain in the basement.
- Envelope demolition/renovation of the Operations Building including: new accessible entry ramp, replace glazed skin with mixture of metal panel and storefront, as well as new roofing.
- Upgrade the HVAC, plumbing, and electrical infrastructure in the Operations Building.

- All the common items to each proposed alternative as described in Section 6-7 including, but not limited, the installation of headworks upgrades, sludge pumping station upgrades, new equipment for the primary and secondary clarifiers, aeration tanks upgrades, new chlorination system, and new plant water system.

Refer to Appendix S-5 for a conceptual layout of this alternative.

6.7.7 Alternative 3C – Rehab Operations Building, New Administration Building and GTs

This alternative would include the construction of a new Administration Building and new Gravity Thickeners, in addition to the rehabilitation of the Operations Building. The following items are included:

- Demolition of the abandoned incinerator in the Operations Building.
- Demolition of the undersized Sludge Holding Tank and construction of two (2) 35-ft diameter gravity thickeners and sludge pumping building to store, thicken, and pump the combined primary and secondary sludge to the new dewatering system.
- Removal of all the hazardous materials based on the abatement report (see Appendix I).
- Construction of a new Administration Building to separate office space from mechanical and chemical equipment. This building would contain essentially the conference room, lab room, single and shared offices, lunchroom, and boiler room.
- Rehabilitation of the incineration area in the Operations Building as described in the structural evaluation to meet the current building code requirements and to house the new blowers, the new dewatering equipment, and the new chemical feed systems.
- Heavy and light renovation in the admin and dewatering areas of the Operations Building including: relocated shop, relocated electrical, women's locker room, men's locker room, laundry area, new shared offices, and the installation of the proposed odor control system in the second floor at the current location of the belt filter presses.
- Light renovation in the basement of the Operations Building including the demolition of the existing blowers and chemical systems. The primary sludge pumps will remain in the basement.
- Envelope demolition/renovation of the Operations Building including replacement of glazed skin with mixture of metal panel and storefront, as well as new roofing.
- Upgrade the HVAC, plumbing, and electrical infrastructure in the Operations Building.
- Construction of a new chemical building to house the chemical feed systems proximity of the aeration tanks and to improve operation and maintenance of the biological system.
- All the common items to each proposed alternative as described in Section 6-7 including, but not limited, the installation of headworks upgrades, sludge pumping station upgrades, new equipment for the primary and secondary clarifiers, aeration tanks upgrades, new chlorination system, and new plant water system.

Refer to Appendix S-6 for a conceptual layout of this alternative.

6.7.8 Economic Evaluation of Alternatives

6.7.8.1 Life Cycle Cost Analysis

The preferred alternative will be identified based on an evaluation of costs among the viable alternatives as well as qualitative factors (non-monetary) that may influence the decision process. Using the capital and annual operating cost

of the different alternatives, W&C performed a life cycle cost comparison to determine the cost of constructing, operating and maintaining all the proposed buildings and processes for a 20-year period.

We made the following assumptions in order to conduct the life cycle analysis:

- Life cycle costs include the capital and annual operating costs;
- The basis of cost estimates is similar to the basis used for the wastewater treatment alternatives evaluation. Refer to section 6.4.8 for more details;
- The cost of the common items to each proposed alternative was determined separately and added to the total cost of each alternative as shown in the Cost Analysis Matrix (Figure 6-7); and
- Future costs of polymer, electricity, and disposal may be higher than present day costs; however, an increase in any of these costs would have a similar effect on all of the dewatering alternatives and therefore a constant price for polymer and electricity can be assumed.

A cost comparison of each alternative is presented in Tables 6-33, 6-34, and 6-35. The detailed cost estimates are included in Appendix R. The cost estimates shown, and any resulting conclusions on project financial or economic feasibility or funding requirements, have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. As a result, the final project costs will vary from estimates presented here.

6.7.8.2 Technical Comparison

The advantages and limitations of each alternative are summarized in Table 6-36.

6.7.8.3 Recommended Alternative

The life cycle analysis results suggest that Alternative 1A (Rehab OB) is the lowest cost alternative, in terms of capital and O&M costs. Alternative 2 (New AB, SHB, BB, and GTs) is the highest alternative in capital and O&M costs due to the high cost to demolish the Operations Building and the cost to construct all the additional buildings required to separately house the office space (Admin Building), the sludge processing equipment (Sludge Handling Building) and the aeration equipment (Blower Building). The rest of the intermediate alternatives (3A, 3B, and 3C) all have lower capital and O&M costs than alternative 2, but still higher than alternatives 1A and 1B (Rehab OB and new GTs), due to the additional buildings needed (SHB for Alternative 3A, BB for Alternative 3B, and AB for Alternative 3C). Alternative 1B has similar O&M costs that Alternative 1A, but higher capital cost due to the additional gravity thickeners.

Based on the cost and technical comparison between each alternative, Alternative 1B (Rehab OB and new GTs) is recommended for the Enfield WPCF. Though Alternative 1B does not have the lowest life cycle cost, it is the lowest cost alternative that can efficiently provide better operational flexibility for the operators and decouple liquid and solids processing trains.

Figure 6-5: Cost Analysis Matrix

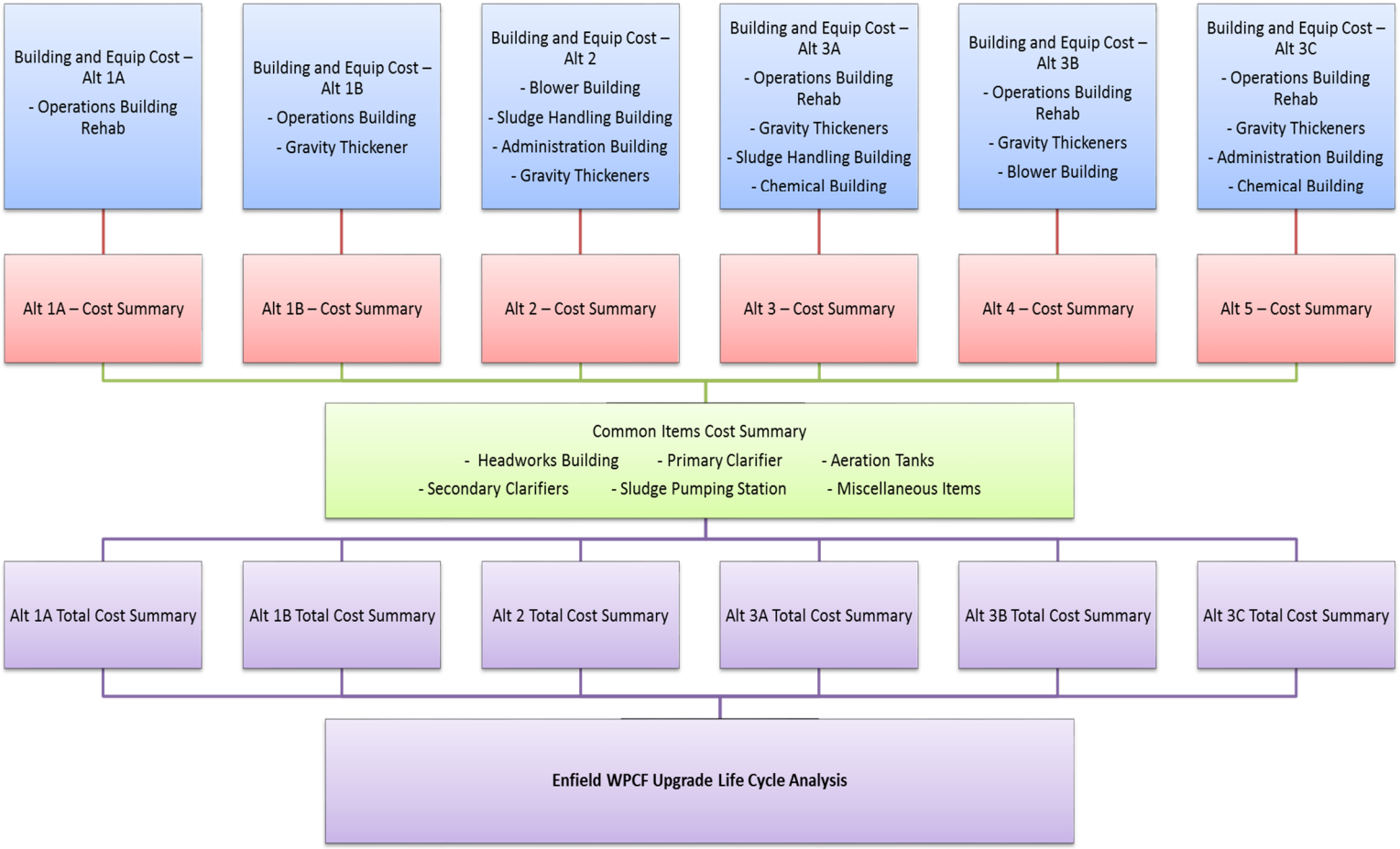


Table 6-37: Comparative Costs - Building Layout Alternatives Evaluation

Capital and O&M Anticipated Costs (2015 Costs)							
		Alternative 1A	Alternative 1B	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C
Item No.	Cost Item	Rehab OB	Rehab OB & New GT	New AB, SHB, BB & GT	Rehab OB New SHB & GT	Rehab OB New BB & GT	Rehab OB New AB & GT
1	CAPITAL COST SUMMARY						
1.1	Excavation / Backfill	$14,000	$142,000	$495,000	$325,000	$289,000	$309,000
1.2	Demolition	$57,000	$57,000	$735,000	$263,000	$57,000	$82,000
1.3	Concrete	$1,656,000	$2,380,000	$3,116,000	$3,313,000	$3,075,000	$3,184,000
1.4	Process Piping	$431,000	$482,000	$297,000	$495,000	$574,000	$763,000
1.5	Building Construction	$ 2,319,000	$2,319,000	$4,762,000	$4,875,000	$3,399,000	$3,502,000
1.6	Equipment	$9,381,000	$10,694,000	$10,708,000	$10,638,000	$10,634,000	$10,634,000
1.7	Site / Miscellaneous	$631,000	$898,000	$1,091,000	$961,000	$949,000	$1,070,000
1.8	**CONSTRUCTION BASE COST**	**$14,489,000**	**$16,972,000**	**$21,204,000**	**$20,870,000**	**$18,977,000**	**$19,544,000**
1.9	Overhead, Insurance, & General Conditions (25%)	$3,622,000	$4,243,000	$5,301,000	$5,218,000	$4,744,000	$4,886,000
1.10	Contingency & Engineering (40%)	$7,244,000	$8,486,000	$10,602,000	$10,435,000	$9,488,000	$9,772,000
1.11	**TOTAL CAPITAL COST**	**$25,355,000**	**$29,701,000**	**$37,107,000**	**$36,523,000**	**$33,209,000**	**$34,202,000**
2	O&M COST SUMMARY						
2.1	Electricity	$357,500	$373,500	$372,500	$373,500	$371,500	$373,500
2.2	Chemical & Sludge Disposal	$478,000	$478,000	$477,000	$477,000	$477,000	$477,000
2.3	Operation	$117,000	$128,700	$128,700	$128,700	$128,700	$128,700
2.4	Maintenance	$165,200	$185,600	$185,800	$184,500	$184,500	$184,500
2.5	**TOTAL ANNUAL O&M COST**	**$1,118,000**	**$1,166,000**	**$1,164,000**	**$1,164,000**	**$1,162,000**	**$1,164,000**

Table 6-38: Equivalent Uniform Annual Cost (EUAC)

Alternative	Total Capital Cost	Capital EUAC[1]	O&M PWC[1]	Total PWC
1A - Rehab OB	$ 25,355,000	$1,551,000	$1,118,000	$2,669,000
1B - Rehab OB & New GT	$ 29,701,000	$1,816,000	$1,166,000	$2,982,000
2 - New AB, SHB, BB & GT	$ 37,107,000	$2,269,000	$1,164,000	$3,433,000
3A - Rehab OB, New SHB & GT	$ 36,523,000	$2,234,000	$1,164,000	$3,398,000
3B - Rehab OB, New BB & GT	$ 33,209,000	$2,031,000	$1,162,000	$3,193,000
3C - Rehab OB, AB & GT	$ 34,202,000	$2,092,000	$1,164,000	$3,256,000

Table 6-39: Equivalent Present Worth Cost (PWC)

Alternative	Total Capital Cost	Total O&M	O&M PWC[1]	Total PWC
1A - Rehab OB	$ 25,355,000	$1,118,000	$18,281,000	$43,636,000
1B - Rehab OB & New GT	$ 29,701,000	$1,166,000	$19,066,000	$48,767,000
2 - New AB, SHB, BB & GT	$ 37,107,000	$1,164,000	$19,033,000	$56,140,000
3A - Rehab OB, New SHB & GT	$ 36,523,000	$1,164,000	$19,033,000	$55,556,000
3B - Rehab OB, New BB & GT	$ 33,209,000	$1,162,000	$19,000,000	$52,209,000
3C - Rehab OB, New AB & GT	$ 34,202,000	$1,164,000	$19,033,000	$53,235,000

LEGEND	
OB	Operations Building
GT	Gravity Thickener
AB	Admin Building
SHB	Sludge Handling Building
BB	Blower Building

Table 6-40: Summary of Advantages & Limitations of Building Alternatives Considered

Process	Advantages	Limitations
Alternative 1A – Rehab Operations Building	- Least land area - Less building construction - Lowest capital cost	- Least office space - Least storage space - Solids processing and chemical equipment shared with office space - Safety and odor concerns for staff and public - More building maintenance
Alternative 1B – Rehab Operations Building & New Gravity Thickener	- Less land area needed - Less building construction - Low capital cost - Decouples liquid and solids processing trains	- Less office space - Limited storage space - Solids processing and chemical equipment shared with office space - Safety and odor concerns for staff and public - More building maintenance
Alternative 2 – New Administration Building, Sludge Handling Building, Blower Building and Gravity Thickener	- Ease of construction - Office space separated from mechanical and chemical equipment - Safer environment for staff and public - Decouples liquid and solids processing trains - Least building maintenance - Efficient building space - Efficient land use	- Highest capital costs - More building construction needed
Alternative 3A– Rehab Operations Building, New Sludge Handling Building and Gravity Thickener	- Ease of construction - Safer environment for staff and public - Decouples liquid and solids processing trains - Most building space for staff and storage - Less building maintenance	- High capital cost - Requires more land area - Requires more building construction
Alternative 3B – Rehab Operations Building, New Blower Building and Gravity Thickener	- Aeration blowers proximity to reactor tanks improves operation and maintenance of biological system - Decouples liquid and solids processing trains - More space for staff and storage	- High capital cost - Safety and odor concerns for admin staff and public - More building construction
Alternative 3C – Rehab Operations Building, New Administration Building and Gravity Thickener	- Office space separated from mechanical and chemical equipment - Safer environment for admin staff and public - Decouples liquid and solids processing trains - More space for staff and storage	- High capital cost - More building construction - Requires more space

6.8 ENERGY OPPORTUNITY EVALUATION

6.8.1 Pump Stations Energy Evaluation

Woodard and Curran contracted JK Muir, LLC as a sub-consultant to conduct an energy evaluation of the four largest pumping stations in the Town of Enfield's collection system. These stations include:

- Grape Brook;
- Simon Road;
- South Maple Street; and
- South River Street.

JK Muir and Woodard & Curran visited each pumping station, collected nameplate data, and performed field measurements to determine the hydraulic efficiency of selected pumps. Billing data was utilized to summarize the pump station's current energy usage and costs.

The objectives of the energy report include the following:

- Provide a summary description of the evaluated Pump Stations;
- Summarize the energy usage and billing rates for the facilities, and demonstrate how electrical energy is being used; and
- Identify specific operational and capital improvements at the facility, and estimate the energy savings and cost for each project.

The projects have been categorized as Energy Conservation Measures (ECMs), for projects that require a capital investment, and operational measures (OMs) for projects that can be done at a minimal cost.

6.8.1.1 Summary of Energy Use and Proposed Measures

The energy usage summary shown below provides an overview of annual electrical (kWh), as well as costs based on billing information provided from April 2014 through March 2015. The data for this period is summarized below.

Table 6-41: Enfield Pump Station Energy Usage Summary – 2014 and 2015

Energy Source	Annual Energy Use (kWh)	Annual Cost	Unit Cost (per kWh)
Electrical Use	422,240	$65,795	$0.15

Pump Station Energy Usage

Currently, the Enfield Pump Stations receive electric supply through a multi-year contract with TransCanada and delivery service through Eversource. Each service is metered and billed separately by both TransCanada and Eversource. A summary of the annual electrical usage and costs for the facilities is summarized in Table 6-42 below, and is based on the 2014 and 2015 billing records. Please note that the unit cost per kWh is based on the utility bill value, which may have additional charges that fluctuate month to month resulting in a unit cost that is higher than the current Eversource supply rate.

Table 6-42: Annual Electrical Usage and Costs Summary – 2014 and 2015

Account	Rate	Average Monthly Usage (kWh)	Average Monthly Cost	Average kW Demand	Annual Energy Use (kWh)	Annual Cost	Unit Cost per kWh
Simon Road	030	4,947	$780	14	59,360	$9,363	$0.16
South River	030	7,293	$1,102	20	87,520	$13,218	$0.15
South Maple	030	9,160	$1,505	32	109,920	$18,063	$0.16
Grape Brook	030	13,787	$2,096	36	165,440	$25,151	$0.15
	Total				**422,240**	**$65,795**	

Under the TransCanada contract, generation/supply costs are based on the total kWh consumed by the station. Eversource is currently billing the four pump stations under the Small General Electric Service Rate 30. Rate 30 is for customers with a maximum annual demand less than 200 kW. There are two demand charges under this rate – distribution and transmission. The demand charge schedule is based on the greatest average 30 minute kW demand recorded during the billing month. This rate is based on a demand no less than 2 kW.

All electric customers have the option to negotiate their own rates with independent power supply companies or brokers. Customers who opt not to purchase generation power directly are automatically placed on either Eversource's Standard Service (maximum demand less than 500 kW) or Last Resort Service (maximum demand equal to or greater than 500 kW). Under this arrangement, Eversource negotiates a price for generation supply on behalf of aggregated customer blocks. The Enfield Pump Stations are currently purchasing power generation through TransCanada, a third party supplier. Under the current electrical supply contract, the facility pays a flat rate for power, and costs are not dependent on on/off peak pricing. In 2014, Enfield paid an average rate of $0.083 per kWh of electrical supply. At the end of the current contract, the facility should review electrical supply rates from other third party suppliers and Eversource. The current Eversource supply rate for Rate 30 is $0.121 per kWh. If electrical supply rates continue to decrease, the facility may wish to explore a "blend and extend" agreement with their current independent power supply company.

The project evaluation economic summary shown below provides an overview of JK Muir's estimates for total project costs and annual savings. A more detailed summary of the qualified measures and their associated savings is presented in the Pump Stations energy report attached in Appendix T.

Table 6-43: Projected Annual Cost and Savings Summary – Pump Stations

Cost Saving Measures	Annual Energy Savings	First Year Annual Dollars	Initial Cost	Simple Payback (years)
South Maple – Pump Rebuild	7,858	$1,289	$15,000	11.6
South Maple – Pump Rebuild & Flow Reduction	11,692	$1,918	$15,000	7.8

Notes: 1. Calculations that did not demonstrate savings were not presented in the table.
2. ECM paybacks are based on first year savings.
3. Potential energy program cost and savings do not include the potential Eversource Incentives

6.8.2 WPCF Energy Evaluation

Woodard and Curran has contracted JK Muir, LLC as a sub-consultant to conduct an energy evaluation of the Enfield WPCF. JK Muir summarized the results of the energy evaluation in a report dated May, 2015 and attached in Appendix U. W&C performed energy calculations and reviewed industry literature to confirm the adequacy of JK Muir's technical and economic evaluation.

The objectives of the energy report include the following:

- Provide a summary description of the evaluated WPCF;
- Summarize the energy usage and billing rates for the facility, and demonstrate how electrical energy is being used;
- Identify specific operational and capital improvements at the facility, and estimate the energy savings and cost for each project; and
- Identify viable renewable energy projects that provide environmental, economic and social benefits to the community.

The projects have been categorized as Energy Conservation Measures (ECMs), for projects that require a capital investment, and operational measures (OMs) for projects that can be done at a minimal cost. An initial site visit to the WPCF was conducted by JKMuir, LLC on June 20, 2014. The facility descriptions are based on site reconnaissance, staff input and available drawings. Billing data were utilized to summarize the facility's current energy demands.

6.8.2.1 Summary of Energy Use and Proposed Measures

The energy usage summary shown below provides an overview of annual electrical (kWh), as well as costs based on billing information provided from January through December 2013. The data for the 2013 period is summarized below.

Table 6-44: Enfield WPCF Energy Usage Summary – 2013

Energy Source	Annual Energy Use (kWh)	Unit	Annual Cost	Unit Cost
Electrical Use	2,157,295	kWh	$267,707	$0.124

The project evaluation economic summary shown below provides an overview of JK Muir's estimates for total project costs and annual savings. A more detailed summary of the qualified measures and their associated savings is presented in the energy report attached in Appendix U. The tables have been separated into two tables: Table 6-45 presents the ECMs associated with the facility upgrades and Table 6-46 shows the potential short-term options that could be incorporated prior to the facility upgrades.

Table 6-45: Projected Annual Cost and Savings Summary – Upgrade ECMs

	Cost Saving Measures	Annual Energy Savings (kWh)	First Year Annual Dollars ($)	Initial Cost ($)	Simple Payback (yrs)
ENERGY CONSERVATION MEASURES					
ECM 2	Aeration Blower Replacement	599,877	$74,385	$234,000	3.1
ECM 6A	Aeration Tanks Mixing – Compressed Gas Mixing	743,987	$92,254	$696,000	7.5
ECM 7	HVAC Upgrades	----------			
ECM 8	Lighting Upgrades	----------			
Potential Energy Program Cost and Savings		**1,343,864**	**$166,639**	**$930,000**	**5.6**

Note: Potential energy program cost and savings do not include the potential Eversource Incentives

Table 6-46: Projected Annual Cost and Savings Summary – Short-Term ECMs

	Cost Saving Measures	Annual Energy Savings	First Year Annual Dollars ($)	Initial Cost ($)	Simple Payback (yrs)
ENERGY CONSERVATION MEASURES					
OM 1	Bar Screen Control	16,201	$2,009	$0	Immediate
ECM 1	RAS Pump Rebuild[1]	81,988	$10,167	$42,900	4.2
ECM 3	Plant Water System VFD Installation	41,880	$5,193	$50,500	9.7
ECM 4	Internal Recycle Pump Control	182,190	$22,592	$3,000	0.1
ECM 5	Odor Control Fan VFD Installation	15,470	$1,918	$15,000	7.8
Potential Energy Program Cost and Savings[2]		**337,729**	**$41,879**	**$111,400**	**2.7**

Notes: 1. ECM paybacks are based on first year savings

2. Potential energy program cost and savings do not include the potential Eversource Incentives

6.8.2.2 Summary of Renewable Energy Options

The following renewable energy alternatives were evaluated as a part of the energy evaluation.

1. **Wind Power** – small scale wind turbine on WPCF property
2. **Hydroelectric** – small scale hydro turbine from plant effluent flow
3. **Photovoltaic Array** – solar power on available land on WPCF property

The summary of the alternatives analysis are presented in the following table. A more detailed evaluation is presented in the WPCF energy evaluation report attached in Appendix U.

Based on the evaluation, the Wind Mill alternative is not an economically feasible alternative for the Enfield WPCF.

Table 6-47: Renewable Energy Alternative Summary

Energy Alternative	Potential Energy Production (kWh/yr)	Potential Energy Production ($/year)	Percent of Annual Energy Production
Hydroelectric Turbine	40,413	$5,011	2%
Photovoltaic Array	274,307	34,015	12%

6.8.3 Funding For Pump Stations and WPCF Energy Efficiency Improvements

Eversource: The incentive programs offered by Eversource (Energize CT programs) can provide funding for any portions of pump station and/or WPCF upgrades that can be shown to provide energy savings (i.e. VFDs, jockey pumps, updated controls, etc). Pump rebuilds are also eligible through these programs if the efficiency of the pump will be improved or returned to original design conditions. Any planned upgrades to the pump stations and WPCF should be considered for this program.

CT DEEP – "Green Infrastructure Reserve": WPCF, pump station, and/or collection system improvement projects that incorporate cost-effective renewable energy components are eligible through this program (100% loan). The CT DEEP has indicate that "green" and "renewable" could include energy efficiency projects, in addition to on-site renewable energy projects. This could be used for specific energy efficiency improvements at the wastewater pump stations, or capital improvement projects that will provide energy savings. (Pump rebuilds are not eligible for funding through the DEEP programs as they are considered maintenance projects)

CT DEEP – "Pump Station Rehabilitation Project Reserve": This program provides funding for the rehabilitation of pump stations and can be used for replacing aging infrastructure, reducing hydraulic overloading, incorporating energy efficient equipment and providing emergency power (100% Loan). Any upgrades or equipment replacement projects at the pump stations could utilize this reserve funding, including efficiency projects. This reserve fund may be eliminated when the next priority list is released.

6.9 ENVIRONMENTAL IMPACT EVALUATION

6.9.1 General

The alternatives analysis evaluated alternatives designed to ensure compliance with the NPDES discharge permit. Potential environmental impacts associated with these alternatives were also evaluated during the selection process, in a manner consistent with the Connecticut Environmental Policy Act (CEPA). The selected plan, which is presented in Section 7, was chosen based on its technical feasibility while recognizing the environmental impacts of each option. While the selected plan represents an environmentally feasible and acceptable plan, potential impacts have been identified in the implementation of the selected plan. Most of the impact is due to the construction of new facilities and will therefore be temporary in nature. These impacts, as well as mitigating strategies, are presented in the following sections.

6.9.2 Surface Water Quality

See Section 2 for a description of Enfield's surface water quality. No negative impacts to surface water quality are anticipated from construction of the WPCF upgrades. Erosion and sedimentation control measures will be implemented as required by Best Management Practices (BMPs) to prevent runoff into nearby surface waters.

The current WPCF discharges to the Connecticut River and will continue to do so after the upgrade. Water quality is expected to improve as a result of this project due to the process upgrades at the WPCF and the Town's management of its wastewater collection system. Following implementation of the WPCF upgrades, the WPCF effluent will be treated to a higher degree in terms of organic matter and nutrient removal, thus improving water quality in the downstream Connecticut River. The SCADA upgrades at the pump stations will also allow for quicker response to emergencies and better management of the flows and controls.

There are no provisions in the upgraded WPCF to bypass treatment processes. All unit processes will be designed to operate during power failures, and will be sized to accommodate future flows, both hydraulically and from a treatment perspective. During construction of the upgraded WPCF, existing treatment capability will be maintained until the new facilities are installed and tested.

6.9.3 Groundwater Quality

The WPCF site is not located on or near any existing public water supply from groundwater source. The use of the site in the future as a source of potable groundwater is both impractical and unlikely. Connecticut Water and Hazardville Water currently provide public water supply to most residents and any future water supply in the Town of Enfield is likely to be supplied by this system.

There will be no impact on individual wells or groundwater quality as a result of this project. The WPCF discharge is a point source discharge into the Connecticut River and therefore will not have any impact on existing groundwater quality conditions.

6.9.4 Stormwater Discharge

Stormwater discharges from construction sites where one or more acres are to be disturbed, regardless of project phasing, require an NPDES permit from the Permitting & Enforcement Division. The General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities (DEEP-WPED-GP-015) will cover these discharges. The construction stormwater general permit dictates separate compliance procedures for locally approvable projects and locally exempt projects (as defined in the permit).

Locally exempt construction projects disturbing over one acre must submit a registration form and Stormwater Pollution Control Plan (SWPCP) to CT-DEEP. Locally approvable construction projects with a total disturbed area of one to five acres are not required to register with CT-DEEP provided the development plan has been approved by a municipal land use agency and adheres to local erosion and sediment control land use regulations and the CT Guidelines for Soil Erosion and Sediment Control. Locally approvable construction projects with a total disturbed area of five or more acres must submit a registration form to CT-DEEP prior to the initiation of construction. This registration shall include a certification by a Qualified Professional who designed the project and a certification by a Qualified Professional or regional Conservation District who reviewed the SWPCP and deemed it consistent with the requirements of the general permit. The SWPCP for locally approvable projects is not required to be submitted to CT-DEEP unless requested.

The SWPCP must include measures such as erosion and sediment controls and post construction stormwater management. A goal of 80 percent removal of total suspended solids from the stormwater discharge shall be used in designing and installing post-construction stormwater management measures. The general permit also requires that post-construction control measures incorporate runoff reduction practices, such as low impact development (LID) techniques, to meet performance standards specified in the permit. For further information, contact the division at 860-424-3018. A copy of the general permit as well as registration forms may be downloaded at CT-DEEP's website.

Development plans for utilities in urban areas that entail soil excavation should include a protocol for sampling and analysis of potentially contaminated soil. A soil management plan should be developed for the project to deal with soils during construction. CT-DEEP's Guidance for Utility Company Excavation should be used as a guide in developing the plan. The guidance is available on-line at CT-DEEP's website.

6.9.5 Wetlands

Figure 6-9 shows the existing and proposed sewer service areas overlaid with DEEP defined wetlands. As shown on Figure 6-9, there are no wetlands located on or adjacent to the WPCF site. See Section 2 for a description of wetlands as defined by DEEP. Prior to construction activities startup, the exact location of regulated wetland areas should be determined based on field inspection and testing conducted by a qualified scientist.

The potential for increased erosion and sedimentation into the Connecticut river (via catch basins) exists during the construction phase of this project. This will be mitigated by the use of properly selected, installed and maintained erosion control measures, which will be the responsibility of the contractor to maintain and the construction inspector to enforce. The State of Connecticut "Guidelines for Soil Erosion and Sediment Control" (DEEP Bulletin 34) will be used as a basis for all soil erosion control. The risk to impact inland wetland areas (if any) accidentally during the construction operations will be mitigated by the construction of fencing delineating areas that are not to be disturbed. The contractor will not be able to store equipment, materials or otherwise disturb these areas.

6.9.6 Flood Zones

As discussed in Section 2, the WPCF lies both within 100-year and 500-year floodplains, but is protected by berms to the east, west and south. See Figure 2-3 for locations of floodplains in the Town of Enfield and Figure 5-4 for the existing WPCF hydraulic profile. As shown in the hydraulic profile, nearly all of the process tanks lie below the 100-year flood elevation, however the berms surrounding the site are designed to prevent flooding from the Connecticut River.

All proposed structures will have their grade elevations at or above the 100-year flood elevation. Future WPCF hydraulics will be established so that all plant functions will be operational during 100-year flood conditions.

6.9.7 Aquifer Protection Areas

According to DEEP GIS data, Enfield contains six aquifer protection areas, primarily located in the center of Town. Each aquifer protection area is named after the well field that draws from it, including the Spring Lots, Powder Hollow,

O'Bready, Avery, Scitico, and Town Farm well fields. Figure 6-6 shows the existing and proposed sewer service areas overlaid with DEEP aquifer protection areas. As shown on Figure 6-6, the WPCF site does not overlap any aquifer protection areas, however, the Sharp Street, Indian Run, and South Maple Street pump stations do. No construction activities required by the recommended plan are anticipated to affect groundwater quality in any of the aquifer protection areas.

6.9.8 Wild and Scenic Rivers

The Town of Enfield does not contain any designated wild and scenic rivers. According to the Interagency Wild and Scenic Rivers Coordinating Council[11], no rivers in the Town of Enfield are currently under review to be added to the wild and scenic rivers listing.

6.9.9 Air Quality

No long term change in existing air quality is anticipated as a result of the proposed plan. Construction may cause a short-term increase in total suspended particulate matter and emissions from construction equipment in the area, although the level will not be sufficient to impact ambient air quality. Prior to construction, the State air pollution program administrator responsible for enforcing the State Implementation Plan (SIP) will be contacted to determine whether construction activities must comply with the SIP. In order to minimize air quality issues, the contractor will be required to mitigate levels of excessive dust through the application of calcium chloride or water to unpaved areas subject to vehicular traffic.

Once construction is completed, the WPCF structures and processes will have no negative impact on air quality. The existing odor control system will be removed and replaced with a new carbon absorber designed to remove and treat odorous air generated in the proposed headworks building, aerated grit chambers, proposed gravity thickeners, dewatered sludge conveyor, and sludge discharge bay.

CT-DEEP typically encourages the use of newer off-road construction equipment that meets the latest EPA or California Air Resources Board (CARB) standards. If that newer equipment cannot be used, equipment with the best available controls on diesel emissions including retrofitting with diesel oxidation catalysts or particulate filters in addition to the use of ultra-low sulfur fuel would be the second choice that can be effective in reducing exhaust emissions. The use of newer equipment that meets EPA standards would obviate the need for retrofits.

CT-DEEP also encourages the use of newer on-road vehicles that meet either the latest EPA or California Air Resources Board (CARB) standards for construction projects. These on-road vehicles include dump trucks, fuel delivery trucks and other vehicles typically found at construction sites. On-road vehicles older than the 2007-model year typically should be retrofitted with diesel oxidation catalysts or diesel particulate filters for projects. Again, the use of newer vehicles that meet EPA standards would eliminate the need for retrofits.

Additionally, Section 22a-174-18(b)(3)(C) of the Regulations of Connecticut State Agencies (RCSA) limits the idling of mobile sources to 3 minutes. This regulation applies to most vehicles such as trucks and other diesel engine-powered vehicles commonly used on construction sites. Adhering to the regulation will reduce unnecessary idling at truck staging zones, delivery or truck dumping areas and further reduce on-road and construction equipment emissions. Use of posted signs indicating the three-minute idling limit is recommended. It should be noted that only DEEP can enforce Section 22a-174-18(b)(3)(C) of the RCSA. Therefore, it is recommended that the project sponsor include language similar to the anti-idling regulations in the contract specifications for construction in order to allow them to enforce idling restrictions at the project site without the involvement of the Department.

[11] http://www.rivers.gov/connecticut.php. Accessed July 20, 2015

During the construction of the WPCF upgrade, temporary increases in dust, carbon monoxide and other petroleum fuel byproducts will increase. Dust will be controlled by the use of water, temporary gravel roads and the establishment of groundcover during extended periods of inactivity. The increase in combustion engine emissions is a feature of any construction and is difficult to avoid. The temporary increase will be mitigated by the prevailing wind in the area and will be ultimately offset by the abatement of permanent odors at the WPCF.

6.9.10 Land Use

The existing WPCF site has been used for wastewater treatment since the 1930s. The proposed structures and processes in the recommended plan are consistent with the operations currently located at the WPCF. There is no vacant land adjacent to the WPCF site, which is bordered on the east by railroad corridor, abandoned ash decanting lagoons to the north, Parsons Road and the Connecticut River to the west, and the Town dog kennel to the south.

The recommended plan for the WPCF should not affect the land use and development patterns in the areas immediately adjacent to the WPCF. The recommended WPCF upgrades are intended to address maintenance issues and NPDES requirements and are not intended to increase capacity or encourage additional development. The improvement of surface water quality through enhancement of nutrient removal and reduction in odors should help preserve current property values.

It is also unlikely that zoning patterns will change dramatically toward increased density or that sewers would be installed in areas other than those described in Section 2 during the planning period, solely because of WPCF upgrades. Historically, this has not been the case and with the current funding situation for sanitary sewers, is unlikely to change.

6.9.11 Endangered Species and Natural Resources

As described in Section 2, no impacts to listed or protected species are expected if the project remains within the scope of activities described in this facilities plan. Both the DEEP and FWS were consulted as part of the facilities plan development process to determine impacts to sensitive species. If the project area is altered during design, DEEP should be notified to determine possible impacts to natural resources or endangered species. Figure 6-7 shows the existing and proposed sewer service areas overlaid with the DEEP Natural Diversity Database area layer.

6.9.12 Historic Districts and Significant Lands

As discussed in Section 2, no historic districts or buildings, or significant lands are located within or near the WPCF or pump station sites. The recommended plan does not include construction activities outside the existing boundaries of these sites, and therefore will not affect existing historic areas or significant lands in the Town of Enfield.

6.9.13 Prime Farmland

The recommended WPCF and pump stations upgrade plan is not expected to affect any designated farmland within the Town of Enfield. No existing farmland is located on or near the WPCF site or any pump station. As discussed in Section 2, the recommended plan is not anticipated to encourage expansion of the sewer system. One new pump station is proposed to be constructed on previously developed land to replace the existing Sharp Street pump station.

Figure 6-8 shows the existing and proposed sewer service areas overlaid with DEEP designated farmland soils. Farmland soils include locally or statewide important land based on soil type, or land that is considered prime for farming. These areas are identified as the most suitable for production of food, fiber, forage, feed, and oilseed crops, and may qualify for protection in the Federal Farm and Ranch Lands Protection Program (FRPP). The FRPP is designed to protect working agricultural land from non-agricultural uses.

There are two types of Farmland Soils in the Town of Enfield, including Prime Farmland Soils and Statewide Important Farmland Soils. Prime Farmland Soils exhibit optimal combinations of physical and chemical properties to produce crops and may include existing cropland, pasture, or forest, but is not developed. Statewide Important Farmland Soils fail to meet at least one requirement of prime farmland but are still considered important for crop production. Some existing and proposed sewer service areas overlap designated Farmland Soils, however, no development of existing farmland is proposed.

6.9.14 Pesticides, Toxic, or Hazardous Materials

No detrimental environmental impact is anticipated from the use of pesticides, toxic or hazardous materials as part of the proposed project. Pump stations upgrades will be designed to meet State and Federal flood and spill proofing requirements for generator fuels and odor control chemicals, with the goal of protecting the surrounding environment during major storm or flood events. The WPCF upgrades will include similar designs to protect against chemical spill or flood related environmental impacts.

6.9.15 Aesthetics

The proposed project is not anticipated to negatively impact aesthetics in the Town. Visual aesthetics related to the WPCF and pump stations upgrades will either remain as is or be improved as part of the upgrades. The pump station proposed to replace the existing Sharp Street pump station will be designed to blend-in with the existing residential character of the neighborhood and minimize visual impact.

6.9.16 Noise

The upgraded WPCF facilities will be designed to permanently reduce noise levels from operations. In addition, all other noise generating operations will be mitigated by acoustical enclosures, use of sound attenuating construction materials such as acoustic block and insulation, and equipment specifications that will dictate allowable noise levels emanating from the equipment.

The construction of the upgraded facilities will involve the use of various trucks and construction equipment. The demolition of existing facilities and the new construction may temporarily elevate the noise levels from the WPCF site above current background levels.

The impact of construction and demolition noise can be mitigated by enforcing a weekday work schedule and normal daytime working hours. Equipment and construction noise, while noticeable, is not expected to raise noise levels from the site boundary above levels that would be considered deleterious.

6.9.17 Traffic

During the estimated 24-month construction period of the WPCF upgrade, the daily volume of truck and other vehicular traffic to and from the site during project working hours, typically 7:00 AM to 3:30 PM, will increase significantly. Upon completion of the daily work routine and on weekends and holidays, existing traffic patterns will prevail.

Access to the WPCF site is from Parsons Road via Bridge Lane form the north and via Old King Street from the south. Access to these roads for truck traffic from the north and south is via Connecticut Interstate 91 to Route 5, and traffic from east and west is via Routes 140 and 190. Construction traffic will be mostly limited to the above mentioned routes and for the sake of safety, will be limited as such by specification in the contract documents. The construction contractor will provide traffic control flagmen for egress from the plant site during periods of high truck traffic. It should be noted that existing traffic on Parsons Road is limited to residents, users of King's Island Boat Launch, and WPCF employees.

Once operations at the upgraded WPCF start, additional truck traffic consisting of sludge removal operations and occasional chemical deliveries will prevail in addition to the current vehicular traffic, which will not decrease due to the upgrade.

6.9.18 Socioeconomic Impacts

The proposed projects will help improve water quality and therefore, environmental quality. No adverse human or environmental health issues are anticipated from this project work. The proposed project will not change the area's socio-economic make-up. The character of the neighborhoods should not change, as the wastewater treatment system improvements will be done in the existing developed plant site, no population growth is expected, and no new sewer extensions are required.

The beneficial water quality improvements expected from this project will only serve to improve the local environment. This will serve to improve lands such as farm lands and will have a beneficial impact on the surrounding community in terms of environmental improvements.

According to the U.S. Environmental Protection Agency's (EPA) EJView mapping tool[12], Enfield consists primarily of median income ($41,000 to $72,000) and has mostly 0 to 20% minorities except in the Thompsonville area (20 to 40%) and the prisons areas (greater than 40%). The proposed project will not pose any disproportionately high, adverse human health or environmental effects to minority and low-income populations. The improvements are proposed in this area due to aging and failure of existing wastewater infrastructure, and are unrelated to the economic or ethnic make-up of the area.

6.9.19 Induced Growth

As discussed in Section 2.18, 77 EDUs are expected to be added to the Enfield collection system through sewer extension within the 20-year planning period. Each of the connected parcels are already developed as residential living areas and are not anticipated to induce further growth. Stable population trends suggest little growth that would justify additional sewer extensions.

6.9.20 Permitting Requirements

The current WPCF NPDES permit was updated with more stringent requirements in 2013 and prompted the development of this facilities plan to address the new permit requirements. Since the WPCF capacity is not being upgraded as part of the recommended plan, no modifications to the existing NPDES permit are required. Future iterations of the NPDES permit may include nutrient discharge limits for phosphorus, thereby necessitating a recommended plan that will provide for phosphorus removal.

As part of the upgrade, a Flood Management Certification is required and the WPCF will apply for this certification prior to bidding the project. However, there is no anticipated impact on the Connecticut River floodway. A Storm Water Pollution Prevention Plan (SWPPP) may also be required as part of the construction process. Prior to beginning construction activities, the contractor will complete a SWPPP and apply for any necessary permits.

Other local permits and approvals may be required for this project. A preliminary list includes Local Inland Wetland Approval, Planning and Zoning Commission approval, local building permits, and fire marshal approval. This project is outside of coastal management jurisdictional boundaries.

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[12] http://epamap14.epa.gov/ejmap/entry.html. Accessed July 20, 2015.

6.9.21 Proposed Sewer Service Area

As noted in Section 2.20, impacts on natural resources, including farmland soils, wetlands, and groundwater, are not anticipated due to updating the sewer service area. The proposed changes to the sewer service area are intended to reflect currently sewered parcels within the Town and identify unsewered, developed parcels which may be considered for addition to the sewer service area. No existing natural resource areas are proposed to be sewered. Parcels designated by OPM as protected land were excluded from the proposed sewer service area, as shown in Figure 2-13. Figures 2-3 through 2-8 and Figure 2-14 show flood hazards, surficial materials, wetlands, natural diversity areas, open space, groundwater aquifers, and farmland soils, respectively.

6.9.22 Summary of Mitigation

As each of the projects including the WPCF upgrade and the collection system upgrade will be on previously developed and disturbed sites, no impacts to wetlands or other natural resource areas are anticipated. Mitigation measures to prevent erosion and sedimentation will be implemented whenever excavation work will take place. Excavations will occur for the WPCF Upgrade and the pump station upgrades.

Erosion control measures such as hay bales, silt fence, and composite socks will be placed on the downhill side of excavations to prevent sediment from reaching nearby water bodies and/or wetlands. In addition, silt sacks will be placed in nearby catch basins, if such exist, that may receive run off from site work. In the event dewatering is required, the contractor will be required to properly discharge the water to either a hay bale sedimentation capturing device, silt bag, or other qualified device. This will prevent sediment from reaching nearby water bodies and/or wetlands.

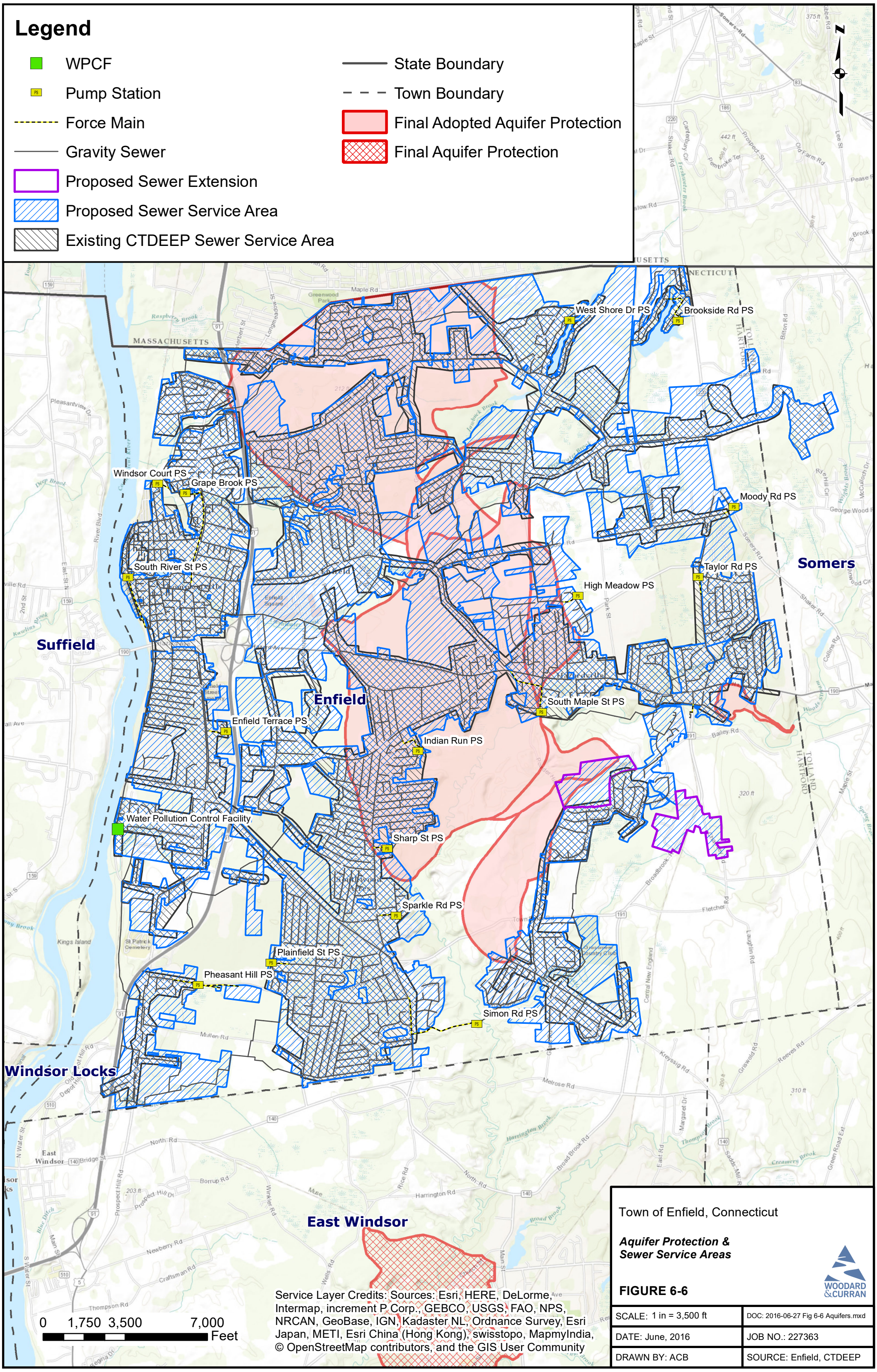
Where bypass pumping is required, sewage flow will be pumped from the suction manhole and be discharged to a downstream manhole, which will vary depending on the particular site. The contractor will be required to submit a bypass plan, stamped by a certified Professional Engineer in the State of Connecticut, and will be required to inspect the bypass system and hoses/pipes for leaks. Any leaks discovered will be repaired before further work continues. The DEEP will be notified whenever bypass pumping occurs.

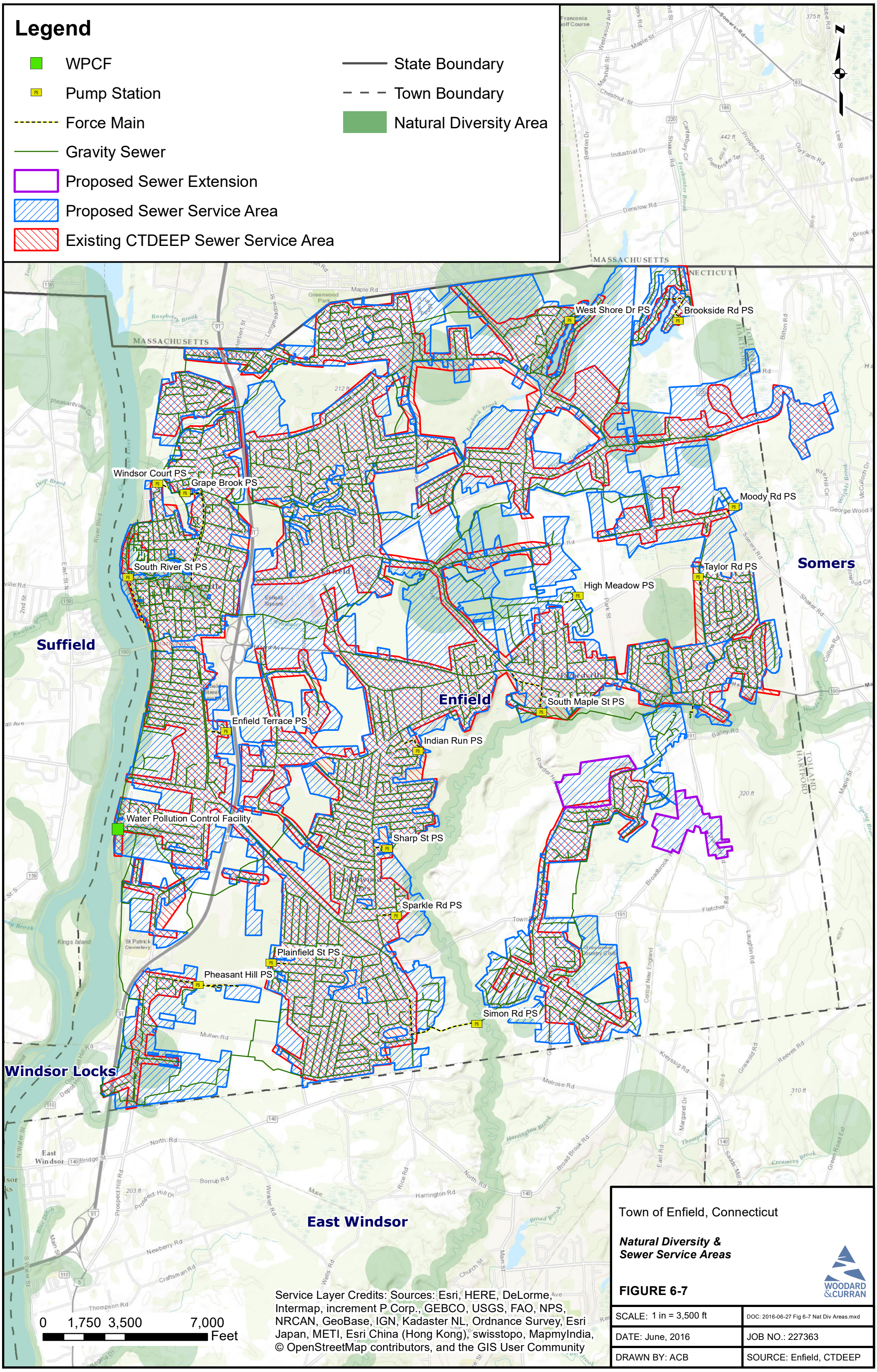
The direct effects of the proposed project will be temporary effects on air quality, transportation, and noise due to construction activities. The proposed project does not pose any adverse long term indirect effects to the area. The proposed project areas include an existing developed wastewater treatment plant site and existing pump station sites. The proposed improvements will be constructed within the existing occupation limits of the sites, and are consistent with the current and historical land use. One new pump station is proposed to be constructed on existing developed land.

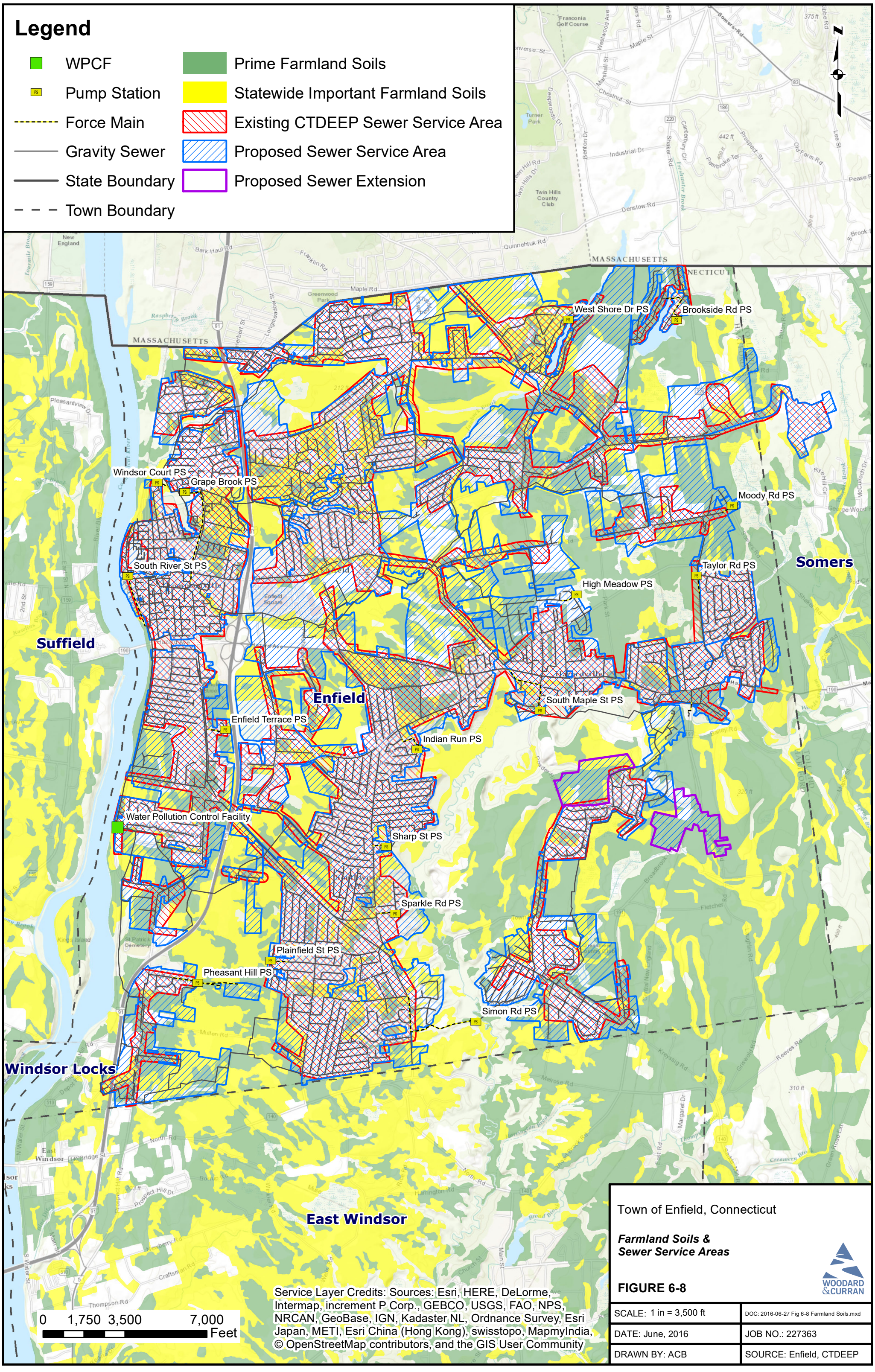
During construction of the WPCF and pumps station upgrades NPDES permit limits will not be waived. As such, construction will be phased so as to minimize disruption to the treatment process and collection system. There are no known adverse cumulative effects to the area as a result of the proposed project. No adverse impacts due to pesticides, toxic or hazardous materials, or aesthetics or anticipated. The proposed WPCF Upgrade will significantly improve water quality in the receiving stream and Long Island Sound.

6.10 CONCLUSION

This chapter has evaluated several different options and alternative configurations for the biological wastewater treatment process, sludge handling process, mixing system, odor control system, and building layouts. Each evaluation and subsequent recommendation was based upon capital costs, long-term operation and maintenance costs, and in some cases, other non-quantifiable factors. Refer to Section 7 for a detailed discussion of the overall system-wide modifications and recommendations for other areas of concern, such as the pumping stations, collection and conveyance system, and other areas of the treatment facility that were not discussed or examined in this chapter.


Legend
WPCF
Pump Station
Force Main
Gravity Sewer
Proposed Sewer Extension
Proposed Sewer Service Area
Existing CTDEEP Sewer Service Area
State Boundary
Town Boundary
Final Adopted Aquifer Protection
Final Aquifer Protection
West Shore Dr PS
Brookside Rd PS
Windsor Court PS
Grape Brook PS
Moody Rd PS
South River St PS
Taylor Rd PS
High Meadow PS
Somers
Suffield
Enfield
South Maple St PS
Enfield Terrace PS
Indian Run PS
Water Pollution Control Facility
Sharp St PS
Sparkle Rd PS
Plainfield St PS
Pheasant Hill PS
Simon Rd PS
Windsor Locks
East Windsor
0 1,750 3,500 7,000 Feet
Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Town of Enfield, Connecticut
Aquifer Protection & Sewer Service Areas
FIGURE 6-6
WOODARD &CURRAN
SCALE: 1 in = 3,500 ft
DOC: 2016-06-27 Fig 6-6 Aquifers.mxd
DATE: June, 2016
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Enfield, CTDEEP


Legend
WPCF
Pump Station
Force Main
Gravity Sewer
Proposed Sewer Extension
Proposed Sewer Service Area
Existing CTDEEP Sewer Service Area
State Boundary
Town Boundary
Natural Diversity Area
West Shore Dr PS
Brookside Rd PS
Windsor Court PS
Grape Brook PS
Moody Rd PS
South River St PS
Taylor Rd PS
High Meadow PS
Somers
Suffield
Enfield
South Maple St PS
Enfield Terrace PS
Indian Run PS
Water Pollution Control Facility
Sharp St PS
Sparkle Rd PS
Plainfield St PS
Pheasant Hill PS
Simon Rd PS
Windsor Locks
East Windsor
0 1,750 3,500 7,000 Feet
Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Town of Enfield, Connecticut
Natural Diversity & Sewer Service Areas
FIGURE 6-7
WOODARD &CURRAN
SCALE: 1 in = 3,500 ft
DOC: 2016-06-27 Fig 6-7 Nat Div Areas.mxd
DATE: June, 2016
JOB NO.: 227363
DRAWN BY: ACB
SOURCE: Enfield, CTDEEP



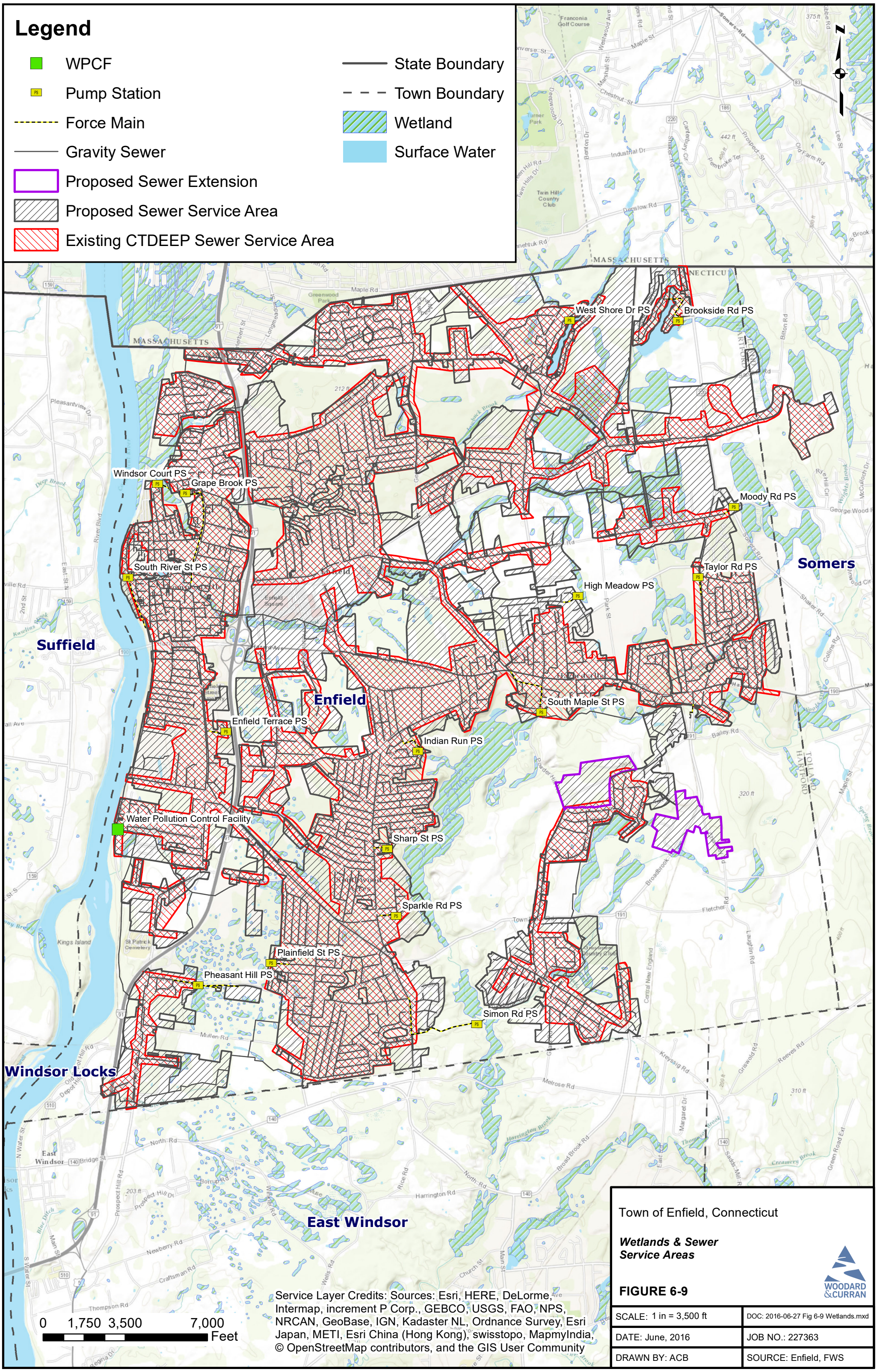
Town of Enfield, Connecticut

Farmland Soils & Sewer Service Areas

FIGURE 6-8

WOODARD & CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2016-06-27 Fig 6-8 Farmland Soils.mxd
DATE: June, 2016	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Enfield, CTDEEP



Town of Enfield, Connecticut

Wetlands & Sewer Service Areas

FIGURE 6-9

WOODARD & CURRAN

SCALE: 1 in = 3,500 ft	DOC: 2016-06-27 Fig 6-9 Wetlands.mxd
DATE: June, 2016	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Enfield, FWS

7. RECOMMENDED PLAN

7.1 INTRODUCTION

Presented in this Section of the report are recommended improvements to the WPCF, pump stations, and collection system. These improvements are required to achieve compliance with the Town's NPDES permit requirements, improve nitrogen removal capabilities, improve wet weather operations, and accommodate the future flows and loads (within the permitted capacity) that are projected over the next twenty years. The recommended plan is based on Woodard & Curran's evaluations described within this report and summarizes our recommendations for improvements described in Section 4 for the collection system and the pump stations and Section 6 for the WPCF. Proposed project costs are developed, staffing needs are estimated, and a plan of implementation is presented. Possible funding sources and the project schedule are also included in this section.

7.2 COLLECTION SYSTEM RECOMMENDATIONS

Table 7-1 summarizes the collection system repair needs identified through CCTV, internal manhole inspections, smoke testing, and sewer modeling. Repairs listed include only those designed to correct structural defects that have a moderate to high probability of causing pipe or manhole failure within the near future. Repairs associated with removal of inflow sources are expected to place little financial burden on the Town, as in most cases it is the property owner's responsibility to remove or repair them, however, costs for correcting one suspected inflow source is included as it lies within the Town's right of way. Also included in the cost estimate is overhead, insurance and general conditions associated with the construction contractor (25% of the base repair cost) and estimated engineering fees and contingency (40% of the construction cost and construction contractor expenses).

Table 7-1: Recommended Collection System Repair Cost Summary

Item	Cost
Pipe Repairs	$44,000
Manhole Repairs	$24,000
Point Source Inflow Removal*	$20,000
CT River Interceptor Relief Sewer Installation	$114,000
Subtotal	*$202,000*
Overhead, Insurance and General Conditions (25%)	$51,000
Contingency and Engineering (40%)	$101,000
Total	***$354,000***

*CCTV inspection of potential cross connections identified during smoke testing is ongoing. Cost estimate assumes repair of cross connection and construction of additional storm sewer.

A detailed cost effectiveness analysis for removal of I/I was not performed as little evidence for infiltration was found in the flow metering study, CCTV work, or internal manhole inspections. Based on the investigations performed in this study the majority of extraneous flow to the system is caused by inflow from roof leaders connected to the sewer. These illicit connections should be removed regardless of the cost to treat. The cost to transport and treat I/I was determined to be low at $1.70 per 1,000 gallons. Given that the cost to transport and treat I/I is low, and the CCTV located minimal infiltration sources, only repair of structural defects is recommended. WPCF monthly operating report data shows that the maximum peak hourly flow seen within the last five years has not exceeded 20 MGD, which is less than four times the average daily flow of 5.25 MGD. Other plants experience peak hourly flows exceeding ten times the average daily flow where I/I contributes significantly to flow.

A detailed survey of the Connecticut River interceptor pipe and manholes is currently ongoing to confirm a capacity limitation and identify structural issues. Preliminary results of both the hydraulic model and the flow allocation

spreadsheet indicate that there may be a capacity concern with a 24-inch diameter pipe on the interceptor (see Figure 3-2), which consists of primarily 30 to 36-inch diameter pipe. If insufficient capacity is confirmed, installation of a relief sewer is recommended to prevent possible surcharging, which may lead to overflow or sewage backup into nearby residences.

The following improvements are recommended for the collection system:

- Perform structural repairs of manholes and pipes where noted in the CCTV and manhole inspections;
- Perform further CCTV inspection to identify additional sources of I/I and damaged infrastructure; and
- Perform detailed field survey of the Connecticut River interceptor manholes to determine capacity limitations.

7.3 PUMP STATION RECOMMENDATIONS

As described in Section 4.7, several deficiencies were observed with many of the pump stations. Some of these deficiencies include high priority items such as replacing pneumatic ejector pots at the Indian Run, Sharp Street, and Sparkle Street Pump Stations. Other improvements can be classified as moderate priority which includes replacing outdated pumps, and low priority improvements such as providing better access to the wet well. We suggest that the high priority improvements be identified and designed first, and the less important improvements be made after the treatment plant is upgraded. Following are the recommended improvements at each station.

7.3.1 High Priority Pump Station Improvements

7.3.1.1 Grape Brook

Woodard & Curran recommends the following improvements to the Grape Brook Pump Station:

- Replace the largest and smallest pumps and control panels;
- Replace MCC with a new 480-volt 3-phase, 3-wire type with a main circuit breaker, an integral surge suppression device, power monitoring capabilities, and an appropriate motor starter/circuit breaker combinations required for the new pumps, grinder and all other process loads;
- Replace the existing panelboard with a new 100A, 120/240 volt, single phase, 3-wire type with the appropriate branch circuit breakers sized for lighting, general receptacles, control instruments and general power for the station;
- Replace backflow preventers;
- Replace roof;
- Replace HVAC in wet well and dry well sides of building;
- Repair building entrance concrete pad;
- Replace the light fixtures with new LED lights in a gasketed and sealed hinged housing. New wall switches and wiring would be run to all the new fixtures. Exterior lighting is also recommend to be the LED wall mounted type controlled from an automatic dusk to dawn timer;
- Replace the pump suction and effluent pipe manifolds and valving;
- Install a force main bypass vault with a quick connection;
- Install a heating fuel oil tank to separate the diesel generator and boiler fuel sources;

- Replace the wet well isolation slide gate; and
- Repair or replace the surge relief valve.

The existing generator and ATS appear to be in satisfactory condition and it is recommended that it remain in service to supply the existing and new loads at the pump station and continue to supply power for the entire station.

7.3.1.2 South River

Woodard & Curran recommends the following improvements to the South River Pump Station:

- Due to the age and condition of the existing building and equipment, we recommend that the entire station be replaced with a combination wet well dry well configuration. This would include constructing a new wet well and dry well at an adjacent location. A new MCC with variable frequency drives as required, an integral surge suppression device, power monitoring capabilities and the appropriate motor starter/circuit breaker combinations required for the respective loads. This would also include new electrical distribution panels for lighting and general receptacles throughout the station and all necessary wiring for pumps, instruments and associated SCADA wiring. Additionally, a force main bypass vault is recommended to be installed as part of the pump station replacement to allow for emergency bypass pumping in the event of both pump and backup power failure.

- The generator and ATS are approximately 10 years old have had no apparent failures or breakdowns, and have not reached the end of their service life. However, since a new station is going to be constructed, we recommend that a new generator and ATS be provided. This will simplify construction and also provide the Town with all new equipment.

- It is recommended that all the light fixtures for the new pump station be LED style enclosed in a gasketed and sealed hinged housing. New wall switches and wiring would be run to all the new fixtures, exterior lighting is recommend to be the LED wall mounted type controlled from an automatic dusk to dawn timer. These items must be explosion-proof.

- The exposed portion of force main appears to show little deterioration despite having been in continuous operation for over 80 years. The structural support components appear to be in good condition and adequately restrain the piping. However, the drain valve is likely no longer functional and cannot be used for bypass pumping or draining of the force main without spillage into the nearby Connecticut River. Therefore, Woodard & Curran recommends removal of the drain valve and tee, replacement with a section of ductile iron pipe secured with mechanical pipe joint restraints, and supported with a galvanized steel support column with a concrete pad.

7.3.1.3 Indian Run Pump Station

Woodard & Curran recommends the following upgrades to the Indian Run Pump Station:

- Replace the existing pneumatic ejector pots with submersible pumps. This will require the construction of a new precast concrete wet well adjacent to the existing structure and new piping and valves in a new concrete valve vault;
- Replace the existing generator with a new diesel generator and a weatherproof sound enclosure;
- Replace the automatic transfer switch;
- Remove the antiquated motor control center (MCC) and service panels. The main electrical panel will also contain individual branch circuit breakers for the Pump Control Panel and the new 120/240 volt electrical panel. The electrical panel would provide power for lights, receptacles and other 120-volt instruments or miscellaneous loads;

- Install controls for the submersible pumps at the ground level to avoid having to enter a confined space; and
- Replace the existing building.

7.3.1.4 South Maple Street

Woodard & Curran recommends the following as part of a pump station upgrade:

- Replace both pump motors, one of the pumps, and the control panels;
- Replace the roof;
- Replace the MCC with a new 480-volt, 3-phase, 3-wire type with a main circuit breaker, an integral surge suppression device, power monitoring capabilities and the appropriate motor starter/circuit breaker combinations required for the respective loads;
- Provide slide gates to isolate flow to each wet well;
- Replace the existing panelboard with a new 100A, 120/208 volt, three phase, 4-wire type with the appropriate branch circuit breakers sized for the respective loads;
- Replace the generator with a new Cummins generator to match the recently replaced automatic transfer switch. A separate fuel tank should also be installed to isolate the fuel supply from the existing boiler. This would satisfy the EPA requirements that require Low Sulfur Fuel be run in all diesel engines;
- Install a concrete force main bypass vault with a quick connection;
- Replace the force main check valves;
- Replace HVAC in wet well and dry well sides of building; and
- Replace the light fixtures with new LED lighting enclosed in a gasketed and sealed hinged housing. New wall switches and wiring would be run to all the new fixtures. Exterior lighting is also recommend to be the LED wall mounted type controlled from an automatic dusk to dawn timer.

7.3.1.5 Sharp Street

We recommend that the existing pump station be replaced with two new pump stations as described in Alternative 1. Pump station #1 would be constructed as a packaged suction lift station. Station #2 would be a packaged submersible station. Each station would have an outside generator with a soundproof enclosure.

7.3.1.6 Sparkle Street

Woodard & Curran recommends the following upgrades to the Sparkle Street Pump Station:

- Replace the existing pneumatic ejector pots with submersible pumps. This will require the construction of a new precast concrete wet well adjacent to the existing structure and new piping and valves;
- Replace the antiquated motor control center (MCC) and service panels. The main electrical panel will also contain individual branch circuit breakers for the Pump Control Panel and the new 120/240 volt electrical panel. The electrical panel would provide power for lights, receptacles and other 120-volt instruments or miscellaneous loads;
- Install controls for the submersible pumps at the ground level to avoid having to enter a confined space;
- Construct a new building; and
- Replace the generator.

7.3.2 Moderate Priority Pump Station Improvements

7.3.2.1 Brookside

Woodard & Curran recommends the following as part of the pump station upgrade:

- Replace the entire station, including all electrical components (i.e., the automatic transfer switch, enclosures, etc.) with a pre-fabricated station;
- Replace the existing station, including all electrical components, with a new submersible station with a concrete wet well, valve vault, pumps, and a prefabricated building;
- Replace the section of force main that has failed multiple times with ductile iron pipe and/or install a flexible coupling to prevent future breaks; and
- Install a diesel generator and automatic transfer switch.

7.3.2.2 High Meadow

Woodard & Curran recommends the following as part of the High Meadow pump station upgrade:

- Replace the pumps and control panels.
- Replace the service entrance enclosure with a new weatherproof stainless steel enclosure housing new electrical equipment which includes the following:
  - 200 amp Main Circuit Breaker
  - Automatic Transfer Switch
  - One 120/240 volt Load Center for required lights and receptacles for the station
  - All required pump controllers and communications equipment
- Provide new service entrance conduit and conductors from the Utility Service Entrance Pole to the new Service Entrance Enclosure.

7.3.2.3 Taylor Road

Woodard & Curran recommends the following as part of the Taylor Road pump station upgrade:

- Replace the can structure with a precast concrete wet well and valve vault and retain the pumps;
- Replace the existing 100-amp meter enclosure;
- Replace the Main Circuit Breaker Enclosure and 100-amp Main Circuit Breaker;
- Replace the Automatic Transfer Switch with a new 100 amp Switch enclosed in a weatherproof enclosure; and
- Connect the generator to the natural gas line in the street adjacent to the pump station.

7.3.2.4 Pheasant Hill

Woodard & Curran recommends replacing the generator.

7.3.3 Low Priority Pump Station Improvements

7.3.3.1 Plainfield Street

Woodard & Curran recommends the following as part of the Plainfield Street pump station upgrade:

- Connect the generator to the natural gas line in the street adjacent to the pump station;
- Install a fall protection grate on the new wet well hatch;
- Install a new ladder in the wet well;
- Complete a structural analysis on the metal can dry well;
- Replace the pumps and control panels; and
- Install a grinder.

7.3.3.2 Simon Road

We recommend the following as part of the Simon Road pump station upgrade:

- Replace the pumps, motors and pump controls;
- Replace the check valves and pump supports;
- Perform an infrared scan on the existing MCC to determine if there are any hot spots that would indicate defects in any connections or components;
- Remove the existing panelboard and transformer behind the MCC; replace the panelboard with new and relocate both the transformer and new panelboard so they have the proper working clearances;
- Replace the generator with an outdoor unit and replace the transfer switch;
- Replace the roof hatch;
- Replace the MCC;
- Rebuild the comminutor; and
- Repaint the columns.

7.3.3.3 Moody Road

Woodard & Curran recommends the following as part of the pump station upgrade:

- Connect the generator to natural gas in the road.

7.3.3.4 Enfield Terrace

Woodard & Curran recommends the following as part of the Enfield Terrace pump station upgrade:

- Rebuild the pumps as needed;
- Add insulation to the aboveground structure;
- Construct an access driveway; and
- Convert generator to natural gas.

7.3.3.5 Windsor Court

Woodard & Curran recommends the following as part of the Windsor Court pump station upgrade:

- Replace the entire pump station with a packaged suction lift station including a fiberglass wet well with the hatch three feet above grade;
- Re-support the plywood backboard structure with new galvanized steel supports throughout the entire length of the backboard and raise all hardware at least three feet above grade; and
- Install the generator on a new concrete pad three feet above grade.

7.3.3.6 West Shore Drive

Woodard & Curran recommends the following as part of the West Shore Drive pump station upgrade:

- Install new main breaker, panelboard, transfer switch and meter;
- Replace the propane generator with an equivalent diesel generator; and
- Replace the wet well with a concrete vault.

7.3.4 Summary of Pump Station Costs

Table 7-2 summarizes the costs of the pump station improvements recommended in Section 7.3. Also included in the cost estimate is overhead, insurance and general conditions associated with the construction contractor (25% of the base cost) and estimated engineering fees and contingency (40% of the construction cost and construction contractor expenses). Woodard & Curran recommends performing all pump station improvements of high, moderate and low priority to address the needs described in in Section 4. All pump station upgrade costs include force main repairs.

7.4 WPCF RECOMMENDATIONS

Recommendations for headworks and primary treatment upgrades, activated sludge system improvements to enhance nitrogen removal, solids handling system upgrades, odor control upgrade, and disinfection system improvements are discussed here. In addition, building and space needs recommendations are also included.

Section 6 recommended that the treatment facility's biological process be upgraded to a Variable Operating Mode (VOM) configuration. As shown therein, the VOM configuration is deemed the most cost effective system to utilize for the planning period of this study.

Presented in Figure 7-1 is a proposed site layout showing the new structures required for the recommended plan. The proposed process flow diagram is presented in Figure 7-2. The following sections provide a detailed discussion of the projected WPCF operation, including descriptions of each major treatment process and system.

Table 7-2: Recommended Pump Station Improvements Cost Summary

Priority	Pump Station	Opinion of Probable Cost
High	Grape Brook	$666,513
High	South River	$1,185,706
High	Indian Run	$348,700
High	South Maple Street	$519,400
High	Sharp Street #1	$256,206
High	Sharp Street #2	$372,978
High	Sparkle Street	$394,699
	Subtotal High Priority Upgrade Costs	**$3,744,202**
Moderate	Brookside	$206,875
Moderate	High Meadow (Rye Hill)	$62,100
Moderate	Taylor Road	$66,117
Moderate	Pheasant Hill	$52,500
	Subtotal Moderate Priority Upgrade Costs	**$387,592**
Low	Plainfield Street	$135,025
Low	Simon Road	$407,575
Low	Moody Road	$16,225
Low	Enfield Terrace	$35,000
Low	Windsor Court	$205,950
Low	West Shore Drive	$77,375
	Subtotal Low Priority Upgrade Costs	**$877,150**
	Subtotal	**$5,008,944**
	Overhead, Insurance and General Conditions (25%)	$1,252,236
	Contingency and Engineering (40%)	$2,504,472
	Total	***$8,765,652***

7.4.1 Preliminary Treatment

The preliminary treatment facility, which currently houses the mechanical bar screen, the aerated grit removal system, and the bypass bar rack, will require modifications within the recommended process configuration. The construction of a new headworks building around the existing facility is recommended to enclose the new screening equipment and to replace the outdated equipment for improved solids removal. The new masonry building will include two ¼ inch mechanical bar screening that automatically remove rags and other large debris. The removed screenings are then washed, dewatered and compacted in an integrated screening press and the organics are returned to the influent channel. The conceptual layout of the proposed headworks building is shown in Figure 7-3.

The concrete in the covered aerated grit chambers should be repaired and ductwork piping should be installed to collect and treat the generated odors using the proposed odor control system. In addition, the non-operational motorized clamshell and the outdated aeration system need to be replaced in kind or with another type of grit removal equipment to improve grit removal. The grit collected will be discharged into a roll-off dumpster and transported off-site for disposal. Air will be provided by new dedicated positive displacement blowers located in the ground floor of the remodeled

Operations Building. Since the single speed grit blowers will deliver a fixed volume of air, blow offs will be provided for each air header to be able to blow off excess air into the influent channels to the grit chambers and to allow adjustment of the quantity of air delivered to the diffusers.

7.4.2 Primary Treatment

While the primary clarifiers need rehabilitation, they are sufficiently sized to meet future treatment needs. We recommend in-kind replacement of weirs, sludge collection equipment, scum collection equipment, scum baffles, influent columns, walkway, handrails, and concrete repair at the primary settling tanks and Structure No.2. In addition, the mixer at the scum pit, the sluice gates, the scum shear gate need to be replaced.

To provide an internal carbon source to enhance the denitrification process and improve nitrogen removal, a primary clarifier bypass will be provided to divert a portion of the pretreated wastewater flow directly to the aeration tanks.

7.4.3 Aeration Tanks

The recommended plan includes the reconfiguration of the existing aeration tanks to support the recommended VOM process. The existing aeration tanks will be fitted with partition walls to form anoxic selector zones, anoxic zones, swing zones, and aerobic zones. Aeration piping will be replaced in each of the aerobic zones. The compressed gas mixing system will be placed in the anoxic and swing zones. The submersible type nitrified recirculation pumps will be replaced and installed in the primary aerobic zones with piping to direct nitrate rich mixed liquor back to the area in the first anoxic zones.

The ability to operate the biological process in various modes is facilitated by "swing zones" that could be operated with either aerobic or anoxic conditions. The three modes consist of the following:

- VOM-1: the process configuration is as previously described for the MLE mode. The WPCF could be operated in MLE mode during the winter season, under normal flow conditions, if low water temperatures necessitate a greater aeration volume for nitrification. The increased aeration volume is accomplished by changing the swing zones from anoxic (in Four-Stage mode) to aerated.
- VOM-2: the process configuration is as previously described for the Four-Stage Bardenpho mode. The WPCF would be operated in Four-Stage mode during the summer season under normal flow conditions (i.e. not during peak wet weather flow events) and likely during part of the winter season under normal flow conditions.
- VOM-3: the process configuration is intended for wet-weather peak flow events and is accomplished by changing most zones to be aerated and directing the return activated sludge to the beginning of the aeration basins and sending the primary effluent toward the end of the aeration tanks. This process allows storage of biomass in the stabilization reactor (at the beginning of the aeration tanks) and contact time with the MLSS and primary effluent in the contact reactor (towards the end of the aeration tanks). The level of nutrient removal is reduced during contact stabilization mode, however, it is only needed for short-term durations. Having the ability to operate in contact stabilization during wet weather allows the system to operate at higher MLSS concentration (and therefore lower reactor volume) during normal flow conditions.

The Variable Operating Mode will give plant operators maximum flexibility to change the operating modes depending on the season and flow conditions without the use of propriety equipment. The design documents, O&M manual and a comprehensive operator training program will be provided to assist the operations staff to transition from the existing secondary system to BNR operation.

In the MLE and Bardenpho modes, nitrate is fed to the anoxic reactor from nitrate in the return activated sludge and by pumping mixed liquor from the aerobic zone. To size the anoxic and aerobic zones, key design parameters were used including: (1) anoxic zone detention time, (2) mixed liquor volatile suspended solids (MLVSS) concentration, (3) internal

recycle rate and return sludge flow, (4) influent BOD concentration, (5) temperature and (6) the specific denitrification rate (SDNR), which is the nitrate reduction rate in the anoxic zone normalized to the MLSS concentration. A mass balance was developed to determine the nitrate produced in the aeration zone, and the internal recycle ratio needed to meet the desired effluent nitrate concentration. The amount of nitrate produced in the aerobic zone is based on the influent flowrate and nitrogen concentration, the amount consumed for cell synthesis, and the effluent ammonia and soluble organic nitrogen concentrations.

Design criteria for the fine bubble aeration system considered here are taken from TR-16. TR-16 recommends the aeration system be sized to provide sufficient oxygen to satisfy the maximum day demand of 1.2 pounds of oxygen per pound of BOD removed plus 4.2 pounds of oxygen per pound of ammonia nitrogen oxidized. In addition, the design should consider operation at the minimum day BOD and TKN loading, while allowing for a credit of 2.86 pounds of oxygen per pound of nitrate-nitrogen denitrified.

Aeration blowers will be required to provide air to the aeration zone of the BNR process. New hybrid blowers have been selected to replace the existing oversized and inefficient centrifugal blowers. However, we recommend that several blower types (such as PD, centrifugal, turbo, and hybrids) are evaluated in more detail during the design phase to determine the most efficient blower option for this project. The proposed blower system consists of four blowers (3 duty / 1 spare) located in the ground floor of the Operations Building. The blowers should be provided with a means of automatic speed control so that the blower speed and oxygen delivery to the process tanks can be controlled. A common stainless steel manifold and air main would be run from the Operations Building out to each of the aeration tank diffuser grids.

Based on the life cycle analysis conducted in Section 6, we recommend the installation of a compressed gas mixing system in the aeration tanks to mix the wastewater and mixed liquor and to keep the solids in suspension. The compressed gas mixing system provide mixing in liquids by firing programmed short bursts of compressed air through nozzles installed at the floor of the aeration tanks. The compressed air is intermittently fired in fractional second durations to mix the tank. The relatively small surface area of the large gas bubbles and their rapid upward velocity enable the system to transfer a negligible amount of oxygen to the wastewater.

Instrumentation and control features of the aeration system would include dissolved oxygen transmitters (DO), nitrate analyzers, power operated air control valves, air flow, and air pressure transmitters. Each of the aerobic zones would be fitted with two grids of diffusers to allow control of aeration and DO concentration in the various zones. An aeration control system would be employed to control the blowers and the aeration system control valves.

Additional aerations tanks improvements will include minor concrete repairs, new foam spray system, new influent gates, and new handrails.

7.4.4 Secondary Clarifiers

The existing four secondary clarifiers have sufficient capacity to handle future flows and loads, but in need of major rehabilitation to improve performance and operation. Modifications to the clarifiers should include complete removal of the tank mechanisms, providing completely new mechanical systems within each tank. Each of the four secondary clarifiers will be provided with identical collector systems, along with density current baffles to enhance settling and minimize short-circuiting within the tanks, effluent weirs, Energy Dissipating Inlets (EDIs) to produce uniform flow into the feedwell and promote flocculation within the feedwell, influent and effluent gates, mixers at the flow distribution structures, handrails, as well as covering the launders with fiberglass covers or the installation of a weir washing system to reduce algae growth. Each of the collector mechanisms should also be provided with full-radius scum troughs and collectors.

7.4.5 Sludge Pump Station

The Return Activated Sludge (RAS), WAS, and secondary scum pumps located in the basement of the sludge pump station should be replaced to improve sludge management and provide adequate capacity. The RAS pumps will be operated using variable frequency drives (VFDs) that are paced off the plant flow signal. VFDs will also be provided for the WAS pumps to allow sludge to be wasted at a variable rate. Valving and piping would allow flexibility in assigning pump service to all four clarifiers. Both the return and waste sludge systems should be provided with reliable and accurate flow metering and recording capabilities.

7.4.6 Sludge Processing

The recommended alternative for sludge processing is to construct two new gravity thickeners. This alternative is recommended because of the following advantages: (1) better performance, (2) more consistent and uniform sludge feed rate ahead of the sludge dewatering system, (3) less capital and O&M costs, and (4) the need of less operation time to operate the sludge dewatering equipment. The proposed gravity thickeners should be 35-feet in diameter with a side water depth of at least 14 feet. Pumped primary sludge will be directed to the proposed gravity thickeners where it will be blended with waste activated sludge, thickened and stored while awaiting further processing.

Waste activated sludge should be wasted daily from the secondary clarifiers into the proposed gravity thickeners, where it will be blended with the primary sludge. VFD control and timers should be provided and integrated with the updated SCADA system so that the operator can exercise control of the wasting rate and waste on weekends without operator attendance. As an option, the operators should have the ability to feed the sludge dewatering system directly from the primary clarifiers in case gravity thickeners are out of service.

Odor control should be provided for the proposed gravity thickeners. New fixed cover should be provided on the tanks to limit exposure to odorous emissions from the tanks. Ductwork will also be installed to ventilate the gravity thickeners at 800 cfm each to central 9,100 cfm biofilter located at the second floor of the Operations Building. Sodium permanganate feed system should also be used to prevent septicity and to control odors from the gravity thickeners.

From the gravity thickeners or the primary clarifiers in case co-settling is used, the sludge should be pumped to the sludge dewatering system, which should be comprised of a dual rotary press, designed to dewater the blended sludge to approximately 25-27% solids in average. Two rotary presses should be provided in the dewatering system so that sludge processing can be accomplished in a typical workweek at design conditions, while also allowing for maintenance of the units. Three positive displacement sludge feed pumps should be located in the basement of the Operations Building to pump the thickened sludge from the gravity thickeners to the dewatering system, allowing one pump to be removed from service for maintenance without interrupting the dewatering schedule. Variable speed drives should be provided with the pumps for varying the feed rate to the presses. Either pump should be able to feed either press.

The proposed rotary press system was selected based on the life cycle analysis conducted in Section 6 and should be located in the former incinerator area of the Operations Building. Location of the units in the second floor allows sufficient free space for storage of the required polymer tanks and feed system in the basement of the Operations Building. Pressate from the dewatering operation should be directed to the inlet works facility for reprocessing with influent flow. The press room should be provided with odor control.

From the dewatering system, sludge cake should be conveyed by two new screw sludge conveyors, and conveyed to the roll-off dumpster located in the sludge discharge bay for disposal. The proposed shaftless screw conveyors are totally covered, which minimize sludge spillage and odor generation. The first screw conveyor is directly connected to the rotary presses, and the second screw conveyor is perpendicular to the first conveyor and horizontal to the roll-off dumpster. The second dewatered sludge conveyor should be equipped with motorized electrical actuated gates and ultrasonic level detectors to automatically distribute sludge evenly within the sludge container and provide a safer environment for the workers. The sludge discharge bay should be provided with odor control.

Due to budget constraints, the base approach will be to continue co-settling but an alternative to provide gravity thickening will be included in the design. As an alternative, waste activated sludge can be wasted directly to the influent end of the primary clarifiers, where it can be co-settled with the primary sludge and pumped to the new dewatering system by new primary sludge pumps. This is not the preferable mode of treatment as it results in a thinner sludge fed to the dewatering system, less efficient use of primary clarifiers capacity, more operation time of the sludge dewatering system as well as septic conditions, gasification, and odor generation that can be caused by excessive retention of solids in the primary clarifiers.

7.4.7 Odor Control System

The proximity of the WPCF to nearby occupied structures dictates that odor control be provided at this facility. To meet NPDES permit requirements, the existing non-operational chemical scrubber should be demolished and removed, and replaced with a new state-of-the-art odor control system, designed to remove and treat odorous air generated in the proposed headworks building, aerated grit chambers, proposed gravity thickeners, dewatered sludge conveyor, and sludge discharge bay.

The odorous air should be collected in ducts, which transport the contaminated air to a central odor control system, which will be located on the second floor of the Operations Building. Table 6-25 in section 6 summarizes sources of odors, with volume of air treated and equivalent concentration of hydrogen sulfide. The odor collection system should be balanced by installing fixed orifices located adjacent to the damper in the duct serving each odor source. The dampers may be utilized to close off the odor control system to processes not in operation; however the dampers should be maintained in the full open position for all processes that are in operation.

Based on the odor control report prepared by our sub-consultant Bowker and Associates, the following are the major recommendations to control odor emissions from an upgraded Enfield WPCF:

- Ventilate proposed headworks building at 4,100 cfm (12 air changes per hour) to a central activated carbon adsorber system;
- Evacuate air from existing covered aerated grit chamber at 1,400 cfm to central carbon adsorber;
- Ventilate covered primary clarifier distribution box at 100 cfm to central carbon adsorber. Coat concrete to protect against corrosion;
- Ventilate proposed gravity thickeners (2) at 800 cfm each to central, 9,100 cfm carbon adsorber;
- Ventilate dewatered sludge conveyor and truck bay at 1,900 cfm to central carbon adsorber; and
- Use 9,100 cfm radial flow carbon adsorber system. Footprint of carbon adsorber with 9-ft diameter FRP vessel and fan enclosure is approximately 24 ft. x 15 ft.

Typical factors to be considered in the design of a carbon adsorber unit are the size of the carbon bed, linear flow velocity of the vapor through the bed, type and concentration of constituents, and temperature and relative humidity of the inlet gas stream. Truck access is necessary for carbon media replacement, but truck traffic is minimal. The proposed carbon unit is small enough to be installed indoors at existing Operations Building, but the system can also be installed outdoors with less concern for security, because it has no chemical tanks.

The proposed carbon adsorber is a 9-ft diameter radial flow adsorber equipped with a grease/ mist eliminator, a centrifugal fan, and a sound attenuation package. The stack of the adsorber will be a high velocity vertical dispersion stack with over-cap to prevent rain. Under the proposed scenario of a central 9,100 cfm odor control system, a 3 to 4 year media life is expected using the high H_2S –capacity activated carbon media. System performance and detail equipment are provided in Appendix Q.

7.4.8 Disinfection System

As discussed in Section 5, the improvements needed for the disinfection system include the replacement of the third chemical storage tank and the chemical feed pump, new sodium hypochlorite carrying water pumps, repair PVC piping to inject the disinfectant into RAS, WAS, or effluent water lines, as well as the update of instrumentation and controls.

7.4.9 Chemical Feed Systems

The chemical feed systems proposed include: (1) Sodium hypochlorite (HYPO) equipment to control sludge bulking and to provide occasional feed to the gravity thickeners, (2) Sodium hydroxide (Caustic) feed equipment for pH adjustment, (3) polymer addition requirements for the proposed rotary press dewatering system, (4) potassium permanganate for odor control, and (5) carbon addition system to enhance nitrogen removal. These systems are described in the following sections.

7.4.9.1 Sodium Hypochlorite System

In addition to be used for disinfection at the existing chlorine contact tanks, sodium hypochlorite will need to be added on occasion to the return activated sludge to control the growth of filamentous organisms. Metcalf & Eddy's Wastewater Engineering design recommends dosing in the range of 2 to 3 mg/L of chlorine per 1000 mg/l MLVSS. WEF's Design of Municipal Wastewater Treatment Plant (MOP-8) recommends a range of 2 to 8 mg/L of chlorine per 1000 mg/L MLSS.

The sodium hypochlorite system would utilize the updated three 2000-gallons storage tanks and the chemical metering pumps located in the upper level of the Sludge Pumping Station. Sodium hypochlorite will be injected into the RAS discharge line in the lower level of the Sludge Pumping Station.

7.4.9.2 Sodium Hydroxide System

Control of pH and alkalinity is extremely important for the optimization of chemical and biological treatment processes. Nitrification consumes alkalinity and denitrification restores alkalinity.

Alkalinity will be consumed during nitrification in the proposed biological treatment process. Approximately half of the alkalinity consumed during nitrification will be gained by incorporation of anoxic selectors in the VOM process. Since the loss of alkalinity will result in lower pH, which can inhibit the nitrification process, it may become necessary to inject a chemical, such as sodium hydroxide (a.k.a. caustic) that will increase the alkalinity. Materials and equipment will be provided to maintain the minimum level of alkalinity required in the effluent of the biological process (preferably 50 to 75 mg/L of alkalinity).

7.4.9.3 Polymer System

A new polymer feed system is recommended to feed the sludge that enters the proposed rotary press dewatering system. The most accurate method to estimate polymer usage is to take a grab sample of sludge and perform jar tests. As described in Section 6 and based on the pilot test conducted at the WPCF using Fournier rotary press and the WPCF manic polymer ACP 07A, the polymer consumption is expected to average 11 to 15 active lbs of polymer per dry ton of solid. The polymer should be fed using 2000-gallon storage tanks. These tanks, along with the feed equipment, should be located in the basement of the existing Operations Building below the new rotary presses, which will be located in the second floor.

7.4.9.4 Sodium Permanganate System

Sodium permanganate is a strong oxidant that can be used to remove sulfide and other odor and corrosion-causing compounds. Sodium permanganate is more soluble than potassium permanganate. It has the following advantages: (1) permanganate can be used to treat sludge, (2) anecdotal field experience suggests that dewatering equipment will

achieve higher dry solids, and (3) sodium permanganate is an easy to feed liquid product that offset the issues with handling a dry product such as potassium permanganate.

Sodium permanganate feed system is already in use at the plant to control odors at the press room of the Operations Building. This system is outdated and will be replaced with new storage and feed equipment. Sodium permanganate would be injected occasionally, if needed, to the enclosed gravity thickeners and the covered grit chambers to prevent any potential septicity and to control any objectionable odors.

7.4.9.5 Carbon Addition System

Space should also be provided in the Operations Building or near the aeration tanks to allow for the storage of supplemental carbon source required to enhance denitrification. External carbon sources include glucose, corn syrup, glycerin and proprietary mixtures such as Micro-C. External carbon can be added directly to the wastewater stream feeding the process. This can occur directly before the reactor or in one of the upstream processes. We recommend feeding external carbon directly to the anoxic zones, which can be beneficial to both nitrogen and phosphorus removal, when the zones have inadequate carbon. For nitrogen, it directly reduces nitrogen levels.

The external carbon addition system needs to be designed to maximize distribution of the external carbon source within the anoxic zone and minimize any short circuiting to the inlet of the downstream aerobic zone. These goals can be achieved by a combination of locating the external carbon discharge point near the inlet to the anoxic zone mixer or by distributing the carbon across the anoxic zone inlet.

Sizing of carbon storage equipment will depend on the duration of product use, efficiency of the denitrification process (without carbon addition), target effluent nitrogen concentration, product shelf life, shipment flexibility, and product cost. The carbon dose will eventually be determined during full scale operation; it is challenging to determine exactly the amount of carbon required to enhance nutrient removal, and adjustment should be expected.

7.4.10 Plant Water System

The existing effluent plant water system is outdated, undersized and no longer adequate for the proposed WPCF upgrade and need to be replaced. We suggest the installation of a new packaged plant water pumping system in the lower level of the existing Sludge Pump Station. The system will be designed to maintain a constant system discharge pressure at variable flow demands and will supply water throughout the WPCF as listed below:

- Yard hydrants and wash hose stations;
- The screenings wash press system at the proposed Headworks Building;
- Polymer dilution water and water supply to the rotary dewatering press system;
- Foam spray system for the aeration tanks;
- Flushing connections to the clarifiers scum pits;
- Flushing connections to the sludge and scum pump piping; and
- Chemical feed dilution water (sodium hypochlorite and sodium hydroxide).

The plant water system will draw water from the effluent channel of the chlorine contact tanks. Prior to reaching the pumps, the plant water suction will pass through a twin basket strainer that is designed to trap solids carried by the flow. Approved protective devices or means to prevent backflow into the potable water will be provided, when it's necessary, to avoid cross-connection between potable and effluent plant water.

7.4.11 Operations Building and Support Facilities

It is necessary to provide adequate support facilities to ensure efficient O&M at the treatment plant and accommodate staff who operate and maintain the plant. Supervisors need space to carry out management tasks, including completion of paperwork, ordering supplies, scheduling of work, and review and/or disciplining of employees. The administrative area should include space to safety store plans, specifications, and training material related to the facility. Lockers rooms with toilets and showers are essential in the WPCF. According to TR-16 guidelines, lockers rooms should provide at least two full-size vented lockers per employee as well as space to store foul weather gear and personal protective equipment used to respond to spills within the facility. Staff facilities must also comply with Occupational Safety and Health Administration (OSHA) and other federal, state, and local legislations, and national and local standards, guidelines, and codes of practices.

To meet all these requirements, major improvements and modifications are needed at the Operations Building and at the administrative offices. These improvements include the following:

- Demolition of the abandoned incinerator;
- Removal of all the hazardous materials based on the abatement report (see Appendix I);
- Rehabilitation of the incineration area as described in the structural evaluation (Section 6.7.1) to meet the current building code requirements and to house the new blowers, the new dewatering equipment, as well as the new pumping equipment for the proposed gravity thickeners;
- Heavy and light renovation in the admin and dewatering areas including: relocated shop, relocated electrical, lunchroom/conference room, women's locker room, men's locker room, laundry area, expanded lab, new shared offices, and the installation of the proposed odor control system in the second floor at the current location of the belt filter presses;
- Light renovation in the basement of the Operations Building including the demolition of the existing blowers and chemical systems and the installation of the new chemical feed equipment. The primary sludge pumps will remain in the basement;
- Envelope demolition/renovation including: new accessible entry ramp, replace glazed skin with mixture of metal panel and storefront, as well as new roofing; and
- Upgrade the HVAC, plumbing, and electrical infrastructure.

7.4.11.1 Operations Building

This facility, one of the original WPCF buildings, should be maintained for use in the recommended plant configuration. Many of the processes and space allocations within the building should be modified, while some should be eliminated completely. Each floor of this building will be examined separately as follows:

First Floor: This floor currently houses mostly administrative space for the facility, consisting of the laboratory, receptionist's office, superintendent's office, lunchroom, and lavatories, along with the electrical room, the abandoned incinerator area, the truck bay discharge, and spaces for shop and storage. The spaces in this area should be modified as follows:

- Laboratory should be expanded to include former lunchroom space;
- Storage space should be converted to dedicated lunchroom/ conference room;
- Most of the space dedicated to heavy storage should be converted to women's locker room and laundry area;
- Men's locker room should be expanded to provide handicapped access and more space for lockers;
- Modify / Improve building heating system and fresh air ventilation systems;

- Demolish the abandoned incinerator and rehabilitate the incineration area to house the new aeration and grit blowers; and
- Provide new accessible entry ramp.

Second Floor: This floor currently houses the dewatering room, conference room, dewatering office, storage room, toilet room, control room, and incinerator area. The spaces in this area should be modified as follows:

- Dewatering area should be renovated to house the new odor control system;
- Incinerator area should be renovated to house the new dewatering equipment;
- Control room should be converted to shared office space or storage; and
- The new dewatering equipment will be installed on the second floor where the existing incinerator is located.

Basement: This floor currently houses mostly mechanical and process equipment, such as the aeration blowers, primary sludge pumps, chemical storage and feed equipment, sludge mixing pumps, and incinerator equipment, as well as the boiler room. With the upgraded plant configuration, the spaces in this area should be modified as follows:

- Incinerator area should be modified to house the new pumping equipment for the proposed gravity thickeners;
- The existing polymer system and the scrubber's chemical systems located in the chemical room should be removed and replaced with the new chemical feed equipment including the new polymer system, the permanganate system, and the caustic system; and
- The existing aeration blowers should be removed to make room for the new carbon addition system.

Roof: Operating staff have indicated that the existing building have experienced repeated and continuous problems with roof leaks. For this reason, we recommend that the Operations Building be provided with a new sloped roof, providing added protection against leaks, as well as additional protection for roof-mounted mechanical equipment.

Refer to Appendix S for a conceptual layout of the renovated Operations Building.

7.4.11.2 Laboratory Facilities

The existing laboratory facility is too small, not adequate for all necessary on-site wastewater analysis, and does not meet the minimum recommended guidelines for wastewater treatment facility laboratories. In particular, while the existing laboratory occupies approximately 360 square feet of floor space, TR-16 recommends a minimum laboratory size of 500 square feet, roughly 40% larger than the existing facility. Laboratory equipment, although well maintained by plant staff, should be replaced with new state-of-the-art equipment as needed, and new devices should be provided to allow additional testing as might be required by the WPCF's future NPDES permit. Exact equipment schedules should be developed during facility design.

An expanded laboratory of sufficient size, complete with the necessary lab equipment and glassware for process control and DMR reporting requirements should be provided in this upgrade. Included in the remodeled laboratory space should be storage space, counter space, cabinets, desks, chairs and computer. Space for a new SCADA station should also be provided to remotely monitor and control most of the WPCF critical processes.

7.4.11.3 HVAC and Plumbing

The following are the major recommendations for the upgrade of the HVAC and plumbing systems:

- Replacement of the entire HVAC system. This includes the boiler, unit heaters, unit ventilators, window air conditioners, piping, pumps, tanks and appurtenances;
- Replacement of the boiler with a newer design and use of outdoor air reset controls, which should reduce fuel oil consumption by at least 20%;
- Replacement of the piping, unit heaters and unit ventilators, which may reduce the oil consumption an additional 20%. We estimate the renovation of the system may reduce the fuel oil consumption by 40-50% without factoring in upgrades to windows, doors and building insulation;
- In addition to bringing the rest rooms up to current code requirements, all exposed hot and cold water piping exhibiting corrosion should be replaced. All piping should then be insulated to prevent corrosion.
- The water heater and appurtenances need to be upgraded to support upgrading the safety shower system to current standards.

7.4.12 Electrical Infrastructure

Electrical Service

To keep the existing plant operational during the construction phase, we recommended that the storage room adjacent to the existing main electric room in the Operations Building be utilized for all the new electrical service equipment. The proposed electrical service would include the following;

- New 480Y/277 volt, 3-phase, 4-wire pad mount transformer located adjacent to the existing pad mount transformer;
- New 2000 amp, 480 volt, 3-pase, 4-wire Service Switchboard containing the main service switch, automatic transfer switch and feeder breakers for the MCC's; located in new Electric Room of the Operations Building; and
- Underground Electric Service ductbank from the pad mount transformer to the new Switchboard.

Motor Control Centers

Because of the age and poor condition of the existing MCC's, we recommended that they be replaced with new 480 volt, 3-phase, 3-wire intelligent type such as the Allen Bradley 2100 Centerline Series with an integral main circuit breaker and VFD or motor starter buckets as required. Proposed MCC sizes and locations are listed below:

- MCC#1 – 800 amp with integral variable frequency drives (VFD's) for the blower motors located in the new electric room of the Operations Building;
- MCC#2 – 600 amp with integral variable frequency drives, motor starters and feeder breakers for process equipment located in new electric room of the Operations Building;
- MCC#3 – 600 amp located in the second floor storage room adjacent to the existing Dewatering Office of the Operations Building. This MCC would serve various Make-Up air units and exhaust fans;
- MCC#4 – 600 amp with integral VFDs and motor starters as required for the sludge processing equipment, located in the former incinerator area of the Operations Building;
- MCC#5 – 600 amp located in the new Headwork's Building and serving all process loads for the Headworks; and

- MCC#6 – 600 amp located in the Operations Building and serving all process loads for Sludge Thickening.

Generator

Woodard & Curran recommends that new power and control wires be installed from the generator to the new Automatic Transfer Switch located in the new electric room. The existing generator was installed in 2004, therefore the WPCF should consider replacing it in the next 10 to 15 years when the equipment approaches the end of its useful life.

Per a request from the WPCF superintendent, a load bank is being proposed for the existing generator for the purpose of automatic load bank testing of the generator. The load bank would be located on a new concrete pad adjacent to the existing generator, and housed in a weatherproof enclosure.

7.4.13 Controls and Instrumentation

The WPCF's instrumentation and control system should be augmented through the installation of an updated supervisory control and data acquisition (SCADA) system. The upgraded system should provide for collection of pertinent data from the WPCF systems, while providing limited manual control of systems through the WPCF's computerized main control station. The system should utilize a series of programmable logic controllers (PLCs) to gather and disseminate information throughout the WPCF. Some WPCF operations, such as primary sludge pumping, waste and return sludge pumping, and disinfection system operation should be automated through the control system. Control of the WPCF's critical processes, however, such as MLSS concentration, SRT, sludge dewatering, etc., should be maintained by direct operator oversight.

Major recommendations for the upgrade of the existing outdated SCADA system include the following:

- Enhance the alarming capability of the system with a package such as WIN911. The upgraded alarming functionality would eliminate the need and extra cost of phone lines at each pump station and would allow more alarms and notifications of communication issues between the sites and the WPCF;
- Upgrade and standardize all PLCs to a common open architecture platform;
- The installation of a new SCADA computer with a current operating system in an open area that will allow full situational awareness by all key personnel. We also recommend that as the SCADA system is expanded plant wide and the operators become more dependent on the SCADA functionality, that a second backup computer be installed in case of failure to improve reliability;
- The completion of a radio path study as part of any upgrade. This will revisit the antenna heights, radio frequency and hardware selection in the remote sites. For the WPCF, we would recommend a plant wide industrial wireless Ethernet network. The advantage of this type of communications is security and the ability to connect all out building without excavation; and
- The installation of an automated reporting package such as XL Reporter. This Excel based program automatically extracts data from the SCADA system at pre-determined intervals. For instance, effluent pH can be collected every 15 minutes, recorded for the day and minimum / maximum values documented. The report can reset at midnight and print automatically. A new page is created each day and a new month created when needed. All of these files are stored for easy retrieval. As this is Excel based, the forms are created to match any state or local reports that are required.

7.4.14 Hydraulic Profile

The projected hydraulic profile for the recommended treatment configuration is presented in Figure 7-4. The profile is computed for the design flow of 10 MGD at low river level, the peak hour flow of 17.0 MGD at 25-year river level, as well as the peak hour flow for 100-year river level.

7.4.15 Miscellaneous Items

Additional improvements are needed at the WPCF including the installation of a new load bank for the purpose of automatic load bank testing of the existing generator, providing emergency power to diesel fuel pumps, construction of a new vehicle wash station, as well as replacing the aging septage receiving pump.

The new vehicle wash station will provide savings in O&M costs and will be installed near the proposed headworks building. The wash station will be an exterior rollover automated system where you drive your vehicle inside the bay. Once your vehicle is in the correct position, a signal informs you to stop. At that point, the vehicle-wash equipment moves over your vehicle on a track, performing a specific function, such as applying soap or rinsing, with each pass. The wash wastewater will include contaminants such as oil & grease, detergents, phosphates, and solvent-based chemicals that need to be collected separately in an oil water separator. The oil water separator needs to be properly and regularly maintained to stay in good working order. The separator maintenance includes inspection, oil removal and disposal, and wastewater drainage to the headworks structure for preliminary treatment.

7.5 PROCESS MODELING OF RECOMMENDED TREATMENT ALTERNATIVE

Mathematic modelling and computer simulation have become a powerful tool to determine the most suitable design, optimize the control, forecast future behavior of full-scale WPCFs under varying operating conditions and educate operators. GPS-X and Biowin are among the WPCF modelling software packages in the market. In this report, GPS-X software developed by Hydromantis was used to develop and evaluate models of the existing and proposed WPCF biological treatment configurations for the Town of Enfield.

A number of factors are to be considered with regard to activated sludge modelling and model applications, and a step-wise approach is needed to evolve from the model purpose definition to the point where a WWTP model is available for simulations. To reach that goal, the following main steps were completed during the process modelling task:

- Definition of the WPCF model purpose or the objectives of the model application (control, design, simulation);
- Model selection: choice of the models needed to describe the different WWTP units to be considered in the simulation, i.e. selection of the activated sludge model, the sedimentation model, etc.;
- Wastewater and biomass characterization;
- Model building and calibration of the activated sludge model parameters; and
- Scenario evaluations.

The model of the WPCF four-stage Bardenpho existing configuration was built and calibrated using routinely logged plant daily records and data from additional test performed to establish necessary stoichiometric fractions. The results and description of the calibration process are shown in Appendix V.

Using the calibrated model, the bioreactor configuration was modified to simulate the recommended biological treatment alternative (VOM process), which gives the operator the ability to operate the biological process in various modes using “swing zones” that could be operated with either aerobic or anoxic conditions and to provide protection against elevated wet weather flows. The bioreactor was divided into six (6) compartments and the following scenarios were simulated:

- VOM 1: This scenario simulated the MLE process (anoxic and aerobic configuration);
- VOM 2: This scenario simulated the 4-stage Bardenpho process (anoxic, aerobic, anoxic, and aerobic configuration); and
- VOM 3: This scenario evaluated the robustness of the upgraded WPCF to accommodate short-term peak flows by simulating intensive rainfall events. Under these conditions, the process would operate in the contact stabilization mode to protect against secondary clarifier overload and potential solids washout.

As described in Appendix V, the simulation results for all three (3) scenarios suggest that the proposed VOM process could achieve better performance than the existing 4-stage configuration. The simulation results also indicate that the VOM configuration has the capability to enhance BOD and nitrogen removal, achieve effluent requirements, minimize operating cost and handle extreme weather flow conditions within the existing reactor volumes and at minimal supplementary investments. It is recommended that during the design phase, additional process model simulations be performed to fine-tune the VOM configuration and evaluate the effects of different operational parameters (anoxic volume, recycle flow, step feeding, etc.) on process performance and operating cost.

7.6 PLAN DEVELOPMENT AND PUBLIC REVIEW PROCESS

The Town established a public workshop process as part of this Facilities Plan Project to solicit input from stakeholders and partner agencies including Connecticut DEEP. Workshops were held during the development of this Draft Report to provide opportunities for interested parties to provide their input and/or feedback throughout the planning process.

To date, there have been numerous public meetings in which this Facilities Plan was discussed. The recommended plan was presented to the Town's Council during a focused information meeting on June 1, 2015. Public comment has already helped shape the current plan, and we expect this to continue through project design and implementation.

7.7 OPINION OF PROBABLE PROJECT COST

The previous sections have described the technical aspects of how the Town of Enfield can meet its future wastewater needs, as well as meet the present and future water quality objectives that the State of Connecticut has specified for Long Island Sound. The program to be undertaken to meet these present and future needs requires capital for construction of new facilities and operating funds associated with the cost of operating the new facilities. Engineering, legal, and administrative costs to implement this plan also add to the overall cost of the project. With a program of this scope, it is necessary to accurately establish these costs, prepare a schedule that can be followed for the separate projects within the plan, and to determine how to finance and schedule these projects so as to best implement the construction program. The capital costs aspects of this plan will be described in this section. The next sections will describe the plan to implement and finance this project and its impact on the Town's tax system. The final section of this chapter includes a schedule of implementation.

7.7.1 Basis of Cost Estimate

As described in Section 6, the estimated capital cost for this project is based on 2015 costs and does not include escalation factors to account for projects constructed in the future, since the timing of these projects is currently unknown. Building costs include all building support systems such as plumbing, HVAC, and electrical. All costs assume the existing soils have sufficient structural bearing capacity to not require piles for supporting new structures such as buildings and tanks. The costs include the following markups:

Utility Relocation – 1% of Construction Base Cost
General Conditions – 7% of Construction Base Cost
Mobilization, Bond & Insurance – 4% of Construction Base Cost
Overhead – 7% of Construction Base Cost
Profit – 6% of Construction Base Cost
Construction Contingency – 20% of the Construction Cost
Construction Phase Engineering – 20% of the Construction Cost

For major process equipment items or systems, equipment costs used were obtained from vendor estimates or project experience with similar projects. A factor of 40% was added to estimate the installation cost, which also includes miscellaneous items such as equipment pads, anchor bolts and other required items not explicitly itemized or estimated. Factors of between 10% and 20% were used for electrical costs and for instrumentation costs (depending upon the complexity of the system) to support that equipment.

7.7.2 Conceptual Level Capital Cost

After meeting the Town Council in June 1, 2015 to present and discuss the recommended plan, two alternatives were selected for the WPCF upgrade including: (1) Alternative 1A – Rehabilitation of the Operations Building, and (2) Alternative 1B – Rehabilitation of the Operations Building and New Gravity Thickeners. Both alternatives are described in detail in Section 6.7 and Appendix S. The only major difference between the two alternatives is the additional gravity thickeners.

The conceptual level estimated capital cost for the recommended plan is $36.0 M as summarized in Table 7-3. This cost estimate is based on Alternative 1A for WPCF upgrade costs, includes the collection system upgrade costs, but does not include the cost of the gravity thickeners. We recommend including gravity thickening at approximately $4.3 M to improve plant operations and odor control, provide better operational flexibility for operators, decouple liquid and sludge processing trains, and reduce labor costs. We believe that as design requirements are better defined during the design phase of the project, the contingency costs will decrease, allowing the addition of the new gravity thickeners to the overall base case estimate of the WPCF upgrade.

Table 7-3: Conceptual Level Cost Estimate Summary – Recommended Plan (2016 Costs)

ITEM NO.	COST ITEM	2016 FACILITIES PLAN
	CAPITAL COST SUMMARY	
1	**PLANNING**	
1.1	Facilities Plan & I/I Study	$1,111,559
1.2	**TOTAL PLANNING ESTIMATE**	**$1,111,559**
2	**WATER POLLUTION CONTROL FACILITY**	
2.1	Excavation / Backfill	$14,000
2.2	Demolition	$57,000
2.3	Concrete	$1,656,000
2.4	Process Piping	$431,000
2.5	Building Construction	$2,319,000
2.6	Equipment	$9,635,000
2.7	Site / Miscellaneous	$631,000
2.8	**WPCF CONSTRUCTION BASE COST**	$14,743,000
2.9	Overhead, Insurance, & General Conditions (25%)	$3,686,000
2.10	Contingency & Engineering (40%)	$7,372,000
2.11	**TOTAL WPCF UPGRADE CAPITAL COST**	**$25,801,000**
3	**COLLECTION SYSTEM**	
3.1	Collection System Structural Repairs	$202,000
3.2	Pump Station Upgrades	$4,977,000
3.3	**COLLECTION SYSTEM CONSTRUCTION BASE COST**	$5,179,000
3.4	Overhead, Insurance, & General Conditions (25%)	$1,295,000
3.5	Contingency & Engineering (40%)	$2,590,000
3.6	**TOTAL COLLECTION SYSTEM UPGRADE CAPITAL COST**	**$9,064,000**
4	**TOTAL FACILITIES PLAN PROJECT**	**$35,977,000**

NOTE: We recommend including gravity thickeners at approximately $4.3M to improve plant operations, odor control and reduce labor costs. This is not included in the current Base Case estimate, but we

ITEM NO.	COST ITEM	2016 FACILITIES PLAN

suggest that it be included as a design alternate.

7.8 PUBLIC OUTREACH AND PARTICIPATION

Public outreach has been a key focus of the Town and the Enfield WPCA in 2015. Public outreach program included informational booths, newsletters, slide shows on Enfield's Public Access Channel (ETV), as well as Town Council and public hearings. These outreach events provided information to residents about improvements needed at the WPCF and the sewer fee. Public outreach efforts are summarized below:

- Connecticut Wastewater Appreciation Day was declared by Governor Malloy on May 20, 2015. To celebrate that day, the Enfield WPCF opened its doors to the public for an educational Open House. With the help of the Enfield WPCF Superintendent Kevin Shlatz, guests at the Open House were offered tours of the WPCF, which are also available by appointment to anyone interested.
- The Enfield 4th of July Town celebration was held from July 10th through July 12th of 2015. The Town sponsored an information booth and gave away information flyers about the WPCF.
- Informational booths were set up in locations with heavy foot traffic including the Enfield Farmers Market, the Asnuntuck Community College Fall Festival and the Enfield Senior Center. An informational booth with posters and Woodard & Curran representatives was present at the July 15th and August 26th Farmers Market and at the October 26th Fall Festival. An informational slideshow was presented at the Senior Center on May 14. In addition, during three additional days including October 14, October 15 and October 28, an informational booth was available to Senior Center members to inform the public about the sewer fee and the recommended improvements to the WPCF and collection system.
- Newsletters were developed to educate residents about the Facilities Plan, sewer fees and field work expected around the Town including smoke testing. The newsletters were included in two cycles of the quarterly bills. The newsletters also included other information useful to residents, such as ways to reduce the water bill in the summer months.
- Informational flyers were developed with photos of the existing WPCF equipment to educate residents about the state of the WPCF and needed improvements. The flyers were posted at various public locations throughout the Town.
- Two different slide shows were developed specifically for ETV. One slideshow started in April and the second in September. The slides included information about the WPCF, collection system and the sewer fee.
- Woodard & Curran prepared presentations for the Town Council and during Public Hearings on March 16, June 1, August 3 and September 21. Topics included the current state of the WPCF, the Facilities Plan progress and findings, as well as smoke testing.
- The Town referendum to allocate funds raised by the sewer fee for use in design and construction of the WPCF and collection system upgrades was passed in a vote on November 3, 2015.

Public input to date has already had a positive impact in shaping the recommended plan. The Town and WPCA are committed to continuing to provide education and outreach opportunities as the Project is designed and implemented.

7.9 PROJECT IMPLEMENTATION

7.9.1 General Permit Requirements

A WPCF upgrade project typically has four phases: planning, design, construction and operation. The associated permits and approvals anticipated to be required are listed in the Table 7-4.

Table 7-4: List of Permits Required

Permit	Description	Issued by
Building Permit	To construct building extensions (includes building, electrical, mechanical, plumbing, and energy code requirements)	Town of Enfield Building Official
Inland Wetlands Permit	For all activities within 100 feet of wetland and watercourse within the Town	Town of Enfield Department of Planning and Engineering
Dewatering/Water Discharge Permit	For water discharge into storm drainage system or waterway (during construction, if there is high groundwater)	CT DEEP
Municipal NPDES Permit	Town of Enfield WPCF Permit must be renewed every five years	CT DEEP
Air Emissions	If there are upgrades/changes to generator systems. Depending of the site and generator size, a "Permit-by-Rule" or full permit application would be needed	CT DEEP
Flood Management Certificate	Any state agency proposing an activity within or affecting a floodplain or that impacts natural or man-made storm drainage facilities must submit a flood management certification. Such activities include, without limitation: a) any structure, obstruction or encroachment proposed for emplacement within the floodplain area; b) any proposal for site development which increases peak runoff rates; c) any grant or loan which affects land use, land use planning or the disposal of state properties in floodplains; or d) any program regulating flood flows within the floodplain.	CT DEEP

Notes:

- The CT DEEP must review and approve all extensions and modifications of treatment facilities prior to the initiation of construction.

- If construction vehicles and/or material stockpiles are stored on property that does not belong to the WPCF, a temporary construction easement needs to be obtained from the property owner.

7.9.2 Anticipated Staffing Needs

The New England Interstate Water Pollution Control Commission (NEIWPCC) Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants was used to estimate staffing needs. Additional considerations in staffing included CT DEEP requirements, CT General Statutes (Chapter 103: Municipal Sewerage Systems), Town Code (Chapter 86: Utilities), unique operation and maintenance practices, current organizational structure and future developmental plans.

A well run facility and collection system includes operators who are well trained and cross-trained in all operations at the WPCF. They should be operating in compliance with all permits, laws and regulations, and be completing all of their O&M responsibilities. When all of these steps are being met, the staff can take pride in their work and facility, as well as the importance of their job with respect to protecting the environment.

7.9.2.1 Staffing Background Information

Current staffing levels are commensurate with the "Manual on Operation and Maintenance of the Town of Enfield Water Pollution Control Plant for Enfield, Connecticut, September 1972" staffing recommendations. The manual specifies a staff of "10 men capable of performing the routine operating and maintenance chores." Positions specifically described within the manual include Superintendent, Deputy Superintendent, Laboratory Assistant, Maintenance Mechanic, and Attendants (Process Operators) of various levels of supervision. The manual also states that this level of staffing will require cross-training among personnel, insofar as practical. Changes in facility design, process operation, permitting, and regulations, as well as growth of the collection system, may make this level of staffing unfeasible.

Wastewater treatment operations and maintenance require personnel with diverse skill sets. The WPCF emphasizes frequent communication and cross training of operators and mechanics to ensure proper operation of the facilities.

7.9.2.2 NPDES Permit Staffing Requirements

The NPDES Permit, Number CT0100200, provides the requirements the WPCF must meet. The permit has been reviewed for staffing requirements and laboratory testing requirements.

In summary, The WPCF is a Class IV facility requiring the superintendent to be present a minimum of seven hours each week day (five day work week), in addition to an assistant superintendent. Monthly testing for various forms of nitrogen, and other effluent constituents of interest, is required; however, the more complex lab work is currently performed by an outside lab.

The NPDES permit also specifically requires the maintenance of alternative power sources adequate to provide full operation of all pump stations, as well as primary treatment and disinfection at the WPCF.

7.9.2.3 Current WPCF Staffing

Table 7-5 presents the facility personnel as of February 26, 2013. In addition, information indicating the level of certification license is provided.

Table 7-5: Summary of Current Staffing and License Holding

Position	Wastewater License (Class)	Collection System License (Class)	Wastewater Laboratory License (Grade)
Superintendent	4	4	1
Lead Attendant II, Maintenance	3	4	2
Lead Attendant II, Laboratory	3	4	2
Attendant II, Engineering Tech	2	4	1
Attendant II, Laboratory	2	4	1
Lead Attendant I, Collection System	1	2	-
Attendant 1, Operator	2	4	1
Attendant 1, Operator	1	1	-
Attendant 1, Operator	1	1	-
Attendant 1, Operator	1	1	-
Attendant 1, Operator	1	1	-
Attendant 1, Operator	1	1	-
Attendant 1, Operator	1	1	-
Administrative Assistant	-	-	-

7.9.2.4 NEIWPCC Staffing Recommendations

The Northeast Guide for Estimating Staffing at Publically and Privately Owned Wastewater Treatment Plants was developed by NEIWPCC, in conjunction with numerous other entities, to create a consolidated systematic method for estimating staffing needs based on pre-established criteria. Prior to the release of NEIWPCC's staffing guide, the primary source of established staffing criteria was the 1973 U.S. EPA guide Estimated Staffing for Municipal Wastewater Treatment Facilities. The EPA guide, unlike the NEIWPCC guide, focused heavily on treatment processes that are no longer widely used, and failed to address modern technologies, increasingly stringent regulations, industrial pretreatment regulations, advances in laboratory analysis, and the expansion of discharge avenues.

Preliminary forms of the NEIWPCC guide were formulated by an advisory committee of subject matter experts with survey data from 50 wastewater treatment facilities in New England, followed by an extensive pilot study including a range of processes and practices. The current guide provides a valuable baseline estimate for staffing demands based on estimated hours devoted to specific tasks, and typical productive hours derived from full-time personnel, on an annual basis.

The method used to determine the total number of productive hours a full time equivalent employee has in a given year was determined as follows: based on 6.5 hours of day productivity, 52 weeks per year, and 5 days per work week, a facility is estimated to derive 1,690 productive hours from each full-time employee. NEIWPCC estimates the average number of vacation, sick and holiday days allotted for each employee equates to approximately 190 hours. The result is full time equivalent (FTE) work of approximately 1,500 hours per year.

As with any baseline guide, the recommendations require adjustment to fit the specific needs, abilities and resources of each facility. Tabulated results may be found in Section 7.4.2.5 and the complete NEIWPCC staffing analysis may be found in Appendix W. The staffing recommendations for the Enfield WPCF, identified by area of operation, are as follows:

7.9.2.4.1 Process Operations

The staffing demands of process operations considered the treatment process components within the facility (process operators) and the subsequent demand for waste sludge processing (sludge dewatering operator). For the Town of Enfield WPCF, this includes preliminary treatment through screening and grit removal, primary clarification, an activated sludge process with BNR, secondary clarification and disinfection through chlorination.

The NEIWPCC recommended staffing for these operations is 10,205 hours per year, or 6.8 FTEs. An appropriate breakdown of these FTEs would equate to approximately five allocated treatment process operators, with cross-trained support from other areas.

7.9.2.4.2 Equipment Maintenance

The staffing demands of facility maintenance considered all of the components of the process operations, as well as more specific equipment details which may directly and significantly impact maintenance requirements. This additionally includes numbers and types of process tanks, clarifiers, blowers, sludge thickeners and preliminary treatment processes.

The NEIWPCC recommended staffing for these operations is 3,539 hours per year, or 2.4 FTEs. This would equate to two total maintenance personnel, however, specialized maintenance skill requirements may make this impractical. An appropriate breakdown of these FTEs would equate more realistically to approximately three maintenance personnel including personnel with skills in mechanical, pipefitting and instrumentation/electrical work.

7.9.2.4.3 Laboratory Operations

The staffing demands of laboratory operations considered select permit and process related laboratory testing requirements including both tests performed on site and tests performed by outside labs. Lab testing considered test frequency as well as estimated time consumed during the testing process, with some analyses consuming more time than others (i.e. 15 minutes estimated for pH testing, compared to 3 hours estimated for dissolved and suspended solids testing).

The NEIWPCC recommended staffing for these operations is 4,922 hours per year, or 3.3 FTEs. An appropriate breakdown of these FTEs would equate to approximately two allocated lab technicians, with cross-trained support from other areas for basic laboratory tasks (i.e. sample collection, sample preservation).

7.9.2.4.4 Collection System Operations

The staffing demands of collection system operations is estimated based on 3 hours of labor per lift station and siphon, per week, totaling to 54 hours weekly. These operators would be responsible for collection system maintenance, as well as filling the roll as first responders to collection system failures.

Based on the above estimates, the staffing for these operations consumes 2,808 hours per year, or 1.9 FTEs. This would equate to two total collection system operators, however, these personnel may be staffed specifically for cross-trained support in other areas and individual system failures may require a response from a larger number of responding personnel. A more appropriate breakdown of these FTEs may be approximately three collection system operators, cross trained into process and laboratory operations.

The Town might also need to adding staff to meet Capacity, Management, Operations, and Maintenance (CMOM) requirements for their collection system. These requirements are still being developed by the DEEP and EPA, but may require the Town to perform CCTV inspections of their entire system once every five years. Other requirements may include cleaning sections of pipe that backup frequently, maintaining sewer easements so pipe and other infrastructure can be accessed, and regularly cleaning of siphons.

7.9.2.4.5 Sludge Handling Operations

The staffing demands of sludge handling operations simply considered the type of dewatering system utilized and the facility flow rates. The facility operates a belt filter press system, which NEIWPCC estimates requires 8 hours per day of direct oversight, plus additional support labor.

The NEIWPCC recommended staffing for sludge dewatering system operations is 2,600 hours per year, or 1.7 FTEs. An appropriate breakdown of these FTEs would equate to approximately two allocated dewatering system operators. During ideal operations, these operators should be utilized as support for other facility operations including laboratory and process support. This position may also be utilized as a training position, allowing new operators the opportunity to independently operate equipment with lower permit related liability.

One consideration to make in this staffing assessment is that estimated staffing demands for belt filter presses are substantially higher than other dewatering systems. Press systems, such as rotary presses, require substantially less staffing. Installation of a rotary press may reduce the need for allocated dewatering system personnel.

7.9.2.5 Staffing Summary Results & Recommendations

Table 7-6 below summarizes the NEIWPCC Northeast Guide for Estimating Staffing at Publically and Privately Owned Wastewater Treatment Plant results, calculated as FTE annual work hours and separated by area of operation.

Table 7-6: Tabulated NEIWPCC Staffing Recommendations

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS (One Shift) FINAL ESTIMATES	
Chart #	**Annual Hours**
Chart 1 – Basic and Advanced Operations and Processes	10,205.00
Chart 2 – Maintenance	3,539.00
Chart 3 – Laboratory Operations	4,922.00
Chart 4 – Biosolids/Sludge Handling	2,600.00
Chart 5 – Yardwork	490.00
Estimated Operation and Maintenance Hours	21,756.00
Estimated Operation and Maintenance Staff	14.50
Estimated Additional Staff from Chart 7	2
TOTAL STAFFING ESTIMATE	**16.50**
Chart 6 - Automation/SCADA	
Computerized Facilities Management (FM) System	
Computerized preventative maintenance	
Computerized recordkeeping	
E-mail	
Laboratory Information Management System (LIMS)	
Local Area Network (LAN)	
Supervisory Control and Data Acquisition (SCADA)	
Telemetry	
Chart 7 - Considerations for Additional Plant Staffing	
Management responsibilities (i.e., training, scheduling) and responsible for clerical duties (i.e., correspondence, phones, time sheets, etc.)	
Plant staff responsible for operation and maintenance of pump stations and inspections.	
Wetwell Grease Removal	
Plant operators responsible for operating generators and emergency power	
Lawn and grounds maintenance	
Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)	
Age of plant and equipment (over 15 years of age)	

Table 7-7 includes a tabulated summary of existing staffing levels compared to NEIWPCC recommended staffing levels, along with the recommended increase/decrease in staffing.

Table 7-7: Summary of Current and Recommended Staffing

Position	Number of Currently Allocated Personnel	Number of Recommended Allocated Personnel	Recommended Change (+/-)
Management	2*	2	0
Process Operations	2	4	+2
Equipment Maintenance	2**	3	+1
Laboratory Operations	1**	2	+1
Collection System Operations	4	4	0
Sludge Handling Operations	2	2	---
TOTAL	**13**	**17**	**+4**

* Management personnel includes the Superintendent and the Administrative Assistant as many of the Administrative Assistant's duties include duties that may be defined as "management responsibilities." Note that this does not include support for human resources, information technology, legal, financial, assistance from the Department of Public Works, and other duties that are provided by the Town and are included in the WPCA's budget. The amount the WPC paid for these services and also to repay an outstanding loan in 2015 was $728,428.

** Equipment Maintenance and Laboratory Operations exclude personnel assigned as back-up "fill-ins" to those areas; back-up individuals are identified as Process Operations personnel.

7.9.3 Plant Classification

The existing plant is classified as a Class IV, and the upgraded plant will be as well. This is the highest classification in the State of Connecticut.

7.9.4 Project Financing

In 2013, the Town of Enfield elected to move from its long-standing practice of funding its WPCA via ad valorem taxes to a revenue model that was based upon the volume of sewerage each customer sends to the utility. This adjustment was made in contemplation of major upgrades to the WPCF and collection system infrastructure and was intended to ensure that the system's customers were paying appropriate sewer fees for the services they each receive. Additionally, the change helped the WPCA to better align internal policies with the requirements for CT-DEEP Clean Water Funding (CWF) program guidelines, potentially increasing the amount of grant funding available from the State.

In addition to the standard grants of the CWF, the Town of Enfield will qualify for additional grant money from Eversource for upgrading to premium efficient motors, replacing outdated lighting and HVAC equipment, and for other energy efficiency improvements at the WPCF and the pumping stations.

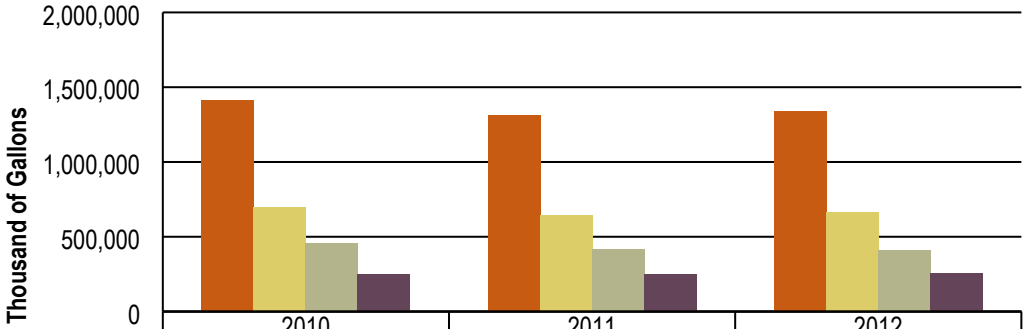
Based upon a series of workshops evaluating the different rate structures available, the Town of Enfield elected to adopt a two-tier volumetric sewer rate structure with the tier structure based upon the amount of metered water each customer use. The rate structure was designed to generate revenues sufficient to cover the WPCA operations and debt service costs for five years after its adoption without any further changes to the rates during this period. The adopted rate structure is shown in Table 7-8.

Table 7-8: Enfield WPCA Rate Structure

Tier	Quarterly Volume (kGal)	Volumetric Rate	Notes
Base Usage	20 kG or less	$ 3.39/kGal	meter water billed as sewer adjusted for summer irrigation
High Usage	> 20 kGal	$ 5.08/kGal (150% of base)	meter water billed as sewer adjusted for summer irrigation
Sewer Meter	All	$ 5.08/kGal (150% of base)	only large point users have sewer meters
Unmetered	Assumed usage	N/A	bill based upon "typical" residential sewer bill value

The calculations used in the establishment of these rates was based upon a combination of water and sewer metering combined with reasonable estimates to account for future cost escalation and sewer sales variation for customers for whom quarterly consumption was unknown. Based upon our evaluation of the data, the projected sewer consumption by customer tier are shown in Figure 7-5.

Figure 7-5: Water Consumption by Tier (20kG/qtr)



	2010	2011	2012
Total	1,413,551	1,310,612	1,340,984
Tier 1 Cons	700,991	644,153	667,219
Tier 2 Cons	460,334	418,416	414,170
Metered Sewer	252,226	248,044	259,595

As part of the Facility Planning effort which formed the basis the rate setting, projections of the costs of both operating the utility as well as constructing needed upgrades to the forty four year old plant and collection system were developed. Combined, these costs present of the projected overall costs which the WPCA will incur over the five year period beginning with the completion of the study. The chart below presents these costs as they were developed for the Rate Study/Master Plan completed in 2013.

Table 7-9: Cost of Service Projection

		Upgrade Plan	Enfield WPCA - Cost of Service Projection ($1,000s)					
			FY2013	FY2014	FY2015	FY2016	FY2017	FY2018
Appropriated Funds	Operating Budget		$3,018	$3,100	$3,183	$3,269	$3,358	$3,448
	Capital Outlay		$0	$500	$500	$500	$500	$500
	Indirect Costs		$0	$515	$528	$541	$555	$568
	Operating Savings due to CIP	Comprehensive	$0	$0	($50)	($215)	($245)	($275)
	Debt Service	Comprehensive	$0	$0	$141	$1,286	$1,369	$1,454
Operational Cost of Service			$3,018	$4,115	$4,274	$5,125	$5,262	$5,404
Funds to/(from) Stabilization			$0	$300	$300	$300	$300	$300
OVERALL COST OF SERVICE			$3,018	$4,415	$4,574	$5,425	$5,562	$5,704

7.9.4.1 Calculation of Five Year Sewer Rates

When setting the rates for the initial five-year period, Woodard & Curran and the Town of Enfield agreed that the rates needed to account for most if not all of the new debt service which would be expected by FY2019 to be included in the revenue requirement. Looking at the overall costs of service on the preceding chart, it was determined that by using the FY2016 cost of service as the revenue target, most of the new debt service would be captured in the expected revenues and the Town would begin to establish operating reserve fund separate from Town accounts and allow Enfield to recoup past funds spent on WPCA costs which were not recovered from the ad valorem rates in prior years.

Based upon this evaluation, the rates were set with a designed revenue generation equal to the FY2016 overall cost of service ($5,424,550).

7.9.4.2 Sewer Rate Performance to Date

As of spring 2015, the sewer rates discussed above have been in force for just over a year. Using data from the Enfield Finance Department, the actual revenue generation performance of the rate structure was compared to the design revenue generation capacity. Presented in Table 7-10 are the first full 12 months of revenues.

Table 7-10: Revenues Generated During First 12 Months of Sewer Rate

Month	Amount Billed	Payments Received
March 2014	$80,115	-
April 2014	$295,968	$34,252
May 2014	$344,206	$90,627
June 2014	$723,355	$229,437
July 2014	$505,928	$611,899
August 2014	-	$642,676
September 2014	$224,231	$304,582
October 2014	$1,194,015	$357,103
November 2014	$527,782	$690,206
December 2014	$259,747	$540,255
January 2015	$456,811	$198,558
February 2015	$480,343	$486,609
March 2015	$231,975	$330,985
Total	**$5,324,476**	**$4,517,189**

As is evident from the total line, the amount of billings generated by the rate structure was approximately 2-percent less than the design revenue included in the rate model. Given the significant uncertainties in the tier billing for the Hazardville Water Company customers, it is uncertain whether this slight discrepancy is due to a wetter than average summer or some other small impact.

Given the delay in the capital program related bonding, this small shortfall is not expected to cause any shortfalls over the five-year rate set period. To the contrary, the delay in bonding should allow the WPCA to more quickly build its operating reserves and reimburse the Town for past WPCA-related deficit accounts currently on the Town general fund.

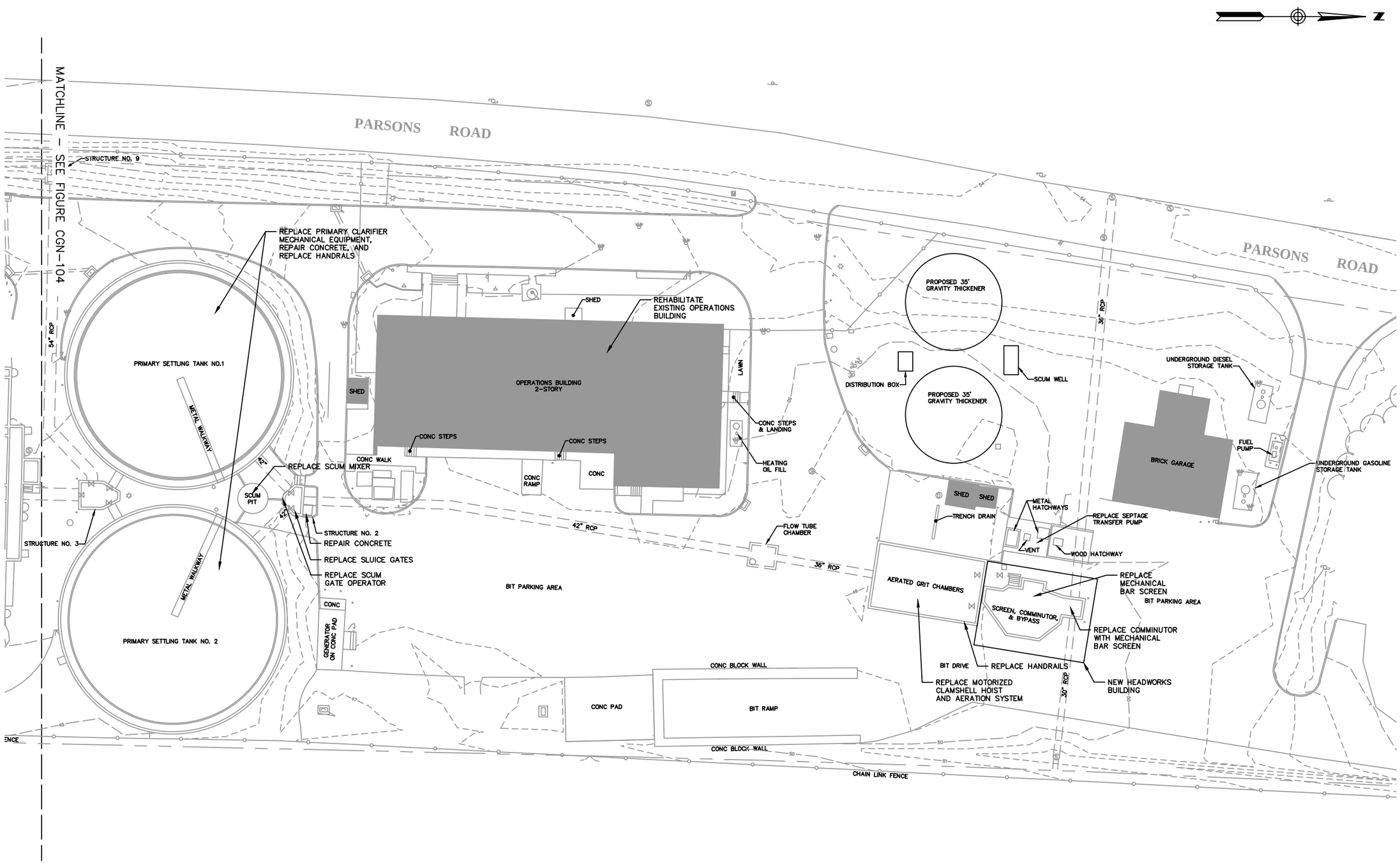
7.9.5 Implementation Schedule

The DEEP issued a Notice of Violation (NOV) to address excessive odors at the WPCF. In addition, the aging infrastructure requires an increasingly frequent amount of maintenance and must be replaced as soon as possible. Therefore, we recommend that the design phase of this project be started as quickly as possible. Following this phase, the project can be put out to public bid. Detailed design is expected to take approximately 10 months, commencing in September of 2016, and construction is expected to take approximately 2 years. Completion of the project is anticipated by August of 2019.

A proposed schedule for implementation of the recommended plan is presented in graphic form in Figure 7-6. The schedule is based on the final Facility Plan report being approved by DEEP in September of 2016.

In preparing the schedule of implementation the following priority has been assigned to the recommendations:

- Proceed with the design of the WPCF, pump station, and collection system improvements;
- Construction of high priority collection system and pump station improvements;
- Construction of the WPCF improvements; and
- Construction of the remaining collection system and pump station improvements.



NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

PROPOSED/CONCEPTUAL WPCF SITE LAYOUT

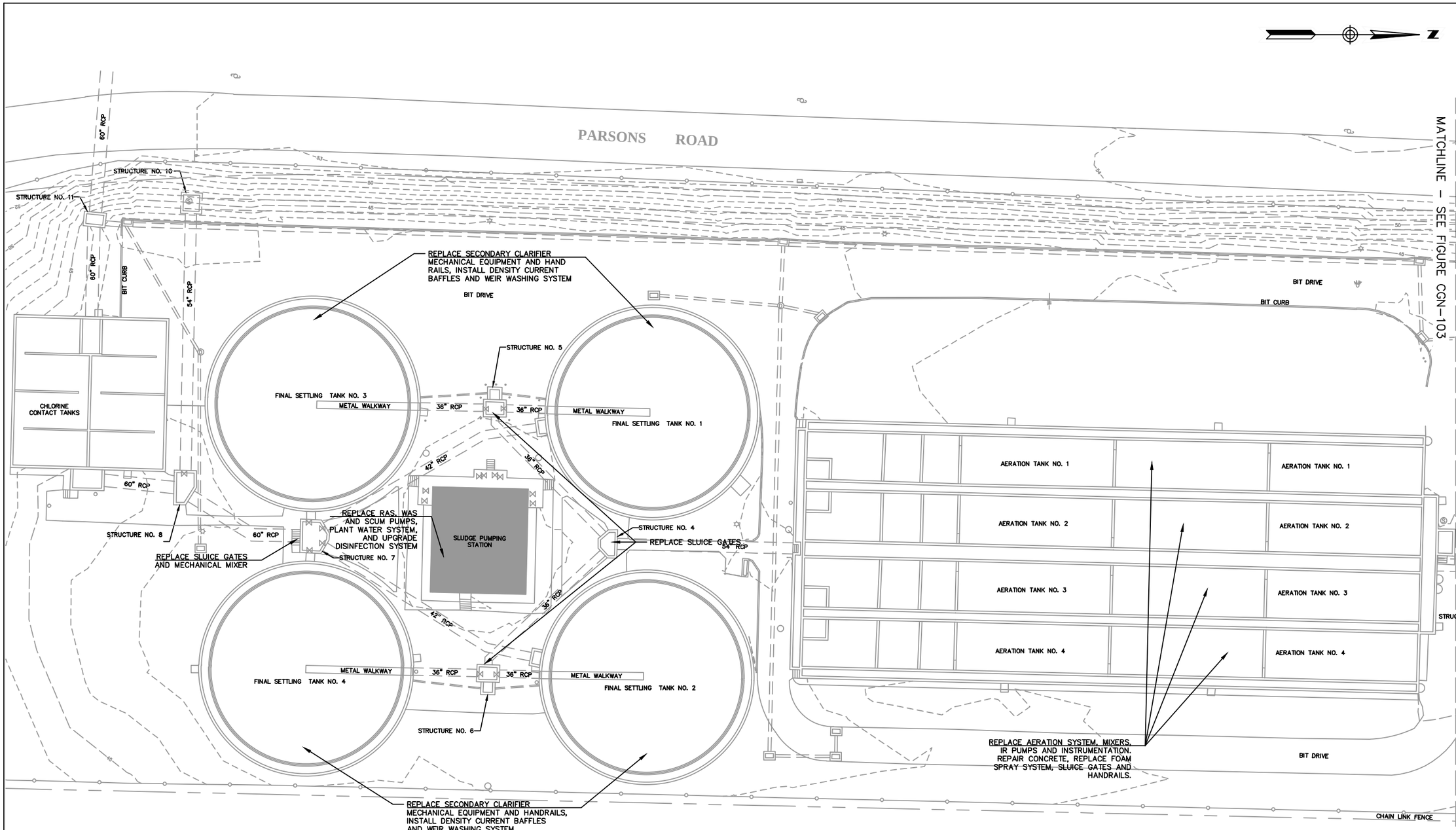
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-110.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO: 227363
DATE: JULY 2015
SCALE: 1" = 40'

FIG 7.1A



NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

PROPOSED/CONCEPTUAL WPCF SITE LAYOUT

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-110.dwg

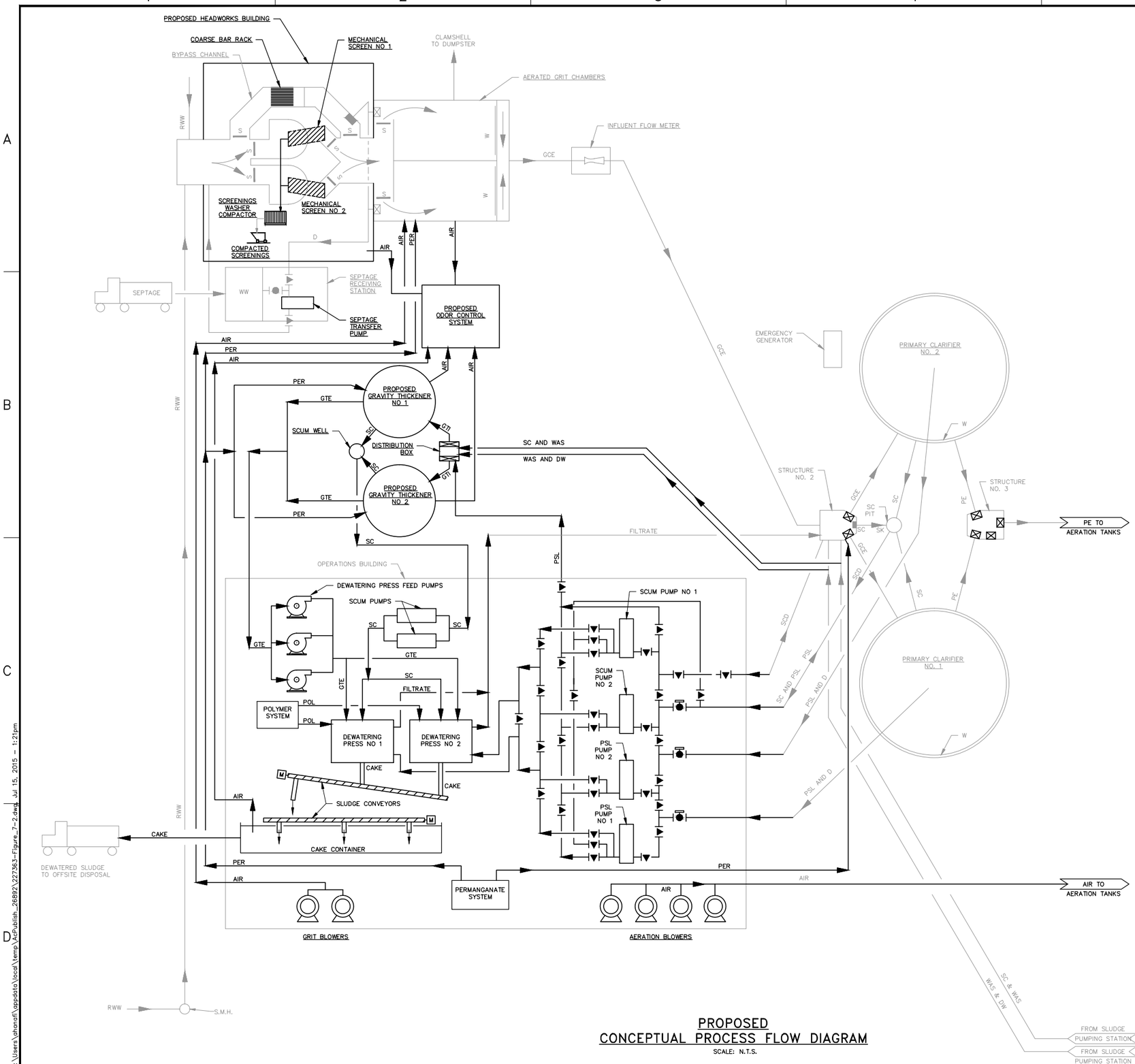
TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO: 227363
DATE: JULY 2015
SCALE: 1" = 40'

FIG 7.1B

22x34 SHEET
1:1



PROPOSED
CONCEPTUAL PROCESS FLOW DIAGRAM

SCALE: N.T.S.

LEGEND

GATE VALVE	
PLUG VALVE	
BALL VALVE	
CYLINDER OPERATED BALL VALVE	
CHECK VALVE	
BUTTERFLY VALVE	
S	SLIDE GATE
	SLUICE GATE
W	WEIR
	FLAP VALVE
SMH	SEWER MANHOLE
	SHEAR GATE

AS	ASH SLURRY
ATE	AERATION TANK EFFLUENT
AX	ANOXIC
B	BYPASS
CCW	CHEMICAL CARRYING WATER
D	DRAIN
DW	DEWATERING
DWW	DEWATERING WET WELL
EFW	EFFLUENT FLUSHING WATER
FE	FINAL EFFLUENT
FSL	FILTERED SLUDGE
FSW	FOAM SPRAY WATER
GCE	GRIT CHAMBER EFFLUENT
GT	GRAVITY THICKENER
GTE	GRAVITY THICKENER EFFLUENT
GTI	GRAVITY THICKENER INFLUENT
HSL	SODIUM HYPOCHLORITE SOLUTION
IR	INTERNAL RECYCLE
NRC	NITRIFIED RECYCLE PUMP
OF	OVERFLOW
OX	OXIC (AEROBIC)
PE	PRIMARY EFFLUENT
PER	PERMANGANATE
POL	POLYMER
PSL	PRIMARY SLUDGE
RAS	RETURN ACTIVATED SLUDGE
RWW	RAW WASTEWATER
SC	SCUM
SCD	SCUM DECANT
SCE	SECONDARY CLARIFIER EFFLUENT
SK	SKIMMER
T1–1	TRAIN 1, ZONE 1 (TYP FOR ALL ZONES)
WAS	WASTE ACTIVATED SLUDGE
WW	WET WELL

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REV	DESCRIPTION	DATE

DESIGNED BY: AH
DRAWN BY: DMB
CHECKED BY: MJB
227363-FIGURE_7-2.DWG

RECOMMENDED PLAN
PROPOSED/CONCEPTUAL
PROCESS FLOW DIAGRAM

TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO.: 227363
DATE: JULY 2015
SCALE: NTS
SHEET: 1 OF 2

FIG 7.2A

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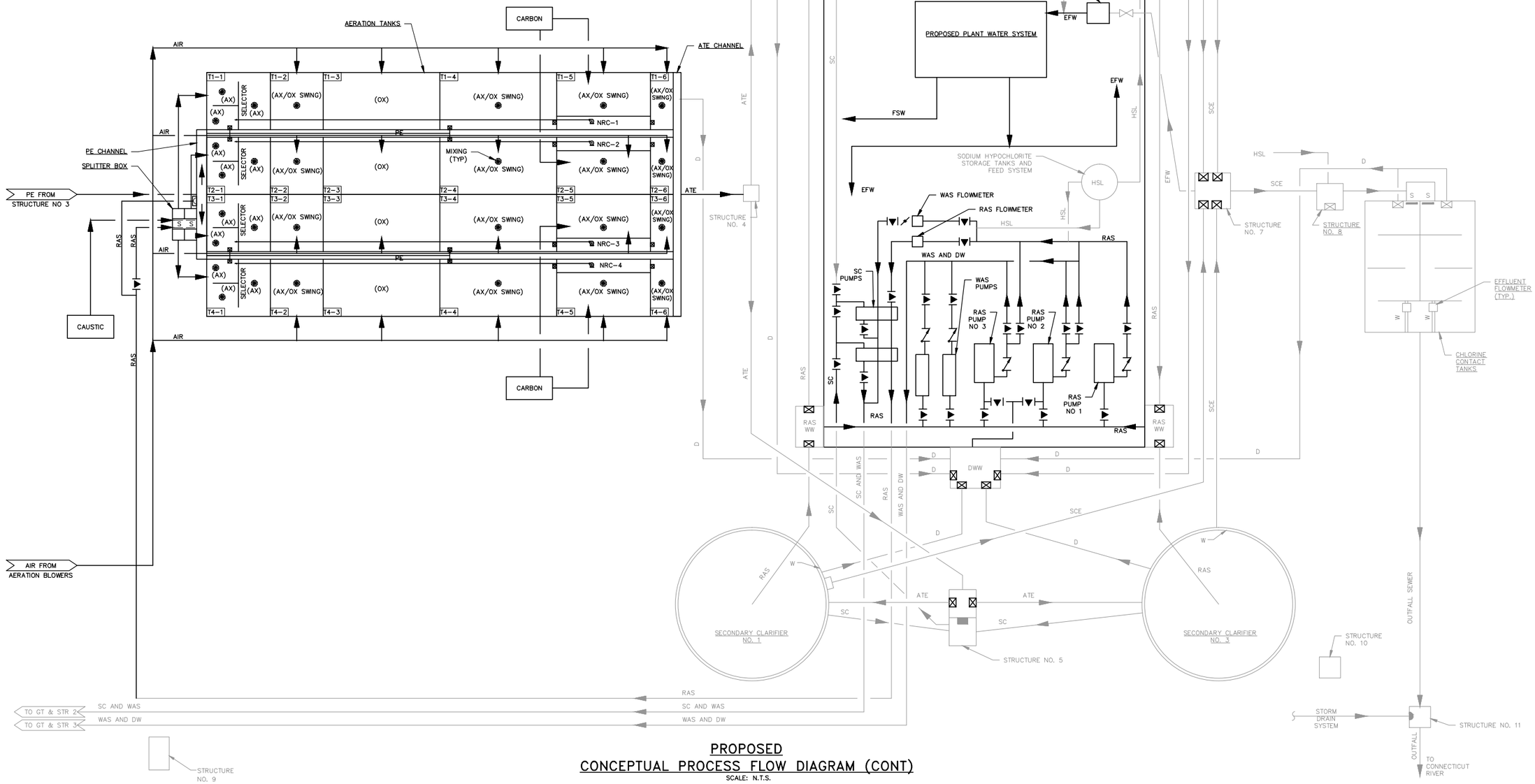
22x34 SHEET
1:1

LEGEND

	GATE VALVE	AS	ASH SLURRY	NRC	NITRIFIED RECYCLE PUMP
	PLUG VALVE	ATE	AERATION TANK EFFLUENT	OF	OVERFLOW
	BALL VALVE	AX	ANOXIC	OX	OXIC (AEROBIC)
	CYLINDER OPERATED BALL VALVE	B	BYPASS	PE	PRIMARY EFFLUENT
	CHECK VALVE	CCW	CHEMICAL CARRYING WATER	PER	PERMANGANATE
	BUTTERFLY VALVE	D	DRAIN	POL	POLYMER
S	SLIDE GATE	DW	DEWATERING	PSL	PRIMARY SLUDGE
	SLUICE GATE	DWW	DEWATERING WET WELL	RAS	RETURN ACTIVATED SLUDGE
W	WEIR	EFW	EFFLUENT FLUSHING WATER	RWW	RAW WASTEWATER
	FLAP VALVE	FE	FINAL EFFLUENT	SC	SCUM
SMH	SEWER MANHOLE	FSL	FILTERED SLUDGE	SCD	SCUM DECANT
	SHEAR GATE	FSW	FOAM SPRAY WATER	SCE	SECONDARY CLARIFIER EFFLUENT
		GCE	GRIT CHAMBER EFFLUENT	SK	SKIMMER
		GT	GRAVITY THICKENER	T1-1	TRAIN 1, ZONE 1 (TYP FOR ALL ZONES)
		GTE	GRAVITY THICKENER EFFLUENT	WAS	WASTE ACTIVATED SLUDGE
		GTI	GRAVITY THICKENER INFLUENT	WW	WET WELL
		HSL	SODIUM HYPOCHLORITE SOLUTION		
		IR	INTERNAL RECYCLE		



PROPOSED CONCEPTUAL PROCESS FLOW DIAGRAM (CONT)

SCALE: N.T.S.

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REV	DESCRIPTION	DATE

DESIGNED BY: AH
DRAWN BY: DMB
CHECKED BY: MJB
227363-FIGURE_7-2.DWG

RECOMMENDED PLAN
PROPOSED/CONCEPTUAL
PROCESS FLOW DIAGRAM

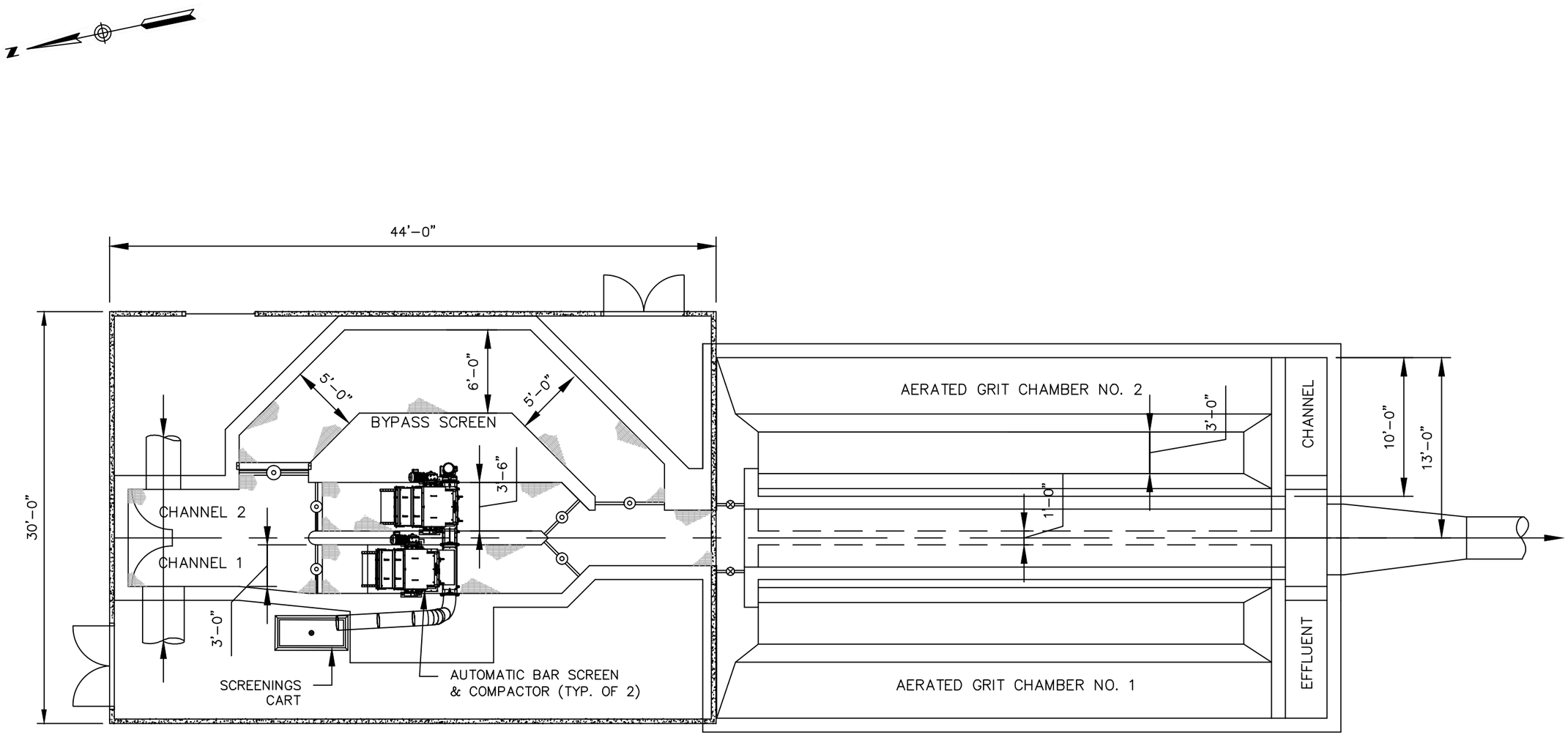
TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO.: 227363
DATE: JULY 2015
SCALE: NTS
SHEET: 2 OF 2

FIG 7.2B

\\woodardcurran.net\shared\Projects\227363 Town of Enfield CT-Wastewater Facilities Plan\wip\Drawings\Process\227363-Figure_7-2.dwg, Jul 15, 2015 - 12:59pm



PROPOSED HEADWORKS BUILDING
CONCEPTUAL LAYOUT
PLAN VIEW

SCALE: 1/8" = 1'–0"

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PROPOSED HEADWORKS BUILDING
CONCEPTUAL LAYOUT

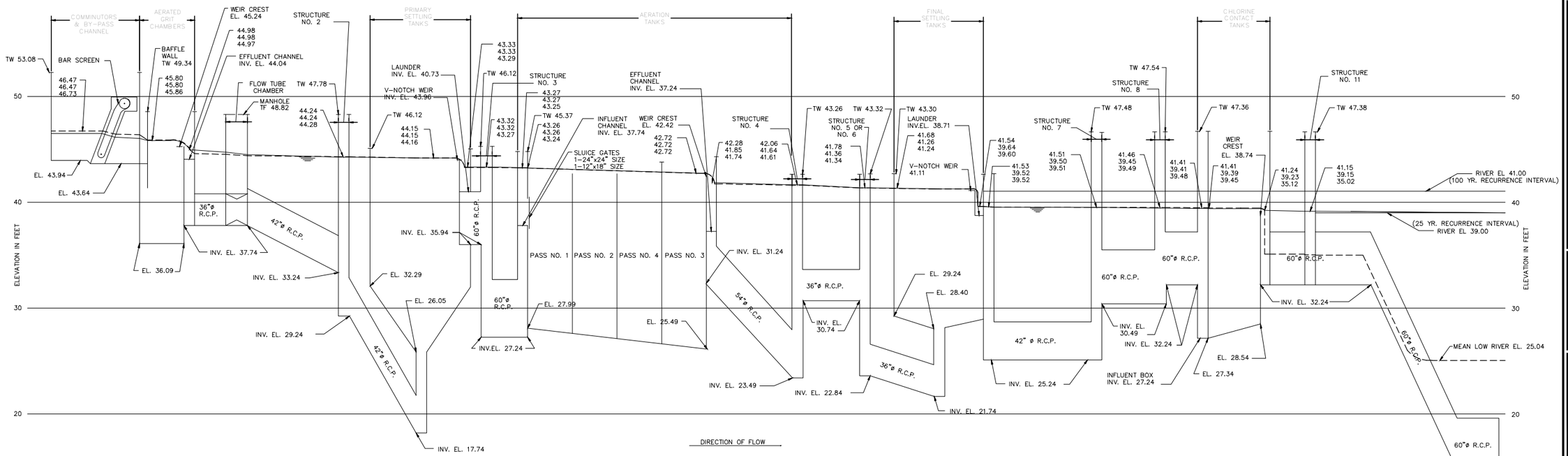
DESIGNED BY: AH/CCK
DRAWN BY: CCK
CHECKED BY: MJB
2015.05.01 HEADWORKS.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO: 227363
DATE: JULY 2015
SCALE: 1/8" = 1'–0"

FIG 7.3



HYDRAULIC PROFILE

SCALE: HOR. NO SCALE
VER. 1" = 5'

BASIS OF HYDRAULIC PROFILES

FLOW DESCRIPTION	SEWAGE FLOW	*PERCENT RETURN SLUDGE	RETURN SLUDGE FLOW	NUMBER OF TANKS IN SERVICE
FUTURE PEAK HOURLY	17 MGD	100	10 MGD	2 CHLORINE CONTACT TANKS 4 FINAL SETTLING TANKS 4 AERATION TANKS 2 PRIMARY SETTLING TANKS 2 AERATED GRIT CHAMBERS 2 SCREENS/COMMINUTORS
DESIGN AVERAGE	10 MGD	100	10 MGD	1 CHLORINE CONTACT TANK 3 FINAL SETTLING TANKS 3 AERATION TANKS 1 PRIMARY SETTLING TANK 1 AERATED GRIT CHAMBER 1 SCREEN/COMMINUTOR

* BASED ON DESIGN AVERAGE FLOW

ELEVATION LEGEND

46.11 — WATER SURFACE ELEVATION AT FUTURE PEAK HOURLY FLOW, 100-YR RIVER LEVEL

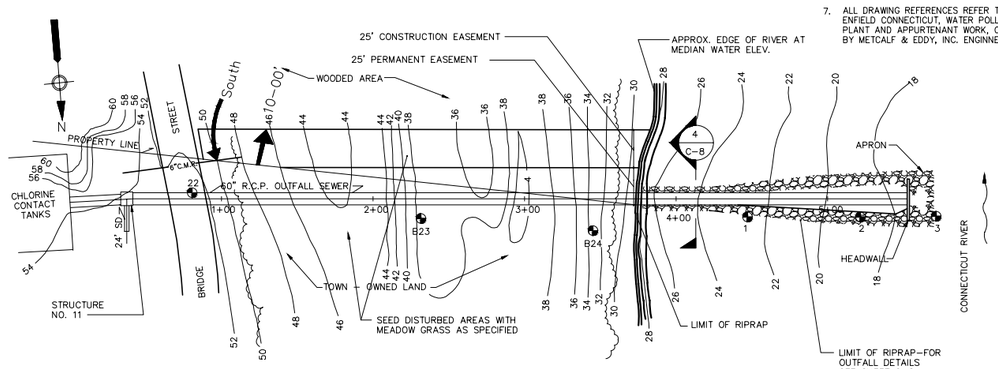
45.10 — WATER SURFACE ELEVATION AT FUTURE PEAK HOURLY FLOW, 25-YR RIVER LEVEL

44.99 — WATER SURFACE ELEVATION AT DESIGN AVERAGE FLOW, MEAN RIVER LEVEL

TW — TOP OF EXTERIOR WALL

NOTES:

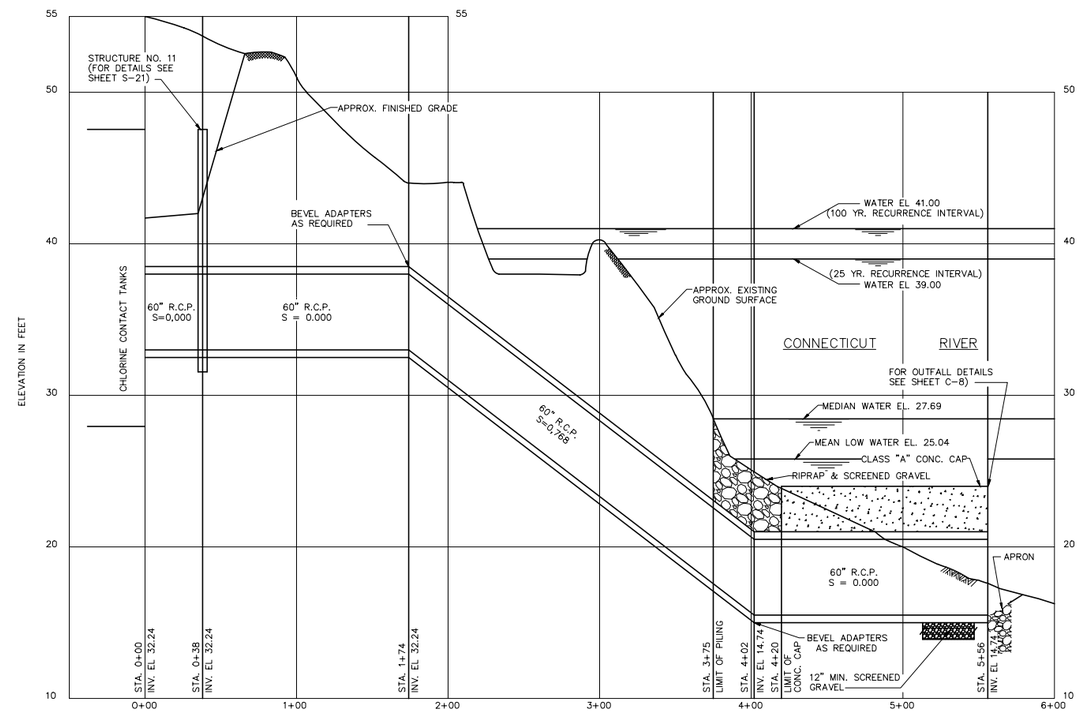
1. ADDITIONAL FLOW RESULTING FROM THE PLANTS WASTEWATER SYSTEM, PROCESS WATER AND RECYCLED FLOWS OTHER THAN RETURN SLUDGE FLOWS HAVE BEEN INTENTIONALLY NEGLECTED.
2. THE HYDRAULIC PROFILE FOR 17 MGD IS BASED ON CONNECTICUT RIVER ELEVATIONS OF 39.0 AND 41.0 FEET, WHICH HAVE 25 AND 100 YEAR RECURRENCE INTERVALS, AND INCLUDES STORMWATER DISCHARGE INTO STRUCTURE NO. 11.
3. ELEVATIONS INDICATED REFER TO USGS MEAN SEA LEVEL DATUM, NAVD88, UNLESS NOTED OTHERWISE.
4. ORIGINAL PIPE INVERT ELEVATIONS AND MEAN/MEDIAN SURFACE WATER ELEVATIONS WERE CONVERTED FROM NGVD29 TO NAVD88 WITH A -0.76' CORRECTION. ALL ABOVE GRADE ELEVATIONS WERE RESURVEYED IN 2015 BY PEREIRA ENGINEERING, LLC.
5. FLOOD ELEVATIONS PROVIDED BY FEMA FLOOD INSURANCE STUDY NUMBER 09001CV003B, REVISED SEPTEMBER 16, 2011. PROCESS SURCHARGE ELEVATIONS ARE BASED ON CONNECTICUT RIVER SURFACE ELEVATIONS, HOWEVER, THE SURROUNDING LAND WILL BE FLOODED BY BEEMAN'S BROOK.
6. ACCORDING TO TR-16, 2011 EDITION, TREATMENT FACILITIES SHOULD PROVIDE UNINTERUPTED SERVICE UNDER 25-YR FLOOD CONDITIONS, AND SHOULD BE PROTECTED AGAINST DAMAGE UNDER 100-YR FLOOD CONDITIONS.
7. ALL DRAWING REFERENCES REFER TO "TOWN OF ENFIELD CONNECTICUT, WATER POLLUTION CONTROL PLANT AND APPURTENANT WORK, CONTRACT 1969-1" BY METCALF & EDDY, INC. ENGINNEERS.



OUTFALL PLAN

SCALE: 1" = 50'-0"

NOTE: STEEL SHEET PILING SHALL BE INSTALLED FROM STA. 3+75 TO THE END OF THE OUTFALL.
ALL CONTOURS SHOWN RELATIVE TO USGS MEAN SEA LEVEL DATUM NGVD29.



OUTFALL PROFILE

SCALE: HOR. 1" = 50'-0"
VER. 1" = 5'-0"

BAR SCALE
1" = 50'-0"
CHECK GRAPHIC SCALE BEFORE USING

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REV	DESCRIPTION	DATE
1		1
2		2
3		3
4		4
5		5
6		6
7		7

DESIGNED BY: CCK
DRAWN BY: CCK
CHECKED BY: MJB/PAD
2015.09.24_HYDRAULIC_PR.dwg

PROPOSED HYDRAULIC PROFILE

TOWN OF ENFIELD WPCF
ENFIELD, CT

WASTEWATER FACILITIES PLAN

JOB NO.: 227363
DATE: JULY 2015
SCALE: AS NOTED
SHEET: 1 OF 1

FIG 7.4

22x34 SHEET
1:1

\\wc\shared\Projects\227363 Town of Enfield CT-Wastewater Facilities Plan\wip\Drawings\Process\2015.09.24_Hydraulic_Profile-Proposed-Fig 7-4.dwg, Sep 25, 2015 - 4:53pm

Figure 7-6

Implementation Schedule - Facilities Improvements

Town of Enfield WPCF Facilities Planning Study

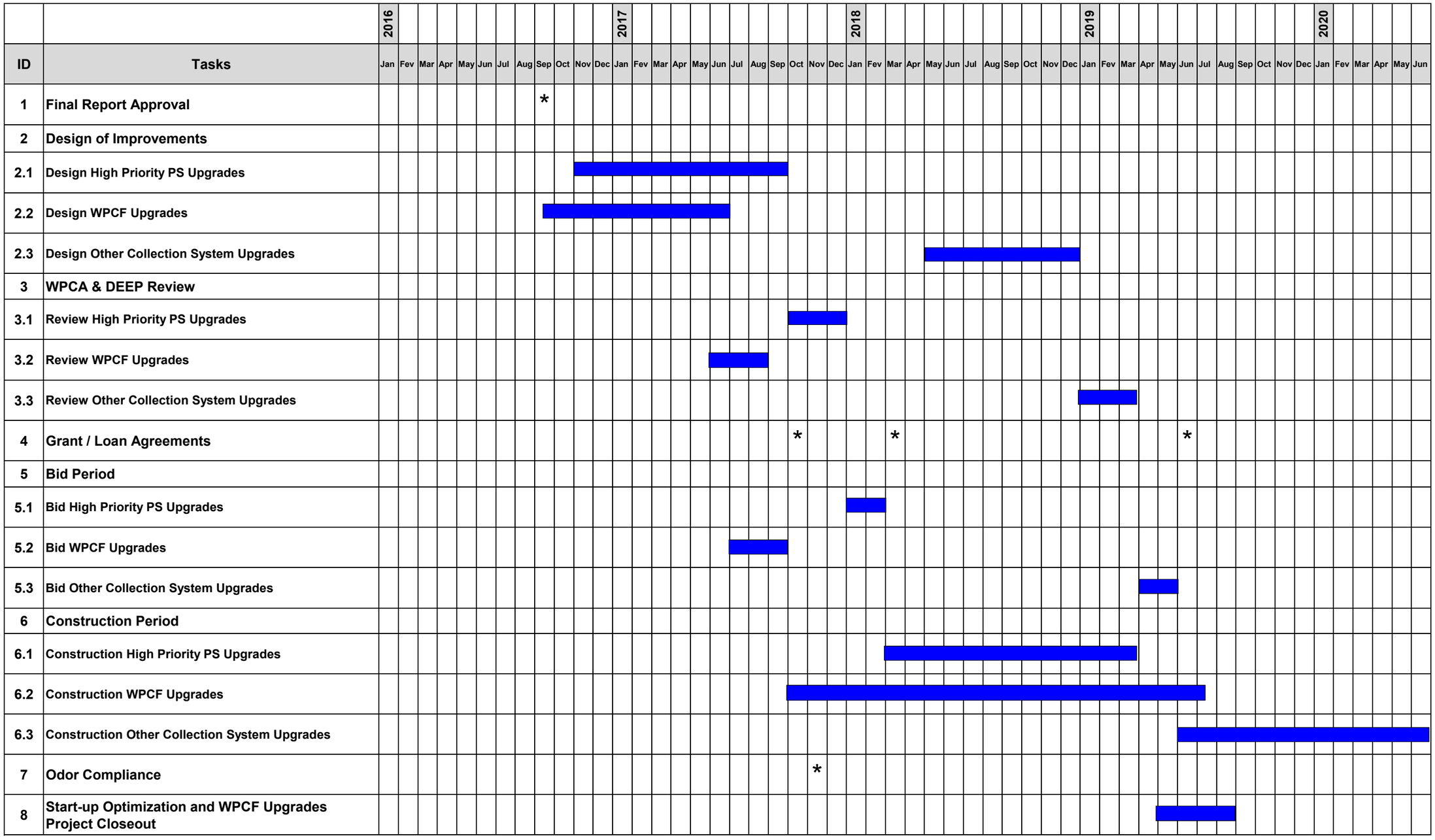
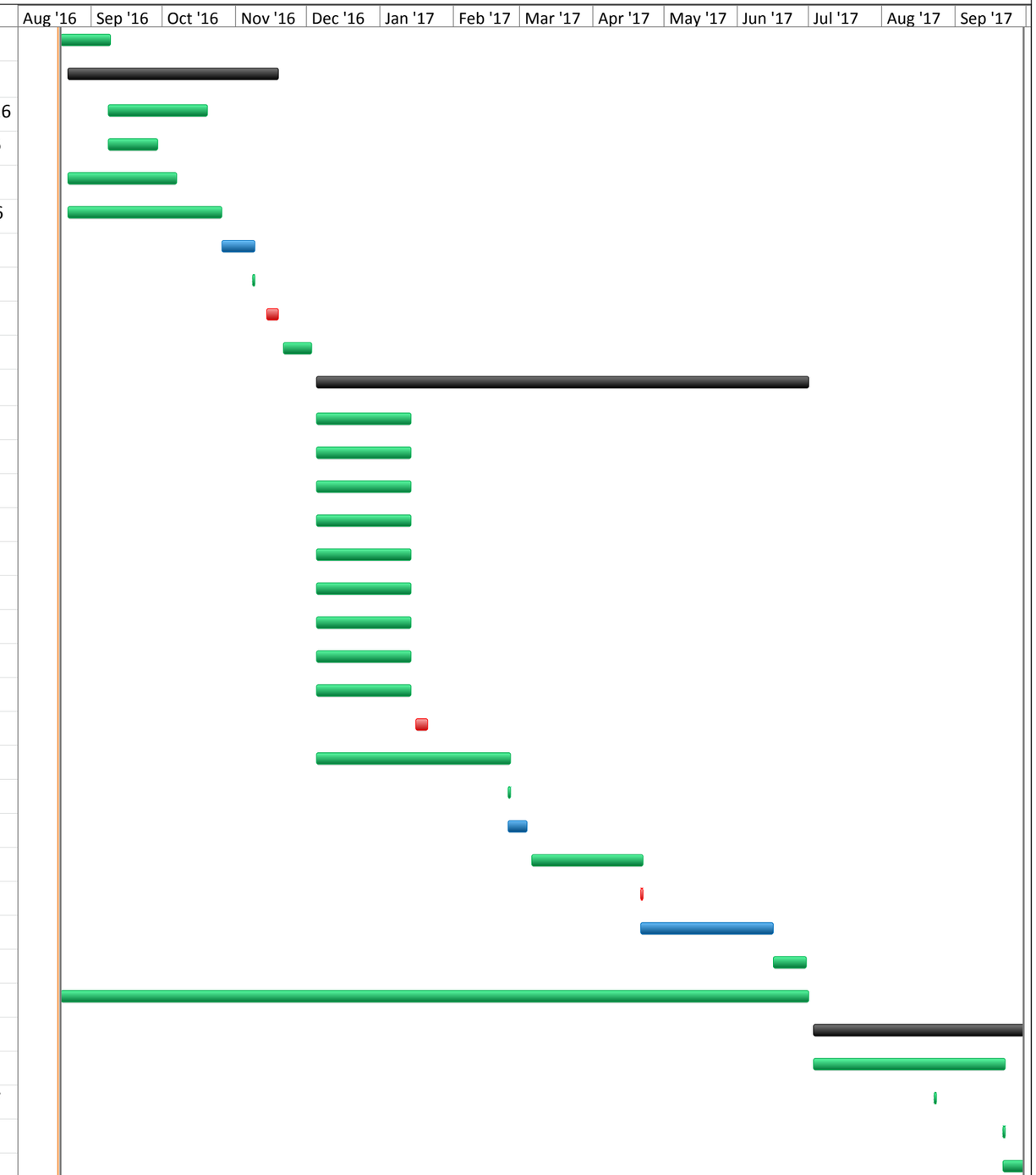


Figure 7-6A: Detailed Schedule for WPCF Design

Enfield WPCF Design

August 18, 2016

ID	Task	Task Name	Duration	Start	Finish
1		Finalize MBE/WBE Subcontracts	15 days	Fri 8/19/16	Thu 9/8/16
2	**1.0**	**Preliminary Design**	**65 days**	**Mon 8/22/16**	**Fri 11/18/16**
3	1.1	Subsurface Explorations	30 days	Thu 9/8/16	Wed 10/19/16
4	1.2	Begin Environmental Permitting	15 days	Thu 9/8/16	Wed 9/28/16
5	1.3	Site Visits with Operators	34 days	Mon 8/22/16	Thu 10/6/16
6	1.4	Draft Basis of Design Report	47 days	Mon 8/22/16	Tue 10/25/16
7		Town and DEEP Review	2 wks	Wed 10/26/16	Tue 11/8/16
8	1.5	Workshop with Town and DEEP	1 day	Tue 11/8/16	Tue 11/8/16
9	1.6	Value Engineering Study (30% complete)	1 wk	Mon 11/14/16	Fri 11/18/16
10	1.7	Finalize Basis of Design Report	2 wks	Mon 11/21/16	Fri 12/2/16
11	**2.0**	**Final Design**	**150 days**	**Mon 12/5/16**	**Fri 6/30/17**
12	2.1	Headworks Modifications	30 days	Mon 12/5/16	Fri 1/13/17
13	2.2	Primary Clarifiers	30 days	Mon 12/5/16	Fri 1/13/17
14	2.3	Activated Sludge	30 days	Mon 12/5/16	Fri 1/13/17
15	2.4	Secondary Clarifiers	30 days	Mon 12/5/16	Fri 1/13/17
16	2.5	Sludge Processing Equipment	30 days	Mon 12/5/16	Fri 1/13/17
17	2.6	Operations Building	30 days	Mon 12/5/16	Fri 1/13/17
18	2.7	SCADA System	30 days	Mon 12/5/16	Fri 1/13/17
19	2.8	Electrical System	30 days	Mon 12/5/16	Fri 1/13/17
20	2.9	HVAC and Plumbing Equipment	30 days	Mon 12/5/16	Fri 1/13/17
21	2.10	Value Engineering Study (60% complete)	1 wk	Mon 1/16/17	Fri 1/20/17
22	2.11	60% Cost Estimate	60 days	Mon 12/5/16	Fri 2/24/17
23	2.12	Submit 60% Design Documents to Town and WPCA	1 day	Fri 2/24/17	Fri 2/24/17
24		Town and DEEP Review	1.2 wks	Fri 2/24/17	Fri 3/3/17
25	2.13	Incorporate Comments and Develop 90% Design & Cost Estimate	7 wks	Mon 3/6/17	Fri 4/21/17
26	2.12	Submit 90% Design Documents to Town and WPCA	1 day	Fri 4/21/17	Fri 4/21/17
27		Town and DEEP Review	8 wks	Fri 4/21/17	Thu 6/15/17
28		Incorporate Comments & Finalize Bid Documents	2 wks	Fri 6/16/17	Thu 6/29/17
29	2.14	Public Education	226 days	Fri 8/19/16	Fri 6/30/17
30	**3.0**	**Bidding Phase Services**	**65 days**	**Mon 7/3/17**	**Fri 9/29/17**
31	3.1	Advertise Project for Bids	59 days	Mon 7/3/17	Thu 9/21/17
32	3.2	Prebid Meeting	1 day	Wed 8/23/17	Wed 8/23/17
33		Open Bids	1 day	Thu 9/21/17	Thu 9/21/17
34	3.2	Review Bids / Recommend Award	7 days	Thu 9/21/17	Fri 9/29/17



APPENDIX A: NPDES PERMIT

Connecticut Department of
ENERGY & ENVIRONMENTAL PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep Affirmative Action/Equal Opportunity Employer

MUNICIPAL NPDES PERMIT

Issued to

Permittee:
Town of Enfield
820 Enfield Street
Enfield, Connecticut 06022

Location Address:
Enfield POTW
90 Parsons Road
Enfield, Connecticut 06022

Facility ID: 049-001 **Permit ID:** CT- 0100200 **Permit Expires:** **November 25, 2018**

Receiving Stream: Connecticut River **Design Flow Rate:** 10.0 MGD

SECTION 1: GENERAL PROVISIONS

(A) This permit reissued in accordance with Section 22a-430 of Chapter 446k, Connecticut General Statutes ("CGS"), and Regulations of Connecticut State Agencies ("RCSA") adopted thereunder, as amended, and Section 402(b) of the Clean Water Act, as amended, 33 USC 1251, et. seq., and pursuant to an approval dated September 26, 1973, by the Administrator of the United States Environmental Protection Agency for the State of Connecticut to administer a N.P.D.E.S. permit program.

(B) The Town of Enfield, ("permittee"), shall comply with all conditions of this permit including the following sections of the RCSA which have been adopted pursuant to Section 22a-430 of the CGS and are hereby incorporated into this permit. **Your attention is especially drawn to the notification requirements of subsection (i)(2), (i)(3), (j)(1), (j)(6), (j)(8), (j)(9)(C), (j)(10)(C), (j)(11)(C), (D), (E), and (F), (k)(3) and (4) of Section 22a-430-3.** To the extent this permit imposes conditions more stringent than those found in the regulations, this permit shall apply.

Section 22a-430-3 General Conditions

- **(a)** Definitions
- **(b)** General
- **(c)** Inspection and Entry
- **(d)** Effect of a Permit
- **(e)** Duty to Comply
- **(f)** Proper Operation and Maintenance
- **(g)** Sludge Disposal
- **(h)** Duty to Mitigate
- **(i)** Facility Modifications; Notification
- **(j)** Monitoring, Records and Reporting Requirements
- **(k)** Bypass
- **(l)** Conditions Applicable to POTWs
- **(m)** Effluent Limitation Violations
- **(n)** Enforcement
- **(o)** Resource Conservation
- **(p)** Spill Prevention and Control
- **(q)** Instrumentation, Alarms, Flow Recorders
- **(r)** Equalization

Section 22a-430-4 Procedures and Criteria

- **(a)** Duty to Apply
- **(b)** Duty to Reapply
- **(c)** Application Requirements
- **(d)** Preliminary Review
- **(e)** Tentative Determination
- **(f)** Draft Permits, Fact Sheets

(g) Public Notice, Notice of Hearing
(h) Public Comments
(i) Final Determination
(j) Public Hearings
(k) Submission of Plans and Specifications. Approval.
(l) Establishing Effluent Limitations and Conditions
(m) Case-by-Case Determinations
(n) Permit Issuance or Renewal
(o) Permit or Application Transfer
(p) Permit Revocation, Denial or Modification
(q) Variances
(r) Secondary Treatment Requirements
(s) Treatment Requirements
(t) Discharges to POTWs - Prohibitions

(C) Violations of any of the terms, conditions, or limitations contained in this permit may subject the permittee to enforcement action including, but not limited to, seeking penalties, injunctions and/or forfeitures pursuant to applicable sections of the CGS and RCSA.

(D) Any false statement in any information submitted pursuant to this Section of the permit may be punishable as a criminal offense under Section 22a-438 or 22a-131a of the CGS or in accordance with Section 22a-6, under Section 53a-157b of the CGS.

(E) The permittee shall comply with Section 22a-416-1 through Section 22a-416-10 of the RCSA concerning operator certification.

(F) No provision of this permit and no action or inaction by the Commissioner shall be construed to constitute an assurance by the Commissioner that the actions taken by the permittee pursuant to this permit will result in compliance or prevent or abate pollution.

(G) Nothing in this permit shall relieve the permittee of other obligations under applicable federal, state and local law.

(H) An annual fee shall be paid for each year this permit is in effect as set forth in Section 22a-430-7 of the RCSA. As of October 1, 2009 the annual fee is $ 3005.00.

SECTION 2: DEFINITIONS

(A) The definitions of the terms used in this permit shall be the same as the definitions contained in Section 22a-423 of the CGS and Section 22a-430-3(a) and 22a-430-6 of the RCSA, except for "Composite" and "No Observable Acute Effect Level (NOAEL)" which are redefined below.

(B) In addition to the above, the following definitions shall apply to this permit:

"------" in the limits column on the monitoring tables in Attachment 1 means a limit is not specified but a value must be reported on the DMR, MOR, and/or the ATMR.

"Annual" in the context of any sampling frequency, shall mean the sample must be collected in the month of November.

"Average Monthly Limit" means the maximum allowable "Average Monthly Concentration" as defined in Section 22a-430-3(a) of the RCSA when expressed as a concentration (e.g. mg/l); otherwise, it means "Average Monthly Discharge Limitation" as defined in Section 22a-430-3(a) of the RCSA.

"Bi-Monthly" in the context of any sampling frequency, shall mean once every two months including the months of January, March, May, July, September and November.

"Bi-Weekly" in the context of any sampling frequency, shall mean once every two weeks.

"Composite" or **"(C)"** means a sample consisting of a minimum of eight aliquot samples collected at equal intervals of no less than 30 minutes and no more than 60 minutes and combined proportionally to flow over the sampling period provided that during the sampling period the peak hourly flow is experienced.

"Critical Test Concentration" or **"(CTC)"** means the specified effluent dilution at which the permittee is to conduct a single-concentration Aquatic Toxicity Test.

"Daily Composite" or **"(DC)"** means a composite sample taken over a full operating day consisting of grab samples collected at equal intervals of no more than sixty (60) minutes and combined proportionally to flow; or, a composite sample continuously collected over a full operating day proportionally to flow.

"Daily Concentration" means the concentration of a substance as measured in a daily composite sample, or, arithmetic average of all grab sample results defining a grab sample average.

"Daily Quantity" means the quantity of waste discharged during an operating day.

"Geometric Mean" is the "n"th root of the product of "n" observations.

"Infiltration" means water other than wastewater that enters a sewer system (including sewer system and foundation drains) from the ground through such means as defective pipes, pipe joints, connections, or manholes. Infiltration does not include, and is distinguished from, inflow.

"Inflow" means water other than wastewater that enters a sewer system (including sewer service connections) from sources such as, but not limited to, roof leaders, cellar drains, yard drains, area drains, drains from springs and swampy areas, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters, or drainage. Inflow does not include, and is distinguished from, infiltration.

"Instantaneous Limit" means the highest allowable concentration of a substance as measured by a grab sample, or the highest allowable measurement of a parameter as obtained through instantaneous monitoring.

"In-stream Waste Concentration" or **"(IWC)"** means the concentration of a discharge in the receiving water after mixing has occurred in the allocated zone of influence.

"MGD" means million gallons per day.

"Maximum Daily Limit" means the maximum allowable "Daily Concentration" (defined above) when expressed as a concentration (e.g. mg/l), otherwise, it means the maximum allowable "Daily Quantity" as defined above, unless it is expressed as a flow quantity. If expressed as a flow quantity it means "Maximum Daily Flow" as defined in Section 22a-430-3(a) of the RCSA.

"Monthly Minimum Removal Efficiency" means the minimum reduction in the pollutant parameter specified when the effluent average monthly concentration for that parameter is compared to the influent average monthly concentration.

"NA" as a Monitoring Table abbreviation means "not applicable".

"NR" as a Monitoring Table abbreviation means "not required".

"No Observable Acute Effect Level" or **"(NOAEL)"** means any concentration equal to or less than the critical test concentration in a single concentration (pass/fail) toxicity test, conducted pursuant to Section 22a-430-3(j)(7)(A)(i) of the RCSA, demonstrating 90% or greater survival of test organisms at the CTC.

"Quarterly" in the context of any sampling frequency, shall mean sampling is required in the months of February, May, August, and November.

"Range During Sampling" or **"(RDS)"** as a sample type means the maximum and minimum of all values recorded as a result of analyzing each grab sample of; 1) a Composite Sample, or, 2) a Grab Sample Average. For those permittees with pH meters that provide continuous monitoring and recording, Range During Sampling means the maximum and minimum readings recorded with the continuous monitoring device during the Composite or Grab Sample Average sample collection.

"Range During Month" or **"(RDM)"** as a sample type means the lowest and the highest values of all of the monitoring data for the reporting month.

"Sanitary Sewage" means wastewaters from residential, commercial and industrial sources introduced by direct connection to the sewerage collection system tributary to the treatment works including non-excessive inflow/infiltration sources.

"Twice per Month" in the context of any sampling frequency, mean two samples per calendar month collected no less than 12 days apart.

"ug/l" means micrograms per liter

"Work Day" in the context of a sampling frequency means, Monday through Friday excluding holidays.

SECTION 3: COMMISSIONER'S DECISION

(A) The Commissioner of Energy and Environmental Protection ("Commissioner") has issued a final decision and found continuance of the existing system to treat the discharge will protect the waters of the state from pollution. The Commissioner's decision is based on application #201100526 for permit reissuance received on January 27, 2011and the administrative record established in the processing of that application.

(B) The Commissioner hereby authorizes the Permittee to discharge in accordance with the provisions of this permit, the above referenced application, and all approvals issued by the Commissioner or his authorized agent for the discharges and/or activities authorized by, or associated with, this permit.

(C) The Commissioner reserves the right to make appropriate revisions to the permit, if required after Public Notice, in order to establish any appropriate effluent limitations, schedules of compliance, or other provisions which may be authorized under the Federal Clean Water Act or the CGS or regulations adopted thereunder, as amended. The permit as modified or renewed under this paragraph may also contain any other requirements of the Federal Clean Water Act or CGS or regulations adopted thereunder which are then applicable.

SECTION 4: GENERAL LIMITATIONS AND OTHER CONDITIONS

(A) The Permittee shall not accept any new sources of non-domestic wastewater conveyed to its POTW through its sanitary sewerage system or by any means other than its sanitary sewage system unless the generator of such wastewater; (a) is authorized by a permit issued by the Commissioner under Section 22a-430 CGS (individual permit), or, (b) is authorized under Section 22a-430b (general permit), or, (c) has been issued an emergency or temporary authorization by the Commissioner under Section 22a-6k. All such non-domestic wastewaters shall be processed by the POTW via receiving facilities at a location and in a manner prescribed by the permittee which are designed to contain and control any unplanned releases.

(B) No new discharge of domestic sewage from a single source to the POTW in excess of 50,000 gallons per day shall be allowed by the permittee until the Municipal Facilities Section has been notified in writing by the permittee of said new discharge.

(C) The permittee shall maintain a system of user charges based on actual use sufficient to operate and maintain the POTW (including the collection system) and replace critical components.

(D) The permittee shall maintain a sewer use ordinance that is consistent with the Model Sewer Ordinance for Connecticut Municipalities prepared by the Department of Energy and Environmental Protection. The Commissioner of Energy and Environmental Protection alone may authorize certain discharges which may not conform to the Model Sewer Ordinance.

(E) No discharge shall contain or cause in the receiving stream a visible oil sheen, floating solids, visible discoloration, or foaming.

(F) No discharge shall cause acute or chronic toxicity in the receiving water body beyond any Zone Of Influence (ZOI) specifically allocated to that discharge in this permit.

(G) The permittee shall maintain an alternate power source adequate to provide full operation of all pump stations in the sewerage collection system and to provide a minimum of primary treatment and disinfection at the water pollution control facility to insure that no discharge of untreated wastewater will occur during a failure of a primary power source.

(H) The average monthly effluent concentration shall not exceed 15% of the average monthly influent concentration for BOD_5 and Total Suspended Solids for all daily composite samples taken in any calendar month.

(I) Any new or increased amount of sanitary sewage discharge to the sewer system is prohibited where it will cause a dry weather overflow or exacerbate an existing dry weather overflow.

(J) Sludge Conditions

(1) The permittee shall comply with all existing federal and state laws and regulations that apply to sewage sludge use and disposal practices, including but not limited to 40 CFR Part 503.

(2) If an applicable management practice or numerical limitation for pollutants in sewage sludge more stringent than existing federal and state regulations is promulgated under Section 405(d) of the Clean Water Act (CWA), this permit shall be modified or revoked and reissued to conform to the promulgated regulations.

(3) The permittee shall give prior notice to the Commissioner of any change(s) planned in the permittees' sludge use or disposal practice. A change in the permittees' sludge use or disposal practice may be a cause for modification of the permit.

(4) Testing for inorganic pollutants shall follow "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 as updated and/or revised.

(K) This permit becomes effective on the 1st day of the month following the date of signature.

(L) When the arithmetic mean of the average daily flow from the POTW for the previous 180 days exceeds 90% of the design flow rate, the permittee shall develop and submit within one year, for the review and approval of the Commissioner, a plan to accommodate future increases in flow to the plant. This plan shall include a schedule for completing any recommended improvements and a plan for financing the improvements.

(M) When the arithmetic mean of the average daily BOD_5 or TSS loading into the POTW for the previous 180 days exceeds 90% of the design load rate, the permittee shall develop and submit for the review of the Commissioner within one year, a plan to accommodate future increases in load to the plant. This plan shall include a schedule for completing any recommended improvements and a plan for financing the improvements.

(N) On or before July 31st of each calendar year the main flow meter shall be calibrated by an independent contractor in accordance with the manufacturer's specifications. The actual record of the calibration shall be retained onsite and, upon request, the permittee shall submit to the Commissioner a copy of that record.

(O) The permittee shall operate and maintain all processes as installed in accordance with the approved plans and specifications and as outlined in the associated operation and maintenance manual. This includes but is not limited to all preliminary treatment processes, primary treatment processes, recycle pumping processes, anaerobic treatment processes, anoxic treatment processes, aerobic treatment processes, flocculation processes, effluent filtration processes or any other processes necessary for the optimal removal of pollutants. The permittee shall not bypass or fail to operate any of the aforementioned processes without the written approval of the Commissioner

(P) The permittee is hereby authorized to accept septage at the treatment facility; or other locations as approved by the Commissioner.

(Q) The temperature of any discharge shall not increase the temperature of the receiving stream above 85°F, or, in any case, raise the normal temperature of the receiving stream more than 4°F.

SECTION 5: SPECIFIC EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

(A) The discharge(s) shall not exceed and shall otherwise conform to the specific terms and conditions listed in this permit. The discharge is restricted by, and shall be monitored in accordance with Tables A through G incorporated in this permit as Attachment 1.

(B) The Permittee shall monitor the performance of the treatment process in accordance with the Monthly Operating Report (MOR) incorporated in this permit as Attachment 2.

SECTION 6: SAMPLE COLLECTION, HANDLING and ANALYTICAL TECHNIQUES

(A) Chemical Analysis

(1) Chemical analyses to determine compliance with effluent limits and conditions established in this permit shall be performed using the methods approved pursuant to the Code of Federal Regulations, Part 136 of Title 40 (40 CFR 136) unless an alternative method has been approved in writing pursuant to 40 CFR 136.4 or as provided in Section 22a-430-3-(j)(7) of the RCSA. Chemicals which do not have methods of analysis defined in 40 CFR 136 or the RCSA shall be analyzed in accordance with methods specified in this permit.

(2) All metals analyses identified in this permit shall refer to analyses for Total Recoverable Metal, as defined in 40 CFR 136 unless otherwise specified.

(3) Grab samples shall be taken during the period of the day when the peak hourly flow is normally experienced.

(4) Samples collected for bacteriological examination shall be collected between the hours of 11 a.m. and 3 p.m. or at that time of day when the peak hourly flow is normally experienced. A chlorine residual sample must be taken at the same time and the results recorded.

(5) The Minimum Levels specified below represent the concentrations at which quantification must be achieved and verified during the chemical analyses for the parameters identified in Attachment 1, Tables A and C. Analyses for these parameters must include check standards within ten percent of the specified Minimum Level or calibration points equal to or less than the specified Minimum Level.

Parameter	Minimum Level
Arsenic, Total	0.005 mg/l
Cadmium, Total	0.0005 mg/l
Thallium, Total	0.005 mg/l
Mercury, Total	0.0002 mg/l

(6) The value of each parameter for which monitoring is required under this permit shall be reported to the maximum level of accuracy and precision possible consistent with the requirements of this Section of the permit.

(7) Effluent analyses for which quantification was verified during the analysis at or below the minimum levels specified in this Section and which indicate that a parameter was not detected shall be reported as "less than x" where 'x' is the numerical value equivalent to the analytical method detection limit for that analysis.

(8) Results of effluent analyses which indicate that a parameter was not present at a concentration greater than or equal to the Minimum Level specified for that analysis shall be considered equivalent to zero (0.0) for purposes of determining compliance with effluent limitations or conditions specified in this permit.

(B) Acute Aquatic Toxicity Test

(1) Samples for monitoring of Acute Aquatic Toxicity shall be collected and handled as prescribed in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA-821-R-02-012).

(a) Composite samples shall be chilled as they are collected. Grab samples shall be chilled immediately following collection. Samples shall be held at 0 - 6°C until Acute Aquatic Toxicity testing is initiated.

(b) Effluent samples shall not be dechlorinated, filtered, or, modified in any way, prior to testing for Aquatic Toxicity unless specifically approved in writing by the Commissioner for monitoring at this facility. Facilities with effluent dechlorination and/or filtration designed as part of the treatment process are not required to obtain approval from the Commissioner.

(c) Samples shall be taken prior to chlorination for Acute Aquatic Toxicity unless otherwise approved in writing by the Commissioner for monitoring at this facility.

(d) Chemical analyses of the parameters identified in Attachment 1, Table C shall be conducted on an aliquot of the same sample tested for Acute Aquatic Toxicity.

(i) At a minimum, pH, specific conductance, total alkalinity, total hardness, and total residual chlorine shall be measured in the effluent sample and, during Acute Aquatic Toxicity tests, in the highest concentration of the test and in the dilution (control) water at the beginning of the test and at test termination. If total residual chlorine is not detected at test initiation, it does not need to be measured at test termination. Dissolved oxygen, pH, and temperature shall be measured in the control and all test concentrations at the beginning of the test, daily thereafter, and at test termination.

(e) Tests for Acute Aquatic Toxicity shall be initiated within 36 hours of sample collection.

(2) Monitoring for Acute Aquatic Toxicity to determine compliance with the permit limit on Acute Aquatic Toxicity (invertebrate) shall be conducted for 48 hours utilizing neonatal (less than 24 hours old) *Daphnia pulex*.

(3) Monitoring for Acute Aquatic Toxicity to determine compliance with the permit limit on Acute Aquatic Toxicity (vertebrate) shall be conducted for 48 hours utilizing larval (1 to 14-day old with no more than 24 hours range in age) *Pimephales promelas*.

(4) Tests for Acute Aquatic Toxicity shall be conducted as prescribed for static non-renewal acute tests in "Methods for measuring the Acute Aquatic Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA/821-R-02-012), except as specified below.

(a) For Acute Aquatic Toxicity limits, and for monitoring only conditions, expressed as a NOAEL value, Pass/Fail (single concentration) tests shall be conducted at a specified Critical Test Concentration (CTC) equal to the Aquatic Toxicity limit, (100% in the case of monitoring only conditions), as prescribed in Section 22a-430-3(j)(7)(A)(i) of the RCSA.

(b) Organisms shall not be fed during the tests.

(c) Synthetic freshwater prepared with deionized water adjusted to a hardness of 50±5 mg/L as $CaCO_3$ shall be used as dilution water in the tests.

(d) Copper nitrate shall be used as the reference toxicant.

(5) For monitoring only conditions, toxicity shall be demonstrated when the results of a valid pass/fail Acute Aquatic Toxicity indicates less than 90% survival in the effluent at the CTC (100%).

SECTION 7: RECORDING AND REPORTING REQUIREMENTS

(A) The results of chemical analyses and any aquatic toxicity test required above in Section 5 and the referenced Attachment 1 shall be entered on the Discharge Monitoring Report (DMR) and reported to the Bureau of Water Protection and Land Reuse. The report shall also include a detailed explanation of any violations of the limitations specified. The DMR must be received at the following address by the 15th day of the month following the month in which samples are collected.

ATTN: Municipal Wastewater Monitoring Coordinator
Connecticut Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse, Planning and Standards Division
79 Elm Street
Hartford, Connecticut 06106-5127

(1) For composite samples, from other than automatic samplers, the instantaneous flow and the time of each aliquot sample collection shall be recorded and maintained at the POTW.

(B) Complete and accurate test data, including percent survival of test organisms in each replicate test chamber, LC_{50} values and 95% confidence intervals for definitive test protocols, and all supporting chemical/physical measurements performed in association with any aquatic toxicity test, shall be entered on the Aquatic Toxicity Monitoring Report form (ATMR) and sent to the Bureau of Water Protection and Land Reuse at the address specified above in Section 7 (A) of this permit by the 15th day of the month following the month in which samples are collected.

(C) The results of the process monitoring required above in Section 5 shall be entered on the Monthly Operating Report (MOR) form, included herein as Attachment 2, and reported to the Bureau of Water Protection and Land Reuse. The MOR report shall also be accompanied by a detailed explanation of any violations of the limitations specified. The MOR, must be received at the address specified above in Section 7 (A) of this permit by the 15th day of the month following the month in which the data and samples are collected.

(E) NetDMR Reporting Requirements

(1) Unless otherwise approved in writing by the Commissioner, no later than one-hundred and twenty (120) days after the issuance of this permit, the Permittee shall begin reporting to the Department electronically using NetDMR, a web-based tool that allows Permittees to electronically submit discharge monitoring reports (DMRs) and other required reports through a secure internet connection. Specific requirements regarding subscription to NetDMR and submittal of data and reports in hard copy form and for submittal using NetDMR are described below:

(a) NetDMR Subscriber Agreement

On or before fifteen (15) days after the issuance of this permit, the Permittee and/or the person authorized to sign the Permittee's discharge monitoring reports ("Signatory Authority") as described in RCSA Section 22a-430-3(b)(2) shall contact the Department and initiate the subscription process for electronic submission of Discharge Monitoring Report (DMR) information. On or before ninety (90) days after issuance of this permit the Permittee shall submit a signed and notarized copy of the *Connecticut DEP NetDMR Subscriber Agreement* to the Department.

(b) Submittal of Reports Using NetDMR

Unless otherwise approved by the Commissioner, on or before one-hundred and twenty (120) days after issuance of this permit, the Permittee and/or the Signatory Authority shall electronically submit DMRs and reports required under this permit to the Department using NetDMR in satisfaction of the DMR submission requirement of this permit. DMRs shall be submitted electronically to the Department no later than the 15th day of the month following the completed reporting period.

(c) Submittal of NetDMR Opt-Out Requests

If the Permittee is able to demonstrate a reasonable basis, such as technical or administrative infeasibility, that precludes the use of NetDMR for electronically submitting DMRs and reports, the Commissioner may approve the submission of DMRs and other required reports in hard copy form ("opt-out request"). Opt-out requests must be submitted in writing to the Department for written approval on or before fifteen (15) days prior to the date a Permittee would be required under this permit to begin filing DMRs and other reports using NetDMR. This demonstration shall be valid for twelve (12) months from the date of the Department's approval and shall thereupon expire. At such time, DMRs and reports shall be submitted electronically to the Department using NetDMR unless the Permittee submits a renewed opt-out request and such request is approved by the Department.

All opt-out requests and requests for the NetDMR subscriber form should be sent to the following address:

Attn: NetDMR Coordinator
Connecticut Department of Energy and Environmental Protection
Water Permitting and Enforcement Division – 2nd Floor
79 Elm Street
Hartford, CT 06106-5127

SECTION 8: RECORDING AND REPORTING OF VIOLATIONS, ADDITIONAL TESTING REQUIREMENTS, BYPASSES, MECHANICAL FAILURES, AND MONITORING EQUIPMENT FAILURES

(A) If any Acute Aquatic Toxicity sample analysis indicates that an Aquatic toxicity effluent limitation has been exceeded, or that the test was invalid, an additional sample of the effluent shall be collected and tested for Acute Aquatic Toxicity and associated chemical parameters, as described above in Section 5 and Section 6, and the results reported to the Bureau of Water Protection and Land Reuse (Attn: Aquatic Toxicity) via the ATMR form (see Section 7 (B)) within 30 days of the previous test. These test results shall also be reported on the next month's DMR report pursuant to Section 7 (A). The results of all toxicity tests and associated chemical parameters, valid and invalid, shall be reported.

(B) If any two consecutive Acute Aquatic Toxicity test results or any three Acute Aquatic Toxicity test results in a twelve month period indicates toxicity, the permittee shall immediately take all reasonable steps to eliminate toxicity wherever possible and shall submit a report, to the Bureau of Water Protection and Land Reuse (Attn: Aquatic Toxicity), for the review and written approval of the Commissioner in accordance with Section 22a-430-3(j)(10)(c) of the RCSA describing proposed steps to eliminate the toxic impact of the discharge on the receiving water body. Such a report shall include a proposed time schedule to accomplish toxicity reduction and the permittee shall comply with any schedule approved by the Commissioner.

(C) Section 22a-430-3(k) of the RCSA shall apply in all instances of bypass including a bypass of the treatment plant or a component of the sewage collection system planned during required maintenance. The Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division, Municipal Facilities Section (860) 424-3704, the Department of Public Health, Water Supply Section (860) 509-7333 and Recreation Section (860) 509-7297, and the local Director of Health shall be notified within 2 hours of the permittee learning of the event by telephone during normal business hours. If the discharge or bypass occurs outside normal working hours (8:30 a.m. to 4:30 p.m. Monday through Friday), notification shall be made within 2 hours of the permittee learning of the event to the Emergency Response Unit at (860) 424-3338 and the Department of Public Health at (860) 509-8000. A written report shall be submitted to the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division, Municipal Facilities Section within five days of the

permittee learning of each occurrence, or potential occurrence, of a discharge or bypass of untreated or partially treated sewage.

The written report shall contain:

(i) The nature and cause of the bypass, permit violation, treatment component failure, and/or equipment failure,

(ii) The time the incident occurred and the anticipated time which it is expected to continue or, if the condition has been corrected, the duration,

(iii) the estimated volume of the bypass or discharge of partially treated or raw sewage,

(iv) the steps being taken to reduce or minimize the effect on the receiving waters, and

(v) the steps that will be taken to prevent reoccurrence of the condition in the future.

(D) Section 22a-430-3(j) 11 (D) of the RCSA shall apply in the event of any noncompliance with a maximum daily limit and/or any noncompliance that is greater than two times any permit limit. The permittee shall notify in the same manner as in paragraph C of this Section, the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse Planning and Standards Division, Municipal Facilities Section except, if the noncompliance occurs outside normal working hours (8:30 a.m. to 4:30 p.m. Monday through Friday) the permittee may wait to make the verbal report until 10:30 am of the next business day after learning of the noncompliance.

(E) Section 22a-430-3(j) 8 of the RCSA shall apply in all instances of monitoring equipment failures that prevent meeting the requirements in this permit. In the event of any such failure of the monitoring equipment including, but not limited to, loss of refrigeration for an auto-sampler or lab refrigerator or loss of flow proportion sampling ability, the permittee shall notify in the same manner as in paragraph C of this Section, the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division, Municipal Facilities Section except, if the failure occurs outside normal working hours (8:30 a.m. to 4:30 p.m. Monday through Friday) the permittee may wait to make the verbal report until 10:30 am of the next business day after learning of the failure.

(F) In addition to the reporting requirements contained in Section 22a-430-3(i), (j), and (k) of the Regulations of Connecticut State Agencies, the permittee shall notify in the same manner as in paragraph C of this Section, the Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division, Municipal Facilities Section concerning the failure of any major component of the treatment facilities which the permittee may have reason to believe would result in an effluent violation.

SECTION 9: COMPLIANCE SCHEDULES

(A) The permittee shall achieve the final water quality-based effluent limits for **Escherichia Coli** for DSN 001-1 established in Section 5 of this permit, in accordance with the following:

(i) On or before 365 days after the date of issuance of this permit, the permittee shall submit for the Commissioner's review and written approval a comprehensive and thorough report which describes the actions to be taken by the permittee to achieve compliance with the requirements in Table A of this permit for **Escherichia coli**. Such report shall include a schedule for implementation of such actions not to exceed **730 days** after the date of issuance of this permit.

(ii) In accordance with the schedule approved in writing by the Commissioner, but in no event later than **730 days** after the date of issuance of this permit, the permittee shall perform the actions approved in writing by the Commissioner necessary to comply with the requirements in Table A of this permit for **Escherichia coli**. Within fifteen days after completing such actions, the permittee shall certify to the Commissioner in writing that the actions have been completed as approved by the Commissioner.

(B) The Commissioner issued Notice of Violation NOV/WR/WU # 10-006 on September 16, 2010, requiring the permittee to correct outstanding issues associated with the Odor Control System and ancillary equipment associated therewith. The permittee has not implemented a permanent corrective action to this outstanding issue. Accordingly, the permittee shall implement a corrective action in accordance with the following:

(i) On or before **60 days** after the date of issuance of this permit, the permittee shall submit to the Commissioner a written report which thoroughly describes the interim corrective measures implemented to control objectionable odors.

(ii) On or before **550 days** after the date of issuance of this permit, the permittee shall submit for the Commissioner's review and written approval a comprehensive and thorough engineering report which describes corrective actions aimed at restoring the full operational capability of the existing odor control system and/or provide an alternate long term corrective measure aimed at controlling objectionable odors and Hydrogen Sulfide gas. This report shall include in detail the most expeditious schedule for implementation of recommended corrective actions.

(iii) The permittee shall submit to the person identified in 9(H) below, semiannual status reports beginning 180 days after the date of approval by the Commissioner of the report referenced in B(ii) above. Status reports shall include, but not be limited to, a detailed description of actions and progress made by the permittee in performing the actions required by this section of the permit and in accordance with the approved project schedule. Status reports shall include information such as the development of plans and specifications, contract bidding status, project funding status, preparation and submittal of permit applications, and the status of any other actions specified in the report and approved by the commissioner pursuant to B(ii) above.

(iv) In accordance with the schedule approved in writing by the Commissioner, but in no event later than **1460 days** after the date of issuance of this permit, the permittee shall perform the actions approved in writing by the Commissioner necessary to comply with the corrective actions recommended pursuant to B(ii) above. Within fifteen days after completing such actions, the permittee shall certify to the Commissioner in writing that the actions have been completed as approved by the Commissioner.

(C) The permittee shall perform the approved actions in accordance with the approved schedule(s), but in no event shall the approved actions be completed later than: 730 days after the date of issuance of this permit for compliance with the new bacteria limits, and 1460 days after the date of issuance of this permit for the implementation of corrective measures pursuant to the requirements described in paragraph 9(B) above. Within fifteen days after completing such actions, the permittee shall certify to the Commissioner in writing that the actions have been completed as approved.

(D) The permittee shall use best efforts to submit to the Commissioner all documents required by this Section of the permit in a complete and approvable form. If the Commissioner notified the permittee that any document or other action is deficient, and does not approve it with conditions or modifications, it is deemed disapproved, and the permittee shall correct the deficiencies and resubmit it within the time specified by the Commissioner or, if no time is specified by the Commissioner, within thirty days of the Commissioner's notice of deficiencies. In approving any document or other action under this Compliance Schedule, the Commissioner may approve the document or other action as submitted or performed or with such conditions or modifications as the Commissioner deems necessary to carry out the purposes of this Section of the permit. Nothing in this paragraph shall excuse noncompliance or delay.

(E) Dates. The date of submission to the Commissioner of any document required by this section of the permit shall be the date such document is received by the Commissioner. The date of any notice by the Commissioner under this section of the permit, including but not limited to notice of approval or disapproval of any document or other action, shall be the date such notice is personally delivered or the date three days after it is mailed by the Commissioner, whichever is earlier. Except as otherwise specified in this permit, the word "day" as used in this Section of the permit means calendar day. Any document or action which is required by this Section only of the permit, to be submitted, or performed, by a date which falls on, Saturday, Sunday, or, a Connecticut or federal holiday, shall be submitted or performed on or before the next day which is not a Saturday, Sunday, or Connecticut or federal holiday.

(F) Notification of noncompliance. In the event that the permittee becomes aware that it did not or may not comply, or did not or may not comply on time, with any requirement of this Section of the permit or of any document required hereunder, the permittee shall immediately notify the Commissioner and shall take all reasonable steps to ensure that any noncompliance or delay is avoided or, if unavoidable, is minimized to the greatest extent possible. In so notifying the Commissioner, the permittee shall state in writing the reasons for the noncompliance or delay and propose, for the review and written approval of the Commissioner, dates by which compliance will be achieved, and the permittee shall comply with any dates which may be approved in writing by the Commissioner. Notification by the permittee shall not excuse noncompliance or delay, and the Commissioner's approval of any compliance dates proposed shall not excuse noncompliance or delay unless specifically so stated by the Commissioner in writing.

(G) Notice to Commissioner of changes. Within fifteen days of the date the permittee becomes aware of a change in any information submitted to the Commissioner under this Section of the permit, or that any such information was inaccurate or misleading or that any relevant information was omitted, the permittee shall submit the correct or omitted information to the Commissioner.

(H) Submission of documents. Any document, other than a DMR, ATMR or MOR required to be submitted to the Commissioner under this Section of the permit shall, unless otherwise specified in writing by the Commissioner, be directed to:

Carlos Esguerra, Sanitary Engineer II
Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse, Planning and Standards Division
Municipal Facilities Section
79 Elm Street
Hartford, Connecticut 06106-5127

This permit is hereby issued on: November 24, 2013

Betsey Wingfield
Bureau Chief
Bureau of Water Protection and Land Reuse

ATTACHMENT 1

Tables A through G

TABLE A

Discharge Serial Number (DSN): **001-1**	Monitoring Location: **1**
Wastewater Description: **Sanitary Sewage**	
Monitoring Location Description: **Final Effluent**	
Allocated Zone of Influence (ZOI): **1540 cfs**	In-stream Waste Concentration (IWC): **1 %**

PARAMETER	Units	FLOW/TIME BASED MONITORING				INSTANTANEOUS MONITORING			REPORT FORM	Minimum Level Analysis See Section 6
		Average Monthly Limit	Maximum Daily Limit	Sample Freq.	Sample type	Instantaneous Limit or Required Range	Sample Freq.	Sample Type		
Alkalinity	mg/l	NA	NA	NR	NA	------	Monthly	Grab	MOR	
Biochemical Oxygen Demand (5 day). See remark E	mg/l	30	50	3/Week	Daily Composite	NA	NR	NA	DMR/MOR	
Chlorine, Total Residual. May 1st through September 30th. See remark A below.	mg/l	NA	NA	NR	NA	0.2 - 1.5	4/ Work Day	Grab	DMR/MOR	
Fecal coliform [2] May 1st through September 30th	Colonies per100 ml	NA	NA	NR	NA	See remarks (B) and (C) below	3/Week	Grab	DMR/MOR	
Escherichia coli [3] May 1st through September 30th. See remark (D) below.	Colonies per100 ml	NA	NA	NR	NA	410	3/Week	Grab	DMR/MOR	
Flow (Average Daily)	MGD	------	------	Continuous [1]	Daily Flow	NA	NR	NA	DMR/MOR	
Nitrogen, Ammonia (total as N)	mg/l	NA	------	Monthly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Nitrate (total as N)	mg/l	NA	------	Monthly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Nitrite (total as N)	mg/l	NA	------	Monthly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Total Kjeldahl	mg/l	NA	------	Monthly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Total	mg/l	NA	------	Monthly	Daily Composite	NA	NR	NA	MOR	
Nitrogen, Total	lbs/day	NA	------	Monthly	Daily Composite	NA	NR	NA	MOR	
Oxygen, Dissolved	mg/l	NA	NA	NR	NA	------	Work Day	Grab	MOR	
pH	S.U.	NA	NA	NR	NA	6 - 9	Work Day	Grab	DMR/MOR	
Phosphate, Ortho	mg/l	NA	------	Monthly	Daily Composite	NA	NR	NA	MOR	
Phosphorus, Total	mg/l	NA	------	Monthly	Daily Composite	NA	NR	NA	DMR/MOR	
Solids, Settleable	ml/l	NA	NA	NR	NA	------	Work Day	Grab	MOR	
Solids, Total Suspended. See remark E.	mg/l	30	50	3/Week	Daily Composite	NA	NA	NA	DMR/MOR	
Temperature	°F	NA	NA	NR	NA	------	Work Day	Grab	MOR	

Turbidity	NTU	NA	NA	NR	NA	------	Work Day	Grab	MOR	

Table A - CONDITIONS

Footnotes:

[1] The permittee shall record and report on the monthly operating report the minimum, maximum and total flow for each day of discharge and the average daily flow for each sampling month. The permittee shall report, on the discharge monitoring report, the average daily flow and maximum daily flow for each sampling month

[2] During the period beginning at the date of issuance of this permit and lasting until the implementation of Escherichia coli monitoring at the Water Pollution Control Facility, the discharge shall not exceed and shall otherwise conform to specific terms and conditions listed.

[3] During the period beginning after the implementation of Escherichia coli monitoring, but no later than 730 days after permit issuance, lasting until expiration, the discharge shall also not exceed and shall otherwise conform to the specific terms and conditions listed.

Remarks:

(A) The use of chlorine for disinfection shall be discontinued from October 1st through April 30th except that chlorination equipment may be started and tested no earlier than April 15th, and any residual chlorine gas or liquid may be used up until, but no later than, October 15th. During these times in April and October the total residual chlorine of the effluent shall not be greater than 1.5 mg/l. The analytical results shall be reported on the MOR for the months of April and October

(B) The geometric mean of the Fecal coliform bacteria values for the effluent samples collected in a period of a calendar month during the period from May 1st through September 30th shall not exceed 200 per 100 milliliters.

(C) The geometric mean of the Fecal coliform bacteria values for the effluent samples collected in a period of a calendar week during the period from May 1st through September 30th shall not exceed 400 per 100 milliliters.

(D) The geometric mean of the Escherichia coli bacteria values for the effluent samples collected in a period of a calendar month during the period from May 1st through September 30th shall not exceed 126 per 100 milliliters.

(E) The Average Weekly discharge Limitation for BOD_5 and Total Suspended Solids shall be 1.5 times the Average Monthly Limit listed above.

TABLE B

Discharge Serial Number (DSN): **001-1**					Monitoring Location: **K**
Wastewater Description: **Sanitary Sewage**					
Monitoring Location Description: **Final Effluent**					
Allocated Zone of Influence (ZOI): **1540 cfs**		In-stream Waste Concentration (IWC): **1 %**			
PARAMETER	**Units**	**FLOW/TIME BASED MONITORING**			**REPORT FORM**
		Average Monthly Minimum	**Sample Freq.**	**Sample type**	
Biochemical Oxygen Demand (5 day) Percent Removal [1]	% of Influent	85	3/Week	Calculated [2]	DMR/MOR
Solids, Total Suspended Percent Removal [1]	% of Influent	85	3/Week	Calculated [2]	DMR/MOR

TABLE B – CONDITIONS

Footnotes:

[1] The discharge shall be less than or equal to 15% of the average monthly influent BOD_5 and total suspended solids (Table E, Monitoring Location G).

[2] Calculated based on the average monthly results described in Table A. Removal efficiency = $\frac{\text{Inf.BOD or TSS} - \text{Effluent BOD or TSS}}{\text{Inf.BOD or TSS}} \times 100$

TABLE C

Discharge Serial Number (DSN): **001-1**					Monitoring Location: **T**	
Wastewater Description: **Sanitary Sewage**						
Monitoring Location Description: **Final Effluent prior to chlorination**						
Allocated Zone of Influence (ZOI): **1540 cfs**			In-stream Waste Concentration (IWC): **1 %**			
PARAMETER	**Units**	**Maximum Daily Limit**	**Sampling Frequency**	**Sample Type**	**Reporting form**	**Minimum Level Analysis See Section 6**
Aluminum, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Antimony, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
NOAEL Static 48Hr Acute D. Pulex[1]	% survival	------	Quarterly	Daily Composite	ATMR/DMR	
NOAEL Static 48Hr Acute Pimephales[1]	% survival	------	Quarterly	Daily Composite	ATMR/DMR	
Arsenic, Total	mg/l	------	Quarterly	Daily Composite	ATMR	*
Beryllium, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
BOD_5	mg/l	------	Quarterly	Daily Composite	ATMR	
Cadmium, Total	mg/l	------	Quarterly	Daily Composite	ATMR	*
Chromium, Hexavalent	mg/l	------	Quarterly	Daily Composite	ATMR	
Chromium, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Chlorine, Total Residual	mg/l	------	Quarterly	Daily Composite	ATMR	
Copper, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Cyanide, Amenable	mg/l	------	Quarterly	Daily Composite	ATMR	
Cyanide, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Iron, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Lead, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Mercury, Total	mg/l	------	Quarterly	Daily Composite	ATMR	*
Nickel, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Nitrogen, Ammonia (total as N)	mg/l	------	Quarterly	Daily Composite	ATMR	
Nitrogen, Nitrate, (total as N)	mg/l	------	Quarterly	Daily Composite	ATMR	
Nitrogen, Nitrite, (total as N)	mg/l	------	Quarterly	Daily Composite	ATMR	
Phosphorus, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Phenols, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Selenium, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Silver, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Suspended Solids, Total	mg/l	------	Quarterly	Daily Composite	ATMR	
Thallium, Total	mg/l	------	Quarterly	Daily Composite	ATMR	*
Zinc, Total	mg/l	------	Quarterly	Daily Composite	ATMR	

TABLE C - CONDITIONS

Remarks:[1] The results of the Toxicity Tests are recorded in % survival. The permittee shall report <u>% survival</u> on the DMR based on criteria in Section 6(B) of this permit.

ATMR – Aquatic Toxicity Monitoring Report

TABLE D

Discharge Serial Number: **001-1**	Monitoring Location: **N**			
Wastewater Description: **Activated Sludge**				
Monitoring Location Description: **Each Aeration Unit**				
PARAMETER	**REPORTING FORMAT**	**INSTANTANEOUS MONITORING**		**REPORTING FORM**
		Sample Frequency	Sample Type	
Oxygen, Dissolved	High & low for each WorkDay	4/WorkDay	Grab	MOR
Sludge Volume Index	WorkDay	WorkDay	Grab	MOR
Mixed Liquor Suspended Solids	WorkDay	WorkDay	Grab	MOR

TABLE E

Discharge Serial Number: **001-1**			Monitoring Location: **G**				
Wastewater Description: **Sanitary Sewage**							
Monitoring Location Description: **Influent**							
PARAMETER	**Units**	**DMR REPORTING FORMAT**	**FLOW/TIME BASED MONITORING**		**INSTANTANEOUS MONITORING**		**REPORTING FORM**
			Sample Frequency	**Sample Type**	**Sample Frequency**	**Sample Type**	
Biochemical Oxygen Demand (5 day)	mg/l	Monthly average	3/Week	Daily Composite	NA	NA	DMR/MOR
Nitrogen, Ammonia (total as N)	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Nitrate (total as N)	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Nitrite (total as N)	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Total Kjeldahl	mg/l		Monthly	Daily Composite	NA	NA	MOR
Nitrogen, Total	mg/l		Monthly	Daily Composite	NA	NA	MOR
Phosphate, Ortho	mg/l		Monthly	Daily Composite	NA	NA	MOR
Phosphorus, Total	mg/l		Monthly	Daily Composite	NA	NA	MOR
pH	S.U.		NA	NA	Work Day	Grab	MOR
Solids, Total Suspended	mg/l	Monthly average	3/Week	Daily Composite	NA	NA	DMR/MOR
Temperature	°F		NA	NA	Work Day	Grab	MOR

TABLE F

Discharge Serial Number: **001-1**							Monitoring Location: **P**
Wastewater Description: **Primary Effluent**							
Monitoring Location Description: **Primary Sedimentation Basin Effluent**							
PARAMETER	**Units**	**REPORTING FORMAT**	**TIME/FLOW BASED MONITORING**		**INSTANTANEOUS MONITORING**		**REPORTING FORM**
			Sample Frequency	**Sample Type**	**Sample Frequency**	**Sample type**	
Alkalinity, Total	mg/l		NA	NA	Monthly	Grab	MOR
Biochemical Oxygen Demand (5 day)	mg/l	Monthly average	Weekly	Composite	NA	NA	MOR
Nitrogen, Ammonia (total as N)	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Nitrate (total as N)	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Nitrite (total as N)	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Total Kjeldahl	mg/l		Monthly	Composite	NA	NA	MOR
Nitrogen, Total	mg/l		Monthly	Composite	NA	NA	MOR
pH	S.U.		NA	NA	Monthly	Grab	MOR
Solids, Total Suspended	mg/l	Monthly average	Weekly	Composite	NA	NA	MOR

TABLE G

Discharge Serial Number: **001-1**	Monitoring Location: **SL**		
Wastewater Description: **Dewatered Sludge**			
Monitoring Location Description: **Belt filter press discharge**			
PARAMETER	**INSTANTANEOUS MONITORING**		**REPORTING FORM**
	Units	**Grab Sample Freq.**	
Arsenic, Total	mg/kg	Bi-monthly	DMR
Beryllium, Total	mg/kg	Bi-monthly	DMR
Cadmium, Total	mg/kg	Bi-monthly	DMR
Chromium, Total	mg/kg	Bi-monthly	DMR
Copper, Total	mg/kg	Bi-monthly	DMR
Lead, Total	mg/kg	Bi-monthly	DMR
Mercury, Total	mg/kg	Bi-monthly	DMR
Nickel, Total	mg/kg	Bi-monthly	DMR
Nitrogen, Ammonia *	mg/kg	Bi-monthly	DMR*
Nitrogen, Nitrate (total as N) *	mg/kg	Bi-monthly	DMR*
Nitrogen, Organic *	mg/kg	Bi-monthly	DMR*
Nitrogen, Nitrite (total as N) *	mg/kg	Bi-monthly	DMR*
Nitrogen, Total *	mg/kg	Bi-monthly	DMR*
pH *	S.U.	Bi-monthly	DMR*
Polychlorinated Biphenyls	mg/kg	Bi-monthly	DMR
Solids, Fixed	%	Bi-monthly	DMR
Solids, Total	%	Bi-monthly	DMR
Solids, Volatile	%	Bi-monthly	DMR
Zinc, Total	mg/kg	Bi-monthly	DMR
(*) required for composting or land application only Testing for inorganic pollutants shall follow "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 as updated and/or revised.			

ATTACHMENT 2

MONTHLY OPERATING REPORT FORM

Sample month: **Facility: Enfield WPCF**

Sludge disposal location: **Permit # CT0100200**

							TRAIN 1													
	Daily Flow			Primary Sludge			Pre-Anoxic #1			Aeration Tank #1				Post-Anoxic #1			Internal recycle	Pre-Anoxic #2		
							Zone #1							Zone #1				Zone #2		
	Max	Min	Total	Volume	Solids	weight	Hi DO	Lo DO	Nitrate	MLSS	SVI	DO (max)	DO (min)	Hi DO	Lo DO	Nitrate	%	Hi DO	Lo DO	Nitrate
Units	MGD			gallons	%	lbs	mg/l		mg/l	mg/L		mg/L	mg/L	mg/l		mg/l	work	mg/l		mg/l
Freq	daily			work day			4/work day		weekly	work day				4/work day		weekly	day	4/work day		weekly
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31																				
Total																				
Minimum																				
Maximum																				
Average																				

TRAIN # 4																			
Pre-Anoxic #4			Aeration Tank #4				Post-Anoxic #4			Internal recycle	BOD (5-day)			Suspended Solids			Return Sludge		Waste Sludge
Hi DO	Lo DO	Nitrate	MLSS	SVI	DO (max)	DO (min)	Hi DO	Lo DO	Nitrate	%	Inf.	Prim.	Eff.	Inf.	Prim.	Eff.			
mg/l		mg/l	mg/L		mg/L	mg/L	mg/l		mg/l	work	mg/L			mg/L			% flow	%solids	lbs.
4/work day		weekly	work day				4/work day		weekly	day	3/week	1/ week	3/week	3/week	1/ week	3/week	work day		work day

Total Nitrogen	Alkalinity		Settleable Solids	Turbidity	DO	pH			Total P		Ortho P		Temperature	
Eff	Prim.	Eff.	Eff.	Eff.	Eff.	Inf.	Prim.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
lbs/day	mg/L		mL/L	NTU	mg/L	S.U.			mg/L		mg/L		degrees F	
Monthly	monthly		workday	work day	week	workday	monthly	workday	monthly		monthly		work day	

Statement of Acknowledgment

I certify that under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

Authorized Official:

Signature:

Date:

DATA TRACKING AND TECHNICAL FACT SHEET

Permittee: Town of Enfield

PERMIT, ADDRESS, AND FACILITY DATA

PERMIT #:CT-0100200 **APPLICATION #:** 201100526 **FACILITY ID.** 049-001

Mailing Address:	Location Address:
Street: 40 Moody Rd	Street: 90 Parsons Rd
City: Enfield CT 06082:	City: Enfield CT 06082
Contact Name: Jonathan Bilmes, Public Works Director	Contact Name: Kevin Shlatz, Chief Operator
Phone No.: 860-272-1140	Phone No.: (860) 253-6450
	DMR Contact Same as above
	email address: kshlatz@enfield.org

PERMIT INFORMATION

DURATION 5 YEAR _X_ 10 YEAR __ 30 YEAR ___

TYPE New _ Reissuance _X_ Modification __

CATEGORIZATION POINT (X) NON-POINT ( ) GIS #

NPDES (X) PRETREAT () GROUND WATER(UIC) ( ) GROUND WATER (OTHER) ( )

NPDES MAJOR(**MA**) X
NPDES SIGNIFICANT MINOR or PRETREAT SIU **(SI)** ___
NPDES or PRETREATMENT MINOR **(MI)** ___

COMPLIANCE SCHEDULE YES__ NO_X
POLLUTION PREVENTION __ TREATMENT REQUIREMENT__
WATER QUALITY REQUIREMENT __ OTHER ___

OWNERSHIP CODE
Private __ Federal __ State __ Municipal (town only) X Other public__

DEP STAFF ENGINEER Carlos Esguerra

PERMIT FEES

Discharge Code	DSN Number	Annual Fee
111000(f)	001	$ 3,005

FOR NPDES DISCHARGES
Drainage Basin Code: Water Quality Classification Goal: **B**
Segment: CT River (4000-03)

NATURE OF BUSINESS GENERATING DISCHARGE
Municipal Sanitary Sewage Treatment

PROCESS AND TREATMENT DESCRIPTION (by DSN)
Secondary Biological Treatment with Nitrogen removal and seasonal Chlorine disinfection.

RESOURCES USED TO DRAFT PERMIT

X__ Federal Effluent Limitation Guideline 40CFR 133 Secondary Treatment Category

__ Performance Standards

__ Federal Development Document
name of category

X Department File Information

X Connecticut Water Quality Standards

X Anti-degradation Policy ***(MUST BE EVALUATED - see language choices under general comments)***

__ Coastal Management Consistency Review Form

__ Other - Explain

BASIS FOR LIMITATIONS, STANDARDS OR CONDITIONS

X Secondary Treatment (Section 22a-430-4(r) of the Regulations of Connecticut State Agencies)

__ Case-by-Case Determination (See Other Comments)

__ In order to meet in-stream water quality (See General Comments)

X Anti-degradation policy

GENERAL COMMENTS

The activities authorized within this permit have been reviewed for consistency with the Connecticut Anti-degradation Policies and associated implementation guidance contained in the Connecticut Water Quality Standards. The authorized activities are consistent with maintenance and protection of water quality in accordance with Tier I Anti-degradation Evaluation and Implementation Review provisions of the Connecticut Water Quality Standard.

The need for inclusion of water quality based discharge limitations in this permit was evaluated consistent with Connecticut Water Quality Standards and criteria, pursuant to 40 CFR 122.44(d). Each parameter was evaluated for consistency with the available aquatic life criteria (acute and chronic) and human health (fish consumption only) criteria, considering the zone of influence allocated to the facility where appropriate. The statistical procedures outlined in the EPA Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001) were employed to calculate the need for such limits. Comparison of monitoring data and its inherent variability with the calculated water quality based limits indicates a low statistical probability of exceeding such limits. Therefore, no water quality based metal limits were included in the permit at this time.

E. Coli monitoring requirements have been included in permit in accordance with WQS (2011) and consistent with the Bacteria Total Maximum Daily Load analysis for the Connecticut River available http://www.ct.gov/dep/lib/dep/water/tmdl/statewidebacteria/connecticutriver4000.pdf.

Permittee must follow existing bacteria monitoring requirements until the implementation of E. Coli testing. Said implementation must be conducted in less than 730 days after permit issuance. Aluminum, and iron monitoring has been included herein following WQS guidance as well. Mercury monitoring has been included following guidance included in the Northeast Regional Mercury TMDL The permit also include a compliance schedule for addressing outstanding issues with the Odor Control system at the facility which was first documented in NOV/WR/WU # 10-006 on September 16, 2010.

OTHER COMMENTS

This is a permit reissuance.

WATER QUALITY LIMIT CALCULATIONS

See attached

WQB LIMITS:

Discharger: Enfield WPCF — by: EsguerraC, 8/27/2012, 15:47

Receiving Water: CT River

Design Flow:	10.000	MGD	CURRENT CONDITIONS Avg. Flow:	6.210	MGD
Allocated ZOI:	1540.00	CFS	Max. Flow:	9.050	MGD
Samples/Month:	4		IWC:	1.00	%

WQB Limits - **Freshwater**

Compound	C.V.	AML ug/l	MDL ug/l	AML kg/d	MDL kg/d	LIMIT? ML?
Aluminum	0.0	8.75E+03	8.75E+03	3.31E+02	3.31E+02	
Ammonia	1.7	8.70E+04	2.59E+05	3.30E+03	9.81E+03	
Antimony	1.4	1.24E+04	3.52E+04	4.71E+02	1.33E+03	
Arsenic	0.1	2.10E-02	2.43E-02	7.95E-04	9.21E-04	ML
Beryllium	1.0	2.62E+02	6.61E+02	9.94E+00	2.50E+01	
Cadmium	0.8	9.67E+00	2.21E+01	3.66E-01	8.39E-01	ML
Chlorine	0.6	9.05E+02	1.82E+03	3.43E+01	6.88E+01	
Chromium (hex)	0.4	9.60E+02	1.61E+03	3.64E+01	6.09E+01	
Chromium (tri)	0.8	3.25E+03	7.44E+03	1.23E+02	2.82E+02	
Copper	0.7	4.83E+02	1.04E+03	1.83E+01	3.94E+01	
Cyanide (amen)	1.2	3.58E+02	9.67E+02	1.36E+01	3.66E+01	
Lead	0.6	9.88E+01	1.98E+02	3.74E+00	7.51E+00	
Mercury	0.1	5.13E+00	6.10E+00	1.94E-01	2.31E-01	
Nickel	0.6	2.38E+03	4.77E+03	9.01E+01	1.81E+02	
Phenol	0.7	1.28E+04	2.75E+04	4.83E+02	1.04E+03	
Selenium	0.4	4.39E+02	7.36E+02	1.66E+01	2.79E+01	
Silver	0.4	6.12E+01	1.03E+02	2.32E+00	3.88E+00	
Thallium	1.4	4.83E+01	1.37E+02	1.83E+00	5.18E+00	ML
Zinc	0.3	4.36E+03	6.53E+03	1.65E+02	2.48E+02	

Current Conditions

Compound	# DETECTS	AMC ug/l	MMC ug/l	AMM kg/d	MMM kg/d
Aluminum	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ammonia	11	5.50E+02	4.06E+03	1.29E+01	1.39E+02
Antimony	0	3.21E+01	1.00E+02	7.55E-01	3.43E+00
Arsenic	1	4.30E+00	5.00E+00	1.01E-01	1.71E-01
Beryllium	0	3.20E+00	1.00E+01	7.53E-02	3.43E-01
Cadmium	0	4.50E+00	1.00E+01	1.06E-01	3.43E-01
Chlorine					
Chromium (hex)	1	6.70E+00	1.00E+01	1.58E-01	3.43E-01
Chromium (tri)	0	8.90E+00	2.00E+01	2.09E-01	6.86E-01
Copper	9	8.20E+00	2.88E+01	1.93E-01	9.87E-01
Cyanide (amen)	1	8.90E+00	5.00E+01	2.09E-01	1.71E+00
Lead	0	1.07E+01	2.00E+01	2.52E-01	6.86E-01
Mercury	0	2.10E-01	3.00E-01	4.94E-03	1.03E-02
Nickel	0	7.30E+00	2.00E+01	1.72E-01	6.86E-01
Phenol	0	2.47E+01	5.00E+01	5.81E-01	1.71E+00
Selenium	0	1.19E+01	1.50E+01	2.80E-01	5.14E-01
Silver	0	6.20E+00	1.00E+01	1.46E-01	3.43E-01
Thallium	0	3.17E+01	1.00E+02	7.46E-01	3.43E+00
Zinc	18	4.04E+01	6.59E+01	9.50E-01	2.26E+00

	A	B	C	D	E	F	G
60	Final WQB Limits						
61		AML (kg/d)	MDL (kg/d)				
62							
63							
64							
65	Interim WQB Limits						
66		AML (kg/d)	MDL (kg/d)				
67							
68							
69							
70	Minimum Levels						
71							
72	Arsenic	0.005 mg/L					
73	Cadmium	0.0005 mg/L					
74	Thallium	0.005 mg/L					
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APPENDIX B: FISH AND WILDLIFE SERVICE CORRESPONDENCE

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

January 7, 2014

To Whom It May Concern:

This project was reviewed for the presence of federally listed or proposed, threatened or endangered species or critical habitat per instructions provided on the U.S. Fish and Wildlife Service's New England Field Office website:

http://www.fws.gov/newengland/EndangeredSpec-Consultation.htm

Based on information currently available to us, no federally listed or proposed, threatened or endangered species or critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area(s). Preparation of a Biological Assessment or further consultation with us under section 7 of the Endangered Species Act is not required. No further Endangered Species Act coordination is necessary for a period of one year from the date of this letter, unless additional information on listed or proposed species becomes available.

Thank you for your cooperation. Please contact Maria Tur of this office at 603-223-2541 if we can be of further assistance.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN CONNECTICUT

COUNTY	SPECIES	FEDERAL STATUS	GENERAL LOCATION/HABITAT	TOWNS
Fairfield	Piping Plover	Threatened	Coastal beaches	Westport, Bridgeport and Stratford
	Roseate Tern	Endangered	Coastal beaches, islands and the Atlantic Ocean	Westport and Stratford
	Bog Turtle	Threatened	Wetlands	Ridgefield and Danbury
	Red Knot[1]	Proposed Threatened	Coastal beaches and rocky shores, sand and mud flats	Coastal towns
	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer–wide variety of forested habitats	Statewide
Hartford	Dwarf Wedgemussel	Endangered	Farmington and Podunk Rivers, Muddy Brook, Philo Brook, Stony Brook	South Windsor, East Granby, Suffield, Simsbury, Avon and Bloomfield
	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer--wide variety of forested habitats	Statewide
Litchfield	Small Whorled Pogonia	Threatened	Forests with somewhat poorly drained soils and/or a seasonally high water table	Sharon
	Bog Turtle	Threatened	Wetlands	Sharon and Salisbury
	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer–wide variety of forested habitats	Statewide
Middlesex	Roseate Tern	Endangered	Coastal beaches, islands and the Atlantic Ocean	Westbrook and New London
	Piping Plover	Threatened	Coastal beaches	Clinton, Westbrook, Old Saybrook
	Puritan Tiger Beetle	Threatened	Sandy beaches along the Connecticut River	Cromwell, Portland
	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer–wide variety of forested habitats	Statewide
New Haven	Bog Turtle	Threatened	Wetlands	Southbury
	Piping Plover	Threatened	Coastal beaches	Milford, Madison and West Haven
	Roseate Tern	Endangered	Coastal beaches, islands and the Atlantic Ocean	Branford, Guilford and Madison
	Indiana Bat	Endangered	Mines, caves	
	Red Knot[1]	Proposed Threatened	Coastal beaches and rocky shores, sand and mud flats	Coastal towns
	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer–wide variety of forested habitats	Statewide

COUNTY	SPECIES	FEDERAL STATUS	GENERAL LOCATION/HABITAT	TOWNS
New London	Piping Plover	Threatened	Coastal beaches	Old Lyme, Waterford, Groton and Stonington
	Roseate Tern	Endangered	Coastal beaches, islands and the Atlantic Ocean	East Lyme and Waterford
	Small Whorled Pogonia	Threatened	Forests with somewhat poorly drained soils and/or a seasonally high water table	Waterford
	Red Knot[1]	Proposed Threatened	Coastal beaches and rocky shores, sand and mud flats	Coastal towns
	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer–wide variety of forested habitats	Statewide
Tolland	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer–wide variety of forested habitats	Statewide
Windham	Sandplain Gerardia	Endangered	Dry, sandy loam, nutrient-poor soils of sandplain grasslands	Plainfield
	Northern Long-eared Bat	Proposed Endangered	Winter-mines and caves, summer–wide variety of forested habitats	Statewide

[1] Migratory only, scattered along the coast in small numbers.

- Eastern cougar, gray wolf, Indiana bat, Seabeach amaranth and American burying beetle are considered extirpated in Connecticut.
- There is no federally designated Critical Habitat in Connecticut.

APPENDIX C: CCTV INSPECTION REPORT

CCTV Inspection of Sewers in The Town of Enfield, Connecticut

Stacey DePasquale Engineering

NATIONAL WATER MAIN CLEANING CO.

Specializing in today's needs for environmental protection

The Environmental Protection Specialists

National Water Main Cleaning Company
1000R Elm Street
Rocky Hill, CT 06067
Tel: 860.372.4199
Fax: 781-828-2473
E-mail: boston@nwmcc-bos.com

Project Information

Project name :	Project No. :	Contact :	Date :
STA008-2 MERGED			**4/20/2015**

Client:	**Stacey DePasquale Engineers**
Contact Name:	**Miss. Stacey DePasquale**
Department:	**President/Chief Engineer**
Po Box:	
Street:	**354 Merrimack Street, Suite 200**
City:	**Lawrence, MA 01843**
Telephone:	**978.975.0500**
Fax:	**978.975.0550**
Mobile:	**978.273.3307**
E-mail:	**sdepasquale@sde-inc.com**

Site:	**Town of Enfield**
Contact Name:	**Mr. Kevin Shlatz**
Department:	**Water Pollution Control**
Po Box:	
Street:	
City:	
Telephone:	**860.253.6450**
Fax:	**860.253.6417**
Mobile:	
E-mail:	**kshlatz@enfield.org**

Contractor	**National Water Main Cleaning Company**
Contact Name:	**Jim Falconieri**
Department:	**Senor Project Manager**
Po Box:	
Street:	**1000R Elm Street**
City:	**Rocky Hill, CT 06067**
Telephone:	**860.372.4199**
Fax:	**781-828-2473**
Mobile:	
E-mail:	**boston@nwmcc-bos.com**

The Environmental Protection Specialists

National Water Main Cleaning Company
1000R Elm Street
Rocky Hill, CT 06067
Tel: 860.372.4199
Fax: 781-828-2473
E-mail : boston@nwmcc-bos.com

Defect Grade Description

Project Name :	Project number :	Contact :	Date :
STA008-2 MERGED			**4/20/2015**

1: Excellent Condition

Minor Defects- Failure unlikley in the foreseeable future

2: Good Condition

Defects that have not begun to deteriorate- Pipe unlikely to fail for at least 20 years.

3: Fair Condition

Moderate defects that will continue to deteriorate- Pipe may fail in 10-20 years.

4: Poor Condition

Severe Defects that will become Grade 5 defects within the foerseeable future- Pipe will probably fail in 5-10 years

5: Immediate Attention

Defects require immediate attention- Pipe has failed or will likely fail within the next 5 years or sooner.

The Environmental Protection Specialists

National Water Main Cleaning Company
1000R Elm Street
Rocky Hill, CT 06067
Tel: 860.372.4199
Fax: 781-828-2473
E-mail: boston@nwmcc-bos.com

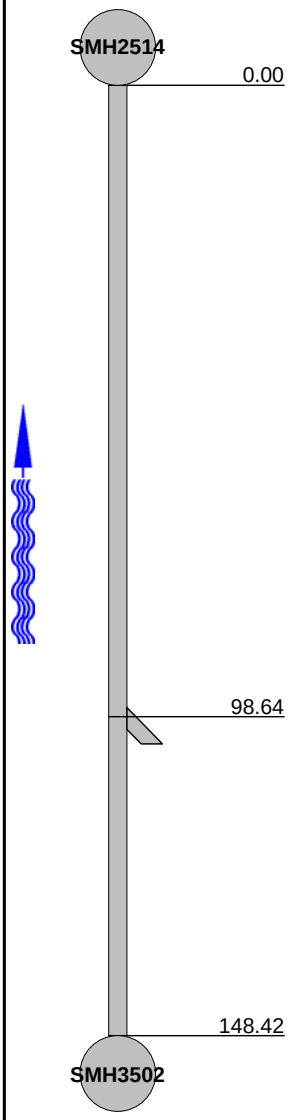
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**1**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BRAINARD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3502**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2514**
Loc. details		Flow Control		Dir. of Survey	**Upstream**
Location Code		Length surveyed	**148.42 ft**	Section Length	**148.42 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:360	Position	Code	Observation	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / SMH2514	
	98.64	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
	148.42	AMH	Upstream Manhole, Survey Ends / SMH3502	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

The Environmental Protection Specialists

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**2**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BRAINARD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3501**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3502**
Loc. details		Flow Control		Dir. of Survey	**Upstream**
Location Code		Length surveyed	**135.75 ft**	Section Length	**135.75 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**15.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :

1:330	Position	Code	Observation	Grade
SMH3502				
	0.00	AMH	Downstream Manhole, Survey Begins / SMH3502	
	4.36	TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
	135.75	AMH	Upstream Manhole, Survey Ends / SMH3501	
SMH3501				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

STA008-2 MERGED

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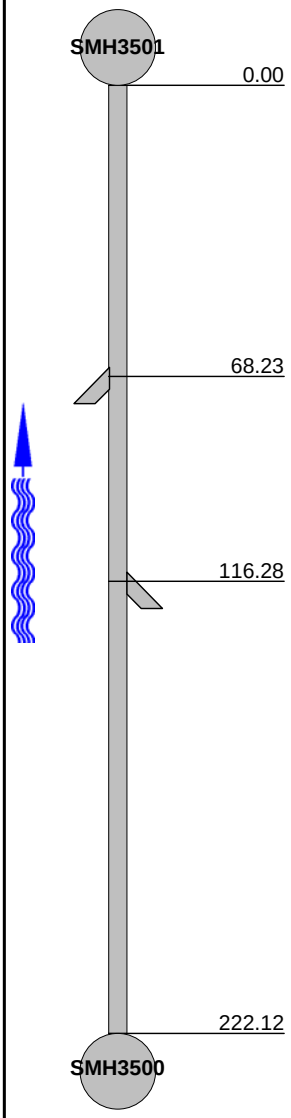
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**3**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BRAINARD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3500**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3501**
Loc. details		Flow Control		Dir. of Survey	**Upstream**
Location Code		Length surveyed	**222.12 ft**	Section Length	**222.12 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**15.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:540	Position	Code	Observation	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / SMH3501	
	68.23	TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
	116.28	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
	222.12	AMH	Upstream Manhole, Survey Ends / SMH3500	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**4**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BRAINARD RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2514**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2506**
Loc. details		Flow Control		Dir. of Survey	**Downstream**
Location Code		Length surveyed	**50.99 ft**	Section Length	**50.99 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**15.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :

1:135	Position	Code	Observation	Grade
SMH2514				
	0.00	AMH	Upstream Manhole, Survey Begins / SMH2514	
	50.99	AMH	Downstream Manhole, Survey Ends / SMH2506	
SMH2506				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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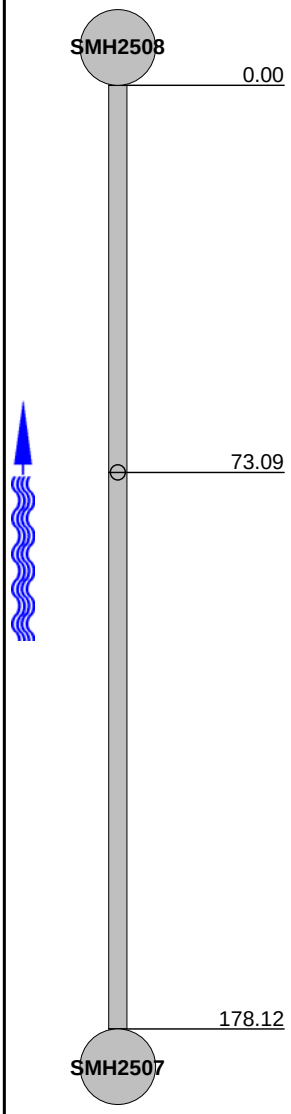
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**5**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WOOD DR**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2507**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2508**
Loc. details		Flow Control		Dir. of Survey	**Upstream**
Location Code		Length surveyed	**178.12 ft**	Section Length	**178.12 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**15.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:435	Position	Code	Observation	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / SMH2508	
	73.09	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
	178.12	AMH	Upstream Manhole, Survey Ends / SMH2508	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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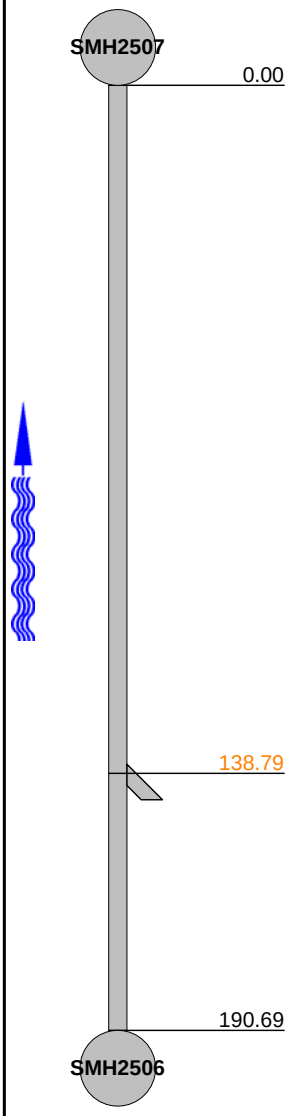
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**6**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WOOD DR**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2506**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2507**
Loc. details		Flow Control		Dir. of Survey	**Upstream**
Location Code		Length surveyed	**190.69 ft**	Section Length	**190.69 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**15.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:465	Position	Code	Observation	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / SMH2507	
	138.79	TBI	Tap Break-In Intruding, at 10 o'clock, 6", 2", within 8 inches of joint: YES, 10 %	M 3
	190.69	AMH	Upstream Manhole, Survey Ends / SMH2506	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**3100**	**0**	**3**	**3**	**0**	**3**	**3**

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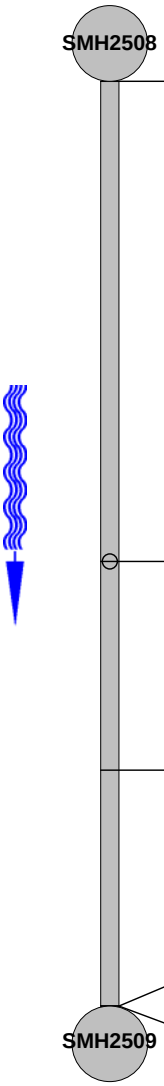
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**7**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WOOD DR**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2508**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2509**
Loc. details		Flow Control		Dir. of Survey	**Downstream**
Location Code		Length surveyed	**126.42 ft**	Section Length	**126.42 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:315	Position		Code	Observation	Grade
SMH2508	0.00		AMH	Upstream Manhole, Survey Begins / SMH2508	
	65.59		TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
	94.18	**S1**	SAPC	Surface Aggregate Projecting Chemical, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
	126.42	**F1**	SAPC	Surface Aggregate Projecting Chemical, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
SMH2509	126.42		AMH	Downstream Manhole, Survey Ends / SMH2509	

94.18 FT

94.18 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3600	**0000**	**18**	**0**	**18**	**3**	**0**	**3**

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Inspection photos

City :	Street :	Date :	Pipe Segment Reference :	Section No :
ENFIELD CT	**WOOD DR**			**7**

Photo:
7_SMH2508_SMH2509_09042015_D_SAPC_94.1801_103710_A.JPG, VCR No.: 76-040915
94.18FT, Surface Aggregate Projecting Chemical, from 09 to 03 o'clock, within 8 inches of joint: YES, Start

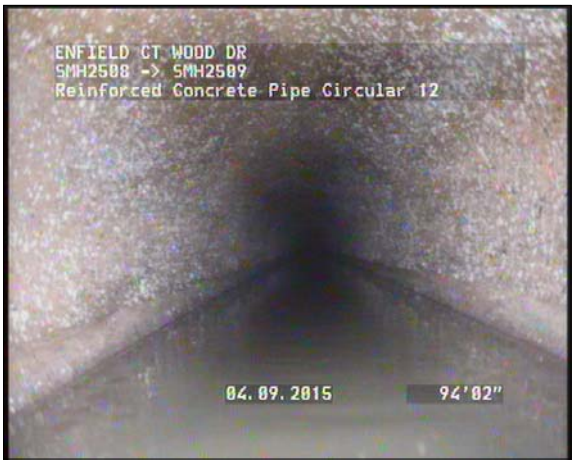

Photo:
7_SMH2508_SMH2509_09042015_D_SAPC_94.1801_103657_A.JPG, VCR No.: 76-040915
94.18FT, Surface Aggregate Projecting Chemical, from 09 to 03 o'clock, within 8 inches of joint: YES, Start

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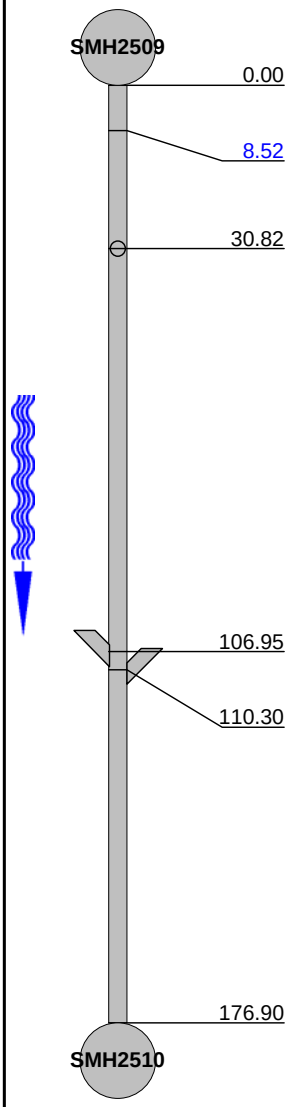
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**8**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WOOD DR**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2509**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2510**
Loc. details		Flow Control		Dir. of Survey	**Downstream**
Location Code		Length surveyed	**176.90 ft**	Section Length	**176.90 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:435 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2509	
8.52	DAGS	Deposits Attached Grease, 5 %of cross sectional area, at 08 o'clock, , within 8 inches of joint: YES	M 2
30.82	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
106.95	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
110.30	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
176.90	AMH	Downstream Manhole, Survey Ends / SMH2510	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**2100**	**0**	**2**	**2**	**0**	**2**	**2**

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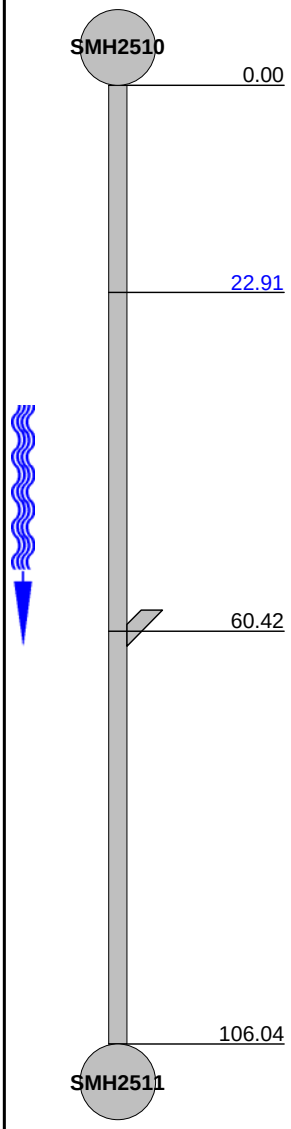
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**9**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ROBBIN RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2510**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2511**
Loc. details		Flow Control		Dir. of Survey	**Downstream**
Location Code		Length surveyed	**106.04 ft**	Section Length	**106.04 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:255	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH2510	
	22.91	DAGS	Deposits Attached Grease, 5 %of cross sectional area, at 04 o'clock, , within 8 inches of joint: YES	M 2
	60.42	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
	106.04	AMH	Downstream Manhole, Survey Ends / SMH2511	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**2100**	**0**	**2**	**2**	**0**	**2**	**2**

STA008-2 MERGED

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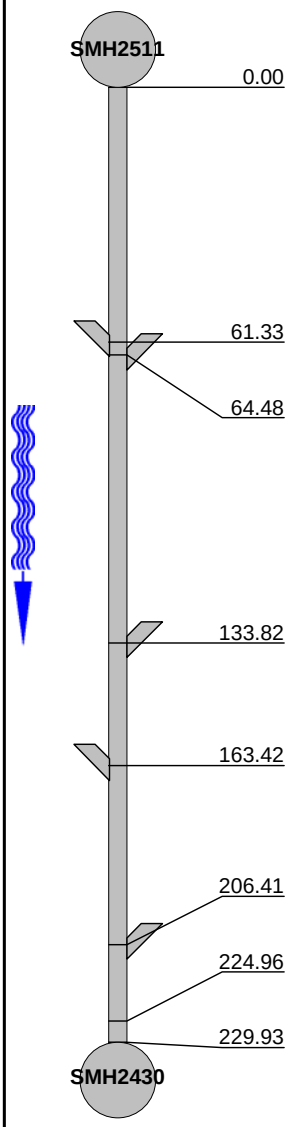
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/9/2015			**RODNEY BRICK**		**10**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ROBBIN RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2511**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2430**
Loc. details		Flow Control		Dir. of Survey	**Downstream**
Location Code		Length surveyed	**229.93 ft**	Section Length	**229.93 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:555 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2511	
61.33	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
64.48	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
133.82	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
163.42	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
206.41	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
224.96	MGO	General Observation / EXTERNAL DROP	
229.93	AOC	Drop Connection, Survey Ends / SMH2430	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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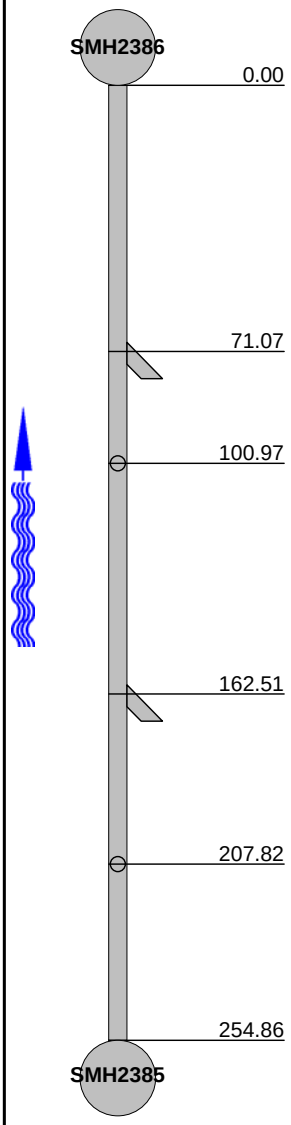
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**11**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**THERESA ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2385**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2386**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**254.86 ft**	Section Length	**254.86 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**12.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Polyvinyl Chloride**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:615	Position	Code	Observation	Grade
	0.00	AMH	Downstream Manhole, Survey Begins / SMH2386	
	71.07	TF	Tap Factory Made, at 09 o'clock, 6", within 8 inches of joint: YES	
	100.97	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
	162.51	TF	Tap Factory Made, at 09 o'clock, 6", within 8 inches of joint: YES	
	207.82	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
	254.86	AMH	Upstream Manhole, Survey Ends / SMH2385	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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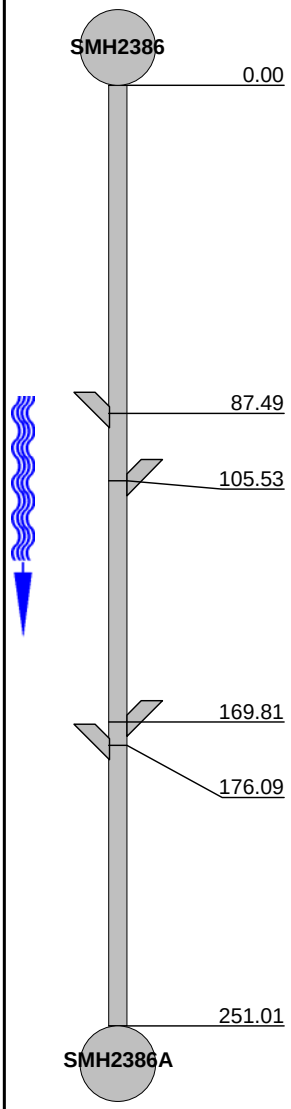
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**12**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**THERESA ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2386**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2386A**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**251.01 ft**	Section Length	**251.01 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**12.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Polyvinyl Chloride**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:615	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH2386	
	87.49	TF	Tap Factory Made, at 02 o'clock, 6", within 8 inches of joint: YES	
	105.53	TF	Tap Factory Made, at 10 o'clock, 6", within 8 inches of joint: YES	
	169.81	TF	Tap Factory Made, at 10 o'clock, 6", within 8 inches of joint: YES	
	176.09	TF	Tap Factory Made, at 02 o'clock, 6", within 8 inches of joint: YES	
	251.01	AMH	Downstream Manhole, Survey Ends / SMH2387	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**13**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**THERESA ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2386A**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2387**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**34.67 ft**	Section Length	**34.67 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**12.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Polyvinyl Chloride**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :

1:90	Position	Code	Observation	Grade
SMH2386A	0.00	AMH	Upstream Manhole, Survey Begins / SMH2386A	
	34.67	AMH	Downstream Manhole, Survey Ends / SMH2387	
SMH2387				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

STA008-2 MERGED

The Environmental Protection Specialists

National Water Main Cleaning Company
1000R Elm Street
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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**14**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TABOR ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2387**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2388**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**46.53 ft**	Section Length	**46.53 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :

1:120	Position		Code	Observation	Grade
SMH2388	0.00		AMH	Downstream Manhole, Survey Begins / SMH2388	
	15.00	**S1**	MCU	Camera Underwater, Start	M 4
	46.53	**F1**	MCU	Camera Underwater, Finish	M 4
SMH2387	46.53		AMH	Upstream Manhole, Survey Ends / SMH2387	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**4600**	**0**	**24**	**24**	**0**	**4**	**4**

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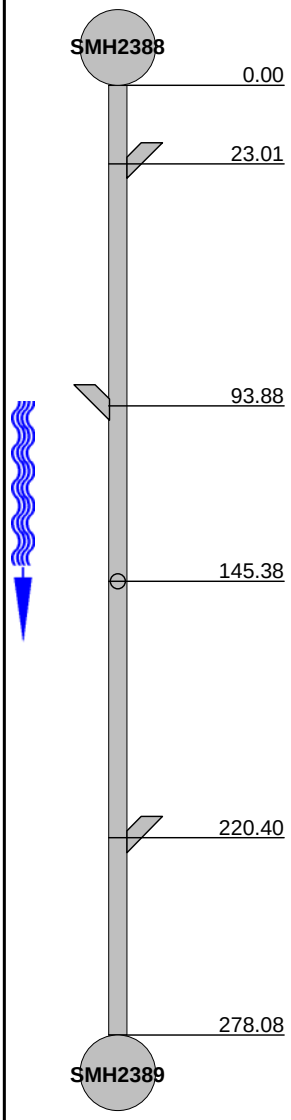
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**15**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TABOR ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2388**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2389**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**278.08 ft**	Section Length	**278.08 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**8.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:675 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2388	
23.01	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
93.88	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
145.38	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
220.40	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
278.08	AMH	Downstream Manhole, Survey Ends / SMH2389	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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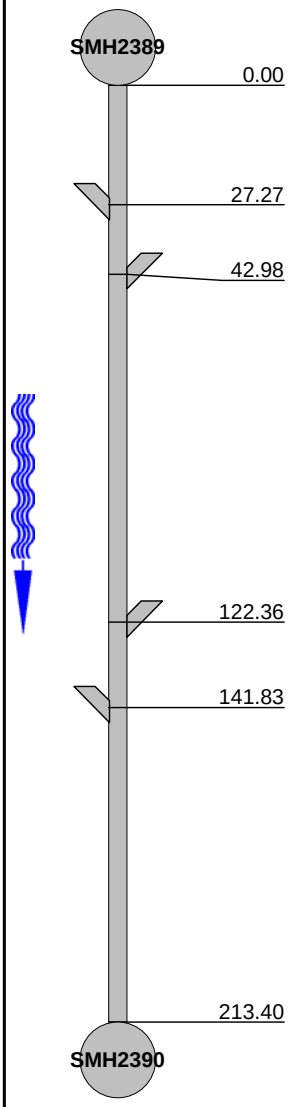
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**16**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TABOR ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2389**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2390**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**213.40 ft**	Section Length	**213.40 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**8.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:525 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2389	
27.27	TFA	Tap Factory Made Active, at 01 o'clock, 6", within 8 inches of joint: YES	
42.98	TFA	Tap Factory Made Active, at 11 o'clock, 6", within 8 inches of joint: YES	
122.36	TFA	Tap Factory Made Active, at 11 o'clock, 6", within 8 inches of joint: YES	
141.83	TFA	Tap Factory Made Active, at 01 o'clock, 6", within 8 inches of joint: YES	
213.40	AMH	Downstream Manhole, Survey Ends / SMH2390	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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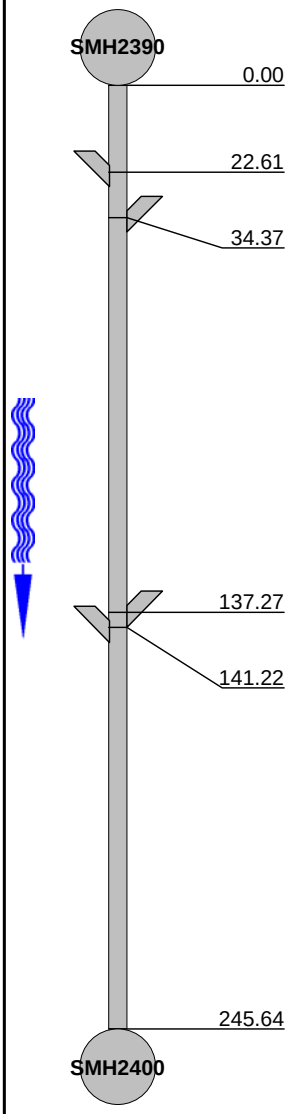
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**17**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TABOR ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2390**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2400**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**245.64 ft**	Section Length	**245.64 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**8.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:600 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2390	
22.61	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
34.37	TFA	Tap Factory Made Active, at 11 o'clock, 6", within 8 inches of joint: YES	
137.27	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
141.22	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
245.64	AMH	Downstream Manhole, Survey Ends / SMH2400	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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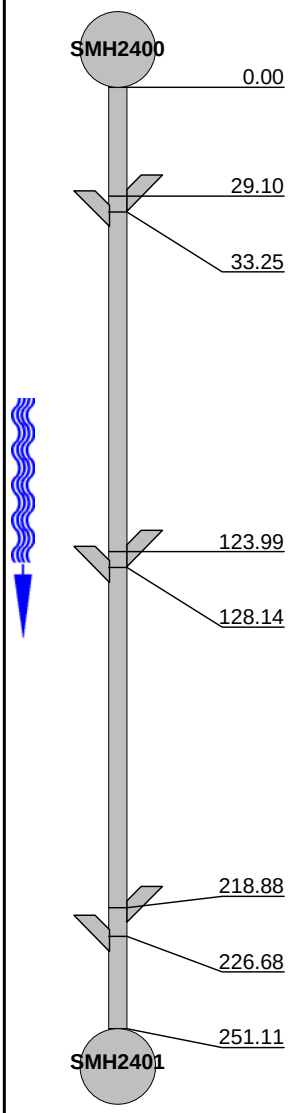
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**18**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TABOR ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2400**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2401**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**251.11 ft**	Section Length	**251.11 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**8.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:615 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2400	
29.10	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
33.25	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
123.99	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
128.14	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
218.88	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
226.68	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
251.11	AMH	Downstream Manhole, Survey Ends / SMH2401	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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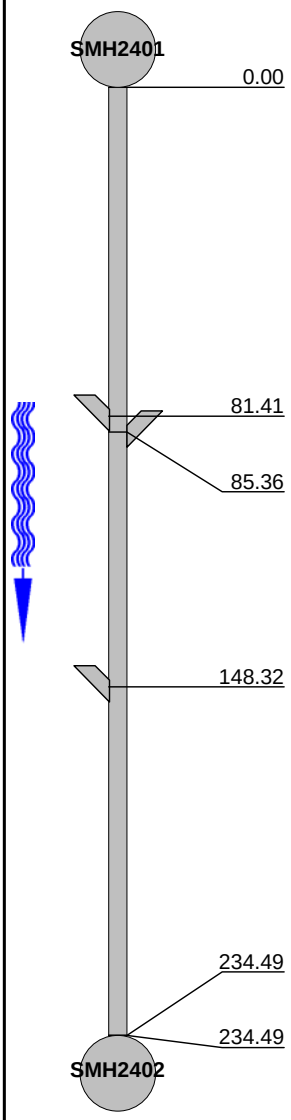
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**19**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TABOR ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2401**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2402**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**234.49 ft**	Section Length	**234.49 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**8.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:570 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2401	
81.41	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
85.36	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
148.32	TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
234.49	MGO	General Observation / EXTERNAL DROP	
234.49	AMH	Downstream Manhole, Survey Ends / SMH2402	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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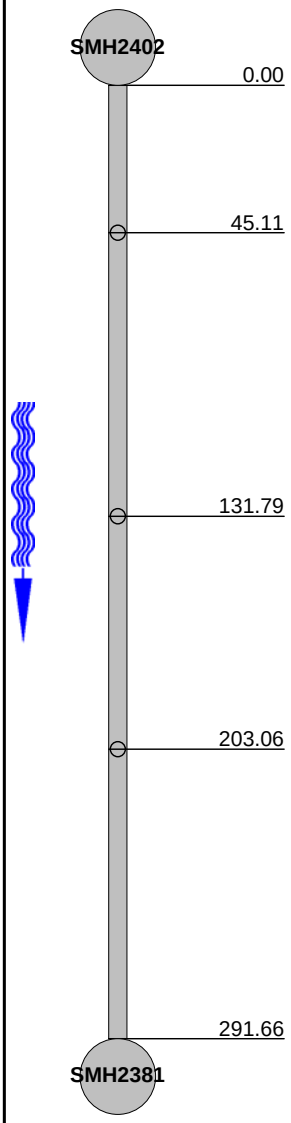
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**20**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BOOTH ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2402**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2381**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**291.66 ft**	Section Length	**291.66 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**8.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:705 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2402	
45.11	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
131.79	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
203.06	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
291.66	AMH	Downstream Manhole, Survey Ends / SMH2381	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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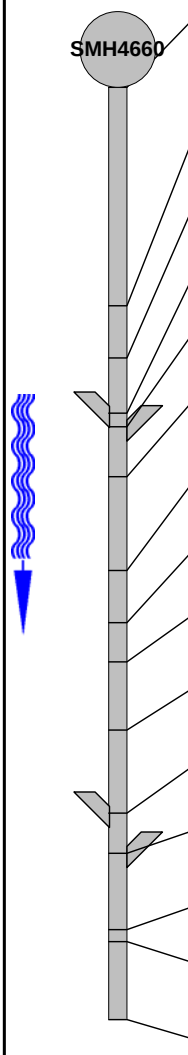
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**21**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**HARTFORD AVE**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4660**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4659**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**304.24 ft**	Section Length	**304.24 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**10 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:360 Position		Code	Observation	Grade
0.00		AMH	Upstream Manhole, Survey Begins / SMH4660	
34.16		CC	Crack Circumferential, from 11 to 01 o'clock, within 8 inches of joint: YES	S 1
42.27		FL	Fracture Longitudinal, at 10 o'clock, within 8 inches of joint: YES	S 3
50.89		TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
53.02		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
60.83		CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES	S 3
75.53		CM	Crack Multiple, from 08 to 12 o'clock, within 8 inches of joint: YES	S 3
83.64		CM	Crack Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES	S 3
89.72		CM	Crack Multiple, from 02 to 04 o'clock, within 8 inches of joint: YES	S 3
100.36		CM	Crack Multiple, from 12 to 04 o'clock, within 8 inches of joint: YES	S 3
113.34		TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
119.63		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
131.59		CC	Crack Circumferential, from 12 to 05 o'clock, within 8 inches of joint: YES	S 1
133.41	**S1**	FM	Fracture Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Start	S 4
145.58	**S2**	DAGS	Deposits Attached Grease, 5 %of cross sectional area, from 10 to 02 o'clock, , within 8 inches of joint: YES, Start	M 2

City : ENFIELD CT

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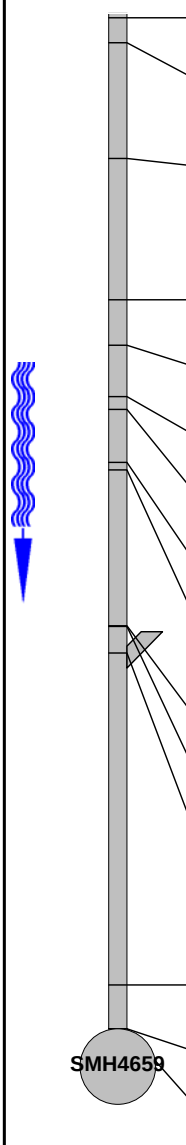
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
		Dry	**RODNEY BRICK**		
Certificate No.	**Survey Customer**	**System Owner**	**Preset :**	**Cleaned :**	**Sewer Category**
06020363				**Jetting**	



1:360 Position		Code	Observation	Rate
146.29	F1	FM	Fracture Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Finish	S 4
150.14	S3	CM	Crack Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Start	S 3
168.29	S4	MCU	Camera Underwater, Start	M 4
190.29	F4	MCU	Camera Underwater, Finish	M 4
197.38		RFJ	Roots Fine Joint, at 09 o'clock, within 8 inches of joint: YESR	M 1
205.49		RFJ	Roots Fine Joint, at 09 o'clock, within 8 inches of joint: YESR	M 1
207.42		RFJ	Roots Fine Joint, at 02 o'clock, within 8 inches of joint: YESR	M 1
215.73		RFJ	Roots Fine Joint, from 09 to 03 o'clock, within 8 inches of joint: YESR	M 1
216.95	S5	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 40 %, within 8 inches of joint: YESR, Start	M 3
241.28	F2	DAGS	Deposits Attached Grease, 5 %of cross sectional area, from 10 to 02 o'clock, , within 8 inches of joint: YES, Finish	M 2
241.38	F5	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 40 %, within 8 inches of joint: YESR, Finish	M 3
245.54		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
297.34		RMJ	Roots Medium Joint, at 03 o'clock, 20 %, within 8 inches of joint: YESR	M 3
304.24	F3	CM	Crack Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Finish	S 3
304.24		AMH	Downstream Manhole, Survey Ends / SMH4659	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
433F	**4436**	**125**	**76**	**201**	**2.98**	**2.3**	**2.68**

STA008-2 MERGED

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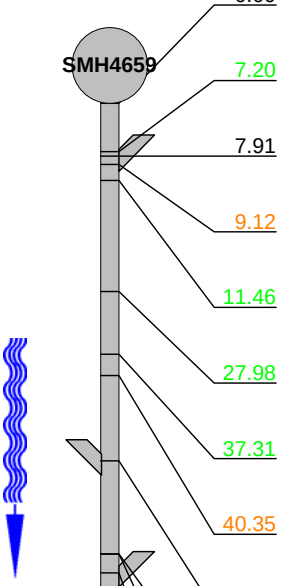
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/10/2015		**Dry**	**RODNEY BRICK**		**22**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**HARTFORD AVE**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4659**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4658**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**300.79 ft**	Section Length	**300.79 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**10 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-040915**	Lining Method	

Add. Information :



1:342 Position		Code	Observation	Grade
0.00		AMH	Upstream Manhole, Survey Begins / SMH4659	
7.20		RFJ	Roots Fine Joint, from 09 to 03 o'clock, within 8 inches of joint: YESR	M 1
7.91		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
9.12		CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES	S 3
11.46		RFJ	Roots Fine Joint, from 02 to 04 o'clock, within 8 inches of joint: YESR	M 1
27.98	**S1**	RFJ	Roots Fine Joint, at 03 o'clock, within 8 inches of joint: YESR, Start	M 1
37.31	**F1**	RFJ	Roots Fine Joint, at 03 o'clock, within 8 inches of joint: YESR, Finish	M 1
40.35	**S2**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
53.02		TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
66.91	**F2**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
66.91		RFJ	Roots Fine Joint, at 12 o'clock, within 8 inches of joint: YESR	M 1
69.65		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
104.62		CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES	S 3
113.34		TF	Tap Factory Made, at 03 o'clock, 6", within 8 inches of joint: YES	
116.89	**S3**	RFJ	Roots Fine Joint, from 10 to 02 o'clock, within 8 inches of joint: YESR, Start	M 1

City : ENFIELD CT

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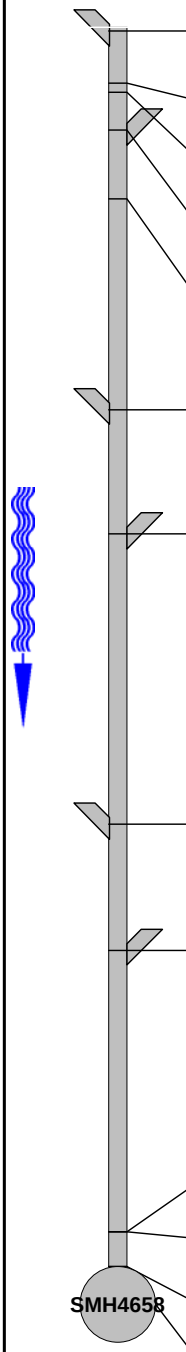
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
		Dry	**RODNEY BRICK**		
Certificate No.	**Survey Customer**	**System Owner**	**Preset :**	**Cleaned :**	**Sewer Category**
06020363				**Jetting**	



1:342 Position		Code	Observation	Rate
117.50		TBA	Tap Break-In Active, at 03 o'clock, 6", within 8 inches of joint: YES	
125.20		RTJ	Roots Tap Joint, at 02 o'clock, 5 %, within 8 inches of joint: YESR	M 2
126.52	**F3**	RFJ	Roots Fine Joint, from 10 to 02 o'clock, within 8 inches of joint: YESR, Finish	M 1
132.20		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
142.33	**S4**	CM	Crack Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Start	S 3
173.66		TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
192.11		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
235.20		TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
253.85		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
295.62	**F4**	CM	Crack Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Finish	S 3
295.62	**S5**	MCU	Camera Underwater, Start	M 4
300.79	**F5**	MCU	Camera Underwater, Finish	M 4
300.79		AMH	Downstream Manhole, Survey Ends / SMH4658	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3G00	**4221**	**114**	**17**	**131**	**3**	**1.7**	**2.73**

STA008-2 MERGED

The Environmental Protection Specialists

National Water Main Cleaning Company
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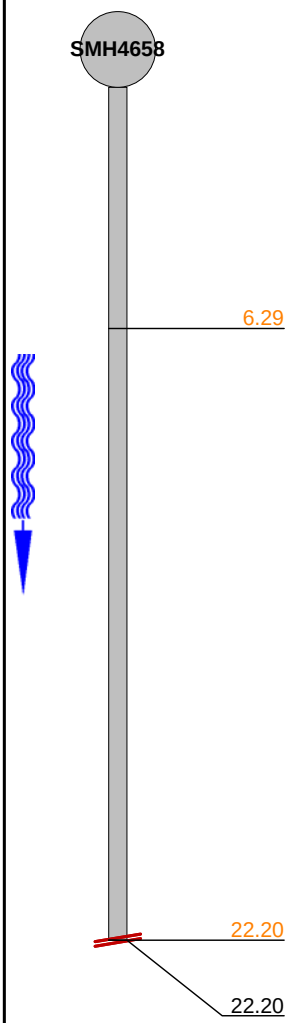
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/13/2015		**Dry**	**RODNEY BRICK**		**23**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**LAFAYETTE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4658**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4653**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**274.33 ft**	Section Length	**274.33 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:60	Position	Code	Observation	Grade
6.29	**S1**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
22.20	**F1**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
22.20		MSA	Survey Abandoned / REQUIRES HVY CLEANING	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3300	**0000**	**9**	**0**	**9**	**3**	**0**	**3**

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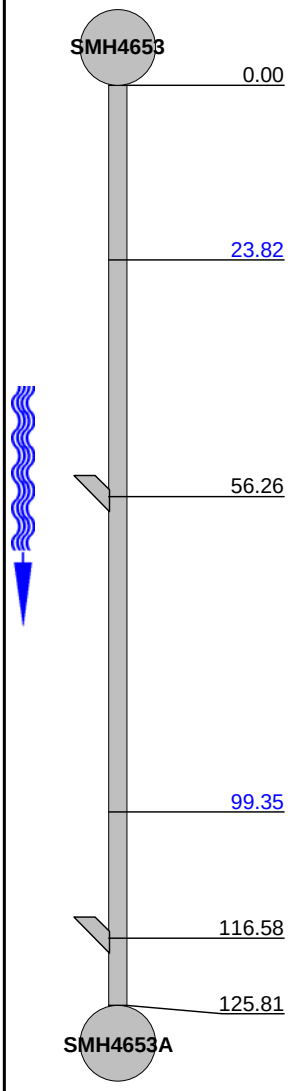
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/13/2015		**Dry**	**RODNEY BRICK**		**24**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**LAFAYETTE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4653**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4653A**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**125.81 ft**	Section Length	**125.81 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:315 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH4653	
23.82	CL	Crack Longitudinal, at 09 o'clock, within 8 inches of joint: YES	S 2
56.26	TB	Tap Break-In, at 03 o'clock, 6", within 8 inches of joint: YES	
99.35	CL	Crack Longitudinal, at 03 o'clock, within 8 inches of joint: YES	S 2
116.58	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
125.81	AMH	Downstream Manhole, Survey Ends / SMH4651	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
2200	**0000**	**4**	**0**	**4**	**2**	**0**	**2**

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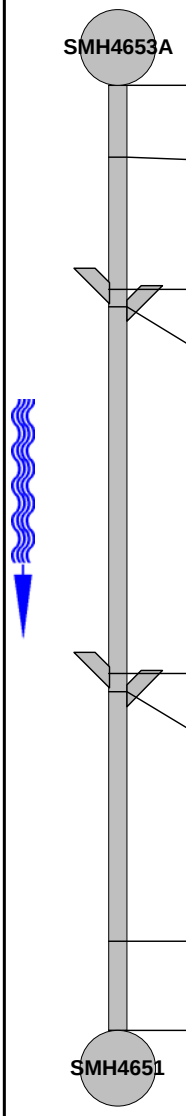
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/13/2015		**Dry**	**RODNEY BRICK**		**25**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**LAFAYETTE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4653A**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4651**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**123.07 ft**	Section Length	**123.07 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:300	Position		Code	Observation	Grade
	0.00		AMH	Upstream Manhole, Survey Begins / SMH4651	
	9.33	**S1**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
	26.56		TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
	28.79		TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
	76.54		TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
	78.97		TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
	111.41	**F1**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
	123.07		AMH	Downstream Manhole, Survey Ends / SMH4648	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3C00	**0000**	**60**	**0**	**60**	**3**	**0**	**3**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/13/2015		**Dry**	**RODNEY BRICK**		**26**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**LAFAYETTE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4651**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4650**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**5.47 ft**	Section Length	**5.47 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :

1:50	Position	Code	Observation	Grade
SMH4651	0.00	AMH	Upstream Manhole, Survey Begins / SMH4651	
	2.94	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
SMH4650	5.47	AMH	Downstream Manhole, Survey Ends / SMH4650	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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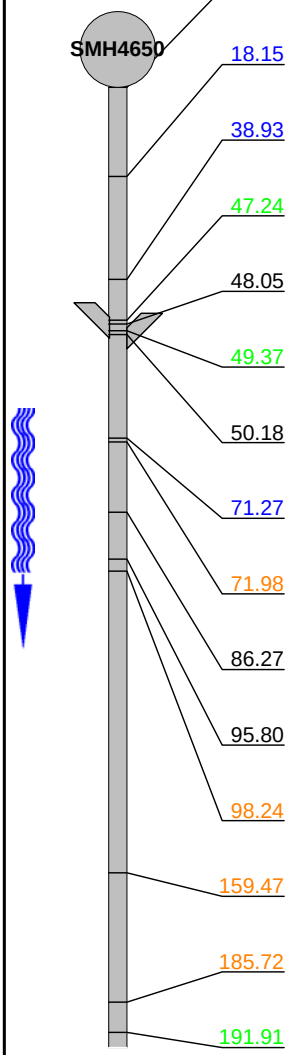
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/13/2015		**Dry**	**RODNEY BRICK**		**27**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Heavy Cleaning**	

Street	**LAFAYETTE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4650**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4648**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**292.27 ft**	Section Length	**292.27 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:468 Position		Code	Observation	Grade
0.00		AMH	Upstream Manhole, Survey Begins / SMH4650	
18.15		CL	Crack Longitudinal, at 03 o'clock, within 8 inches of joint: YES	S 2
38.93		CL	Crack Longitudinal, 6", at 03 o'clock, within 8 inches of joint: YES	S 2
47.24		RFJ	Roots Fine Joint, at 03 o'clock, within 8 inches of joint: YESR	M 1
48.05		TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
49.37		RFJ	Roots Fine Joint, at 09 o'clock, within 8 inches of joint: YESR	M 1
50.18		TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
71.27		OBI	Obstacles Inuding Thru Wall, 10 %of cross sectional area, from 09 to 03 o'clock	M 2
71.98		CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES	S 3
86.27	**S1**	RPR	Repair Pipe Replaced, within 8 inches of joint: YES, Start / PVC	
95.80	**F1**	RPR	Repair Pipe Replaced, within 8 inches of joint: YES, Finish	
98.24	**S2**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
159.47	**F2**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
185.72		FL	Fracture Longitudinal, at 12 o'clock, within 8 inches of joint: YES	S 3
191.91		RFJ	Roots Fine Joint, at 03 o'clock, within 8 inches of joint: YESR	M 1

City : ENFIELD CT

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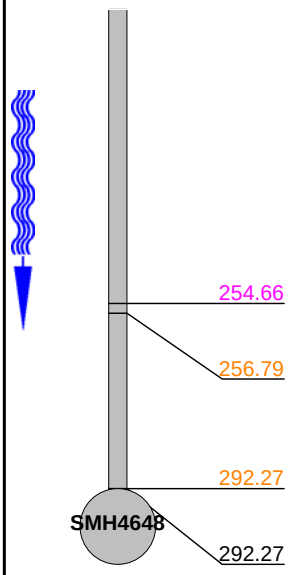
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
		Dry	**RODNEY BRICK**		
Certificate No.	**Survey Customer**	**System Owner**	**Preset :**	**Cleaned :**	**Sewer Category**
06020363				**Heavy Cleaning**	



1:468 Position		Code	Observation	Rate
254.66		CH2	Crack Longitudinal Hinge, 2, at 12 o'clock, within 8 inches of joint: YES / 12,3	S 4
256.79	**S3**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
292.27	**F3**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
292.27		AMH	Downstream Manhole, Survey Ends	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
413C	**2113**	**71**	**5**	**76**	**2.96**	**1.25**	**2.71**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/13/2015		**Dry**	**RODNEY BRICK**		**28**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ROBBIN RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2430**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2523**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**84.25 ft**	Section Length	**84.25 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**8.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :

1:210	Position	Code	Observation	Grade
SMH2430	0.00	AMH	Upstream Manhole, Survey Begins / SMH2430	
	39.33	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
	84.25	MSA	Survey Abandoned / REQUIRES HEAVY CLEANING	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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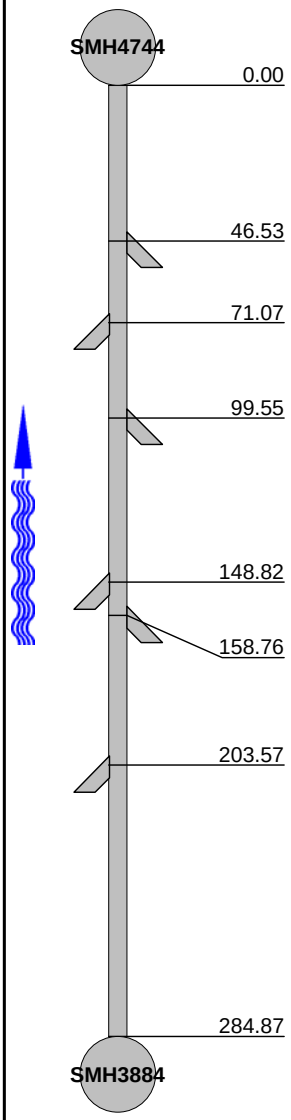
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/13/2015		**Dry**	**RODNEY BRICK**		**29**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**COLLEGE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3884**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4744**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**284.87 ft**	Section Length	**284.87 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**10 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:690 Position	Code	Observation	Grade
0.00	AMH	Downstream Manhole, Survey Begins / SMH4744	
46.53	TBA	Tap Break-In Active, at 09 o'clock, 6", within 8 inches of joint: YES	
71.07	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
99.55	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
148.82	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
158.76	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
203.57	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
284.87	AMH	Upstream Manhole, Survey Ends / SMH3884	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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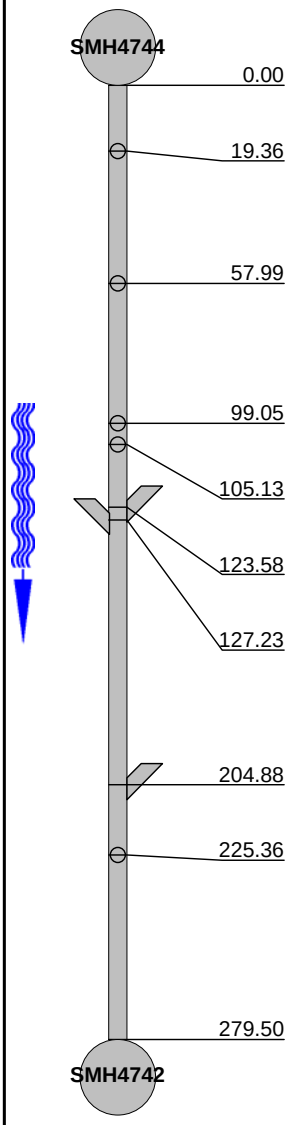
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Light Rain**	**RODNEY BRICK**		**30**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**COLLEGE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4744**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4742**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**279.50 ft**	Section Length	**279.50 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:675 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH4744	
19.36	TFC	Tap Factory Made Capped, at 12 o'clock, 6", within 8 inches of joint: YES	
57.99	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
99.05	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
105.13	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
123.58	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
127.23	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
204.88	TFA	Tap Factory Made Active, at 11 o'clock, 6", within 8 inches of joint: YES	
225.36	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
279.50	AMH	Downstream Manhole, Survey Ends / SMH4742	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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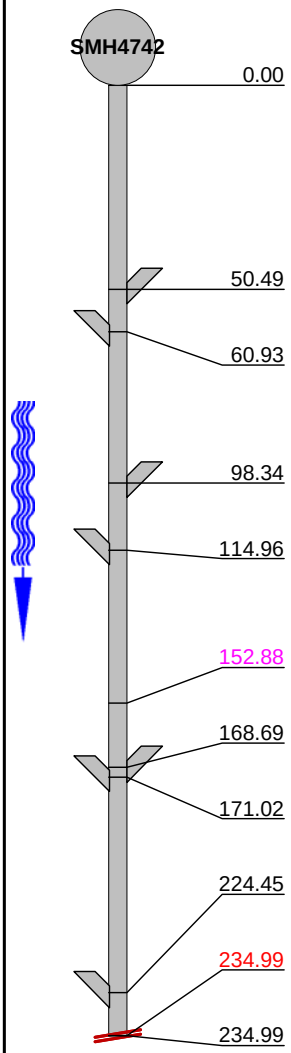
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Light Rain**	**RODNEY BRICK**		**31**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**COLLEGE ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4742**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4741**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**234.99 ft**	Section Length	**234.99 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:570 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH4742	
50.49	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
60.93	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
98.34	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
114.96	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
152.88	FM	Fracture Multiple, from 03 to 06 o'clock, within 8 inches of joint: YES	S 4
168.69	TFC	Tap Factory Made Capped, at 10 o'clock, 6", within 8 inches of joint: YES	
171.02	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
224.45	TF	Tap Factory Made, at 02 o'clock, 6", within 8 inches of joint: YES	
234.99	OBM	Obstacles Pipe Material, 50 %of cross sectional area, from 09 to 03 o'clock	M 5
234.99	MSA	Survey Abandoned / UNABLE TO DISLODGE PIPE MATERIAL	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
4100	**5100**	**4**	**5**	**9**	**4**	**5**	**4.5**

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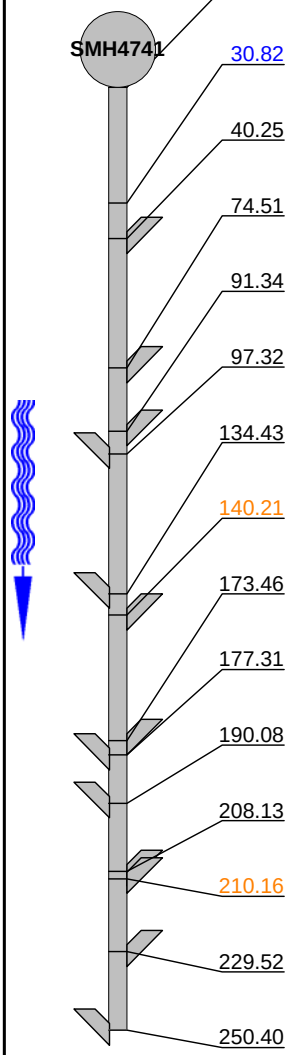
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**32**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**PLEASANT ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4741**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4723**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**388.89 ft**	Section Length	**388.89 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:612 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH4741	
30.82	CL	Crack Longitudinal, at 02 o'clock, within 8 inches of joint: YES	S 2
40.25	TF	Tap Factory Made, at 09 o'clock, 6", within 8 inches of joint: YES	
74.51	TFA	Tap Factory Made Active, at 10 o'clock, 6", within 8 inches of joint: YES	
91.34	TF	Tap Factory Made, at 10 o'clock, 6", within 8 inches of joint: YES	
97.32	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
134.43	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
140.21	TBI	Tap Break-In Intruding, at 09 o'clock, 6", 2", within 8 inches of joint: YES, 10 %	M 3
173.46	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
177.31	TFA	Tap Factory Made Active, at 01 o'clock, 6", within 8 inches of joint: YES	
190.08	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
208.13	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
210.16	TBI	Tap Break-In Intruding, at 08 o'clock, 6", 2", within 8 inches of joint: YES, 10 %	M 3
229.52	TF	Tap Factory Made, at 10 o'clock, 6", within 8 inches of joint: YES	
250.40	TF	Tap Factory Made, at 03 o'clock, 6", within 8 inches of joint: YES	

City : ENFIELD CT

The Environmental Protection Specialists

National Water Main Cleaning Company
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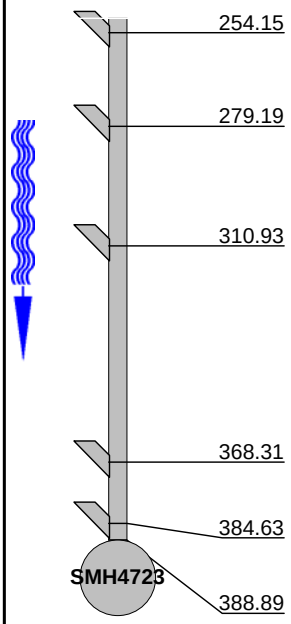
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
		Dry	**RODNEY BRICK**		
Certificate No.	**Survey Customer**	**System Owner**	**Preset :**	**Cleaned :**	**Sewer Category**
06020363				**Jetting**	



1:612 Position	Code	Observation	Rate
254.15	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
279.19	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
310.93	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
368.31	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
384.63	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
388.89	AMH	Downstream Manhole, Survey Ends / SMH4723	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
2100	**3200**	**2**	**6**	**8**	**2**	**3**	**2.67**

STA008-2 MERGED

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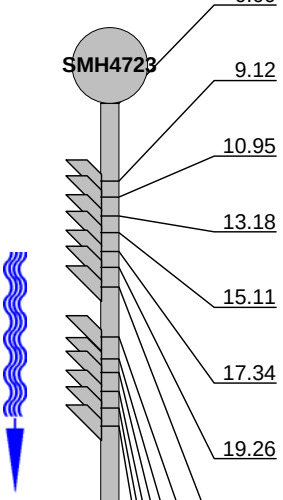
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**33**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WITWORTH ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4723**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4725**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**222.12 ft**	Section Length	**222.12 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:270 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH4723	
9.12	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
10.95	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
13.18	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
15.11	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
17.34	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
19.26	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
21.49	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
27.37	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
29.91	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
31.53	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
33.76	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
35.69	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
37.81	TFC	Tap Factory Made Capped, at 02 o'clock, 6", within 8 inches of joint: YES	
72.18	CL	Crack Longitudinal, 6", at 09 o'clock, within 8 inches of joint: YES	S 2

City : ENFIELD CT

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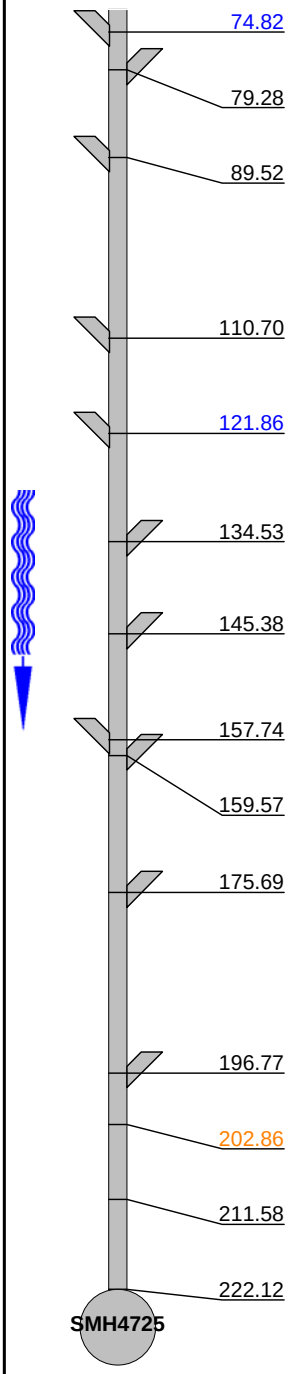
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
		Dry	**RODNEY BRICK**		
Certificate No.	**Survey Customer**	**System Owner**	**Preset :**	**Cleaned :**	**Sewer Category**
06020363				**Jetting**	



1:270 Position	Code	Observation	Rate
74.82	TBI	Tap Break-In Intruding, at 03 o'clock, 6", 2", within 8 inches of joint: YES, 5 %	M 2
79.28	TF	Tap Factory Made, at 09 o'clock, 6", within 8 inches of joint: YES	
89.52	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
110.70	TBA	Tap Break-In Active, at 03 o'clock, 6", within 8 inches of joint: YES	
121.86	TBI	Tap Break-In Intruding, at 01 o'clock, 6", 2", within 8 inches of joint: YES, 10 %	M 2
134.53	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
145.38	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
157.74	TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
159.57	TF	Tap Factory Made, at 09 o'clock, 6", within 8 inches of joint: YES	
175.69	TF	Tap Factory Made, at 09 o'clock, 6", within 8 inches of joint: YES	
196.77	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
202.86	CM	Crack Multiple, from 03 to 09 o'clock, within 8 inches of joint: YES	S 3
211.58	MMC	Material Change, Reinforced concrete pipe	
222.12	AMH	Downstream Manhole, Survey Ends / SMH4725	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3121	**2200**	**5**	**4**	**9**	**2.5**	**2**	**2.25**

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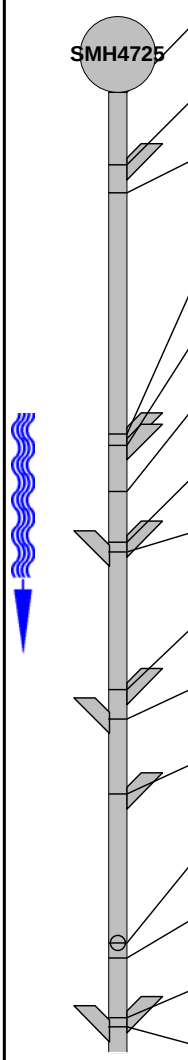
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**34**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WITWORTH ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4725**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4726**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**215.12 ft**	Section Length	**215.12 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:450 Position		Code	Observation	Grade
0.00		AMH	Upstream Manhole, Survey Begins / SMH4725	
14.19		TB	Tap Break-In, at 09 o'clock, 6", within 8 inches of joint: YES	
19.57	**S1**	FM	Fracture Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 4
66.71		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
68.94		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
77.96	**F1**	FM	Fracture Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 4
87.89		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
89.72		TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
116.69		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
122.36		TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
137.06		TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
166.16		TFC	Tap Factory Made Capped, at 12 o'clock, 6", within 8 inches of joint: YES	
169.10		FL	Fracture Longitudinal, at 12 o'clock, within 8 inches of joint: YES	S 3
180.76		TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
182.48		TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	

City : ENFIELD CT

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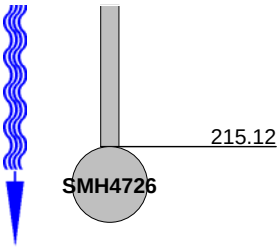
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
		Dry	**RODNEY BRICK**		
Certificate No.	Survey Customer	System Owner	Preset :	Cleaned :	Sewer Category
06020363				**Jetting**	

1:450	Position	Code	Observation	Rate
	215.12	AMH	Downstream Manhole, Survey Ends / SMH4726	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
4A31	**0000**	**51**	**0**	**51**	**3.92**	**0**	**3.92**

STA008-2 MERGED

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**35**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**S MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3872**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3873**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**161.50 ft**	Section Length	**161.50 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**5.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :

1:390	Position	Code	Observation	Grade
SMH3872	0.00	AMH	Upstream Manhole, Survey Begins / SMH3872	
SMH3873	161.50	AMH	Downstream Manhole, Survey Ends / SMH3873	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

STA008-2 MERGED

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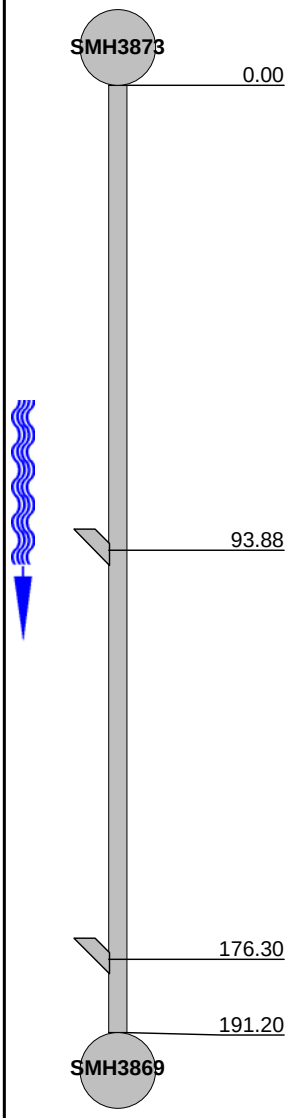
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**36**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**S MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3873**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3869**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**191.20 ft**	Section Length	**191.20 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**20.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Clay Tile**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:465	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3873	
	93.88	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
	176.30	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
	191.20	AMH	Downstream Manhole, Survey Ends / SMH3869	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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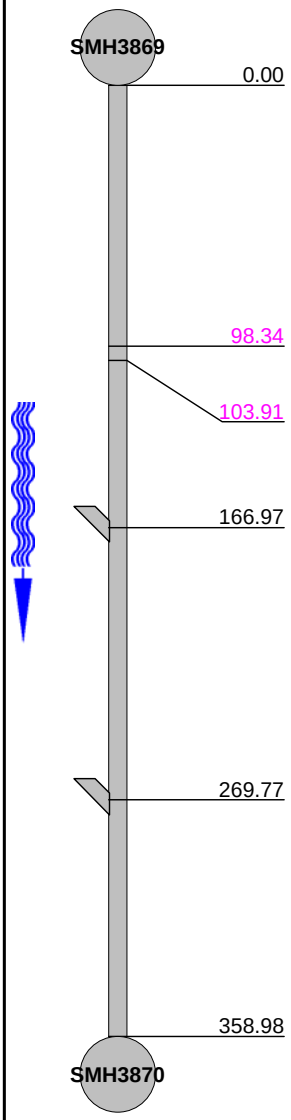
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**37**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**S MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3869**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3870**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**358.98 ft**	Section Length	**358.98 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:870	Position		Code	Observation	Grade
	0.00		AMH	Upstream Manhole, Survey Begins / SMH3869	
	98.34	**S1**	MCU	Camera Underwater, Start	M 4
	103.91	**F1**	MCU	Camera Underwater, Finish	M 4
	166.97		TF	Tap Factory Made, at 03 o'clock, 6", within 8 inches of joint: YES	
	269.77		TFC	Tap Factory Made Capped, at 03 o'clock, 6", within 8 inches of joint: YES	
	358.98		AMH	Downstream Manhole, Survey Ends / SMH3870	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**4200**	**0**	**8**	**8**	**0**	**4**	**4**

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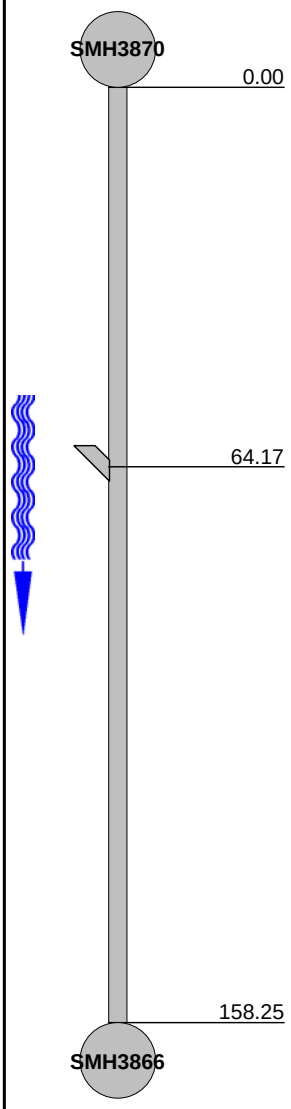
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**38**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**S MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3870**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3866**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**158.25 ft**	Section Length	**158.25 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:390	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3870	
	64.17	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
	158.25	AMH	Downstream Manhole, Survey Ends / SMH3866	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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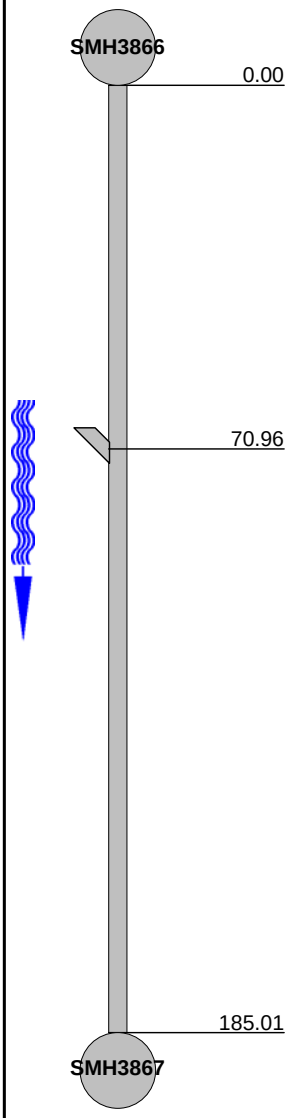
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**39**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**S MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3866**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3867**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**185.01 ft**	Section Length	**185.01 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:450	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3866	
	70.96	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
	185.01	AMH	Downstream Manhole, Survey Ends / SMH3867	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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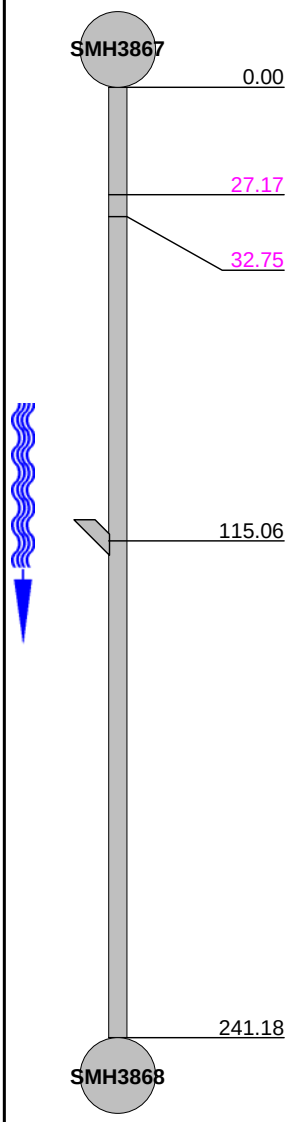
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/14/2015		**Dry**	**RODNEY BRICK**		**40**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**S MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3867**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3868**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**241.18 ft**	Section Length	**241.18 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041315**	Lining Method	

Add. Information :



1:585	Position		Code	Observation	Grade
	0.00		AMH	Upstream Manhole, Survey Begins / SMH3867	
	27.17	**S1**	MCU	Camera Underwater, Start	M 4
	32.75	**F1**	MCU	Camera Underwater, Finish	M 4
	115.06		TF	Tap Factory Made, at 03 o'clock, 6", within 8 inches of joint: YES	
	241.18		AMH	Downstream Manhole, Survey Ends / SMH3868	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**4200**	**0**	**8**	**8**	**0**	**4**	**4**

STA008-2 MERGED

The Environmental Protection Specialists

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/15/2015		**Dry**	**RODNEY BRICK**		**41**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3868**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3874**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**98.64 ft**	Section Length	**98.64 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:240	Position	Code	Observation	Grade
SMH3874				
	0.00	AMH	Downstream Manhole, Survey Begins / SMH3874	
	98.64	AMH	Upstream Manhole, Survey Ends / SMH3868	
SMH3868				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/15/2015		**Dry**	**RODNEY BRICK**		**42**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3874**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3875**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**52.72 ft**	Section Length	**52.72 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:135	Position	Code	Observation	Grade
SMH3874				
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3874	
	52.72	AMH	Downstream Manhole, Survey Ends / SMH3875	
SMH3875				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/15/2015		**Dry**	**RODNEY BRICK**		**43**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3875**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3876**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**100.77 ft**	Section Length	**100.77 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:255	Position	Code	Observation	Grade
SMH3875	0.00	AMH	Upstream Manhole, Survey Begins / SMH3875	
	100.77	AMH	Downstream Manhole, Survey Ends / SMH3876	
SMH3876				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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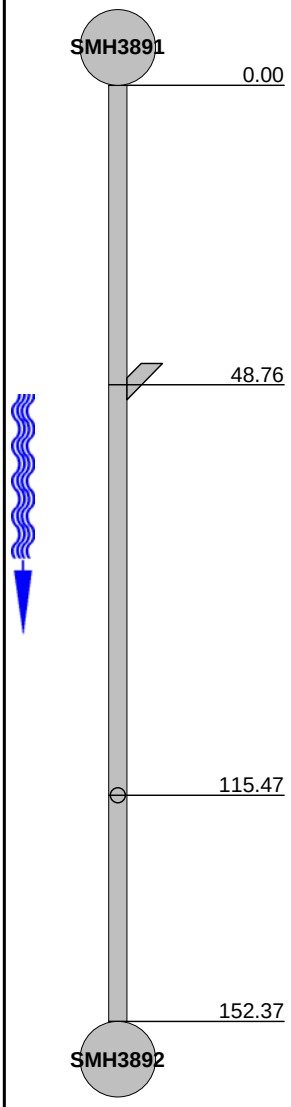
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/15/2015		**Dry**	**RODNEY BRICK**		**44**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**HIGH ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3891**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3892**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**152.37 ft**	Section Length	**152.37 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:375	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3891	
	48.76	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
	115.47	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES / RML	
	152.37	AMH	Downstream Manhole, Survey Ends / SMH3892	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**45**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3876**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3877**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**138.58 ft**	Section Length	**138.58 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:345	Position	Code	Observation	Grade
SMH3876	0.00	AMH	Upstream Manhole, Survey Begins / SMH3876	
	138.58	AMH	Downstream Manhole, Survey Ends / SMH3877	
SMH3877				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

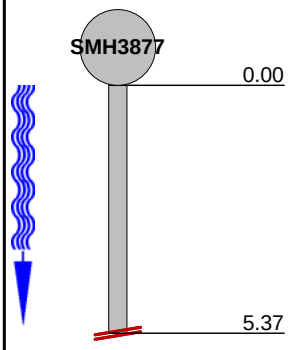
Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**46**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3877**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4772**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**6.18 ft**	Section Length	**6.18 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:50	Position	Code	Observation	Grade
SMH3877	0.00	AMH	Upstream Manhole, Survey Begins / SMH3877	
	5.37	MSA	Survey Abandoned / SMALL DROP @POINT OF CHANGE	



QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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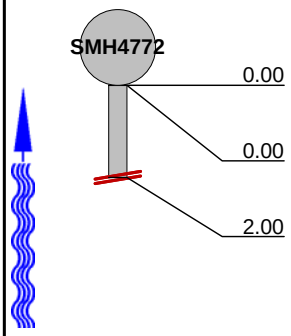
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**47**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3877**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4772**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**2.00 ft**	Section Length	**2.00 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	
Year Laid		Dia./Height	**15 inch**
Year Rehabilitated		Material	**Brick**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:50 Position	Code	Observation	Grade
0.00	MGO	Reversal Inspection	
0.00	AMH	Downstream Manhole, Survey Begins / SMH4772	
2.00	MSA	Survey Abandoned / BAD CONNECTION	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**48**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4819**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4754**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**133.41 ft**	Section Length	**133.41 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:330	Position		Code	Observation	Grade
SMH4754	0.00		AMH	Downstream Manhole, Survey Begins / SMH4754	
	96.00	**S1**	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 10 %, within 8 inches of joint: YESR, Start	M 3
	133.41	**F1**	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 10 %, within 8 inches of joint: YESR, Finish	M 3
SMH4819	133.41		AMH	Upstream Manhole, Survey Ends / SMH4819	

96 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**3700**	**0**	**21**	**21**	**0**	**3**	**3**

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Inspection photos

City :	Street :	Date :	Pipe Segment Reference :	Section No :
ENFIELD CT	**N MAIN ST**			**48**

Photo:
48_SMH4819_SMH4754_16042015_U_RMJ_96.0049_095018
_A.JPG, VCR No.: 76-041515
96FT, Roots Medium Joint, from 09 to 03 o'clock, 10 %, within
8 inches of joint: YESR, Start

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Inspection Report

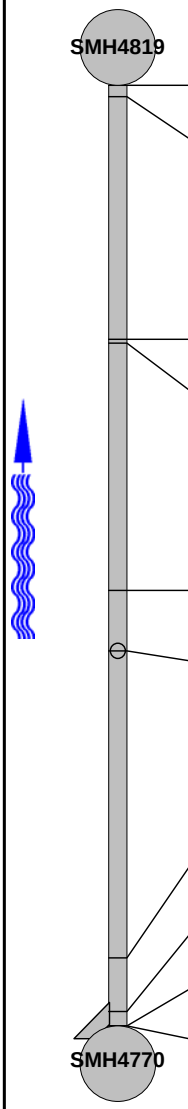
Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**49**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**N MAIN ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4770**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4819**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**208.23 ft**	Section Length	**208.23 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

193.02 FT



1:510 Position		Code	Observation	Grade
0.00		AMH	Downstream Manhole, Survey Begins / SMH4819	
2.43	**S1**	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 10 %, within 8 inches of joint: YESR, Start	M 3
56.26		CL	Crack Longitudinal, at 03 o'clock, within 8 inches of joint: YES	S 2
56.97	**F1**	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 10 %, within 8 inches of joint: YESR, Finish	M 3
111.72	**S2**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
125.20		TB	Tap Break-In, at 12 o'clock, 6", within 8 inches of joint: YES	
193.02		FM	Fracture Multiple, from 10 to 02 o'clock, within 8 inches of joint: YES	S 4
204.99		TFC	Tap Factory Made Capped, at 04 o'clock, 6", within 8 inches of joint: YES	
208.23	**F2**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
208.23		AMH	Upstream Manhole, Survey Ends / SMH4770	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
413C	**3A00**	**63**	**33**	**96**	**3**	**3**	**3**

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Inspection photos

City :	Street :	Date :	Pipe Segment Reference :	Section No :
ENFIELD CT	**N MAIN ST**			**49**

Photo:
49_SMH4770_SMH4819_16042015_U_FM_193.0236_100444
_A.JPG, VCR No.: 76-041515
193.02FT, Fracture Multiple, from 10 to 02 o'clock, within 8 inches of joint: YES

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Inspection Report

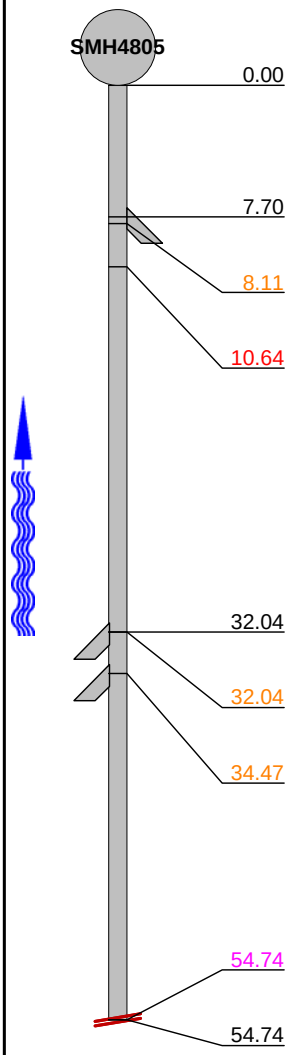
Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**50**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**HIGH ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3892**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4805**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**54.74 ft**	Section Length	**54.74 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**2.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:135



Position		Code	Observation	Grade
0.00		AMH	Downstream Manhole, Survey Begins / SMH4805	
7.70		TF	Tap Factory Made, at 09 o'clock, 6", within 8 inches of joint: YES	
8.11	**S1**	CM	Crack Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Start	S 3
10.64		BSV	Broken Soil Visible, at 02 o'clock, within 8 inches of joint: YES	S 5
32.04		TF	Tap Factory Made, at 03 o'clock, 6", within 8 inches of joint: YES	
32.04	**F1**	CM	Crack Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES, Finish	S 3
34.47		TBI	Tap Break-In Intruding, at 03 o'clock, 6", 1", within 8 inches of joint: YES, 5 %	M 3
54.74		LR	Alignment Right, 40 %	M 4
54.74		MSA	Survey Abandoned / SHARP TURN NO US ACCESS	

10.64 FT

10.64 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
5135	**4131**	**20**	**7**	**27**	**3.33**	**3.5**	**3.38**

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Inspection photos

City :	Street :	Date :	Pipe Segment Reference :	Section No :
ENFIELD CT	**HIGH ST**			**50**

Photo:
50_SMH3892_SMH4805_16042015_U_BSV_10.6447_105749_A.JPG, VCR No.: 76-041515
10.64FT, Broken Soil Visible, at 02 o'clock, within 8 inches of joint: YES

Photo:
50_SMH3892_SMH4805_16042015_U_BSV_10.6447_105757_A.JPG, VCR No.: 76-041515
10.64FT, Broken Soil Visible, at 02 o'clock, within 8 inches of joint: YES

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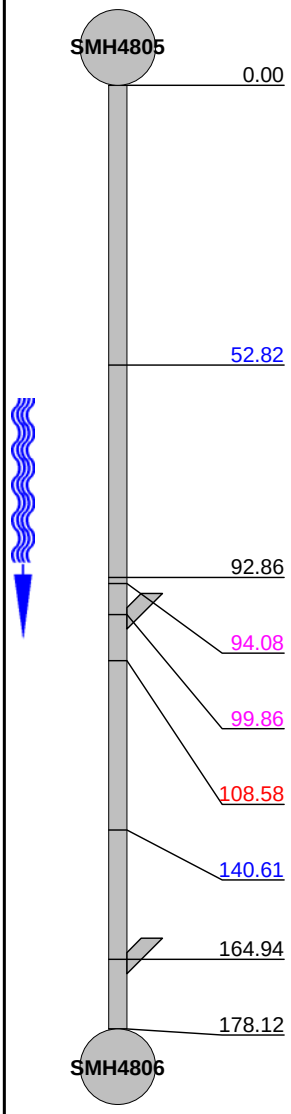
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**51**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**HIGH ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4805**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4806**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**178.12 ft**	Section Length	**178.12 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:435 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH4805	
52.82	CL	Crack Longitudinal, at 10 o'clock, within 8 inches of joint: YES	S 2
92.86	RPP	Repair Patch, at 12 o'clock, within 8 inches of joint: YES	
94.08	FM	Fracture Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES	S 4
99.86	TBI	Tap Break-In Intruding, at 09 o'clock, 6", 2", within 8 inches of joint: YES, 5 %	M 4
108.58	BSV	Broken Soil Visible, at 09 o'clock, within 8 inches of joint: YES	S 5
140.61	CL	Crack Longitudinal, at 09 o'clock, within 8 inches of joint: YES	S 2
164.94	TB	Tap Break-In, at 09 o'clock, 6", within 8 inches of joint: YES	
178.12	AMH	Downstream Manhole, Survey Ends / SMH4806	

92.86 FT

92.86 FT

108.58 FT

108.58 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
5141	**4100**	**13**	**4**	**17**	**3.25**	**4**	**3.4**

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Inspection photos

City :	Street :	Date :	Pipe Segment Reference :	Section No :
ENFIELD CT	**HIGH ST**			**51**

Photo:
51_SMH4805_SMH4806_16042015_D_RPP_92.8622_111600_A.JPG, VCR No.: 76-041515
92.86FT, Repair Patch, at 12 o'clock, within 8 inches of joint: YES

Photo:
51_SMH4805_SMH4806_16042015_D_RPP_92.8622_111610_A.JPG, VCR No.: 76-041515
92.86FT, Repair Patch, at 12 o'clock, within 8 inches of joint: YES

Photo:
51_SMH4805_SMH4806_16042015_D_BSV_108.5758_111852_A.JPG, VCR No.: 76-041515
108.58FT, Broken Soil Visible, at 09 o'clock, within 8 inches of joint: YES

Photo:
51_SMH4805_SMH4806_16042015_D_BSV_108.5758_111901_A.JPG, VCR No.: 76-041515
108.58FT, Broken Soil Visible, at 09 o'clock, within 8 inches of joint: YES

The Environmental Protection Specialists

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**52**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**HIGH ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4806**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4806A**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**11.96 ft**	Section Length	**11.96 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:50	Position	Code	Observation	Grade
SMH4806				
	0.00	AMH	Upstream Manhole, Survey Begins / SMH4806	
	11.96	AMH	Downstream Manhole, Survey Ends / SMH4806A	
SMH4806A				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**53**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ASNUNTUCK ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3878**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3879**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**125.61 ft**	Section Length	**125.61 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :

1:315	Position	Code	Observation	Grade
SMH3878	0.00	AMH	Upstream Manhole, Survey Begins / SMH3878	
	78.57	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
SMH3879	125.61	AMH	Downstream Manhole, Survey Ends / SMH3879	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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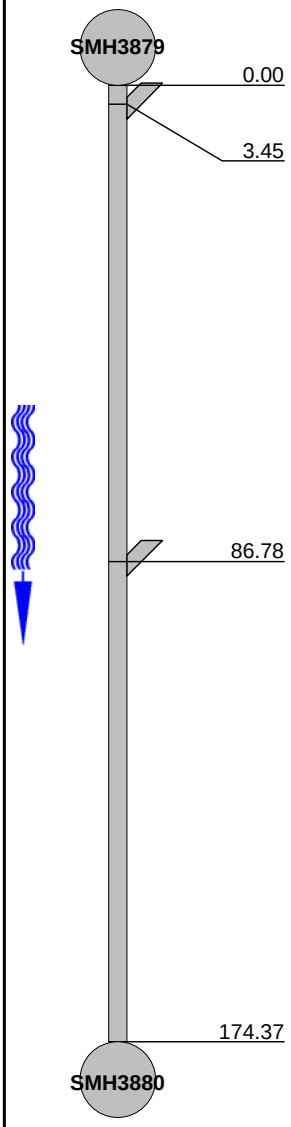
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**54**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ASNUNTUCK ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3879**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3880**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**174.37 ft**	Section Length	**174.37 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:420	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3879	
	3.45	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
	86.78	TFC	Tap Factory Made Capped, at 09 o'clock, 6", within 8 inches of joint: YES	
	174.37	AMH	Downstream Manhole, Survey Ends / SMH3880	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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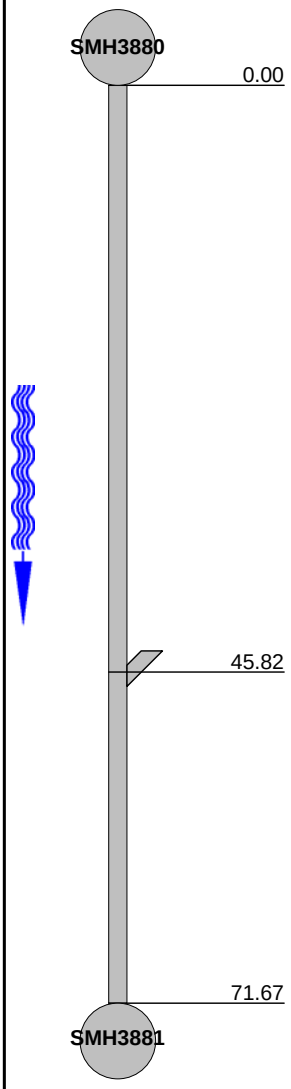
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**55**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ASNUNTUCK ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3880**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3881**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**71.67 ft**	Section Length	**71.67 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:180	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3880	
	45.82	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
	71.67	AMH	Downstream Manhole, Survey Ends / SMH3881	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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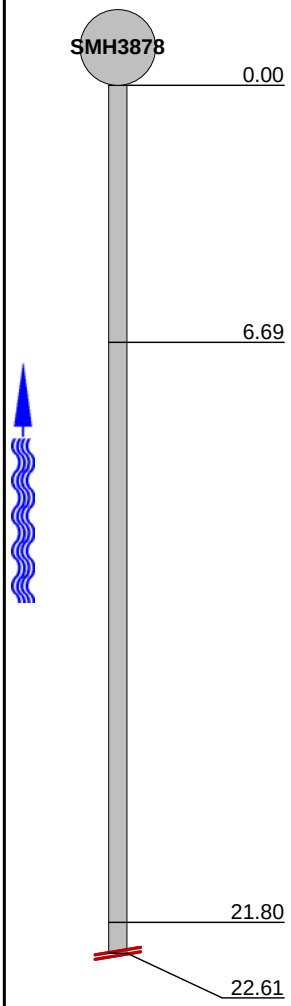
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**56**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**PEARL ST**	Use of Sewer	**Sanitary**	Upstream MH	**UNKNOWN**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3878**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**22.61 ft**	Section Length	**22.61 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Asbestos Cement**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:60 Position	Code	Observation	Grade
0.00	AMH	Downstream Manhole, Survey Begins / SMH3878	
6.69	MMC	Material Change, Vitrified clay pipe	
21.80	RPR	Repair Pipe Replaced, within 8 inches of joint: YES / PVC SLEEVED	
22.61	MSA	Survey Abandoned / UNABLE TO CRAWL INTO REPAIR	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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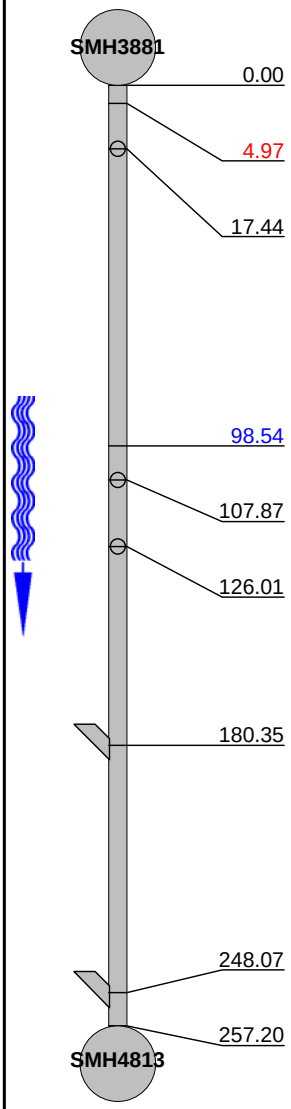
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**57**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ASNUNTUCK**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3881**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4813**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**257.20 ft**	Section Length	**257.20 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:630 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH3881	
4.97	BSV	Broken Soil Visible, from 05 to 07 o'clock, within 8 inches of joint: YES	S 5
17.44	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
98.54	FC	Fracture Circumferential, from 03 to 09 o'clock, within 8 inches of joint: YES	S 2
107.87	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
126.01	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
180.35	TB	Tap Break-In, at 03 o'clock, 6", within 8 inches of joint: YES	
248.07	TB	Tap Break-In, at 02 o'clock, 6", within 8 inches of joint: YES	
257.20	AMH	Downstream Manhole, Survey Ends / SMH4813	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
5121	**0000**	**7**	**0**	**7**	**3.5**	**0**	**3.5**

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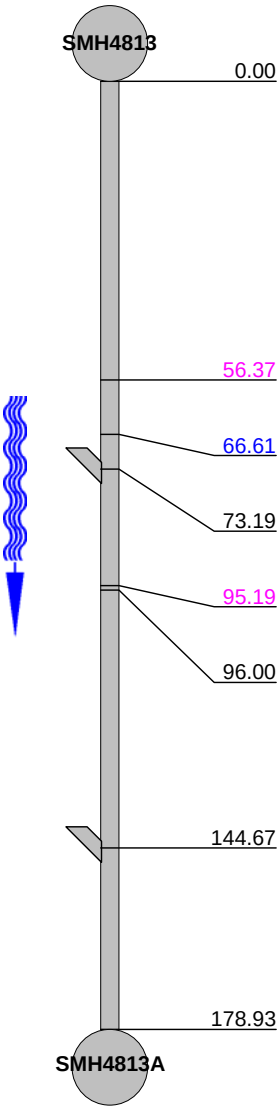
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/16/2015		**Dry**	**RODNEY BRICK**		**58**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**ASNUNTUCK**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4813**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4813A**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**178.93 ft**	Section Length	**178.93 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**8 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041515**	Lining Method	

Add. Information :



1:435 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH4813A	
56.37	FM	Fracture Multiple, from 08 to 04 o'clock, within 8 inches of joint: YES	S 4
66.61	CL	Crack Longitudinal, at 03 o'clock, within 8 inches of joint: YES	S 2
73.19	TF	Tap Factory Made, at 03 o'clock, 6", within 8 inches of joint: YES	
95.19	FM	Fracture Multiple, from 10 to 03 o'clock, within 8 inches of joint: YES	S 4
96.00	RPP	Repair Patch, from 10 to 02 o'clock, within 8 inches of joint: YES	
144.67	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
178.93	AMH	Downstream Manhole, Survey Ends / SMH4750	

96 FT

96 FT

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
4221	**0000**	**10**	**0**	**10**	**3.33**	**0**	**3.33**

STA008-2 MERGED

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Inspection photos

City :	Street :	Date :	Pipe Segment Reference :	Section No :
ENFIELD CT	**ASNUNTUCK**			**58**

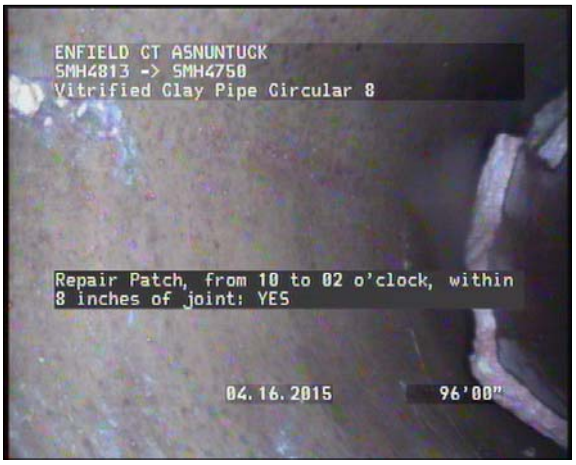

Photo:
58_SMH4813_SMH4813A_16042015_D_RPP_96.0049_140442_A.JPG, VCR No.: 76-041515
96FT, Repair Patch, from 10 to 02 o'clock, within 8 inches of joint: YES

Photo:
58_SMH4813_SMH4813A_16042015_D_RPP_96.0049_140452_A.JPG, VCR No.: 76-041515
96FT, Repair Patch, from 10 to 02 o'clock, within 8 inches of joint: YES

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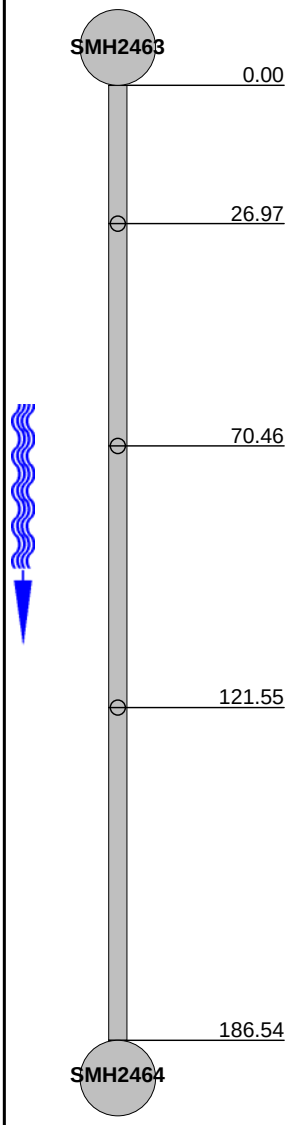
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**59**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BOOTH RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2463**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2464**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**186.54 ft**	Section Length	**186.54 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :



1:450 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2463	
26.97	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
70.46	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
121.55	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
186.54	AMH	Downstream Manhole, Survey Ends / SMH2464	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

STA008-2 MERGED

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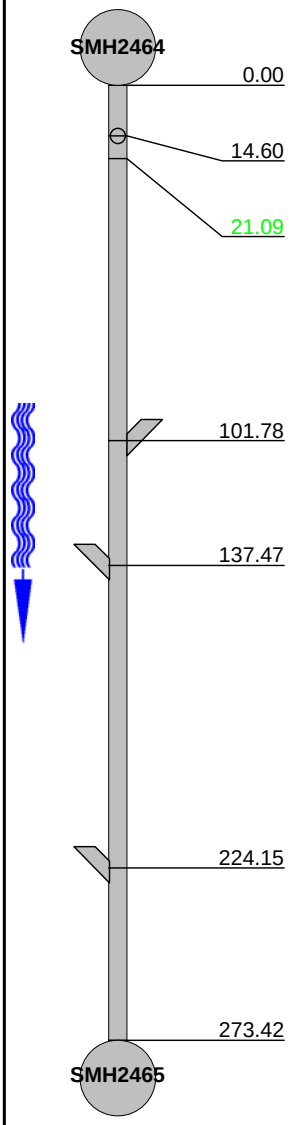
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**60**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BOOTH RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2464**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2465**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**273.42 ft**	Section Length	**273.42 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :



1:660 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2464	
14.60	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES / RBL	
21.09	RFJ	Roots Fine Joint, from 09 to 03 o'clock, within 8 inches of joint: YESR	M 1
101.78	TFA	Tap Factory Made Active, at 09 o'clock, 6", within 8 inches of joint: YES	
137.47	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
224.15	TFA	Tap Factory Made Active, at 02 o'clock, 6", within 8 inches of joint: YES	
273.42	AMH	Downstream Manhole, Survey Ends / SMH2465	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**1100**	**0**	**1**	**1**	**0**	**1**	**1**

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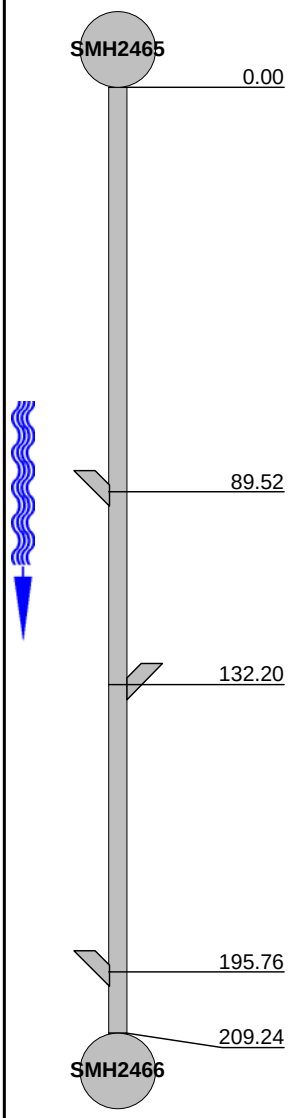
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**61**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BOOTH RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2465**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2466**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**209.24 ft**	Section Length	**209.24 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :



1:510	Position	Code	Observation	Grade
	0.00	AMH	Upstream Manhole, Survey Begins / SMH2465	
	89.52	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
	132.20	TB	Tap Break-In, at 10 o'clock, 6", within 8 inches of joint: YES	
	195.76	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
	209.24	AMH	Downstream Manhole, Survey Ends / SMH2466	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

STA008-2 MERGED

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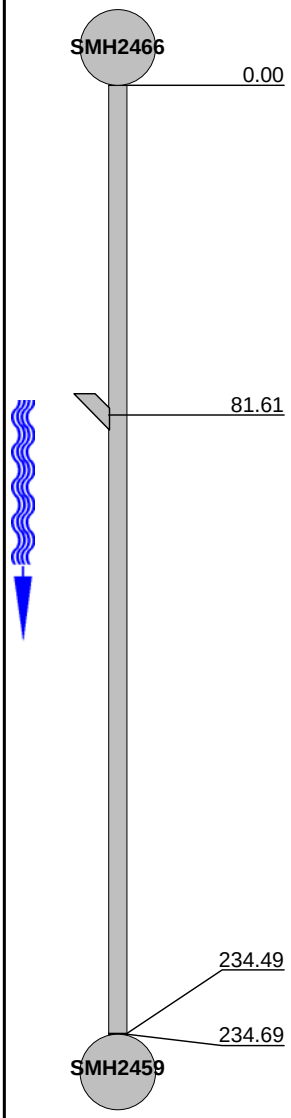
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**62**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**BOOTH RD**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2466**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2459**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**234.69 ft**	Section Length	**234.69 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :



1:570 Position	Code	Observation	Grade
0.00	AMH	Upstream Manhole, Survey Begins / SMH2466	
81.61	TFA	Tap Factory Made Active, at 03 o'clock, 5", within 8 inches of joint: YES	
234.49	MGO	General Observation / EXTERNAL DROP	
234.69	AMH	Downstream Manhole, Survey Ends / WEIR BUILT	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

The Environmental Protection Specialists

National Water Main Cleaning Company
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Rocky Hill, CT 06067
Tel: 860.372.4199
Fax: 781-828-2473
E-mail: boston@nwmcc-bos.com

Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**63**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**CAMP ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3461**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2459**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**236.92 ft**	Section Length	**236.92 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :

1:570	Position	Code	Observation	Grade
SMH2459				
	0.00	AMH	Downstream Manhole, Survey Begins / SMH2459	
	77.25	TFA	Tap Factory Made Active, at 12 o'clock, 6", within 8 inches of joint: YES	
	195.46	TF	Tap Factory Made, at 12 o'clock, 6", within 8 inches of joint: YES	
	236.92	AMH	Upstream Manhole, Survey Ends / SMH3461	
SMH3461				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

STA008-2 MERGED

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**64**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TANGLEWOOD AVE**	Use of Sewer	**Sanitary**	Upstream MH	**SMH2090**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3503**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**289.03 ft**	Section Length	**289.03 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :

1:705	Position	Code	Observation	Grade
SMH2090	0.00	AMH	Upstream Manhole, Survey Begins / SMH2090	
	109.89	TFA	Tap Factory Made Active, at 03 o'clock, 6", within 8 inches of joint: YES	
	289.03	AMH	Downstream Manhole, Survey Ends / SMH3503	
SMH3503				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

STA008-2 MERGED

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**65**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TANGLEWOOD AVE**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3503**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH3504**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**288.52 ft**	Section Length	**288.52 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :

1:705	Position	Code	Observation	Grade
SMH3503				
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3503	
	288.52	AMH	Downstream Manhole, Survey Ends / SMH3504	
SMH3504				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**66**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TANGLEWOOD AVE**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3504**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2052**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**292.37 ft**	Section Length	**292.37 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :

1:705	Position	Code	Observation	Grade
SMH3504				
	0.00	AMH	Upstream Manhole, Survey Begins / SMH3504	
	292.37	AMH	Downstream Manhole, Survey Ends / SMH2052	
SMH2052				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**67**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**TANGLEWOOD AVE**	Use of Sewer	**Sanitary**	Upstream MH	**SMH3533**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH2090**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**194.34 ft**	Section Length	**194.34 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**10.00 ft**
Year Laid		Dia./Height	**12 inch**
Year Rehabilitated		Material	**Reinforced Concrete Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :

1:480	Position	Code	Observation	Grade
SMH2090				
	0.00	AMH	Downstream Manhole, Survey Begins / SMH2090	
	194.34	AMH	Upstream Manhole, Survey Ends / SMH3533	
SMH3533				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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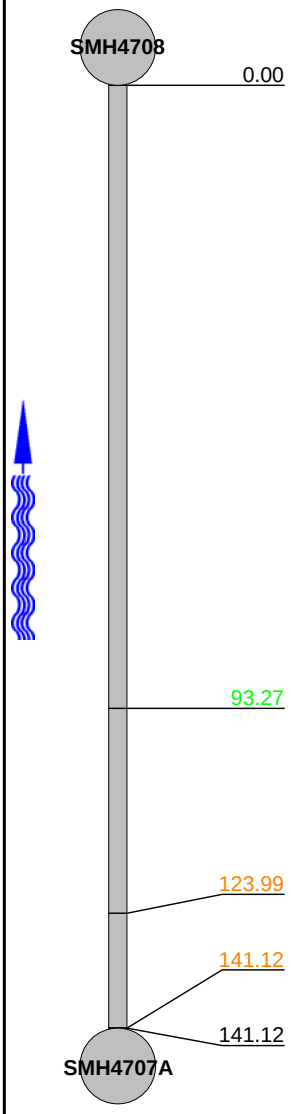
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**68**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WEST ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4707A**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4708**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Upstream**
Location Code		Length surveyed	**141.12 ft**	Section Length	**141.12 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :



1:345	Position		Code	Observation	Grade
	0.00		AMH	Downstream Manhole, Survey Begins / SMH4708	
	93.27		RFJ	Roots Fine Joint, from 09 to 03 o'clock, within 8 inches of joint: YESR	M 1
	123.99	**S1**	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 10 %, within 8 inches of joint: YESR, Start	M 3
	141.12	**F1**	RMJ	Roots Medium Joint, from 09 to 03 o'clock, 10 %, within 8 inches of joint: YESR, Finish	M 3
	141.12		AMH	Upstream Manhole, Survey Ends / 4707A	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**3311**	**0**	**10**	**10**	**0**	**2.5**	**2.5**

STA008-2 MERGED

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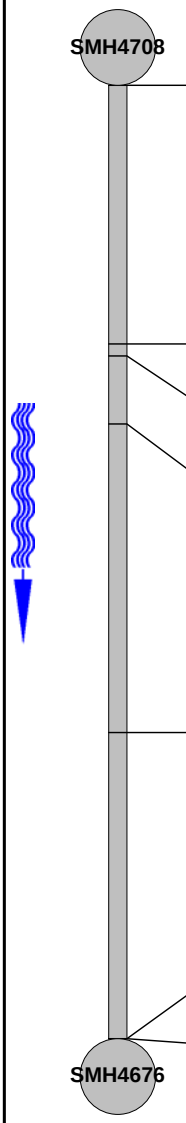
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**69**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WEST ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4708**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4676**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**211.07 ft**	Section Length	**211.07 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :



1:510	Position		Code	Observation	Grade
	0.00		AMH	Upstream Manhole, Survey Begins / SMH4708	
	57.28		IW	Infiltration Weeper, from 09 to 03 o'clock, within 8 inches of joint: YES	M 2
	59.91		ID	Infiltration Dripper, at 12 o'clock, within 8 inches of joint: YES	M 3
	75.02		ID	Infiltration Dripper, at 12 o'clock, within 8 inches of joint: YES	M 3
	143.15	**S1**	DAGS	Deposits Attached Grease, 5 %of cross sectional area, from 09 to 03 o'clock, , within 8 inches of joint: YES, Start	M 2
	211.07	**F1**	DAGS	Deposits Attached Grease, 5 %of cross sectional area, from 09 to 03 o'clock, , within 8 inches of joint: YES, Finish	M 2
	211.07		AMH	Downstream Manhole, Survey Ends / SMH4676	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**322B**	**0**	**36**	**36**	**0**	**2.12**	**2.12**

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Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/17/2015		**Light Rain**	**RODNEY BRICK**		**70**
Certificate No.	Survey Customer	System Owner	Preset :	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street	**WEST ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4676**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4677**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**346.00 ft**	Section Length	**346.00 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**76-041615**	Lining Method	

Add. Information :

1:840	Position	Code	Observation	Grade
SMH4676				
	0.00	AMH	Upstream Manhole, Survey Begins / SMH4676	
	346.00	AMH	Downstream Manhole, Survey Ends / SMH4677	
SMH4677				

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
0000	**0000**	**0**	**0**	**0**	**0**	**0**	**0**

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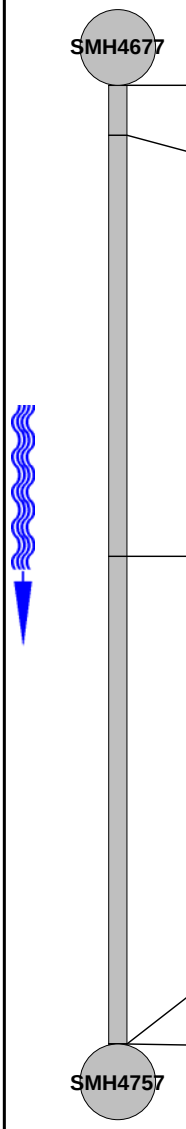
Inspection Report

Date	P/O. No.	Weather	Surveyor's Name	Pipe Segment Reference	Section No.
4/20/2015		**Light Rain**	**RODNEY BRICK**		**71**
Certificate No.	Survey Customer	System Owner	Date Cleaned	Pre-Cleaning	Sewer Category
06020363				**Jetting**	

Street123	**WEST ST**	Use of Sewer	**Sanitary**	Upstream MH	**SMH4677**
City	**ENFIELD CT**	Drainage Area		Dowstream MH	**SMH4757**
Loc. details		Flow Control	**Not Controlled**	Dir. of Survey	**Downstream**
Location Code		Length surveyed	**156.02 ft**	Section Length	**156.02 ft**

Purpose of Survey	**Routine Assessment**	Joint Length	**3.00 ft**
Year Laid		Dia./Height	**18 inch**
Year Rehabilitated		Material	**Vitrified Clay Pipe**
Tape / Media No.	**46-042015**	Lining Method	

Add. Information :



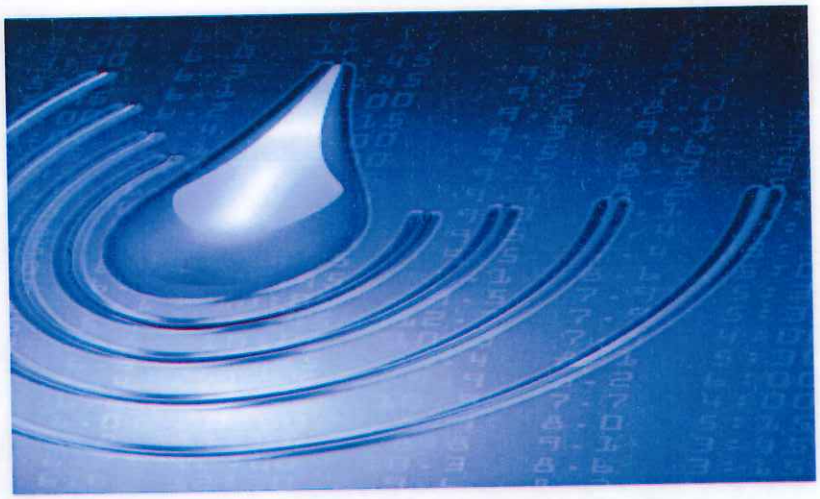
1:375	Position		Code	Observation	Grade
	0.00		AMH	Upstream Manhole, Survey Begins / SMH4677	
	8.11	**S1**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Start	S 3
	76.66		IR	Infiltration Runner, at 12 o'clock, within 8 inches of joint: YES	M 4
	156.02	**F1**	CM	Crack Multiple, from 09 to 03 o'clock, within 8 inches of joint: YES, Finish	S 3
	156.02		AMH	Downstream Manhole, Survey Ends / SMH4757	

QSR	QMR	SPR	MPR	OPR	SPRI	MPRI	OPRI
3E00	**4100**	**90**	**4**	**94**	**3**	**4**	**3.03**

APPENDIX D: FLOW MONITORING REPORT

ADS ENVIRONMENTAL SERVICES®

UNDERGROUND INTELLIGENCE®
FOR ENHANCED COLLECTION SYSTEM PERFORMANCE and ENGINEERED SOLUTIONS



Woodard and Curran

Enfield, CT

Flow Monitoring Report

March 20, 2015 – May 18, 2015

Table of Contents

Enfield, CT 5
Enfield CT 5
Letter of Transmittal 5
Scope and Methodology 6
Attachments 11
Flow Metering Schematic 11
Locations 12
Enfield_FM01 12
Site Commentary 12
Attachments 13
Site Report 13
Graphs 14
Scattergraph 14
Hydrograph 15
Tabular Reports 16
Daily Flow View 16
Enfield_FM02 18
Site Commentary 18
Attachments 19
Site Report 19
Graphs 20
Scattergraph 20
Hydrograph 21
Tabular Reports 22
Daily Flow View 22
Enfield_FM03 24
Site Commentary 24
Attachments 25
Site Report 25
Graphs 26
Scattergraph 26
Hydrograph 27
Tabular Reports 28
Daily Flow View 28
Enfield_FM04 30
Site Commentary 30
Attachments 31
Site Report 31
Graphs 32
Scattergraph 32
Hydrograph 33
Tabular Reports 34
Daily Flow View 34

Table of Contents

Enfield_FM05 36
- Site Commentary 36
- Attachments 37
  - Site Report 37
- Graphs 38
  - Scattergraph 38
  - Hydrograph 39
- Tabular Reports 40
  - Daily Flow View 40

Enfield_FM06 42
- Site Commentary 42
- Attachments 43
  - Site Report 43
- Graphs 44
  - Scattergraph 44
  - Hydrograph 45
- Tabular Reports 46
  - Daily Flow View 46

Enfield_FM07 48
- Site Commentary 48
- Attachments 49
  - Site Report 49
- Graphs 50
  - Scattergraph 50
  - Hydrograph 51
- Tabular Reports 52
  - Daily Flow View 52

Enfield_FM08 54
- Site Commentary 54
- Attachments 55
  - Site Report 55
- Graphs 56
  - Scattergraph 56
  - Hydrograph 57
- Tabular Reports 58
  - Daily Flow View 58

Enfield_FM09 60
- Site Commentary 60
- Attachments 61
  - Site Report 61
- Graphs 62
  - Scattergraph 62
  - Hydrograph 63

Table of Contents

Tabular Reports 64
Daily Flow View 64
Enfield_FM10 66
Site Commentary 66
Attachments 67
Site Report 67
Graphs 68
Scattergraph 68
Hydrograph 69
Tabular Reports 70
Daily Flow View 70
Enfield_FM11 72
Site Commentary 72
Attachments 73
Site Report 73
Graphs 74
Scattergraph 74
Hydrograph 75
Tabular Reports 76
Daily Flow View 76
Enfield_FM12 78
Site Commentary 78
Attachments 79
Site Report 79
Graphs 80
Scattergraph 80
Hydrograph 81
Tabular Reports 82
Daily Flow View 82
Enfield_GWG1 84
Site Commentary 84
Attachments 85
Site Report 85
Graphs 86
Scattergraph 86
Hydrograph 87
Tabular Reports 88
Daily Flow View 88
Enfield_GWG2 90
Site Commentary 90
Attachments 91
Site Report 91
Graphs 92

Table of Contents

Scattergraph 92
Hydrograph 93
Tabular Reports 94
Daily Flow View 94
Enfield_RG1 96
Rainfall data 96
Attachments 97
Site Report 97
Graphs 98
Hydrograph 98
Tabular Reports 99
Daily Flow View 99
Enfield_RG2 101
Rainfall data 101
Attachments 102
Site Report 102
Graphs 103
Hydrograph 103
Tabular Reports 104
Daily Flow View 104

Letter of Transmittal

A Division of ADS LLC

51 Wentworth Ave, Suite11
Londonderry, NH 03053
www.adsenv.com

June 19, 2015

Mr. Michael J. Burns, P.E.
Woodard & Curran
1699 King Street
Suite 406
Enfield, CT 06082

Dear Mr. Burns,

ADS is pleased to submit the final report for the Enfield, CT Temporary Flow Monitoring Study. Data beginning Friday, March 20, 2015 through Monday, May 18, 2015 includes depth, velocity and quantity hydrographs as well as scattergraphs, longtables and 15-minute data in Excel format.

In addition, we would be happy to further explain any details about the report that may seem unclear. Should you have any questions or comments, please contact the Project Manager, Michael Armes at 603-625-1212 or me at 845-268-1201 ext. 222.

Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,
ADS ENVIRONMENTAL SERVICES

Rodianne Cadet
Data Manager

An IDEX Fluid & Metering Business
Accusonic
ADS Environmental Services
Hydra-Stop

Scope and Methodology

Introduction

Background and Scope

Woodard & Curran entered into an agreement with ADS Environmental Services to monitor flow at twelve (12) metering locations, two (2) ground water gauges and to measure rain at two (2) rain gauge located in Enfield, CT. The monitoring period began on Friday, March 20, 2015 and ended on Monday, May 18, 2015. The objectives of this study were to measure rainfall, depth of flow, velocity, and quantify flows.

Monitoring Tasks

Monitoring tasks included:

- Investigating proposed flow monitoring sites for proper hydraulic conditions
- Investigating proposed rain gauge sites for sufficient exposure and non-excessive wind
- Installing flow monitors and rain gauges
- Precisely measuring pipe geometry
- Manually confirming monitor depth and velocity readings
- Manually confirming rain gauge tipping bucket operation
- QC/QC data for bias and outliers, correcting as necessary
- Flow data analysis

Equipment

Flow Monitoring Equipment

The monitor selected for this project was the ***ADS***Flow Shark monitor. This flow monitor is an area velocity flow monitor that uses both the Continuity and Manning's equations to measure flow.

The ADS Flow Shark monitor consists of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. The monitor was programmed to acquire and store depth of flow and velocity readings at 5-minute intervals.

Three types of data acquisition sensors are available for the Flow Shark monitor. The primary depth measurement device is the ADS quad-redundant ultrasonic level sensor. This sensor uses four independent ultrasonic transceivers in pairs to measure the distance from the face of the transceiver housing to the water surface (air range) with up to four transceiver pairs, of the available ones, active at one time. The elapsed time between transmitting and receiving the ultrasonic waves is used to calculate the air range between the sensor and flow surface based on the speed of sound in air. Sensors in the transceiver housing measure temperature, which is used to compensate the ultrasonic signal travel time. The speed of sound will vary with temperature. Since the ultrasonic level sensor is mounted out of the flow, it creates no disturbance to normal flow patterns and does not affect site hydraulics.

Redundant flow depth data can be provided by a pressure depth sensor, and is independent from the ultrasonic level sensor. This sensor uses a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a desiccant filled breather tube. Pressure depth sensors are typically used in large size channels and applications where surcharging is anticipated. Its streamlined shape minimizes flow distortion.

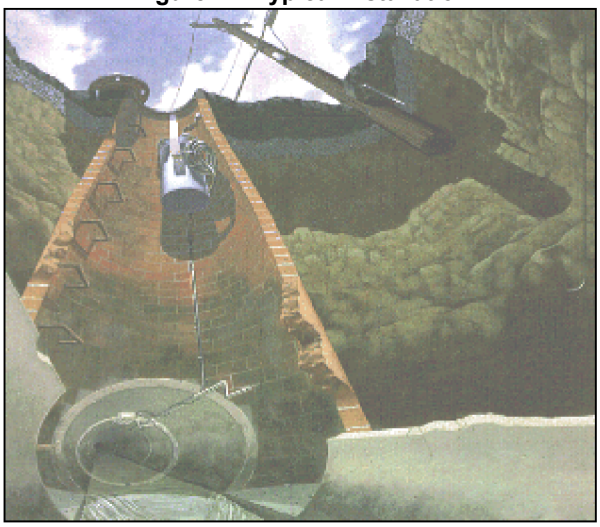
Velocity is measured using the ADS V-3 digital Doppler velocity sensor. This sensor measures velocity in the cross-sectional area of flow. An ultrasonic carrier is transmitted upstream into the flow, and is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity. Collected peak velocity information is filtered and processed using field confirmation information and proprietary software to determine the average velocity, which is used to calculate flow quantities. The sensor's small profile, measuring 1.5 inches by 1.15 inches by 0.50 inches thick, minimizes the affects on flow patterns and site hydraulics.

Installation

Installation of flow monitoring equipment typically proceeds in four steps. First, the site is investigated for safety and to determine physical and hydraulic suitability for the flow monitoring equipment. Second, the equipment is physically installed at the selected location. Third, the monitor is tested to assure proper operation of the velocity and depth of flow sensors and verify that the monitor clock is operational and synchronized to the master computer clock. Fourth, the depth and velocity sensors are confirmed and line confirmations are performed. A typical flow monitor installation is shown in Figure 2.1.

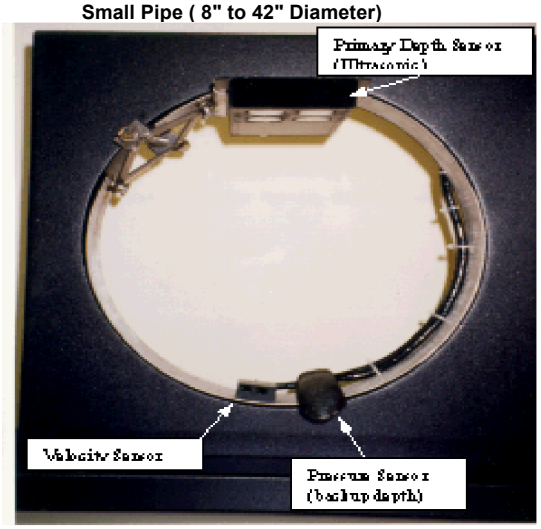
The installations depicted in Figures 2.1 are typical for circular or oval pipes up to approximately 104-inches in diameter or height. In installations into pipes 42-inches or less in diameter, depth and velocity sensors are mounted on an expandable stainless steel ring and installed one to two pipe diameters upstream of the pipe/manhole connection in the incoming sewer pipe. This reduces the affects of turbulence and backwater caused by the connection. In pipes larger than 42 inches in diameter, a special installation is made using two sections of the ring installed one to two feet upstream of the pipe/manhole connection; one bolted to the crown of the pipe for the depth sensor, and the other bolted to the bottom of the pipe (bolts are usually placed just above the water line) to hold the velocity sensor.

Figure 2.1 Typical Installation



Large Pipe (> 42" Diameter)

Small Pipe (8" to 42" Diameter)



Data Collection, Confirmation, and Quality Assurance

Data collects were done remotely via telemetry by a Data Analyst. Periodically during the monitoring period, field crews visit each monitoring location to verify proper monitor operation and document field conditions. The following quality assurance steps are taken to assure the integrity of the collected data :

Measure power supplies: monitors were powered by dry cell battery packs. Voltages were recorded and battery packs replaced, as necessary. Separate batteries provided back-up power to memory allowing primary batteries to be replaced without loss of data.

Clock synchronization: Field crews synchronized monitor clocks to master clocks.

Confirm depth and velocity readings: Field crews descended into meter manholes to manually measure depths and velocities and compare them meter readings to confirm that they agreed. They also measured silt levels, if any, in the inverts of the pipes. Silt areas were subtracted from flow areas to compute true areas of flow.

Confirm average velocities through cross-sectional velocity profiles: Since ADS velocity sensors measures peak velocity, field crews collected cross-sectional velocity profiles in order to develop a relationship between peak and average velocity in lines that meet the hydraulic criteria.

Confirm flows using V-notched weirs: For monitoring locations where the depth of flow is less than 2.00", flow may be verified by inserting a v-notch weir into the mouth of pipe to directly measure the flow rate. This method requires the field crew to seal and level the weir, wait for it to fill and stabilize, then record the flow rates from the numbers on the weir (gpd). Depth and manually recorded flow rates were then used to calculate the average velocity needed to verify velocity sensor readings.

Upload and Review Data: Data collected from the monitors were uploaded and reviewed by a Data Analyst for completeness, outliers and deviations in the flow patterns, which indicate system anomalies or equipment failure.

Methodology

Flow Quantification Methods

There are two main equations used to measure open channel flow: the ***Continuity Equation***and the ***Manning Equation.*** The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available. In cases where velocity measurements are not available or not practical to obtain, the Manning Equation can be used to estimate velocity from the depth data based on certain physical characteristics of the pipe (i.e. the slope and roughness of the pipe being measured). However, the Manning equation assumes uniform, steady flow hydraulic conditions with non-varying roughness, which are typically invalid assumptions in most sanitary sewers. The Continuity Equation was used exclusively for this study.

Continuity Equation

The Continuity Equation states that the flow quantity (Q) is equal to the wetted area (A) multiplied by the average velocity (V) of the flow.

$$Q = A * V$$

This equation is applicable in a variety of conditions including backwater, surcharge, and reverse flow.

Flow Classifications

Flow classifications can be determined using factors such as, varying flow cross-sections, fluctuating flow rates, the presence of surface waves and erratic flows.

Ideal Uniform Flowsremain steady throughout the cross-section of the line whereas ***Gradually Varied Flows,*** as seen in drawdown or backwater, change slowly as we move upstream and/or downstream in the line.

When flow rates remain constant over a period of time, they are classified as having ***Steady Flow***; if not, they have ***Unsteady Flow***.

The speed of surface waves versus that of the flow can be subcategorized to 3 groups: ***supercritical***, ***subcritical***, and ***transitional*** (changing from sub to supercritical). The Froude Number (flow speed divided by surface wave speed) is used to characterize these patterns. Froude numbers greater than one are defined as supercritical and Froude numbers less than one are defined as subcritical. Subcritical flow surfaces are always smooth with is good for depth measurements, but may not be good in terms of silt deposition.

Turbulent flow account for 99.9% of all gravity sewer flow even if the flow surface is smooth.

An ideal monitoring location tend to have near-uniform, near-steady, turbulent flow with a smooth surface..

Data Analysis and Presentation

Data Analysis

A flow monitor is typically programmed to collect data at either 15-minute or 5-minute intervals throughout the monitoring period. The monitor stores raw data consisting of (1) the air range (distance from sensor to top of flow) for each active ultrasonic depth sensor pair and (2) the peak velocity. If the monitor is equipped with a pressure sensor, then a depth reading from this sensor may also be stored. When the field personnel collects the data, the air range is converted to depth data based on the pipe height and physical offset (distance from the top of the pipe to the surface of the ultrasonic sensor). The data is imported into ADS's proprietary software and is examined by a data analyst to verify its integrity. The data analyst also reviews the daily field reports and site visit records to identify conditions that would affect the collected data.

Velocity profiles and the line confirmation data developed by the field personnel are reviewed by the data analyst to identify inconsistencies and verify data integrity. Velocity profiles are reviewed and an average to peak velocity ratio is calculated for the site. This ratio is used in converting the peak velocity measured by the sensor to the average velocity used in the Continuity equation. The data analyst selects which ultrasonic pairs and/or depth sensor entity will be used to calculate the final depth information. Silt levels present at each site visit are reviewed and representative silt levels established.

Occasionally the velocity sensor's performance may be compromised resulting in invalid readings sporadically during the monitoring period. This is generally caused by excessive debris (silt) blocking the sensor's crystals, shallow flows (~< 2") that may drop below the top of the sensor or very clear flows lacking the particles needed to measure rate. In order to use the Continuity equation to quantify the flow during these periods, a Sr. Analyst and/or Engineer will use the site's historical pipe curve (depth vs. velocity) data along with valid field confirmations to reconstitute and replace the false velocity recordings with expected velocity readings for a given historical depth along the curve.

Selections for the above parameters can be constant or can change during the monitoring period. While the data analysis process is described in a linear manner, it often requires an iterative approach to accurately complete.

Data Presentation

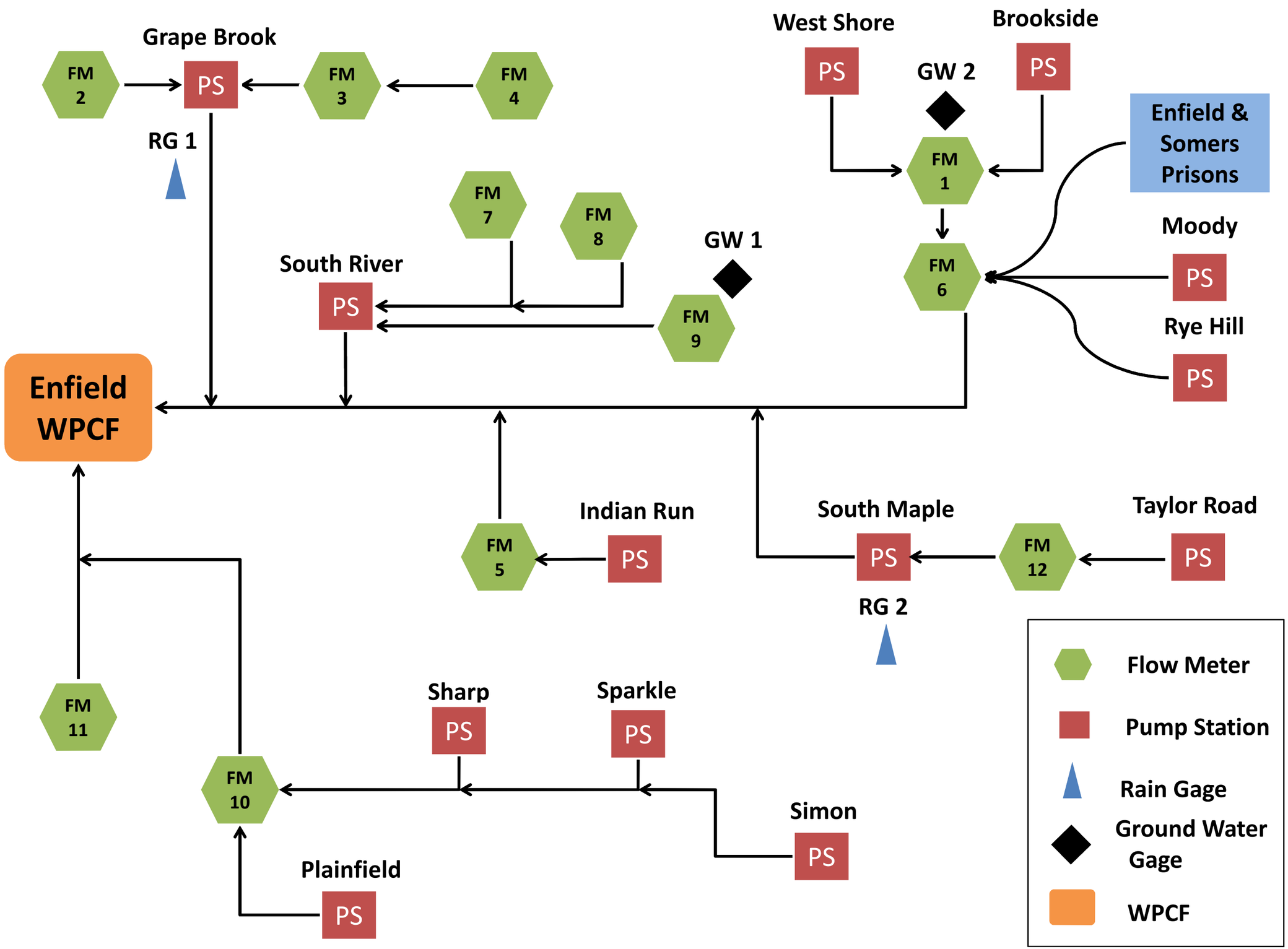
This type of flow monitoring project generates a large volume of data. To facilitate review of the data, results have been provided in graphical and tabular formats. The flow data is presented graphically in the form of scattergraphs and hydrographs. Tables are provided in daily average format. These tables show the flow rate for each day, along with the daily minimum and maximums, the times they were observed, the total daily flow, and total flow for the month (or monitoring period). The following explanation of terms may aid in interpretation of the tables and hydrographs.

DEPTH - Final calculated depth measurement (in inches)

QUANTITY - Final calculated flow rate (in MGD)

VELOCITY - Final calculated flow velocity (in feet per second)

REPORT TOTAL - Total volume of flow recorded for the indicated time period (in MG)


Grape Brook
FM 2
PS
FM 3
FM 4
RG 1
West Shore
PS
GW 2
Brookside
PS
Enfield & Somers Prisons
FM 1
FM 7
FM 8
GW 1
Moody
South River
PS
FM 6
PS
FM 9
Rye Hill
PS
Enfield WPCF
Indian Run
South Maple
Taylor Road
FM 5
PS
PS
FM 12
PS
RG 2
Flow Meter
Pump Station
Rain Gage
Ground Water Gage
WPCF
FM 11
Sharp
PS
Sparkle
PS
FM 10
Simon
PS
Plainfield
PS

Site Commentary

Site Information

Enfield_FM01	
Pipe Dimensions (in.)	Elliptical (18.00 in H, 18.50 in W)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM01 indicate this location functioned mostly in free-flow conditions for the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	4.52	0.85	0.199
Minimum	3.08	0.51	0.076
Maximum	5.94	1.22	0.353
Time of Minimum	5/18/2015 5:00 AM	5/15/2015 3:15 AM	5/18/2015 3:45 AM
Time of Maximum	4/9/2015 1:30 PM	4/11/2015 12:30 AM	4/1/2015 7:45 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.
Graphical data reports are based on an hourly average.

Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in the table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

a division of ADS LLC.

Site Report

FM Initials:	IC
Project Name:	ENFIELD, CT

Site Name:	ENFIELD_FM01	Meter Type:	FLOWSHARK	Monitor S/N:	30012	Manhole #:	
Address / Location:	41 BACON ROAD			Map Page #:			
				Pipe Height:	18 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	18.5 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 19, 2015	4:30 PM	Manhole Depth:	13 Feet	
Site Hydraulics:	SLOW, SMOOTH FLOW		Manhole Material / Condition:	Brick	Good
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	Ductile Iron Pipe	Good
Upstream Manhole:			Mini System Character:	RESIDENTIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	5 +/- 0.38		Access Pole #:	N/A	
Range (Air Dof):	13 +/- 0.38		Distance From Manhole:	N/A Feet	
Peak Velocity:	0.64 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 42° 00' 51.5" W 72° 31' 46.3"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 11506 PO 1.0" ULTRA PO 1.25"

SCATTERGRAPH REPORT

Enfield_FM01

Flow Monitor

Enfield_FM01

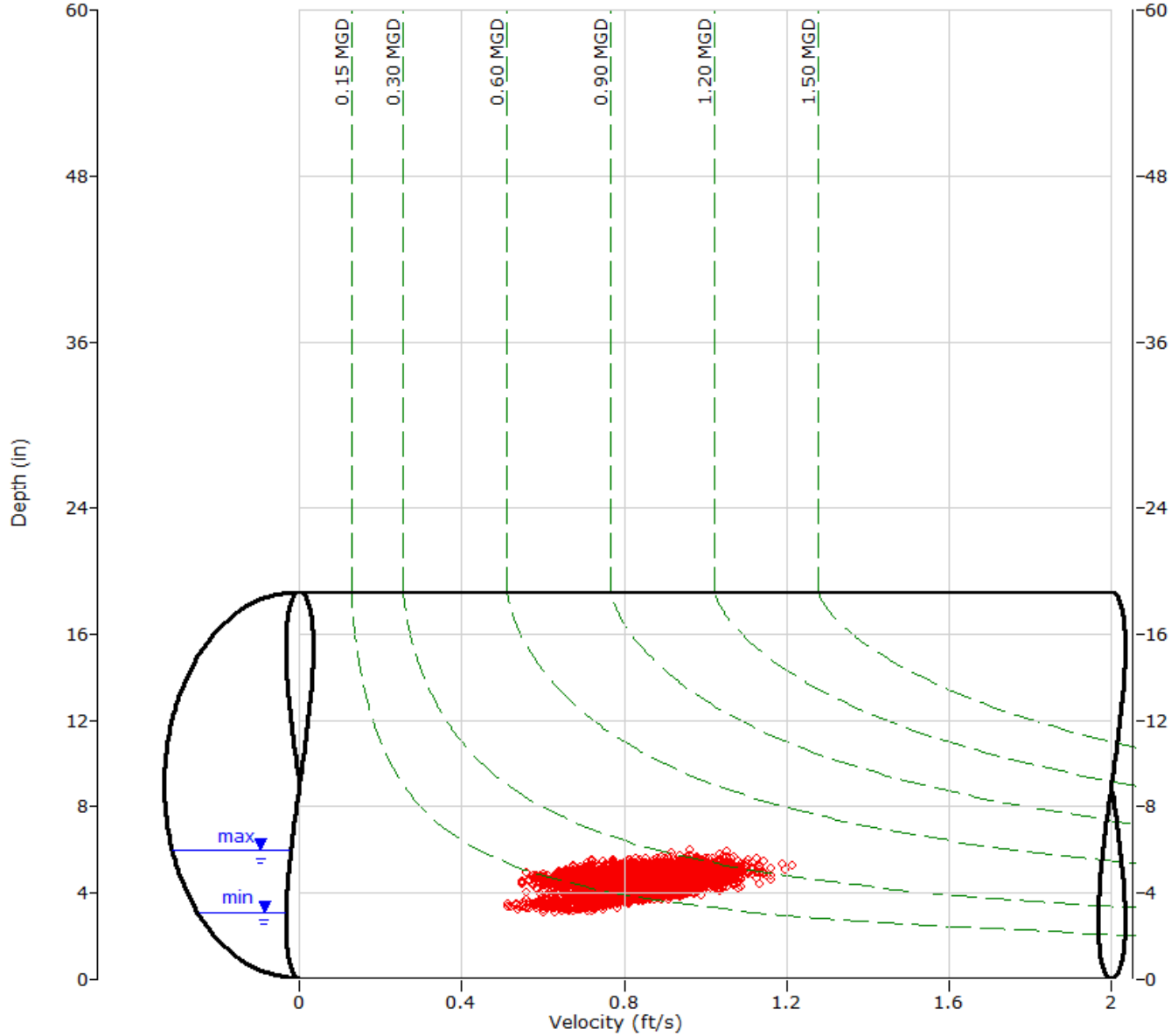
Pipe Height
18.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



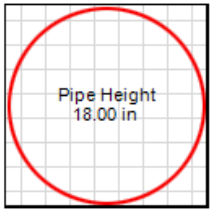
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM01

Flow Monitor

Enfield_FM01

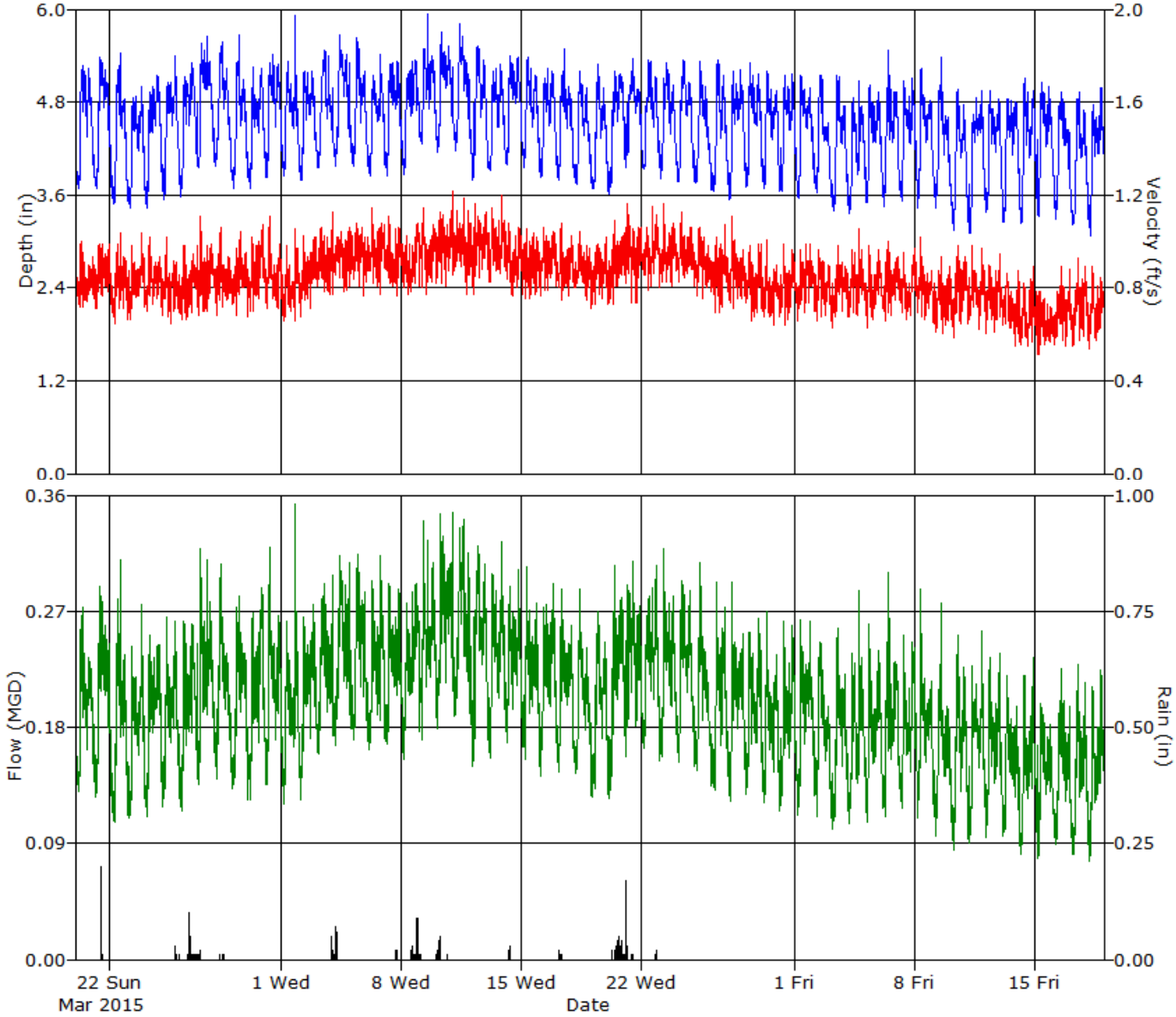


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM01, Pipe Height: 18 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	04:30	3.68	10:15	5.27	4.57	06:30	0.72	08:15	1.00	0.82	04:45	0.130	10:15	0.273	0.194	0.194	
3/21/2015	05:45	3.68	10:45	5.37	4.57	04:30	0.71	11:00	0.99	0.86	04:30	0.125	11:00	0.289	0.205	0.205	0.21
3/22/2015	06:30	3.48	15:30	5.44	4.40	08:00	0.65	15:30	1.03	0.82	07:15	0.107	15:30	0.310	0.186	0.186	
3/23/2015	05:15	3.43	21:30	5.00	4.27	01:30	0.67	21:30	1.03	0.83	03:00	0.110	21:30	0.275	0.178	0.178	
3/24/2015	05:00	3.43	19:15	5.15	4.43	04:00	0.70	08:00	1.02	0.84	04:00	0.110	08:00	0.251	0.190	0.190	0.00
3/25/2015	05:00	3.54	19:15	5.39	4.53	13:45	0.65	07:30	1.02	0.81	02:15	0.118	08:00	0.266	0.189	0.189	0.09
3/26/2015	04:00	3.58	19:15	5.31	4.63	04:45	0.67	08:00	0.98	0.80	04:45	0.115	08:00	0.262	0.193	0.193	0.32
3/27/2015	05:00	3.95	16:00	5.65	4.87	04:00	0.68	07:45	1.11	0.84	04:00	0.135	07:45	0.319	0.218	0.218	0.17
3/28/2015	05:15	3.98	14:00	5.58	4.75	05:30	0.68	11:45	1.06	0.85	05:30	0.140	11:45	0.306	0.212	0.212	0.07
3/29/2015	05:15	3.69	13:45	5.66	4.58	10:00	0.68	16:00	1.04	0.85	03:15	0.133	13:45	0.282	0.201	0.201	
3/30/2015	04:45	3.69	08:45	5.25	4.53	02:15	0.67	22:00	1.07	0.87	02:15	0.123	20:15	0.289	0.204	0.204	
3/31/2015	03:15	3.82	13:15	5.41	4.70	04:45	0.71	08:15	1.11	0.85	04:45	0.135	08:15	0.319	0.209	0.209	
4/1/2015	05:00	3.84	19:45	5.91	4.64	05:00	0.66	19:45	1.05	0.81	05:00	0.120	19:45	0.353	0.195	0.195	
4/2/2015	02:45	3.79	19:15	5.20	4.63	03:30	0.67	07:30	1.03	0.86	03:30	0.123	21:45	0.275	0.206	0.206	
4/3/2015	05:00	3.95	13:30	5.47	4.69	19:45	0.77	23:45	1.12	0.91	05:00	0.160	23:45	0.298	0.221	0.221	0.19
4/4/2015	04:00	3.97	10:30	5.66	4.83	00:45	0.77	23:15	1.06	0.93	04:00	0.166	10:45	0.313	0.236	0.236	0.35
4/5/2015	05:30	3.98	10:30	5.63	4.73	19:30	0.76	09:00	1.08	0.94	06:30	0.171	11:00	0.314	0.231	0.231	
4/6/2015	04:45	3.84	19:15	5.42	4.62	18:45	0.77	07:45	1.14	0.95	03:15	0.163	19:15	0.313	0.226	0.226	
4/7/2015	05:00	3.85	19:15	5.32	4.71	17:30	0.76	07:15	1.11	0.93	03:45	0.167	07:30	0.291	0.227	0.227	0.15
4/8/2015	04:15	3.87	20:15	5.34	4.73	10:30	0.77	23:45	1.08	0.91	04:30	0.155	21:45	0.292	0.225	0.225	0.63
4/9/2015	05:00	4.27	13:30	5.94	4.98	10:45	0.77	07:30	1.14	0.96	05:00	0.171	07:30	0.340	0.253	0.253	0.10
4/10/2015	03:15	4.16	09:00	5.71	5.00	15:15	0.81	22:45	1.13	0.98	03:15	0.179	07:30	0.345	0.263	0.263	0.31
4/11/2015	04:45	4.18	10:45	5.81	4.94	19:15	0.77	00:30	1.22	0.98	03:00	0.189	00:30	0.346	0.258	0.258	
4/12/2015	04:00	3.80	10:45	5.53	4.72	06:45	0.77	08:30	1.16	0.98	04:30	0.150	11:45	0.320	0.242	0.242	
4/13/2015	04:45	3.92	19:15	5.28	4.65	03:00	0.83	21:00	1.20	0.98	04:45	0.156	21:00	0.324	0.236	0.236	
4/14/2015	04:00	3.99	09:15	5.39	4.80	12:45	0.76	00:15	1.09	0.93	03:45	0.168	20:30	0.302	0.233	0.233	0.05
4/15/2015	04:45	3.96	09:45	5.37	4.73	05:45	0.76	07:45	1.05	0.90	05:45	0.155	07:45	0.304	0.223	0.223	
4/16/2015	04:30	3.82	13:15	5.23	4.61	04:15	0.76	08:00	1.06	0.92	04:15	0.142	20:30	0.291	0.220	0.220	
4/17/2015	05:00	3.80	13:15	5.48	4.59	09:15	0.75	08:15	1.08	0.91	04:15	0.145	08:15	0.287	0.215	0.215	0.11
4/18/2015	06:15	3.73	10:45	5.20	4.41	19:15	0.75	09:30	1.04	0.89	04:45	0.144	09:30	0.287	0.199	0.199	
4/19/2015	04:00	3.69	12:30	5.28	4.39	02:45	0.71	22:30	1.02	0.87	04:15	0.126	11:00	0.269	0.193	0.193	
4/20/2015	04:00	3.62	10:15	5.19	4.53	01:15	0.73	10:15	1.09	0.90	03:00	0.125	10:15	0.305	0.211	0.211	0.84
4/21/2015	03:30	3.96	13:15	5.36	4.72	11:00	0.74	04:00	1.16	0.94	03:30	0.157	13:15	0.309	0.233	0.233	0.36
4/22/2015	04:45	3.93	10:45	5.35	4.65	10:30	0.79	16:30	1.15	0.95	04:45	0.164	21:15	0.305	0.229	0.229	0.05
4/23/2015	04:15	3.81	10:45	5.31	4.60	02:15	0.80	08:15	1.16	0.95	02:15	0.154	08:15	0.318	0.226	0.226	
4/24/2015	04:00	3.78	10:30	5.34	4.63	05:30	0.83	08:30	1.12	0.95	05:15	0.153	08:30	0.293	0.229	0.229	
4/25/2015	05:00	3.75	11:15	5.32	4.43	14:00	0.76	09:30	1.06	0.91	07:00	0.147	11:15	0.308	0.206	0.206	
4/26/2015	05:00	3.64	12:00	5.35	4.43	07:15	0.69	21:00	1.07	0.87	07:15	0.132	10:15	0.292	0.197	0.197	
4/27/2015	04:00	3.54	19:30	5.22	4.50	09:15	0.71	07:30	1.11	0.88	04:30	0.123	07:30	0.293	0.202	0.202	
4/28/2015	03:30	3.70	09:00	5.31	4.56	11:00	0.66	20:15	0.99	0.82	03:30	0.128	21:15	0.264	0.194	0.194	
4/29/2015	03:45	3.68	08:15	5.19	4.49	17:00	0.64	07:30	1.01	0.79	04:15	0.122	08:15	0.270	0.182	0.182	
4/30/2015	02:00	3.64	19:15	5.17	4.50	10:30	0.64	07:30	0.99	0.81	02:00	0.115	07:30	0.263	0.187	0.187	
5/1/2015	04:45	3.55	07:45	5.15	4.45	03:30	0.66	14:30	0.99	0.84	03:30	0.112	07:45	0.263	0.191	0.191	
5/2/2015	06:30	3.63	13:15	5.15	4.36	06:30	0.66	08:15	0.96	0.82	06:30	0.111	11:15	0.246	0.181	0.181	
5/3/2015	05:00	3.40	10:45	5.15	4.23	03:00	0.63	11:15	0.98	0.80	03:00	0.102	11:15	0.257	0.171	0.171	
5/4/2015	04:15	3.36	17:45	5.08	4.20	00:45	0.67	17:45	1.05	0.82	04:15	0.105	17:45	0.286	0.172	0.172	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	03:00	3.51	09:00	5.01	4.36	04:00	0.63	07:45	0.98	0.81	04:00	0.107	07:45	0.260	0.179	0.179	
5/6/2015	04:15	3.45	11:00	5.46	4.38	05:15	0.66	11:00	1.00	0.82	05:15	0.111	11:00	0.300	0.182	0.182	
5/7/2015	04:45	3.53	19:30	5.10	4.41	11:00	0.67	22:30	0.97	0.80	05:45	0.117	07:30	0.251	0.180	0.180	
5/8/2015	03:15	3.44	09:00	5.23	4.40	12:45	0.67	07:45	1.02	0.80	03:00	0.110	07:45	0.287	0.180	0.180	
5/9/2015	04:00	3.44	12:45	5.38	4.29	13:30	0.60	12:45	0.94	0.76	04:00	0.096	12:45	0.276	0.163	0.163	
5/10/2015	06:00	3.15	11:00	4.97	4.10	05:00	0.58	12:15	0.98	0.79	05:45	0.085	12:15	0.252	0.162	0.162	
5/11/2015	03:15	3.10	21:30	4.95	4.19	18:00	0.62	07:45	0.98	0.79	03:15	0.090	21:30	0.255	0.165	0.165	
5/12/2015	03:15	3.38	08:45	4.95	4.26	03:45	0.60	22:30	0.94	0.77	03:45	0.094	22:30	0.237	0.164	0.164	
5/13/2015	03:00	3.26	08:30	4.84	4.25	20:30	0.55	08:30	0.86	0.71	02:45	0.096	08:30	0.220	0.152	0.152	
5/14/2015	04:15	3.24	09:30	5.11	4.29	14:00	0.55	20:30	0.89	0.68	04:15	0.081	20:30	0.234	0.147	0.147	
5/15/2015	05:15	3.32	08:30	5.05	4.35	03:15	0.51	00:45	0.78	0.64	03:15	0.078	07:30	0.198	0.142	0.142	
5/16/2015	04:45	3.29	13:15	4.93	4.19	19:00	0.55	11:45	0.89	0.70	05:00	0.089	11:45	0.226	0.146	0.146	
5/17/2015	04:45	3.21	13:15	4.92	4.08	03:15	0.55	11:30	0.93	0.73	06:45	0.081	11:30	0.229	0.147	0.147	
5/18/2015	05:00	3.08	20:00	4.99	4.17	03:45	0.54	08:15	0.89	0.70	03:45	0.076	20:00	0.224	0.147	0.147	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			11.952	4.00
Avg	4.52	0.85	0.199	

Site Commentary

Site Information

Enfield_FM02	
Pipe Dimensions (in.)	Circular (18.00 in H)
Silt (in.)	1.25

Overview

A review of the hydrograph and scattergraph for Enfield_FM02 indicate this location functioned under typical open channel flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	8.48	0.55	0.276
Minimum	6.84	0.31	0.125
Maximum	10.00	0.92	0.558
Time of Minimum	5/18/2015 4:30 AM	5/7/2015 3:00 AM	5/7/2015 3:00 AM
Time of Maximum	4/10/2015 12:00 PM	4/17/2015 8:15 AM	4/17/2015 8:15 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

.

Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

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Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_FM02	Meter Type:	FLOWSHARK	Monitor S/N:	20910	Manhole #:	
Address / Location:	340 ENFIELD STREET ***SIDE OF RT 5 USE CAUTION ***			Map Page #:			
				Pipe Height:	18 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	18 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 19, 2015	8:00 AM	Manhole Depth:	24 Feet	
Site Hydraulics:	SLOW, SMOOTH FLOW		Manhole Material / Condition:	Brick	Good
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	RC	Good
Upstream Manhole:			Mini System Character:	INDUSTRIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	8.5 +/- 0.38		Access Pole #:	N/A	
Range (Air Dof):	9.5 +/- 0.38		Distance From Manhole:	N/A Feet	
Peak Velocity:	0.91 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 42° 00' 56.8" W 72° 35' 33.4"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

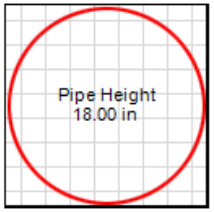
PRESS S/N 55656 ULTRA PO 1.25"

SCATTERGRAPH REPORT

Enfield_FM02

Flow Monitor

Enfield_FM02

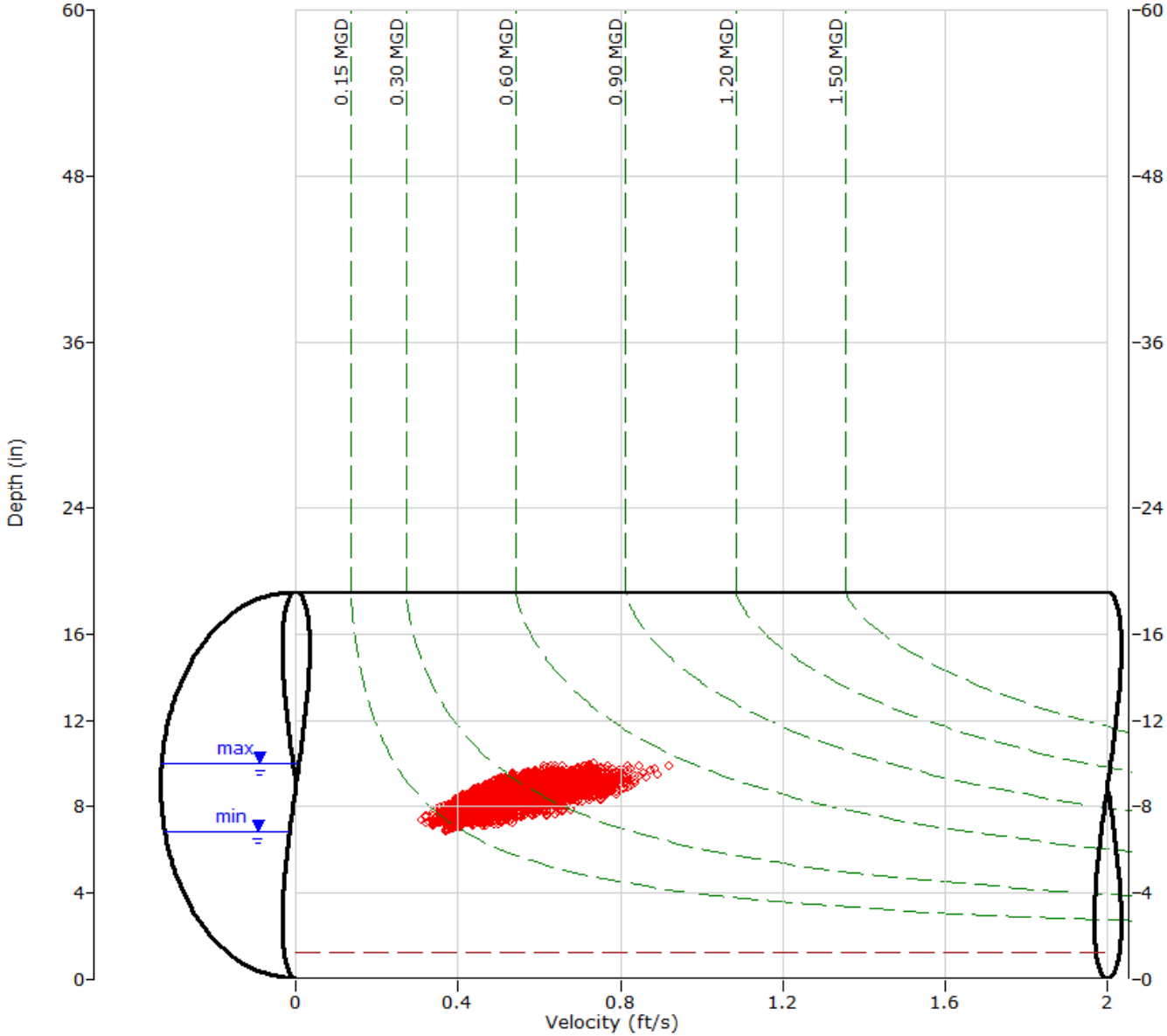


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



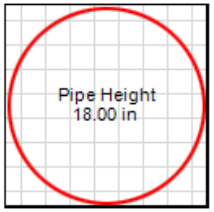
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM02

Flow Monitor

Enfield_FM02

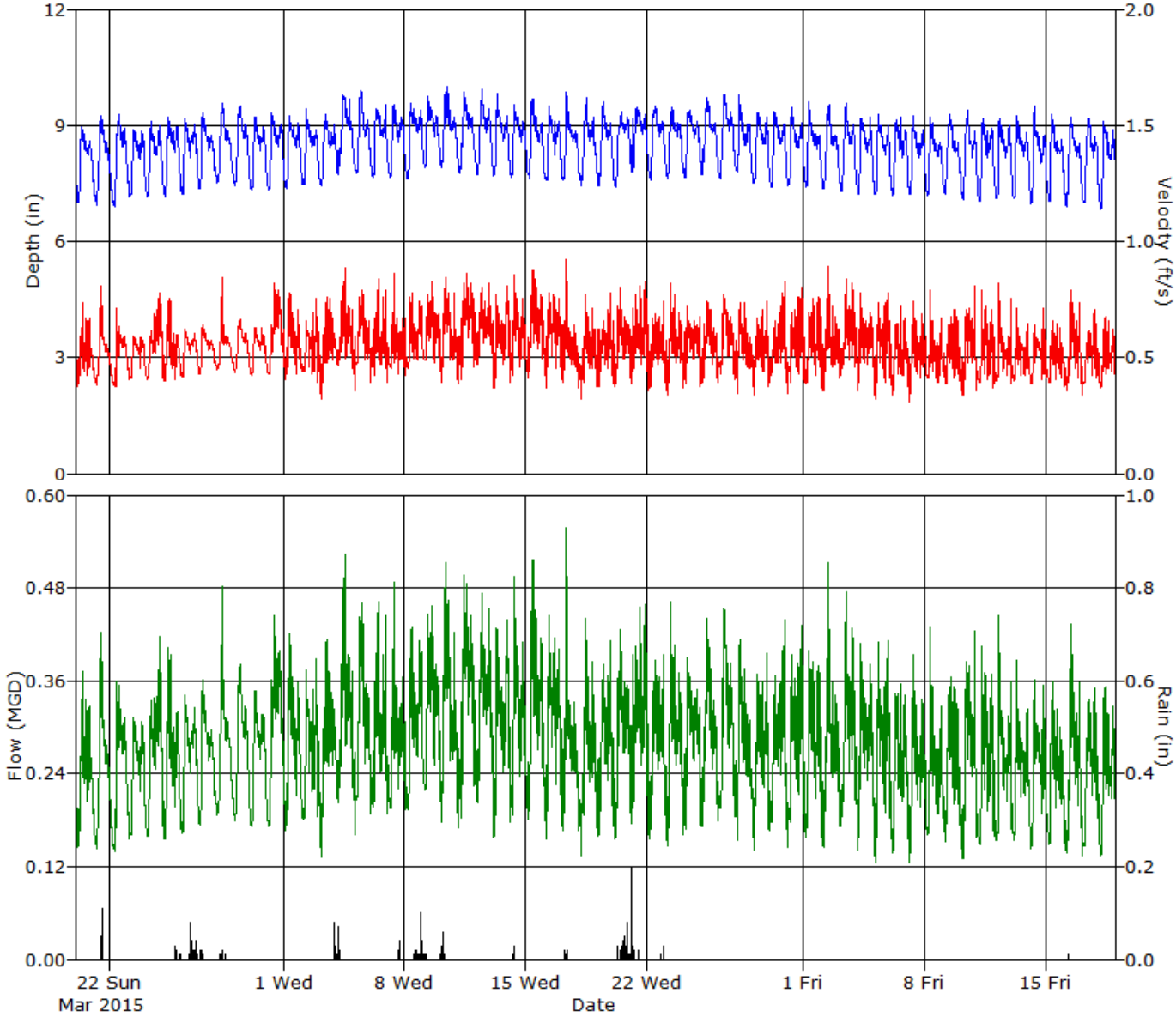


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM02, Pipe Height: 18 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	04:15	7.00	08:30	8.95	8.16	02:45	0.38	10:15	0.73	0.51	02:45	0.146	10:15	0.373	0.241	0.241	
3/21/2015	05:15	6.95	12:30	9.23	8.14	05:15	0.38	11:00	0.81	0.52	05:15	0.142	11:00	0.422	0.246	0.246	0.19
3/22/2015	06:15	6.91	13:00	9.28	8.20	08:45	0.38	09:45	0.71	0.52	06:15	0.139	09:45	0.359	0.248	0.248	
3/23/2015	03:15	7.14	08:30	8.90	8.19	03:15	0.40	08:30	0.59	0.51	03:15	0.157	08:30	0.312	0.245	0.245	
3/24/2015	04:15	7.17	08:30	9.11	8.22	04:15	0.41	21:00	0.78	0.56	04:15	0.159	21:00	0.417	0.269	0.269	0.00
3/25/2015	04:00	7.14	09:30	9.20	8.34	03:30	0.40	11:00	0.75	0.54	03:30	0.156	08:45	0.403	0.261	0.261	0.10
3/26/2015	03:45	7.23	08:00	9.17	8.35	03:45	0.42	08:00	0.62	0.53	03:45	0.164	08:00	0.342	0.261	0.261	0.37
3/27/2015	04:15	7.36	08:15	9.33	8.44	04:15	0.43	08:15	0.64	0.54	04:15	0.174	08:15	0.361	0.269	0.269	0.22
3/28/2015	04:30	7.53	12:45	9.58	8.48	04:30	0.45	11:45	0.85	0.55	04:30	0.187	11:45	0.482	0.275	0.275	0.08
3/29/2015	05:45	7.43	12:45	9.49	8.49	05:45	0.44	12:45	0.66	0.55	05:45	0.179	12:45	0.381	0.276	0.276	
3/30/2015	03:45	7.33	09:00	9.21	8.40	03:45	0.43	17:30	0.63	0.54	03:45	0.171	09:00	0.347	0.265	0.265	
3/31/2015	04:30	7.35	08:30	9.33	8.44	04:30	0.43	10:45	0.82	0.60	04:30	0.173	10:45	0.445	0.300	0.300	
4/1/2015	05:00	7.37	08:15	9.24	8.45	02:15	0.40	08:00	0.78	0.56	03:45	0.166	08:00	0.422	0.279	0.279	
4/2/2015	03:15	7.46	07:45	9.44	8.44	15:45	0.43	22:00	0.75	0.54	03:15	0.182	22:00	0.388	0.267	0.267	
4/3/2015	04:30	7.45	10:45	9.27	8.41	04:15	0.32	13:15	0.76	0.55	04:15	0.132	13:15	0.413	0.272	0.272	0.37
4/4/2015	04:30	7.72	10:30	9.79	8.84	04:30	0.47	13:15	0.88	0.60	04:30	0.203	13:15	0.524	0.315	0.315	0.34
4/5/2015	06:15	7.76	11:15	9.88	8.76	03:45	0.36	13:30	0.79	0.59	03:45	0.160	13:30	0.460	0.307	0.307	
4/6/2015	04:00	7.66	21:45	9.53	8.70	00:30	0.39	12:15	0.84	0.55	00:30	0.189	12:15	0.462	0.285	0.285	
4/7/2015	04:30	7.64	10:30	9.54	8.68	00:15	0.39	09:00	0.86	0.55	00:15	0.188	09:00	0.488	0.280	0.280	0.18
4/8/2015	05:00	7.61	08:00	9.57	8.76	01:30	0.42	11:30	0.78	0.58	01:30	0.193	11:30	0.430	0.302	0.302	0.68
4/9/2015	03:30	7.92	09:00	9.75	8.87	17:15	0.48	13:45	0.83	0.61	03:30	0.219	13:45	0.456	0.322	0.322	0.13
4/10/2015	03:15	7.91	12:00	10.00	8.90	03:45	0.39	08:15	0.85	0.59	03:45	0.178	08:15	0.512	0.316	0.316	0.34
4/11/2015	03:45	7.78	11:00	9.87	8.82	03:30	0.39	14:15	0.86	0.64	03:30	0.171	11:00	0.496	0.339	0.339	
4/12/2015	05:00	7.73	11:00	9.91	8.80	00:45	0.46	21:45	0.82	0.63	05:00	0.203	10:30	0.473	0.331	0.331	
4/13/2015	03:30	7.71	08:15	9.83	8.71	03:30	0.37	22:00	0.81	0.60	03:30	0.159	21:45	0.439	0.308	0.308	
4/14/2015	04:15	7.65	07:45	9.53	8.69	02:00	0.39	07:45	0.86	0.59	02:00	0.178	07:45	0.495	0.306	0.306	0.07
4/15/2015	04:30	7.62	08:15	9.68	8.67	04:00	0.41	08:15	0.87	0.65	04:00	0.180	08:15	0.517	0.333	0.333	
4/16/2015	05:00	7.58	08:00	9.50	8.58	05:15	0.37	08:15	0.78	0.61	05:15	0.155	08:00	0.445	0.307	0.307	
4/17/2015	03:15	7.59	08:15	9.86	8.57	03:15	0.39	08:15	0.92	0.55	03:15	0.167	08:15	0.558	0.279	0.279	0.11
4/18/2015	05:00	7.45	12:00	9.72	8.53	04:15	0.32	10:45	0.77	0.53	04:15	0.135	10:45	0.441	0.266	0.266	
4/19/2015	04:45	7.43	12:00	9.59	8.54	02:15	0.38	21:00	0.78	0.55	04:00	0.160	21:00	0.411	0.275	0.275	
4/20/2015	04:45	7.42	12:30	9.35	8.59	03:00	0.38	10:15	0.80	0.56	03:00	0.156	10:15	0.426	0.285	0.285	0.96
4/21/2015	04:45	7.79	10:45	9.46	8.79	01:45	0.39	21:00	0.83	0.59	01:45	0.176	21:00	0.458	0.307	0.307	0.41
4/22/2015	04:45	7.60	10:30	9.49	8.71	01:30	0.36	21:45	0.74	0.54	04:00	0.156	21:45	0.393	0.280	0.280	0.09
4/23/2015	04:15	7.63	11:15	9.46	8.66	05:15	0.34	08:00	0.82	0.55	05:15	0.146	08:00	0.462	0.283	0.283	
4/24/2015	03:15	7.65	11:00	9.37	8.68	02:15	0.37	07:45	0.72	0.56	02:15	0.162	07:45	0.390	0.287	0.287	
4/25/2015	04:30	7.72	11:15	9.72	8.76	01:15	0.38	11:15	0.74	0.55	02:30	0.172	11:15	0.441	0.289	0.289	
4/26/2015	05:30	7.63	10:30	9.80	8.76	01:45	0.39	10:45	0.77	0.58	01:45	0.180	10:45	0.453	0.302	0.302	
4/27/2015	04:15	7.80	08:00	9.80	8.65	05:00	0.35	08:15	0.73	0.54	05:00	0.155	08:15	0.414	0.275	0.275	
4/28/2015	03:00	7.50	08:30	9.33	8.54	03:30	0.34	21:45	0.74	0.53	03:30	0.142	21:45	0.395	0.268	0.268	
4/29/2015	04:30	7.40	08:15	9.36	8.52	00:30	0.38	22:30	0.83	0.54	02:30	0.167	22:30	0.438	0.273	0.273	
4/30/2015	03:30	7.45	08:30	9.46	8.49	03:15	0.35	21:45	0.80	0.55	03:15	0.146	21:45	0.431	0.275	0.275	
5/1/2015	04:00	7.42	08:00	9.61	8.46	04:45	0.39	21:30	0.76	0.55	04:45	0.158	08:15	0.398	0.272	0.272	
5/2/2015	04:00	7.37	12:00	9.53	8.43	03:15	0.36	10:45	0.89	0.55	04:15	0.145	10:45	0.513	0.274	0.274	
5/3/2015	05:15	7.30	11:15	9.56	8.44	03:00	0.41	11:45	0.84	0.59	03:45	0.173	11:45	0.475	0.291	0.291	
5/4/2015	05:00	7.23	21:15	9.20	8.37	03:15	0.36	07:30	0.78	0.57	03:15	0.142	07:30	0.408	0.280	0.280	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	05:00	7.22	07:45	9.29	8.33	04:45	0.32	21:00	0.78	0.55	05:00	0.126	22:00	0.412	0.268	0.268	
5/6/2015	04:00	7.19	15:00	9.20	8.31	02:45	0.34	15:30	0.72	0.51	02:45	0.137	15:30	0.356	0.249	0.249	
5/7/2015	03:45	7.22	08:30	9.26	8.27	03:00	0.31	07:45	0.74	0.51	03:00	0.125	07:45	0.393	0.245	0.245	
5/8/2015	04:45	7.20	08:15	9.20	8.25	16:45	0.39	08:00	0.79	0.51	04:45	0.161	08:00	0.429	0.245	0.245	
5/9/2015	04:45	7.21	11:00	9.28	8.32	04:30	0.39	16:30	0.70	0.52	04:30	0.152	13:45	0.364	0.253	0.253	
5/10/2015	05:30	7.07	12:15	9.39	8.25	03:30	0.34	21:30	0.81	0.53	05:45	0.130	21:30	0.424	0.258	0.258	
5/11/2015	04:45	7.04	08:30	9.17	8.25	00:30	0.36	07:30	0.79	0.52	04:45	0.149	07:30	0.404	0.251	0.251	
5/12/2015	03:00	7.10	08:00	9.17	8.27	01:30	0.39	07:15	0.82	0.52	03:00	0.154	07:15	0.445	0.249	0.249	
5/13/2015	04:30	7.13	08:00	9.24	8.28	00:45	0.39	07:45	0.71	0.50	03:30	0.155	07:45	0.387	0.241	0.241	
5/14/2015	04:00	6.97	08:00	9.50	8.23	04:00	0.38	20:30	0.71	0.51	04:00	0.144	08:30	0.361	0.246	0.246	
5/15/2015	04:15	7.03	08:30	9.28	8.23	04:15	0.39	10:15	0.66	0.50	04:15	0.148	10:15	0.360	0.241	0.241	
5/16/2015	04:30	6.90	10:45	9.21	8.17	06:15	0.36	11:45	0.79	0.52	04:30	0.139	11:45	0.434	0.249	0.249	0.01
5/17/2015	04:00	7.00	10:45	9.17	8.19	02:30	0.34	19:45	0.70	0.51	02:30	0.135	19:45	0.350	0.242	0.242	
5/18/2015	04:30	6.84	08:30	9.10	8.13	04:30	0.37	11:15	0.68	0.50	04:30	0.134	11:15	0.353	0.235	0.235	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			16.558	4.65
Avg	8.48	0.55	0.276	

Site Commentary

Site Information

Enfield_FM03	
Pipe Dimensions (in.)	Circular (12.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM03 indicate this location functioned in free flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	3.16	5.58	0.614
Minimum	1.96	2.35	0.138
Maximum	4.31	7.14	1.144
Time of Minimum	5/10/2015 4:30 AM	5/15/2015 4:00 AM	5/10/2015 3:30 AM
Time of Maximum	4/4/2015 10:30 AM	4/4/2015 5:00 PM	4/4/2015 10:30 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

.

Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

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Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_FM03	Meter Type:	FLOWSHARK	Monitor S/N:	20768	Manhole #:	
Address / Location:	566 ENFIELD STREET (BEHIND AMERICAN LEGION)			Map Page #:			
				Pipe Height:	12 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	12 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:			
Date/Time of Investigation:	March 18, 2015	12:15 PM	Manhole Depth:	11 Feet		
Site Hydraulics:	FAST, CHOPPY, SEMI-CLEAR FLOW		Manhole Material / Condition:	Brick		Good
			Active Drop Connections?			
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	RC		Good
Upstream Manhole:			Mini System Character:	COMMERCIAL		
Downstream Manhole:			**Telephone Information:**			
Depth of Flow (Wet Dof):	3.75 +/- 0.75		Access Pole #:	N/A		
Range (Air Dof):	8.25 +/- 0.75		Distance From Manhole:	N/A Feet		
Peak Velocity:	6.62 fps		Road Cut Length:	N/A Feet		
Silt:	0 Inches		Trench Length:	N/A Feet		

Other Information:

N 42° 00' 28.4" W 72° 35' 40.9"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 78236 PO 1.0" ULTRA PO 1.50"

SCATTERGRAPH REPORT

Enfield_FM03

Flow Monitor

Enfield_FM03

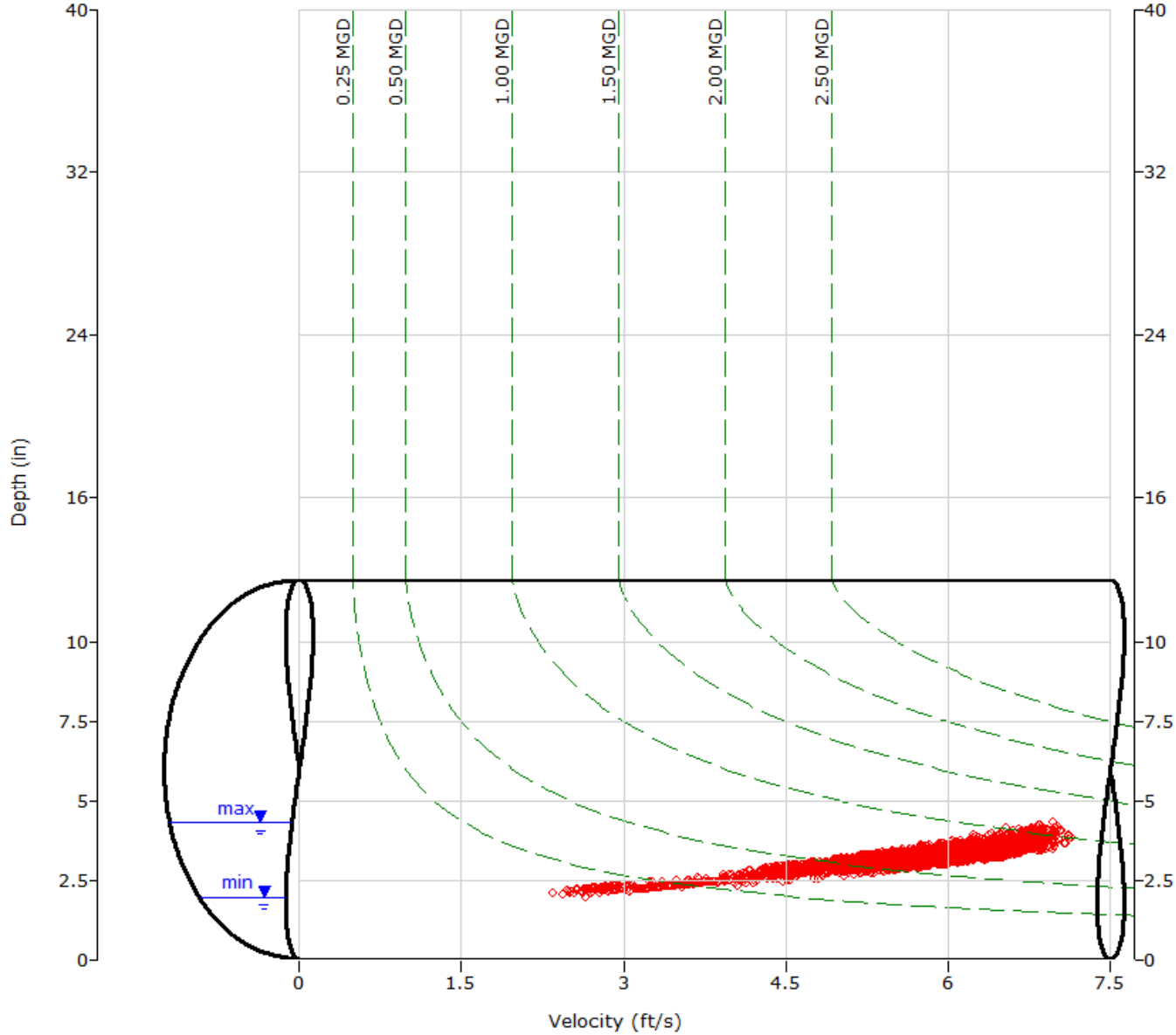
Pipe Height
12.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



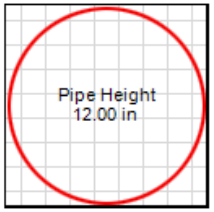
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM03

Flow Monitor

Enfield_FM03

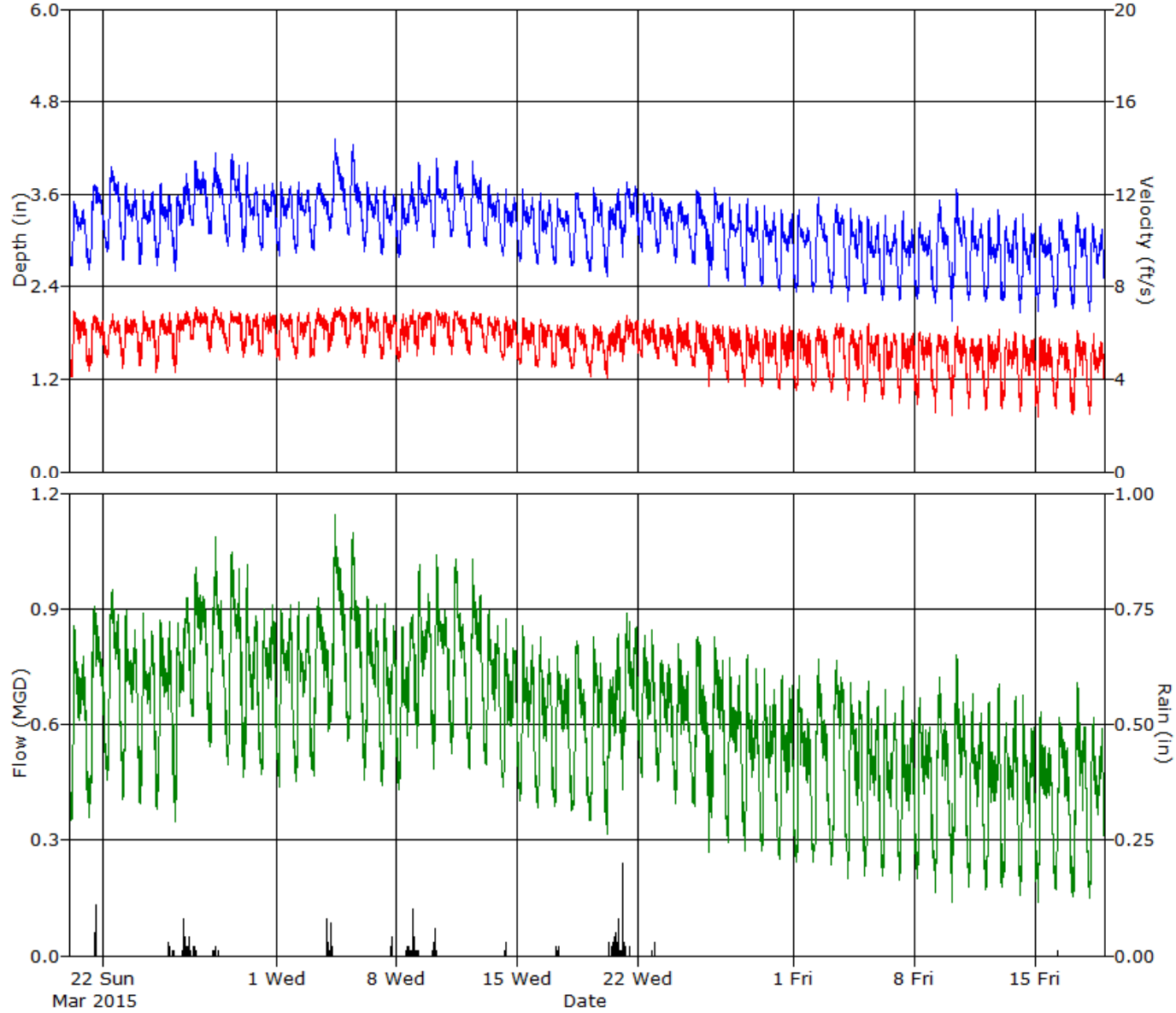


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM03, Pipe Height: 12 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	03:30	2.67	06:45	3.51	3.14	03:45	4.13	07:15	6.97	5.91	03:30	0.353	07:30	0.855	0.635	0.635	
3/21/2015	04:00	2.63	11:00	3.72	3.29	04:00	4.35	11:30	6.77	5.81	04:00	0.358	11:30	0.907	0.671	0.671	0.19
3/22/2015	04:30	2.85	11:30	3.95	3.45	04:30	4.95	13:30	6.81	5.95	04:30	0.457	13:30	0.951	0.728	0.728	
3/23/2015	03:00	2.74	07:30	3.73	3.30	01:45	4.48	07:15	6.69	5.93	03:00	0.406	07:15	0.896	0.680	0.680	
3/24/2015	02:30	2.69	08:15	3.65	3.25	04:15	4.57	07:15	6.95	5.93	04:15	0.393	07:15	0.890	0.666	0.666	0.00
3/25/2015	02:45	2.68	07:45	3.73	3.24	01:15	4.32	19:30	6.86	5.96	02:45	0.380	07:30	0.872	0.667	0.667	0.10
3/26/2015	04:15	2.60	19:45	3.87	3.31	04:15	4.28	20:00	6.97	6.08	04:15	0.347	21:00	0.927	0.705	0.705	0.37
3/27/2015	02:30	3.19	07:30	4.03	3.62	01:30	5.73	08:30	7.11	6.49	02:30	0.621	08:30	1.006	0.841	0.841	0.22
3/28/2015	02:45	3.09	11:30	4.14	3.55	05:00	5.18	09:45	7.11	6.32	05:00	0.541	11:30	1.086	0.800	0.800	0.08
3/29/2015	04:30	2.93	11:30	4.11	3.52	04:30	5.15	10:00	6.93	6.28	04:30	0.494	11:30	1.046	0.789	0.789	
3/30/2015	03:30	2.86	07:30	4.01	3.38	03:30	4.97	21:45	6.84	6.12	03:30	0.461	07:30	1.014	0.724	0.724	
3/31/2015	04:30	2.88	19:45	3.73	3.35	04:30	5.02	16:15	6.87	6.18	04:30	0.471	19:45	0.909	0.723	0.723	
4/1/2015	04:30	2.81	07:00	3.75	3.36	04:30	4.84	07:15	6.81	6.12	04:30	0.438	20:30	0.910	0.718	0.718	
4/2/2015	03:45	2.84	07:00	3.76	3.35	03:45	4.92	21:00	6.88	6.09	03:45	0.452	07:00	0.917	0.712	0.712	
4/3/2015	04:15	2.87	12:00	3.74	3.40	00:15	4.96	10:30	7.08	6.16	04:15	0.466	10:00	0.928	0.735	0.735	0.37
4/4/2015	03:00	3.12	10:30	4.31	3.69	01:15	5.21	17:00	7.14	6.49	01:15	0.584	10:30	1.144	0.867	0.867	0.34
4/5/2015	05:15	3.07	10:30	4.24	3.55	04:00	5.37	09:30	7.12	6.37	04:00	0.556	10:30	1.097	0.806	0.806	
4/6/2015	02:45	2.85	07:30	3.75	3.35	02:45	4.95	07:00	7.07	6.20	02:45	0.457	07:00	0.931	0.724	0.724	
4/7/2015	03:15	2.82	07:30	3.70	3.28	03:15	4.87	07:30	6.86	6.01	03:15	0.443	07:30	0.912	0.682	0.682	0.18
4/8/2015	03:00	2.79	20:30	3.76	3.29	03:00	4.79	22:15	6.98	6.02	03:00	0.429	22:15	0.884	0.688	0.688	0.68
4/9/2015	04:00	3.13	07:00	4.01	3.52	03:45	5.01	15:45	6.90	6.41	03:45	0.540	07:45	1.013	0.797	0.797	0.13
4/10/2015	03:30	2.91	07:00	4.06	3.49	04:00	5.10	07:15	6.98	6.34	03:30	0.485	07:00	1.038	0.784	0.784	0.34
4/11/2015	03:15	3.05	09:45	4.02	3.51	05:15	5.08	08:30	6.96	6.30	05:15	0.525	09:45	1.029	0.784	0.784	
4/12/2015	05:00	2.91	10:00	4.03	3.45	05:00	5.10	10:00	6.88	6.18	05:00	0.485	10:00	1.029	0.756	0.756	
4/13/2015	04:00	2.93	07:45	3.72	3.34	04:00	5.15	16:45	6.71	6.06	04:00	0.494	07:45	0.895	0.703	0.703	
4/14/2015	04:15	2.81	07:30	3.66	3.24	04:15	4.84	07:30	6.68	5.81	04:15	0.438	07:30	0.875	0.648	0.648	0.07
4/15/2015	03:45	2.73	07:30	3.67	3.22	03:45	4.63	08:00	6.65	5.76	03:45	0.402	07:30	0.857	0.639	0.639	
4/16/2015	03:45	2.69	07:45	3.61	3.17	03:45	4.52	07:30	6.56	5.70	03:45	0.384	07:30	0.827	0.620	0.620	
4/17/2015	04:00	2.70	07:30	3.54	3.16	00:30	4.55	12:30	6.35	5.61	04:00	0.389	07:30	0.775	0.606	0.606	0.11
4/18/2015	03:15	2.67	09:30	3.62	3.17	03:15	4.46	11:15	6.37	5.53	03:15	0.376	11:15	0.816	0.600	0.600	
4/19/2015	04:45	2.61	10:30	3.69	3.16	06:15	4.11	10:00	6.31	5.43	04:45	0.350	10:30	0.828	0.589	0.589	
4/20/2015	04:15	2.53	20:00	3.67	3.18	04:15	4.07	20:15	6.49	5.49	04:15	0.317	20:15	0.834	0.600	0.600	0.96
4/21/2015	02:15	2.79	08:30	3.76	3.39	02:15	4.79	08:15	6.74	5.97	02:15	0.429	08:15	0.887	0.707	0.707	0.41
4/22/2015	04:45	2.86	07:15	3.62	3.29	04:45	4.97	08:15	6.56	5.87	04:45	0.461	19:45	0.843	0.667	0.667	0.09
4/23/2015	03:30	2.84	07:15	3.54	3.24	04:15	4.88	16:45	6.35	5.72	03:30	0.452	07:45	0.765	0.636	0.636	
4/24/2015	03:45	2.71	11:15	3.51	3.18	03:45	4.57	08:30	6.66	5.61	03:45	0.393	08:30	0.810	0.609	0.609	
4/25/2015	06:15	2.70	09:30	3.65	3.17	06:15	4.55	08:45	6.52	5.51	06:15	0.389	11:15	0.827	0.597	0.597	
4/26/2015	02:30	2.40	10:45	3.69	3.17	02:30	3.70	15:30	6.35	5.47	02:30	0.268	10:45	0.828	0.596	0.596	
4/27/2015	04:30	2.47	07:15	3.56	3.08	04:30	3.89	08:00	6.28	5.36	04:30	0.293	07:15	0.773	0.559	0.559	
4/28/2015	03:45	2.41	07:30	3.54	3.02	03:45	3.72	07:00	6.32	5.26	03:45	0.270	08:00	0.782	0.536	0.536	
4/29/2015	03:45	2.41	07:00	3.45	2.98	03:45	3.72	07:00	6.16	5.17	03:45	0.270	07:00	0.744	0.517	0.517	
4/30/2015	04:30	2.36	06:45	3.39	2.93	04:30	3.57	08:00	6.34	5.14	04:30	0.252	08:00	0.726	0.504	0.504	
5/1/2015	04:30	2.34	07:00	3.40	2.91	04:30	3.51	07:00	6.13	5.05	04:30	0.245	07:00	0.725	0.491	0.491	
5/2/2015	03:30	2.34	11:15	3.56	2.95	03:30	3.51	10:30	6.28	5.07	03:30	0.245	11:15	0.768	0.506	0.506	
5/3/2015	04:15	2.32	11:45	3.46	2.96	04:15	3.45	18:30	6.42	5.22	04:15	0.238	12:15	0.764	0.526	0.526	
5/4/2015	03:30	2.21	07:30	3.42	2.88	03:30	3.12	09:45	6.13	5.06	03:30	0.200	07:30	0.708	0.487	0.487	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	02:45	2.31	07:00	3.30	2.83	02:45	3.01	07:30	6.37	4.94	02:45	0.206	08:00	0.713	0.462	0.462	
5/6/2015	03:15	2.23	07:00	3.33	2.81	03:15	3.18	07:00	6.00	4.90	03:15	0.207	07:00	0.690	0.455	0.455	
5/7/2015	03:00	2.23	08:15	3.37	2.80	03:45	2.99	22:15	5.99	4.85	03:45	0.196	08:15	0.696	0.447	0.447	
5/8/2015	04:15	2.24	07:00	3.24	2.82	03:45	2.92	07:00	6.06	4.95	03:45	0.201	07:00	0.670	0.461	0.461	
5/9/2015	04:45	2.19	11:45	3.52	2.88	04:45	2.56	09:00	5.94	4.85	04:45	0.163	11:45	0.724	0.469	0.469	
5/10/2015	04:30	1.96	11:00	3.66	2.93	03:30	2.44	11:45	6.30	4.88	03:30	0.138	11:00	0.781	0.486	0.486	
5/11/2015	04:00	2.22	08:30	3.41	2.84	04:15	2.71	20:15	5.74	4.77	04:15	0.177	08:30	0.680	0.450	0.450	
5/12/2015	03:15	2.20	20:30	3.40	2.80	03:15	2.66	21:30	6.14	4.71	03:15	0.170	21:30	0.705	0.436	0.436	
5/13/2015	02:30	2.22	20:30	3.29	2.79	02:00	2.74	19:45	6.02	4.72	02:00	0.180	20:30	0.673	0.435	0.435	
5/14/2015	03:45	2.06	07:30	3.34	2.76	02:45	2.61	07:00	5.94	4.66	02:45	0.158	07:30	0.676	0.423	0.423	
5/15/2015	04:00	2.09	07:30	3.21	2.77	04:00	2.35	07:45	5.87	4.68	04:00	0.139	07:30	0.632	0.424	0.424	
5/16/2015	03:30	2.13	09:30	3.27	2.78	05:15	2.74	09:15	5.73	4.52	05:15	0.170	09:30	0.619	0.417	0.417	0.01
5/17/2015	03:45	2.12	11:15	3.36	2.80	04:00	2.48	11:15	6.09	4.59	04:00	0.154	11:15	0.709	0.430	0.430	
5/18/2015	03:00	2.08	07:00	3.22	2.75	03:30	2.51	09:00	5.96	4.53	03:30	0.149	08:45	0.618	0.410	0.409	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			36.826	4.65
Avg	3.16	5.58	0.614	

Site Commentary

Site Information

Enfield_FM04	
Pipe Dimensions (in.)	Circular (12.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM04 indicate this location functioned in free flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	3.36	1.27	0.151
Minimum	2.35	0.76	0.055
Maximum	4.51	1.74	0.300
Time of Minimum	5/14/2015 4:30 AM	5/18/2015 3:45 AM	5/18/2015 3:45 AM
Time of Maximum	4/4/2015 10:15 AM	4/4/2015 10:00 AM	4/4/2015 10:15 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

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Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_FM04	Meter Type:	FLOWSHARK	Monitor S/N:	21320	Manhole #:	
Address / Location:	29 TANGLEWOOD AVENUE			Map Page #:			
				Pipe Height:	12 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	12 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 19, 2015	2:45 PM	Manhole Depth:	13 Feet	
Site Hydraulics:	SLOW, SMOOTH FLOW		Manhole Material / Condition:	Brick	Good
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	AC	Good
Upstream Manhole:			Mini System Character:	RESIDENTIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	3 +/- 0.38		Access Pole #:	N/A	
Range (Air Dof):	9 +/- 0.38		Distance From Manhole:	N/A Feet	
Peak Velocity:	1.29 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 42° 00' 32.0" W 72° 34' 03.9"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 83396 PO 1.0" ULTRA PO 1.50"

SCATTERGRAPH REPORT

Enfield_FM04

Flow Monitor

Enfield_FM04

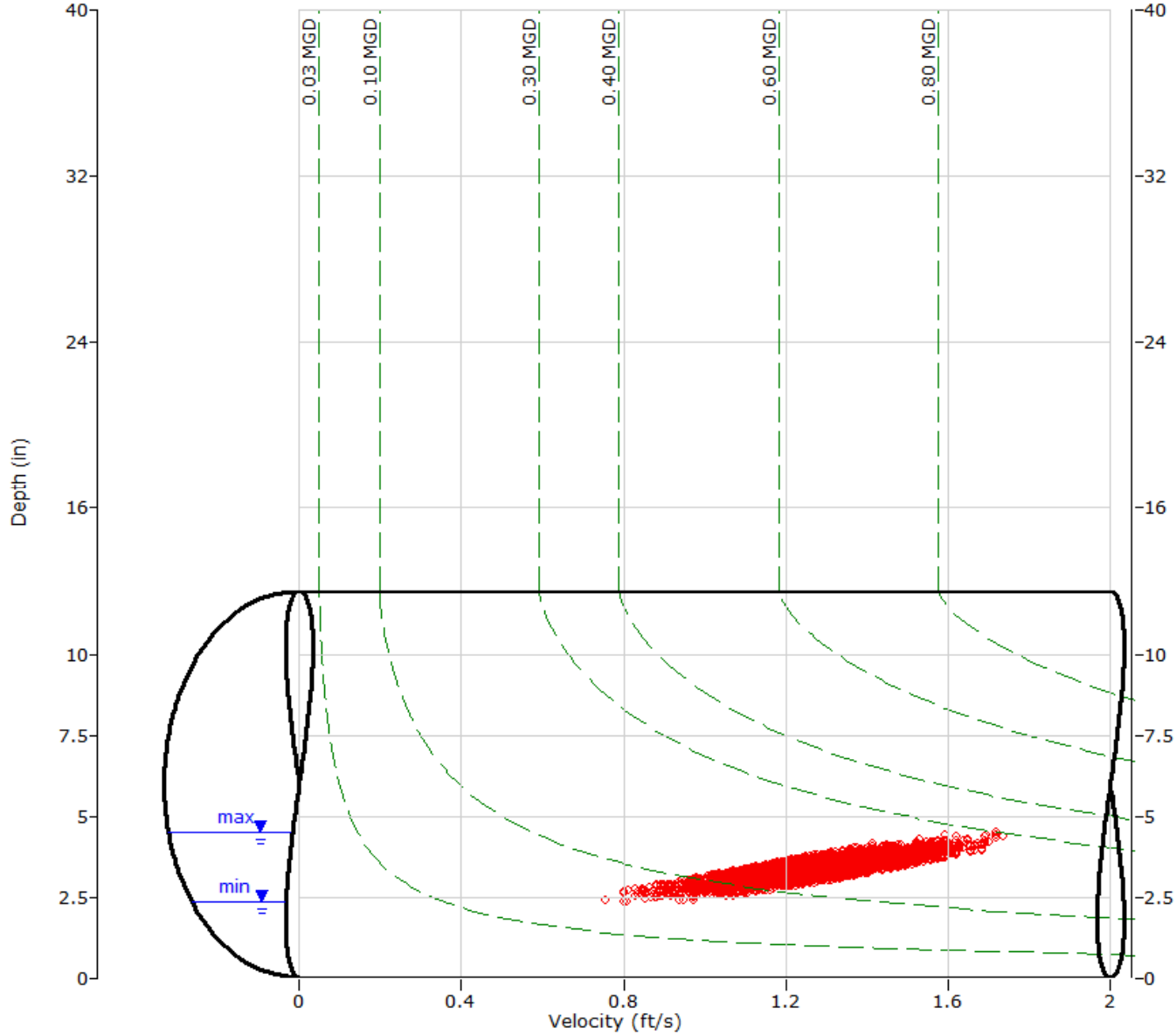
Pipe Height
12.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



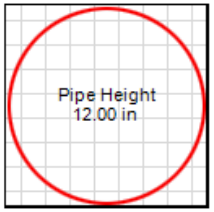
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM04

Flow Monitor

Enfield_FM04

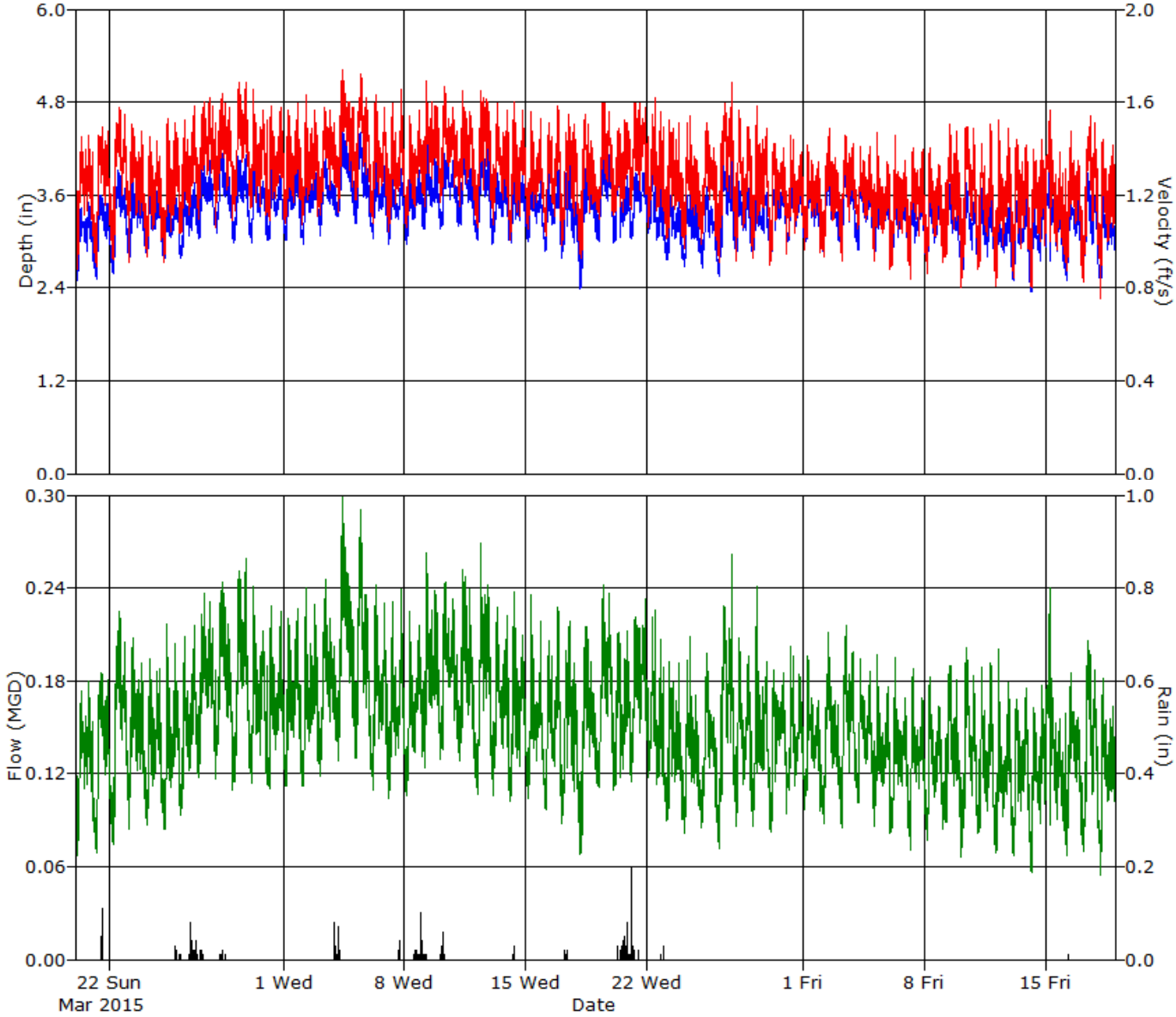


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM04, Pipe Height: 12 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	03:15	2.50	19:15	3.50	3.08	03:15	0.88	19:15	1.46	1.22	03:15	0.068	19:15	0.180	0.127	0.127	
3/21/2015	05:30	2.52	10:30	3.60	3.13	05:30	0.89	13:45	1.49	1.25	05:30	0.069	12:00	0.185	0.134	0.134	0.19
3/22/2015	05:00	2.58	11:00	3.91	3.30	05:00	0.92	12:30	1.57	1.29	05:00	0.074	12:30	0.225	0.150	0.150	
3/23/2015	03:15	2.75	07:15	3.85	3.32	02:15	0.91	07:00	1.50	1.26	02:15	0.084	07:15	0.207	0.146	0.146	
3/24/2015	01:15	2.85	21:15	3.78	3.28	04:15	0.94	08:15	1.45	1.19	04:15	0.087	08:15	0.194	0.135	0.135	0.00
3/25/2015	03:45	2.78	07:15	3.92	3.24	02:15	0.91	08:15	1.53	1.24	02:15	0.084	07:15	0.217	0.138	0.138	0.10
3/26/2015	02:15	2.78	07:00	3.78	3.28	00:00	1.03	20:30	1.58	1.28	02:15	0.093	20:30	0.215	0.145	0.145	0.37
3/27/2015	02:15	3.03	19:15	4.04	3.57	02:45	1.10	18:00	1.62	1.39	02:15	0.118	10:00	0.236	0.177	0.177	0.22
3/28/2015	04:00	3.10	13:00	4.15	3.62	02:15	1.06	11:00	1.64	1.41	02:15	0.116	11:00	0.243	0.183	0.183	0.08
3/29/2015	03:30	2.99	20:30	4.11	3.57	01:45	1.09	11:15	1.68	1.41	01:45	0.110	20:30	0.259	0.181	0.181	
3/30/2015	04:15	2.99	07:15	4.01	3.49	23:45	1.12	07:00	1.66	1.36	04:15	0.114	07:15	0.241	0.168	0.168	
3/31/2015	02:15	3.01	07:00	3.94	3.47	04:45	1.09	06:45	1.58	1.33	04:45	0.110	07:00	0.228	0.163	0.163	
4/1/2015	02:15	3.02	07:15	4.05	3.53	03:15	1.08	20:30	1.59	1.32	02:15	0.112	20:30	0.226	0.166	0.166	
4/2/2015	04:30	2.96	07:15	3.99	3.48	01:45	1.07	07:15	1.63	1.31	04:30	0.112	07:15	0.240	0.161	0.161	
4/3/2015	03:30	3.07	10:00	4.21	3.59	03:00	1.12	09:30	1.57	1.36	03:30	0.118	10:00	0.246	0.175	0.175	0.37
4/4/2015	02:45	3.32	10:15	4.51	3.84	04:15	1.12	10:00	1.74	1.45	04:15	0.129	10:15	0.300	0.205	0.205	0.34
4/5/2015	03:00	3.24	11:00	4.41	3.72	03:00	1.18	11:00	1.72	1.44	03:00	0.130	11:00	0.291	0.195	0.195	
4/6/2015	03:45	3.04	09:30	4.01	3.53	03:45	1.08	09:30	1.63	1.35	03:45	0.109	09:30	0.242	0.169	0.169	
4/7/2015	02:45	2.97	07:15	3.94	3.46	01:15	1.04	20:15	1.66	1.32	02:45	0.104	20:15	0.239	0.161	0.161	0.18
4/8/2015	03:30	2.97	07:15	3.96	3.47	02:30	1.06	20:15	1.57	1.31	03:30	0.106	07:15	0.225	0.160	0.160	0.68
4/9/2015	02:00	3.16	07:15	4.29	3.64	03:30	1.15	06:45	1.69	1.41	03:30	0.124	06:45	0.263	0.185	0.185	0.13
4/10/2015	02:15	3.16	07:15	4.14	3.68	01:15	1.17	06:30	1.66	1.41	02:15	0.130	08:45	0.243	0.187	0.187	0.34
4/11/2015	03:15	3.19	11:30	4.21	3.65	05:00	1.15	08:00	1.65	1.39	03:45	0.129	08:00	0.251	0.183	0.183	
4/12/2015	04:45	3.02	09:30	4.30	3.57	04:45	1.06	09:30	1.65	1.38	04:45	0.106	09:30	0.269	0.177	0.177	
4/13/2015	01:30	2.97	07:15	3.93	3.47	03:30	1.07	08:45	1.59	1.33	03:30	0.106	08:45	0.227	0.163	0.163	
4/14/2015	04:15	2.98	07:15	4.00	3.44	02:45	1.01	07:45	1.60	1.29	02:45	0.102	07:45	0.237	0.157	0.157	0.07
4/15/2015	02:30	3.00	07:15	4.06	3.42	02:30	1.05	07:15	1.56	1.28	02:30	0.104	07:15	0.235	0.153	0.153	
4/16/2015	02:30	2.87	20:30	3.91	3.37	03:30	1.03	20:30	1.58	1.28	03:30	0.097	20:30	0.227	0.152	0.152	
4/17/2015	02:30	2.79	12:45	4.03	3.35	02:30	0.98	12:00	1.55	1.28	02:30	0.088	12:45	0.218	0.150	0.150	0.11
4/18/2015	03:00	2.39	11:45	4.08	3.32	04:00	0.93	10:30	1.55	1.25	03:00	0.068	11:45	0.215	0.146	0.146	
4/19/2015	05:45	3.00	11:45	4.11	3.57	06:15	1.10	10:00	1.59	1.34	05:45	0.111	11:45	0.242	0.172	0.172	
4/20/2015	01:45	2.98	08:30	3.99	3.48	01:45	1.11	17:30	1.52	1.33	01:45	0.109	20:15	0.212	0.163	0.163	0.96
4/21/2015	01:30	3.04	21:15	3.99	3.53	01:30	1.14	06:45	1.59	1.39	01:30	0.115	21:15	0.232	0.174	0.174	0.41
4/22/2015	13:00	3.02	06:45	4.05	3.35	01:45	1.06	10:45	1.62	1.30	13:00	0.113	10:45	0.226	0.152	0.152	0.09
4/23/2015	02:45	2.76	08:15	3.59	3.17	02:45	1.01	06:45	1.52	1.24	02:45	0.089	06:45	0.193	0.135	0.135	
4/24/2015	04:15	2.67	10:45	3.75	3.15	04:15	0.97	10:45	1.54	1.23	04:15	0.081	10:45	0.209	0.132	0.132	
4/25/2015	04:15	2.65	10:45	3.70	3.16	03:45	0.99	11:00	1.51	1.24	03:45	0.085	11:00	0.198	0.134	0.134	
4/26/2015	03:45	2.55	21:00	4.14	3.36	03:45	0.91	21:00	1.68	1.31	03:45	0.072	21:00	0.261	0.156	0.156	
4/27/2015	03:45	2.88	07:30	3.78	3.31	03:45	0.92	06:30	1.57	1.26	03:45	0.086	06:30	0.208	0.144	0.144	
4/28/2015	03:15	2.80	07:15	4.08	3.29	02:15	0.93	07:15	1.58	1.26	02:15	0.086	07:15	0.241	0.143	0.143	
4/29/2015	03:00	2.80	20:15	3.77	3.36	01:30	0.90	07:30	1.42	1.22	03:30	0.083	07:30	0.187	0.144	0.144	
4/30/2015	00:45	3.00	21:00	3.83	3.40	00:45	0.94	06:45	1.46	1.22	00:45	0.094	06:45	0.202	0.145	0.145	
5/1/2015	02:15	3.00	07:00	3.84	3.37	01:15	0.96	06:45	1.41	1.20	01:15	0.097	06:45	0.196	0.140	0.140	
5/2/2015	03:30	2.87	10:45	3.95	3.36	04:15	0.94	12:45	1.48	1.20	04:15	0.088	10:45	0.211	0.141	0.141	
5/3/2015	05:00	2.85	11:15	4.01	3.44	05:45	0.92	10:00	1.46	1.24	05:45	0.086	11:15	0.215	0.150	0.150	
5/4/2015	02:30	2.89	06:45	3.88	3.39	03:15	1.05	07:30	1.41	1.22	02:30	0.101	06:45	0.194	0.145	0.145	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	04:30	2.87	07:00	3.75	3.30	02:30	0.92	07:15	1.47	1.17	02:30	0.086	07:15	0.197	0.134	0.134	
5/6/2015	02:15	2.84	07:30	3.71	3.24	00:45	0.88	07:30	1.46	1.16	00:45	0.081	07:30	0.195	0.130	0.130	
5/7/2015	04:00	2.67	07:45	3.71	3.21	04:00	0.84	07:45	1.40	1.18	04:00	0.070	07:45	0.187	0.130	0.130	
5/8/2015	03:30	2.79	07:00	3.64	3.21	03:30	0.86	07:00	1.40	1.16	03:30	0.077	07:00	0.183	0.128	0.128	
5/9/2015	02:15	2.83	09:00	3.84	3.22	01:15	0.91	10:00	1.50	1.19	01:15	0.084	12:45	0.190	0.132	0.132	
5/10/2015	02:45	2.63	10:30	3.76	3.17	02:45	0.80	10:00	1.49	1.21	02:45	0.066	10:00	0.201	0.133	0.133	
5/11/2015	02:15	2.67	07:30	3.69	3.16	02:30	0.88	18:45	1.50	1.18	02:30	0.082	18:45	0.191	0.127	0.127	
5/12/2015	02:30	2.65	07:00	3.68	3.05	03:30	0.81	07:00	1.52	1.16	03:30	0.069	07:00	0.201	0.119	0.119	
5/13/2015	04:30	2.49	20:30	3.60	3.07	04:00	0.85	07:45	1.44	1.17	04:00	0.067	20:30	0.176	0.122	0.122	
5/14/2015	04:30	2.35	18:30	3.51	3.03	04:30	0.80	18:15	1.44	1.15	04:30	0.056	18:30	0.177	0.118	0.118	
5/15/2015	05:30	2.74	05:15	4.10	3.28	16:30	0.96	05:15	1.57	1.23	05:30	0.087	05:15	0.240	0.140	0.140	
5/16/2015	04:30	2.49	11:15	3.55	3.15	04:30	0.88	11:15	1.48	1.17	04:30	0.067	11:15	0.185	0.126	0.126	0.01
5/17/2015	04:00	2.61	10:00	3.88	3.20	05:15	0.83	14:00	1.54	1.19	04:00	0.070	10:00	0.206	0.132	0.132	
5/18/2015	03:45	2.40	07:15	3.57	3.04	03:45	0.76	06:45	1.44	1.16	03:45	0.055	07:15	0.181	0.118	0.118	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			9.051	4.65
Avg	3.36	1.27	0.151	

Site Commentary

Site Information

Enfield_FM05	
Pipe Dimensions (in.)	Circular (12.00 in H)
Silt (in.)	0.50

Overview

A review of the hydrograph and scattergraph for Enfield_FM05 indicate this location functioned under typical open channel flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	4.96	0.71	0.138
Minimum	4.11	0.38	0.057
Maximum	6.07	0.97	0.236
Time of Minimum	5/18/2015 4:00 AM	5/16/2015 5:15 AM	5/16/2015 5:15 AM
Time of Maximum	4/5/2015 10:30 AM	4/5/2015 12:00 PM	4/5/2015 12:00 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

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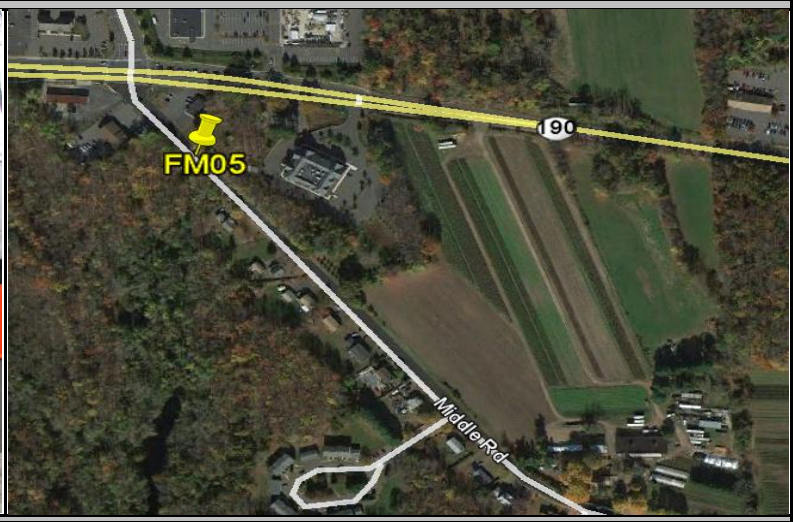
Site Report

FM Initials:	IC
Project Name:	ENFIELD, CT

Site Name:	ENFIELD_FM05	Meter Type:	FLOWSHARK	Monitor S/N:	16082	Manhole #:	
Address / Location:	2 MIDDLE ROAD			Map Page #:			
				Pipe Height:	12 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	12 Inches		
				Phone Number:	N/A		



Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 18, 2015	10:30 AM	Manhole Depth:	11 Feet	
Site Hydraulics:	SLOW, SMOOTH FLOW		Manhole Material / Condition:	Brick	Good
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	RC	Good
Upstream Manhole:			Mini System Character:	COMMERCIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	5.5 +/- 0.38		Access Pole #:	N/A	
Range (Air Dof):	6.5 +/- 0.38		Distance From Manhole:	N/A Feet	
Peak Velocity:	0.67 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 41° 59' 14.5" W 72° 34' 14.4"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 10225 PO 1.50" ULTRA PO 1.50" VEL @ 6:30 CONCRETE CLEANED OUT OF INVERT

SCATTERGRAPH REPORT

Enfield_FM05

Flow Monitor

Enfield_FM05

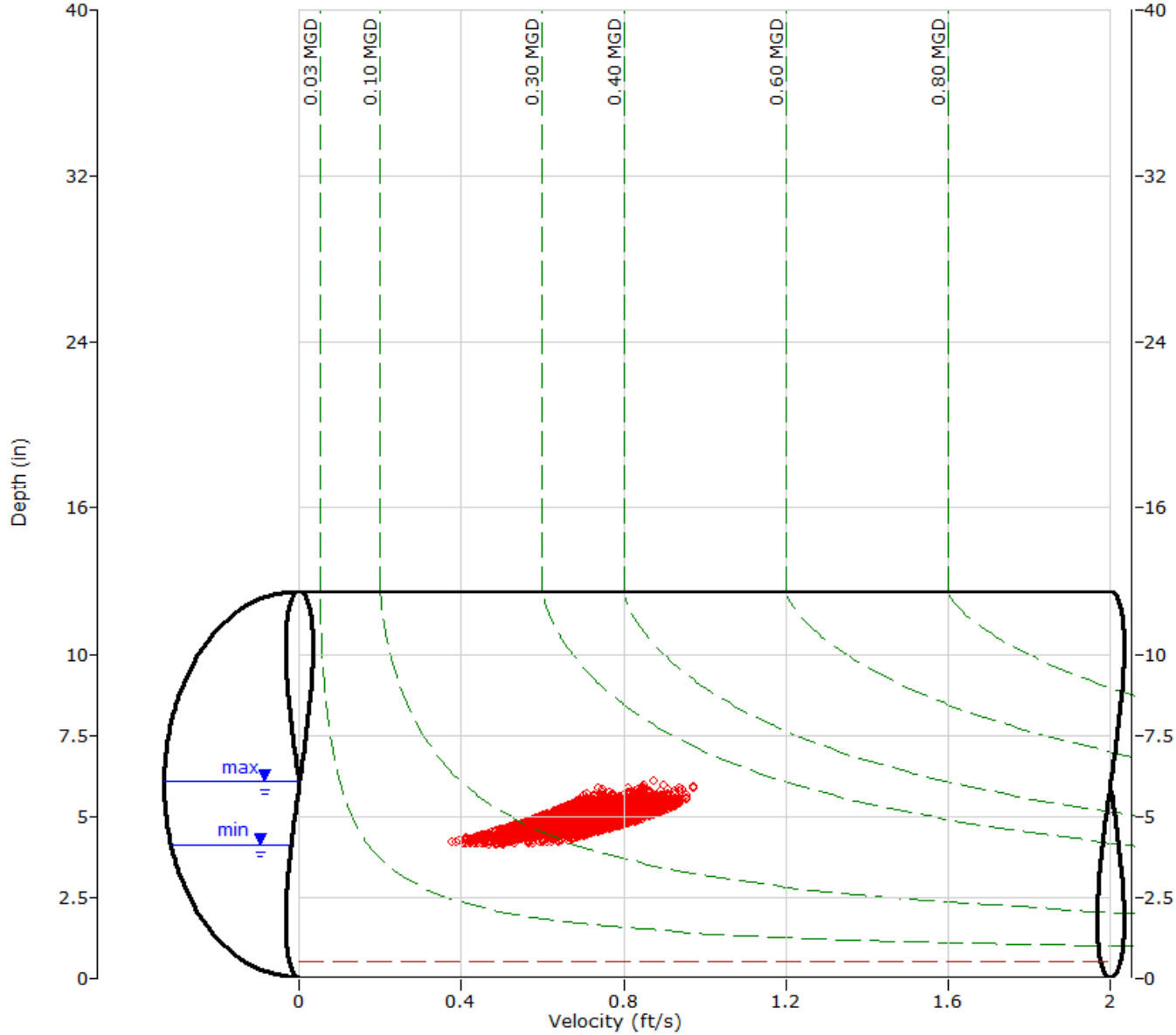
Pipe Height
12.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



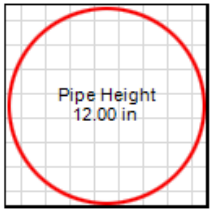
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM05

Flow Monitor

Enfield_FM05

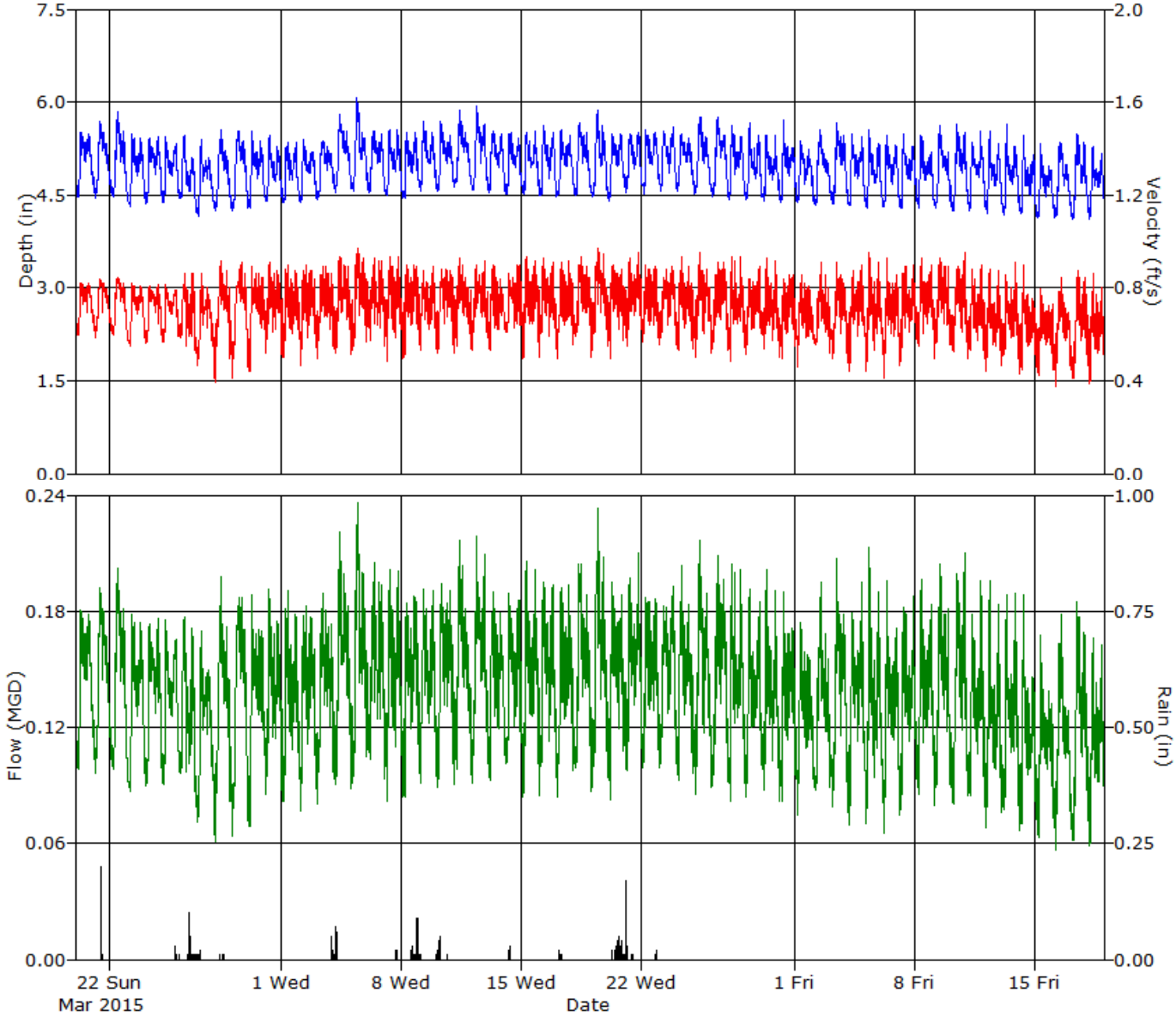


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM05, Pipe Height: 12 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	04:15	4.47	07:45	5.51	5.07	04:15	0.60	07:45	0.82	0.74	04:15	0.098	07:45	0.181	0.147	0.147	
3/21/2015	05:00	4.44	10:00	5.68	5.07	05:00	0.59	10:00	0.84	0.74	05:00	0.096	10:00	0.192	0.146	0.146	0.21
3/22/2015	05:45	4.47	11:45	5.85	5.07	05:45	0.60	11:45	0.85	0.73	05:45	0.098	11:45	0.202	0.146	0.146	
3/23/2015	04:45	4.32	07:30	5.48	4.92	04:45	0.55	07:30	0.82	0.71	04:45	0.087	07:30	0.179	0.135	0.135	
3/24/2015	03:00	4.36	20:45	5.45	4.95	03:00	0.56	20:45	0.81	0.71	03:00	0.090	20:45	0.176	0.137	0.137	0.00
3/25/2015	04:00	4.37	07:00	5.44	4.92	04:00	0.57	07:00	0.81	0.71	04:00	0.091	07:00	0.176	0.134	0.134	0.09
3/26/2015	04:15	4.44	08:30	5.46	4.80	11:00	0.55	10:15	0.86	0.69	04:15	0.096	08:30	0.177	0.128	0.128	0.32
3/27/2015	04:45	4.15	08:00	5.40	4.76	03:45	0.47	09:15	0.86	0.67	03:45	0.071	09:15	0.169	0.122	0.122	0.17
3/28/2015	04:00	4.24	11:30	5.55	4.84	04:00	0.40	12:15	0.92	0.69	04:00	0.061	12:15	0.198	0.129	0.129	0.07
3/29/2015	04:30	4.24	11:30	5.54	4.93	04:15	0.41	17:45	0.91	0.71	04:15	0.064	13:30	0.187	0.136	0.136	
3/30/2015	04:30	4.29	07:30	5.53	4.90	03:30	0.44	07:45	0.89	0.70	04:30	0.069	07:45	0.189	0.134	0.134	
3/31/2015	02:45	4.40	07:45	5.47	4.87	23:45	0.51	09:15	0.91	0.73	03:15	0.086	07:30	0.191	0.137	0.137	
4/1/2015	04:45	4.37	09:30	5.36	4.88	02:15	0.50	09:30	0.90	0.70	03:45	0.082	09:30	0.191	0.132	0.132	
4/2/2015	03:15	4.38	07:30	5.40	4.90	04:30	0.47	11:15	0.90	0.72	04:30	0.077	11:15	0.183	0.136	0.136	
4/3/2015	02:15	4.42	11:15	5.37	4.97	02:15	0.50	11:15	0.89	0.73	02:15	0.080	11:15	0.190	0.140	0.140	0.19
4/4/2015	04:30	4.53	10:00	5.80	5.15	05:15	0.52	10:00	0.94	0.75	05:15	0.091	10:00	0.221	0.152	0.152	0.35
4/5/2015	06:15	4.57	10:30	6.07	5.17	02:45	0.51	12:00	0.97	0.75	02:45	0.088	12:00	0.236	0.154	0.154	
4/6/2015	02:45	4.54	09:15	5.53	5.09	05:45	0.58	11:00	0.93	0.75	05:45	0.103	11:00	0.205	0.149	0.149	
4/7/2015	04:00	4.49	08:15	5.55	5.00	04:15	0.49	08:00	0.94	0.75	04:15	0.082	08:00	0.201	0.145	0.145	0.15
4/8/2015	03:00	4.44	20:30	5.51	5.00	02:00	0.50	08:45	0.90	0.73	02:00	0.084	17:45	0.188	0.142	0.142	0.63
4/9/2015	03:15	4.55	07:30	5.69	5.09	02:45	0.53	21:45	0.89	0.72	02:45	0.091	07:45	0.192	0.144	0.144	0.10
4/10/2015	03:15	4.55	07:15	5.69	5.11	03:00	0.52	09:45	0.88	0.74	03:00	0.089	09:45	0.194	0.149	0.149	0.31
4/11/2015	02:45	4.63	10:45	5.86	5.18	02:45	0.52	09:45	0.93	0.75	02:45	0.091	10:15	0.216	0.153	0.153	
4/12/2015	03:45	4.58	10:15	5.94	5.17	03:30	0.53	20:30	0.92	0.74	03:30	0.091	10:15	0.219	0.150	0.150	
4/13/2015	03:00	4.54	08:30	5.52	5.08	05:30	0.53	09:30	0.90	0.73	05:30	0.092	09:30	0.190	0.145	0.145	
4/14/2015	03:00	4.51	10:45	5.50	5.05	03:00	0.61	18:15	0.90	0.75	03:00	0.102	07:30	0.189	0.147	0.147	0.05
4/15/2015	03:45	4.51	20:15	5.54	5.03	02:45	0.50	07:15	0.94	0.75	02:45	0.084	07:15	0.206	0.147	0.147	
4/16/2015	03:15	4.49	08:15	5.62	5.05	01:30	0.50	07:15	0.93	0.74	01:30	0.085	07:15	0.195	0.146	0.146	
4/17/2015	02:00	4.48	08:15	5.55	5.04	03:15	0.50	18:00	0.92	0.73	03:15	0.084	18:00	0.193	0.144	0.144	0.11
4/18/2015	04:45	4.49	11:00	5.66	5.07	01:15	0.56	11:45	0.94	0.75	01:15	0.098	11:45	0.204	0.150	0.150	
4/19/2015	04:30	4.48	11:00	5.87	5.07	02:30	0.50	11:00	0.97	0.76	02:30	0.087	11:00	0.233	0.150	0.150	
4/20/2015	02:30	4.40	08:00	5.48	5.01	05:15	0.50	09:45	0.90	0.74	05:15	0.083	08:00	0.195	0.144	0.144	0.84
4/21/2015	02:30	4.53	20:45	5.51	5.09	05:30	0.55	20:45	0.95	0.77	05:30	0.098	20:45	0.210	0.153	0.153	0.36
4/22/2015	04:15	4.52	06:45	5.56	5.10	02:15	0.57	06:30	0.90	0.75	02:15	0.099	06:30	0.187	0.148	0.148	0.05
4/23/2015	03:00	4.55	20:45	5.59	5.10	01:45	0.56	19:45	0.89	0.74	01:45	0.099	20:30	0.193	0.148	0.148	
4/24/2015	02:30	4.57	08:00	5.48	5.07	05:15	0.53	08:45	0.94	0.73	05:15	0.093	08:45	0.204	0.145	0.145	
4/25/2015	02:30	4.51	10:45	5.76	5.10	05:15	0.50	10:00	0.95	0.74	05:15	0.085	10:00	0.216	0.148	0.148	
4/26/2015	04:00	4.47	11:00	5.75	5.11	02:00	0.52	12:00	0.91	0.73	02:00	0.089	12:00	0.209	0.147	0.147	
4/27/2015	04:00	4.42	08:15	5.62	5.02	05:15	0.49	06:30	0.94	0.72	05:15	0.081	06:30	0.205	0.140	0.140	
4/28/2015	03:45	4.43	07:45	5.67	4.95	02:00	0.51	21:45	0.89	0.71	03:45	0.084	07:45	0.191	0.137	0.137	
4/29/2015	04:15	4.41	06:45	5.47	4.92	04:15	0.54	07:45	0.93	0.72	04:15	0.087	07:45	0.202	0.136	0.136	
4/30/2015	04:00	4.38	08:15	5.72	4.94	05:30	0.50	15:45	0.85	0.70	05:30	0.081	07:30	0.190	0.133	0.133	
5/1/2015	02:30	4.38	07:00	5.37	4.87	02:45	0.46	09:00	0.85	0.68	02:45	0.075	07:00	0.174	0.128	0.128	
5/2/2015	04:15	4.33	11:00	5.55	4.91	04:15	0.55	11:45	0.91	0.69	04:15	0.087	11:30	0.195	0.131	0.131	
5/3/2015	03:45	4.35	10:30	5.66	4.98	04:45	0.50	10:30	0.91	0.70	04:45	0.079	10:30	0.207	0.136	0.136	
5/4/2015	04:00	4.33	07:30	5.48	4.90	04:00	0.44	20:45	0.90	0.71	04:00	0.070	20:45	0.195	0.134	0.134	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	04:45	4.30	07:45	5.56	4.85	02:45	0.44	07:45	0.95	0.70	02:45	0.071	07:45	0.213	0.131	0.131	
5/6/2015	02:15	4.31	07:45	5.46	4.88	04:15	0.41	08:15	0.93	0.69	04:15	0.065	08:15	0.196	0.131	0.131	
5/7/2015	03:15	4.29	08:15	5.49	4.86	02:00	0.47	21:45	0.90	0.71	01:45	0.075	21:45	0.188	0.134	0.134	
5/8/2015	04:30	4.29	07:45	5.46	4.86	04:15	0.55	08:45	0.93	0.73	04:30	0.085	08:15	0.197	0.136	0.136	
5/9/2015	04:15	4.30	10:00	5.62	4.90	02:45	0.50	10:15	0.93	0.73	02:45	0.080	10:15	0.205	0.138	0.138	
5/10/2015	05:00	4.24	10:00	5.64	4.94	05:00	0.53	21:00	0.95	0.72	05:00	0.081	21:00	0.210	0.138	0.138	
5/11/2015	04:00	4.25	20:00	5.54	4.86	00:45	0.50	20:45	0.90	0.69	00:45	0.085	20:00	0.196	0.129	0.129	
5/12/2015	04:15	4.21	08:00	5.54	4.81	03:00	0.44	08:00	0.88	0.67	03:00	0.068	08:00	0.196	0.124	0.124	
5/13/2015	04:15	4.18	07:30	5.64	4.81	01:15	0.47	19:45	0.91	0.67	01:15	0.076	19:45	0.189	0.124	0.124	
5/14/2015	03:00	4.20	08:00	5.46	4.72	02:15	0.43	06:45	0.90	0.64	02:15	0.066	06:45	0.189	0.116	0.116	
5/15/2015	02:30	4.14	07:45	5.33	4.66	04:15	0.42	07:45	0.80	0.62	04:15	0.063	07:45	0.168	0.110	0.110	
5/16/2015	03:15	4.14	11:00	5.34	4.71	05:15	0.38	11:45	0.85	0.63	05:15	0.057	11:45	0.178	0.114	0.114	
5/17/2015	04:45	4.12	09:45	5.48	4.77	03:45	0.41	11:30	0.87	0.65	05:15	0.061	09:45	0.185	0.120	0.120	
5/18/2015	04:00	4.11	08:30	5.29	4.70	04:15	0.39	09:30	0.86	0.63	04:15	0.058	09:30	0.166	0.113	0.113	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			8.274	4.00
Avg	4.96	0.71	0.138	

Site Commentary

Site Information

Enfield_FM06	
Pipe Dimensions (in.)	Circular (27.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM06 indicate this location functioned under typical open channel flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	10.80	1.54	1.515
Minimum	6.93	0.90	0.471
Maximum	13.76	1.90	2.470
Time of Minimum	5/14/2015 5:15 AM	5/14/2015 4:45 AM	5/14/2015 5:15 AM
Time of Maximum	4/4/2015 11:45 AM	3/27/2015 11:00 AM	3/27/2015 3:15 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	99
Velocity (ft/s)	99
Quantity (MGD)	99

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Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_FM06	Meter Type:	FLOWSHARK	Monitor S/N:	30200	Manhole #:	
Address / Location:	BACK OF BRADLEY CIRCLE ***USE COORDINATES***			Map Page #:			
				Pipe Height:	27 Inches		
Access:	Walk (Residential)	Type of System:	SANITARY	Pipe Width:	27 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 20, 2015	7:30 AM	Manhole Depth:	9 Feet	
Site Hydraulics:	FAST, SMOOTH FLOW		Manhole Material / Condition:	PC	Good
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	RC	Good
Upstream Manhole:			Mini System Character:	RESIDENTIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	10.5 +/- 0.5		Access Pole #:	N/A	
Range (Air Dof):	16 +/- 0.5		Distance From Manhole:	N/A Feet	
Peak Velocity:	1.74 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 41° 59' 50.2" W 72° 33' 57.3"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

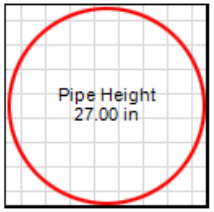
PRESS S/N 55348 PO 1.0" ULTRA PO 1.25"

SCATTERGRAPH REPORT

Enfield_FM06

Flow Monitor

Enfield_FM06

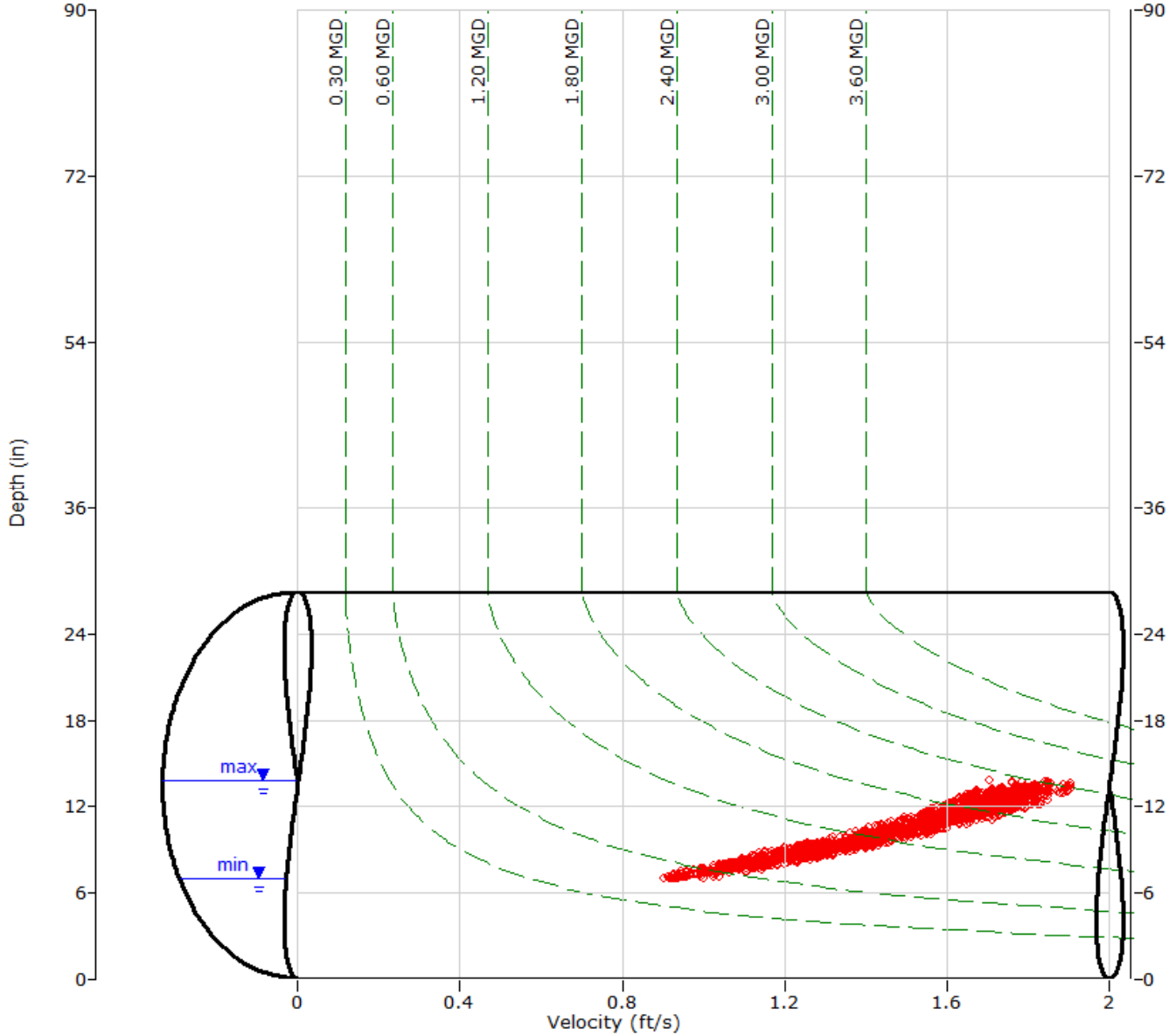


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



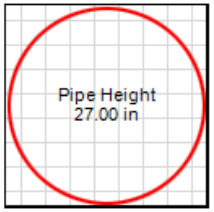
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM06

Flow Monitor

Enfield_FM06

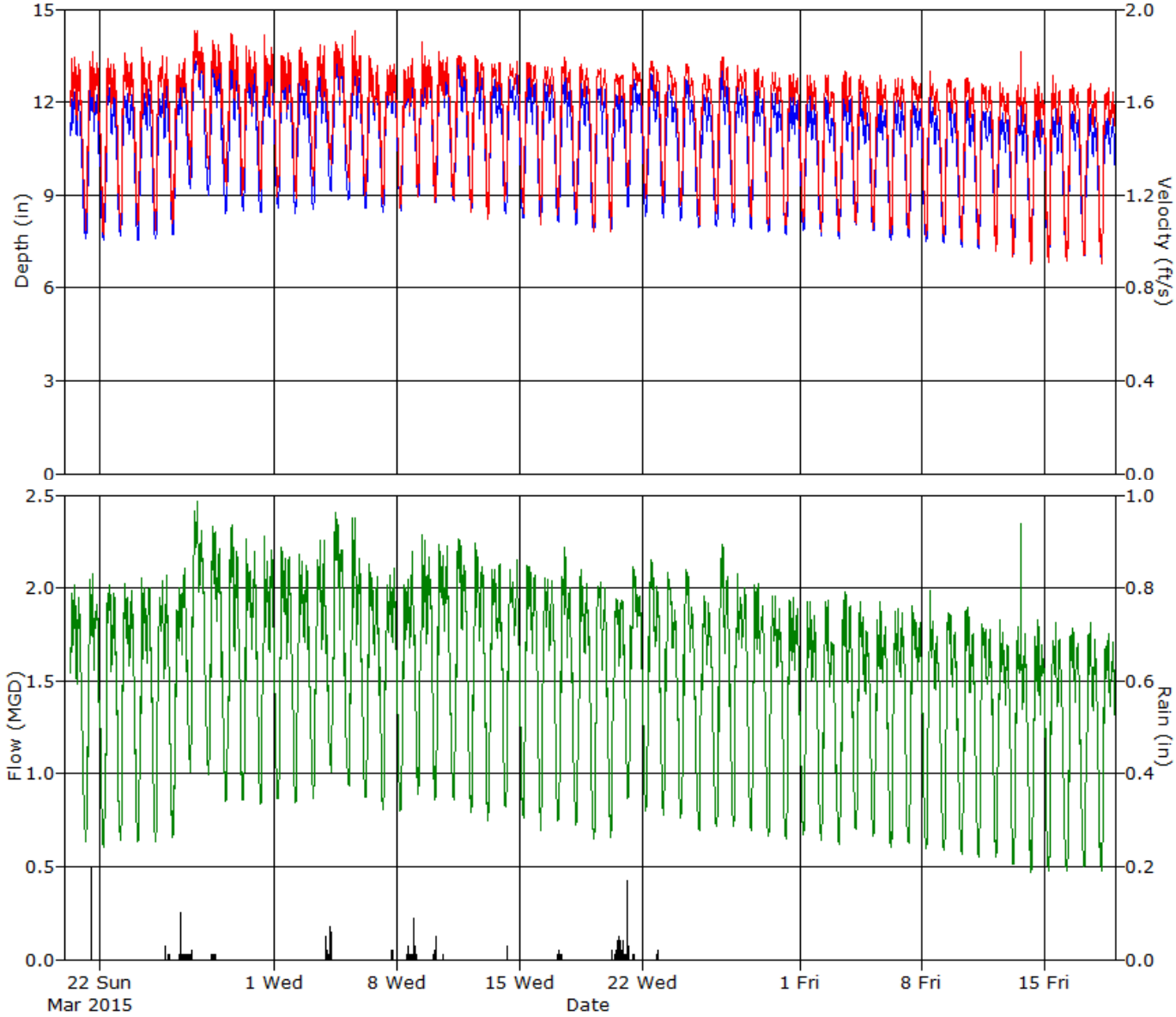


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM06, Pipe Height: 27 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	23:45	10.57	14:45	12.32	11.57	23:45	1.51	15:15	1.79	1.67	23:45	1.410	14:45	2.019	1.758	1.117	
3/21/2015	05:45	7.61	11:45	12.52	10.47	06:00	1.05	14:30	1.82	1.52	05:45	0.637	14:30	2.074	1.448	1.448	0.21
3/22/2015	06:30	7.54	14:30	12.44	10.48	06:30	1.03	12:45	1.78	1.51	06:30	0.606	14:30	2.015	1.439	1.439	
3/23/2015	05:15	7.66	14:30	12.27	10.61	05:45	1.06	10:15	1.81	1.53	05:15	0.638	10:15	2.023	1.482	1.482	
3/24/2015	05:15	7.54	20:15	12.42	10.57	05:00	1.07	11:00	1.83	1.54	05:00	0.631	11:00	2.057	1.480	1.480	0.00
3/25/2015	06:00	7.57	20:30	12.56	10.56	05:00	1.05	15:15	1.80	1.55	05:00	0.633	21:00	2.070	1.484	1.484	0.09
3/26/2015	05:00	7.71	20:45	12.63	10.81	05:00	1.08	20:45	1.78	1.54	05:00	0.654	20:45	2.104	1.521	1.521	0.32
3/27/2015	04:45	9.19	14:15	13.71	11.93	04:30	1.27	11:00	1.90	1.68	04:30	1.006	15:15	2.470	1.871	1.871	0.17
3/28/2015	05:45	8.99	15:00	13.37	11.53	05:15	1.31	11:45	1.86	1.64	05:45	0.994	11:45	2.334	1.748	1.748	0.07
3/29/2015	05:15	8.39	15:00	13.17	11.19	06:45	1.24	12:15	1.90	1.61	05:15	0.855	14:45	2.339	1.655	1.655	
3/30/2015	05:00	8.48	10:30	13.05	11.26	04:45	1.20	10:30	1.84	1.60	05:00	0.857	10:30	2.264	1.659	1.659	
3/31/2015	04:45	8.44	14:30	12.90	11.26	05:30	1.22	10:30	1.89	1.60	04:45	0.840	10:30	2.282	1.653	1.653	
4/1/2015	05:45	8.58	10:15	13.06	11.33	04:15	1.19	19:15	1.81	1.58	04:15	0.867	10:15	2.217	1.649	1.649	
4/2/2015	05:15	8.41	14:30	12.80	11.20	05:30	1.18	11:15	1.83	1.60	05:00	0.841	10:30	2.179	1.647	1.647	
4/3/2015	05:30	8.55	19:45	13.03	11.16	05:30	1.24	14:30	1.85	1.60	05:30	0.866	19:45	2.259	1.635	1.635	0.19
4/4/2015	06:00	9.11	11:45	13.76	11.72	06:00	1.33	11:30	1.86	1.65	06:00	1.013	11:30	2.407	1.792	1.792	0.35
4/5/2015	05:45	8.85	11:45	13.34	11.38	06:15	1.26	15:00	1.90	1.59	06:15	0.938	15:00	2.380	1.671	1.671	
4/6/2015	05:00	8.58	20:30	12.83	11.22	04:00	1.20	10:15	1.80	1.56	04:00	0.871	10:15	2.130	1.607	1.607	
4/7/2015	05:00	8.43	20:30	12.75	11.15	05:30	1.16	20:30	1.77	1.55	05:30	0.809	20:30	2.108	1.583	1.583	0.15
4/8/2015	05:15	8.51	20:45	13.03	11.24	04:15	1.14	20:45	1.79	1.55	04:15	0.801	20:45	2.193	1.599	1.599	0.63
4/9/2015	05:30	8.98	14:30	13.25	11.58	05:30	1.19	11:00	1.86	1.59	05:30	0.891	10:45	2.285	1.701	1.701	0.10
4/10/2015	05:00	8.78	10:30	13.22	11.52	04:30	1.17	10:15	1.82	1.60	04:30	0.861	10:15	2.230	1.709	1.709	0.31
4/11/2015	06:15	8.79	12:00	13.26	11.43	05:45	1.18	12:00	1.80	1.59	06:15	0.860	12:00	2.262	1.684	1.684	
4/12/2015	06:00	8.45	12:00	13.20	11.28	05:00	1.13	12:00	1.80	1.57	05:00	0.795	12:00	2.244	1.639	1.639	
4/13/2015	04:45	8.40	20:45	12.81	11.22	04:45	1.10	20:45	1.77	1.57	04:45	0.747	20:45	2.126	1.627	1.627	
4/14/2015	05:30	8.41	20:30	12.89	11.13	04:00	1.18	20:30	1.78	1.58	05:30	0.819	20:30	2.151	1.612	1.612	0.05
4/15/2015	05:00	8.25	10:45	12.79	11.15	05:30	1.12	10:45	1.77	1.58	05:30	0.764	10:45	2.120	1.619	1.619	
4/16/2015	04:45	8.10	10:15	12.57	10.99	04:45	1.07	10:30	1.75	1.56	04:45	0.695	10:15	2.053	1.572	1.572	
4/17/2015	05:00	8.14	14:30	13.12	10.97	03:45	1.11	14:30	1.79	1.56	03:45	0.747	14:30	2.220	1.568	1.568	0.11
4/18/2015	05:30	8.02	11:45	12.73	10.79	05:30	1.13	11:45	1.76	1.54	05:30	0.722	11:45	2.102	1.515	1.515	
4/19/2015	06:00	7.81	15:00	12.49	10.73	06:30	1.04	15:00	1.74	1.53	06:30	0.649	15:00	2.028	1.497	1.497	
4/20/2015	05:15	7.86	12:45	12.22	10.76	04:45	1.04	12:45	1.72	1.53	04:45	0.656	12:45	1.944	1.505	1.505	0.84
4/21/2015	04:30	8.61	12:00	12.76	11.15	04:30	1.23	12:00	1.77	1.59	04:30	0.870	12:00	2.111	1.618	1.618	0.36
4/22/2015	05:00	8.33	11:45	12.89	11.08	05:00	1.19	11:45	1.78	1.57	05:00	0.799	11:45	2.151	1.597	1.597	0.05
4/23/2015	05:00	8.25	11:45	12.67	10.93	05:00	1.17	11:45	1.76	1.56	05:00	0.778	11:45	2.083	1.553	1.553	
4/24/2015	05:00	8.18	11:45	12.73	10.93	05:00	1.16	11:45	1.76	1.56	05:00	0.761	11:45	2.102	1.553	1.553	
4/25/2015	06:00	7.95	12:30	12.25	10.60	06:30	1.07	12:30	1.72	1.52	06:30	0.692	12:30	1.953	1.454	1.454	
4/26/2015	05:45	7.99	14:15	13.17	10.90	05:45	1.12	14:15	1.80	1.55	05:45	0.714	14:15	2.235	1.547	1.547	
4/27/2015	05:00	8.00	10:30	12.65	10.86	05:00	1.12	10:30	1.76	1.55	05:00	0.717	10:30	2.077	1.534	1.534	
4/28/2015	05:00	7.92	14:30	12.47	10.74	05:00	1.11	14:30	1.74	1.53	05:00	0.697	14:30	2.022	1.497	1.497	
4/29/2015	05:00	7.81	10:30	12.26	10.65	04:45	1.07	10:30	1.72	1.52	04:45	0.664	10:30	1.957	1.468	1.468	
4/30/2015	05:45	7.73	14:30	12.24	10.54	04:00	1.07	14:30	1.72	1.50	05:45	0.652	14:30	1.950	1.436	1.436	
5/1/2015	04:45	7.85	10:15	12.17	10.47	04:45	1.08	10:15	1.72	1.50	04:45	0.672	10:15	1.928	1.414	1.414	
5/2/2015	05:00	7.67	14:30	12.18	10.34	04:30	1.04	14:30	1.72	1.47	05:15	0.638	14:30	1.932	1.372	1.372	
5/3/2015	06:00	7.60	14:45	12.34	10.38	06:15	1.04	14:45	1.73	1.48	06:00	0.623	14:45	1.981	1.388	1.388	
5/4/2015	05:00	8.05	10:30	12.33	10.49	04:30	1.08	10:15	1.71	1.50	04:30	0.699	10:15	1.925	1.414	1.414	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	04:45	7.86	14:15	12.15	10.40	05:00	1.06	14:15	1.71	1.49	05:00	0.665	14:15	1.922	1.392	1.392	
5/6/2015	04:45	7.53	14:30	12.03	10.39	04:45	1.04	14:30	1.70	1.49	04:45	0.607	14:30	1.885	1.394	1.394	
5/7/2015	05:30	7.62	10:30	12.08	10.41	05:30	1.05	10:30	1.71	1.49	05:30	0.627	10:30	1.900	1.400	1.400	
5/8/2015	05:00	7.48	10:15	12.36	10.30	05:00	1.03	10:15	1.73	1.48	05:00	0.595	10:15	1.988	1.369	1.369	
5/9/2015	05:30	7.46	12:00	11.98	10.23	05:30	1.02	12:00	1.70	1.46	05:30	0.591	12:00	1.869	1.349	1.349	
5/10/2015	06:30	7.34	14:30	12.06	10.17	06:30	1.00	14:30	1.71	1.45	06:30	0.564	14:30	1.894	1.331	1.331	
5/11/2015	04:45	7.28	10:15	11.77	10.22	04:45	0.99	10:15	1.68	1.46	04:45	0.551	10:15	1.804	1.346	1.346	
5/12/2015	05:30	7.42	10:30	11.85	10.15	05:15	0.96	10:30	1.68	1.45	05:15	0.553	10:30	1.829	1.322	1.322	
5/13/2015	05:00	7.11	14:45	13.54	10.09	04:15	0.94	14:45	1.82	1.44	05:15	0.515	14:45	2.345	1.312	1.312	
5/14/2015	05:15	6.93	14:30	11.85	9.98	04:45	0.90	14:30	1.68	1.42	05:15	0.471	14:30	1.829	1.269	1.269	
5/15/2015	05:15	6.93	14:30	11.79	9.97	04:15	0.91	10:00	1.71	1.43	05:15	0.478	14:30	1.810	1.276	1.276	
5/16/2015	05:30	6.93	14:30	11.71	9.83	05:30	0.92	14:30	1.67	1.40	05:30	0.478	14:30	1.785	1.235	1.235	
5/17/2015	05:45	7.05	14:30	11.80	9.84	05:45	0.94	14:30	1.68	1.41	05:45	0.502	14:30	1.813	1.237	1.237	
5/18/2015	05:00	6.93	14:45	11.61	9.92	05:30	0.90	14:45	1.66	1.42	05:30	0.474	14:45	1.754	1.260	1.259	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			90.323	4.00
Avg	10.80	1.54	1.515	

Site Commentary

Site Information

Enfield_FM07	
Pipe Dimensions (in.)	Circular (24.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM07 indicate this location experienced both open channel flow and back-water conditions (increase in depth with a corresponding decrease in velocity) during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015. Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	4.12	1.08	0.261
Minimum	2.46	0.24	0.028
Maximum	7.15	2.05	0.868
Time of Minimum	5/18/2015 3:00 AM	5/18/2015 3:45 AM	5/18/2015 3:45 AM
Time of Maximum	3/23/2015 8:45 PM	4/21/2015 3:15 AM	4/4/2015 4:15 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in the table below.

Percent Uptime	
Depth (in)	88
Velocity (ft/s)	88
Quantity (MGD)	88

ADS ENVIRONMENTAL SERVICES®

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Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_FM07	Meter Type:	FLOWSHARK	Monitor S/N:	20974	Manhole #:	
Address / Location:	NORTH RIVER STREET *** SEE COORDINATES***			Map Page #:			
				Pipe Height:	24 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	24 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 20, 2015	10:55 AM	Manhole Depth:	9 Feet	
Site Hydraulics:	SLOW, SMOOTH FLOW		Manhole Material / Condition:	Brick	
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	VCP	Good
Upstream Manhole:			Mini System Character:	COMMERCIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	6.5 +/- 0.38		Access Pole #:	N/A	
Range (Air Dof):	16 +/- 0.38		Distance From Manhole:	N/A Feet	
Peak Velocity:	1.04 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 41° 59' 57.1" W 72° 36' 16.3"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 78247 PO 2.0" ULTRA PO 1.50" VELOCITY @ 6:30

SCATTERGRAPH REPORT

Enfield_FM07

Flow Monitor

Enfield_FM07

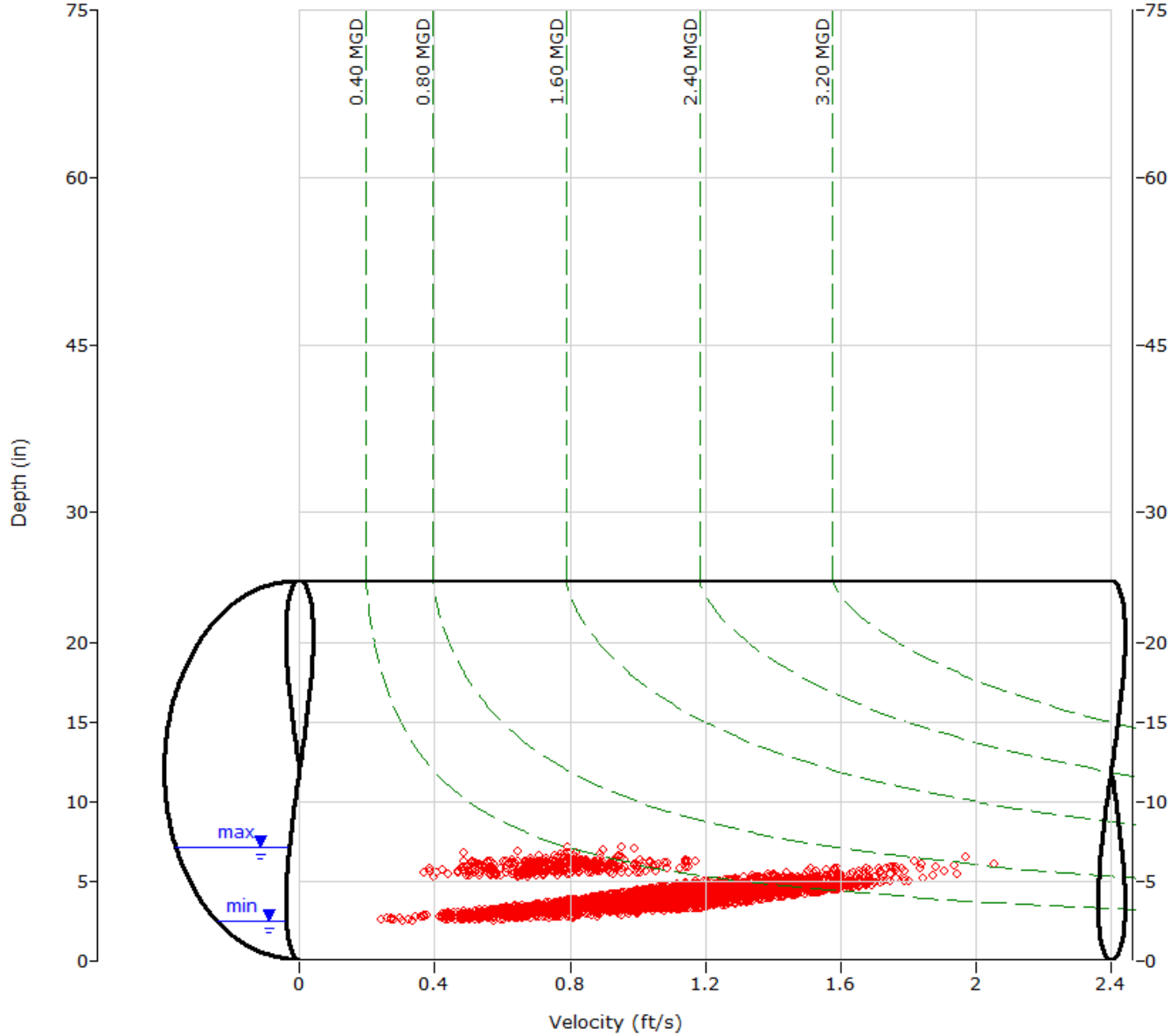
Pipe Height
24.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



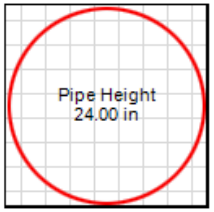
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM07

Flow Monitor

Enfield_FM07

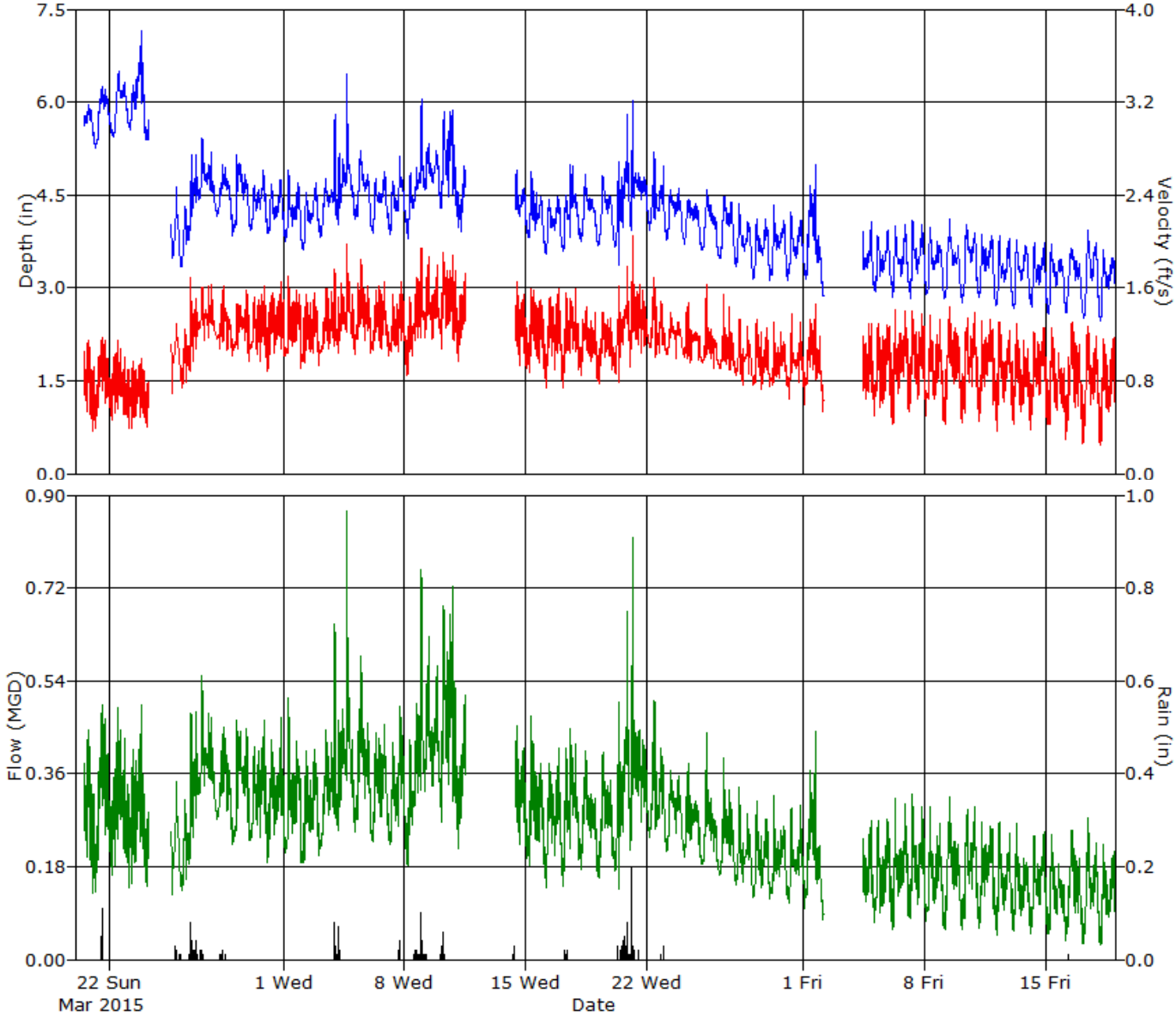


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM07, Pipe Height: 24 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	12:30	5.62	18:15	5.95	5.77	21:30	0.48	17:45	1.15	0.82	21:30	0.181	17:45	0.446	0.309	0.151	
3/21/2015	04:30	5.26	12:45	6.26	5.78	01:00	0.37	13:00	1.17	0.79	01:00	0.129	13:00	0.493	0.301	0.301	0.19
3/22/2015	04:15	5.44	12:00	6.49	5.94	03:30	0.47	11:00	1.15	0.75	03:30	0.164	10:45	0.487	0.297	0.297	
3/23/2015	03:45	5.56	20:45	7.15	6.11	03:00	0.39	20:30	0.99	0.72	03:00	0.139	20:30	0.494	0.296	0.296	
3/24/2015	01:30	5.40	05:45	5.71	5.52	04:15	0.40	05:00	0.78	0.63	04:15	0.142	05:00	0.286	0.224	0.056	0.00
3/25/2015	15:15	3.47	20:15	4.63	3.91	14:30	0.69	20:00	1.29	1.06	14:30	0.127	20:00	0.345	0.231	0.103	0.10
3/26/2015	03:30	3.34	17:00	5.14	4.04	04:30	0.74	16:15	1.69	1.09	04:30	0.133	23:00	0.480	0.253	0.253	0.37
3/27/2015	00:00	4.39	07:00	5.42	4.78	10:00	1.14	21:00	1.63	1.36	03:15	0.320	07:00	0.550	0.392	0.392	0.22
3/28/2015	04:00	4.16	12:00	4.99	4.52	18:00	1.06	13:15	1.62	1.27	04:00	0.273	13:15	0.450	0.339	0.339	0.08
3/29/2015	01:30	3.83	06:45	5.14	4.51	00:30	1.02	20:45	1.57	1.25	01:30	0.223	07:00	0.465	0.334	0.334	
3/30/2015	02:45	3.92	20:45	4.89	4.38	00:15	0.97	22:15	1.62	1.27	00:15	0.231	22:15	0.464	0.323	0.323	
3/31/2015	02:00	3.88	20:30	4.75	4.29	02:00	0.88	20:30	1.65	1.26	02:00	0.188	20:30	0.469	0.313	0.313	
4/1/2015	03:30	3.76	07:30	4.90	4.22	00:45	1.02	07:30	1.70	1.28	03:30	0.207	07:30	0.506	0.311	0.311	
4/2/2015	04:30	3.61	21:00	4.69	4.16	01:00	0.91	19:00	1.56	1.23	01:00	0.187	19:15	0.406	0.292	0.292	
4/3/2015	04:00	3.81	23:45	5.81	4.37	01:45	0.93	23:00	1.76	1.26	01:45	0.201	23:00	0.651	0.325	0.325	0.37
4/4/2015	04:15	4.02	16:15	6.46	4.75	04:45	1.04	16:15	1.97	1.37	04:15	0.249	16:15	0.868	0.396	0.396	0.34
4/5/2015	04:15	4.12	11:30	5.21	4.59	03:00	1.03	12:00	1.84	1.34	03:00	0.247	12:00	0.588	0.368	0.368	
4/6/2015	03:45	3.89	21:00	4.88	4.40	00:15	1.04	20:00	1.65	1.28	03:45	0.228	20:00	0.456	0.330	0.330	
4/7/2015	04:00	3.87	17:30	5.13	4.39	01:30	1.02	18:30	1.66	1.25	04:00	0.224	17:30	0.489	0.322	0.322	0.18
4/8/2015	04:30	3.80	23:30	6.05	4.52	03:15	0.85	22:45	1.94	1.29	04:15	0.183	22:45	0.756	0.351	0.351	0.68
4/9/2015	23:45	4.57	00:00	5.44	4.92	13:45	1.16	00:00	1.94	1.43	04:45	0.325	00:00	0.672	0.431	0.431	0.13
4/10/2015	02:15	4.29	19:00	5.87	4.99	03:00	1.08	06:15	1.91	1.47	03:00	0.265	19:00	0.724	0.454	0.454	0.34
4/11/2015	06:30	3.91	10:00	4.97	4.46	01:45	0.97	11:30	1.72	1.35	01:45	0.215	11:30	0.512	0.355	0.192	
4/12/2015																	
4/13/2015																	
4/14/2015	16:00	4.16	12:15	4.89	4.39	23:45	0.93	12:00	1.66	1.29	23:45	0.219	12:00	0.453	0.330	0.196	0.07
4/15/2015	03:45	3.81	08:00	4.88	4.20	04:45	0.87	08:00	1.59	1.23	04:45	0.182	08:00	0.472	0.295	0.295	
4/16/2015	03:45	3.54	20:45	4.47	4.04	04:45	0.74	21:00	1.59	1.19	04:45	0.140	21:00	0.410	0.272	0.272	
4/17/2015	03:45	3.60	13:15	4.99	4.20	03:15	0.74	21:15	1.59	1.18	03:15	0.142	13:15	0.448	0.286	0.286	0.11
4/18/2015	04:15	3.75	10:45	4.82	4.23	03:45	0.85	11:30	1.43	1.13	03:45	0.175	10:30	0.403	0.275	0.275	
4/19/2015	03:45	3.69	10:00	4.80	4.22	06:00	0.77	11:00	1.39	1.14	06:00	0.157	11:00	0.402	0.276	0.276	
4/20/2015	08:30	3.37	20:00	5.80	4.38	08:30	0.78	20:00	1.78	1.21	08:30	0.136	20:00	0.674	0.313	0.313	0.96
4/21/2015	02:30	3.92	03:15	6.02	4.62	00:45	0.92	03:15	2.05	1.34	00:45	0.212	03:15	0.818	0.370	0.370	0.41
4/22/2015	03:00	3.94	09:45	5.20	4.38	10:45	1.01	09:15	1.68	1.25	03:00	0.236	09:15	0.503	0.318	0.318	0.09
4/23/2015	03:15	3.77	19:45	4.60	4.24	16:30	0.99	09:15	1.39	1.19	03:15	0.208	09:15	0.365	0.289	0.289	
4/24/2015	04:00	3.71	08:45	4.43	4.13	12:15	0.95	08:45	1.48	1.13	04:00	0.199	08:45	0.380	0.265	0.265	
4/25/2015	04:15	3.61	10:30	4.58	4.05	19:45	0.91	10:30	1.63	1.12	04:15	0.184	10:30	0.440	0.255	0.255	
4/26/2015	04:00	3.47	10:30	4.46	3.97	18:45	0.89	10:15	1.55	1.07	04:15	0.164	10:15	0.391	0.237	0.237	
4/27/2015	02:30	3.34	07:45	4.36	3.77	13:00	0.76	07:30	1.33	1.00	02:30	0.146	07:30	0.334	0.206	0.206	
4/28/2015	02:30	3.15	08:15	4.11	3.65	14:45	0.73	07:45	1.33	0.98	02:30	0.121	08:00	0.306	0.193	0.193	
4/29/2015	02:15	3.12	07:45	4.33	3.70	02:15	0.75	07:30	1.31	0.97	02:15	0.117	07:45	0.319	0.196	0.196	
4/30/2015	02:00	3.12	07:15	4.23	3.67	05:00	0.65	08:00	1.38	0.96	05:00	0.109	20:45	0.300	0.192	0.192	
5/1/2015	04:15	3.15	17:15	4.98	3.81	02:00	0.59	17:15	1.45	1.01	02:00	0.098	17:15	0.443	0.215	0.215	
5/2/2015	04:00	2.88	00:00	3.57	3.14	03:30	0.53	00:15	0.88	0.73	03:30	0.076	00:00	0.161	0.115	0.022	
5/3/2015																	
5/4/2015	12:00	3.30	22:15	4.07	3.54	15:30	0.64	22:45	1.30	0.95	15:30	0.111	22:15	0.269	0.178	0.100	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	04:30	2.93	21:00	3.92	3.41	03:00	0.50	08:15	1.29	0.91	03:15	0.072	20:30	0.271	0.165	0.165	
5/6/2015	04:00	2.86	21:15	4.03	3.46	04:00	0.43	08:00	1.41	0.94	04:00	0.059	08:00	0.311	0.172	0.172	
5/7/2015	05:00	2.82	07:30	4.08	3.46	02:00	0.54	07:30	1.39	0.96	05:00	0.081	07:30	0.319	0.178	0.178	
5/8/2015	03:00	2.89	07:45	3.98	3.42	01:45	0.50	07:30	1.36	0.89	01:45	0.075	07:30	0.295	0.161	0.161	
5/9/2015	03:30	2.82	10:45	4.11	3.41	05:15	0.42	11:30	1.43	0.93	05:15	0.058	11:30	0.316	0.168	0.168	
5/10/2015	05:00	2.77	10:00	4.02	3.44	05:00	0.44	22:15	1.39	0.95	05:00	0.058	22:15	0.295	0.176	0.176	
5/11/2015	04:00	2.86	07:45	3.87	3.40	04:30	0.45	19:00	1.32	0.93	04:30	0.062	08:00	0.265	0.168	0.168	
5/12/2015	02:30	2.72	08:00	3.83	3.27	04:00	0.37	07:15	1.31	0.88	04:00	0.047	08:15	0.265	0.150	0.150	
5/13/2015	03:30	2.66	07:45	3.77	3.26	04:15	0.43	07:45	1.30	0.82	04:15	0.055	07:45	0.265	0.138	0.138	
5/14/2015	04:45	2.70	22:30	3.73	3.22	03:30	0.38	21:00	1.26	0.89	03:30	0.050	22:30	0.246	0.148	0.148	
5/15/2015	04:30	2.58	08:15	3.70	3.17	02:30	0.42	08:45	1.25	0.78	04:15	0.051	08:45	0.242	0.127	0.127	
5/16/2015	04:30	2.60	11:45	3.63	3.20	04:00	0.30	12:30	1.31	0.82	04:00	0.036	12:30	0.251	0.135	0.135	0.01
5/17/2015	04:00	2.51	11:00	3.92	3.22	03:30	0.26	11:00	1.27	0.80	04:00	0.030	11:00	0.274	0.136	0.136	
5/18/2015	03:00	2.46	08:00	3.61	3.10	03:45	0.24	22:15	1.17	0.76	03:45	0.028	08:00	0.223	0.121	0.121	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			13.843	4.65
Avg	4.12	1.08	0.261	

Site Commentary

Site Information

Enfield_FM08	
Pipe Dimensions (in.)	Circular (18.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM08 indicate this location functioned mosty in free-flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	1.74	2.75	0.153
Minimum	1.24	2.01	0.072
Maximum	3.17	3.32	0.329
Time of Minimum	3/23/2015 1:15 AM	3/22/2015 3:15 AM	3/22/2015 3:15 AM
Time of Maximum	5/14/2015 7:30 AM	3/27/2015 7:45 AM	4/10/2015 6:15 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	99
Velocity (ft/s)	94
Quantity (MGD)	94

ADS ENVIRONMENTAL SERVICES®

a division of ADS LLC.

Site Report

FM Initials:	IC
Project Name:	ENFIELD, CT

Site Name:	ENFIELD_FM08	Meter Type:	FLOWSHARK	Monitor S/N:	20689	Manhole #:	
Address / Location:	OFF MAIN STREET NEAR RIVER STREET ***USE COORDINATES***			Map Page #:			
				Pipe Height:	18 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	18 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 20, 2015	12:40 PM	Manhole Depth:	Feet	
Site Hydraulics:			Manhole Material / Condition:	Brick	Fair
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	VCP	Good
Upstream Manhole:			Mini System Character:	COMMERCIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	1.75 +/- 0.38		Access Pole #:	N/A	
Range (Air Dof):	14.75 +/- 0.38		Distance From Manhole:	N/A Feet	
Peak Velocity:	2.32 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 41° 59' 55.7" W 72° 36' 14.2"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 10251 PO 2.0" ULTRA PO 1.50"

SCATTERGRAPH REPORT

Enfield_FM08

Flow Monitor

Enfield_FM08

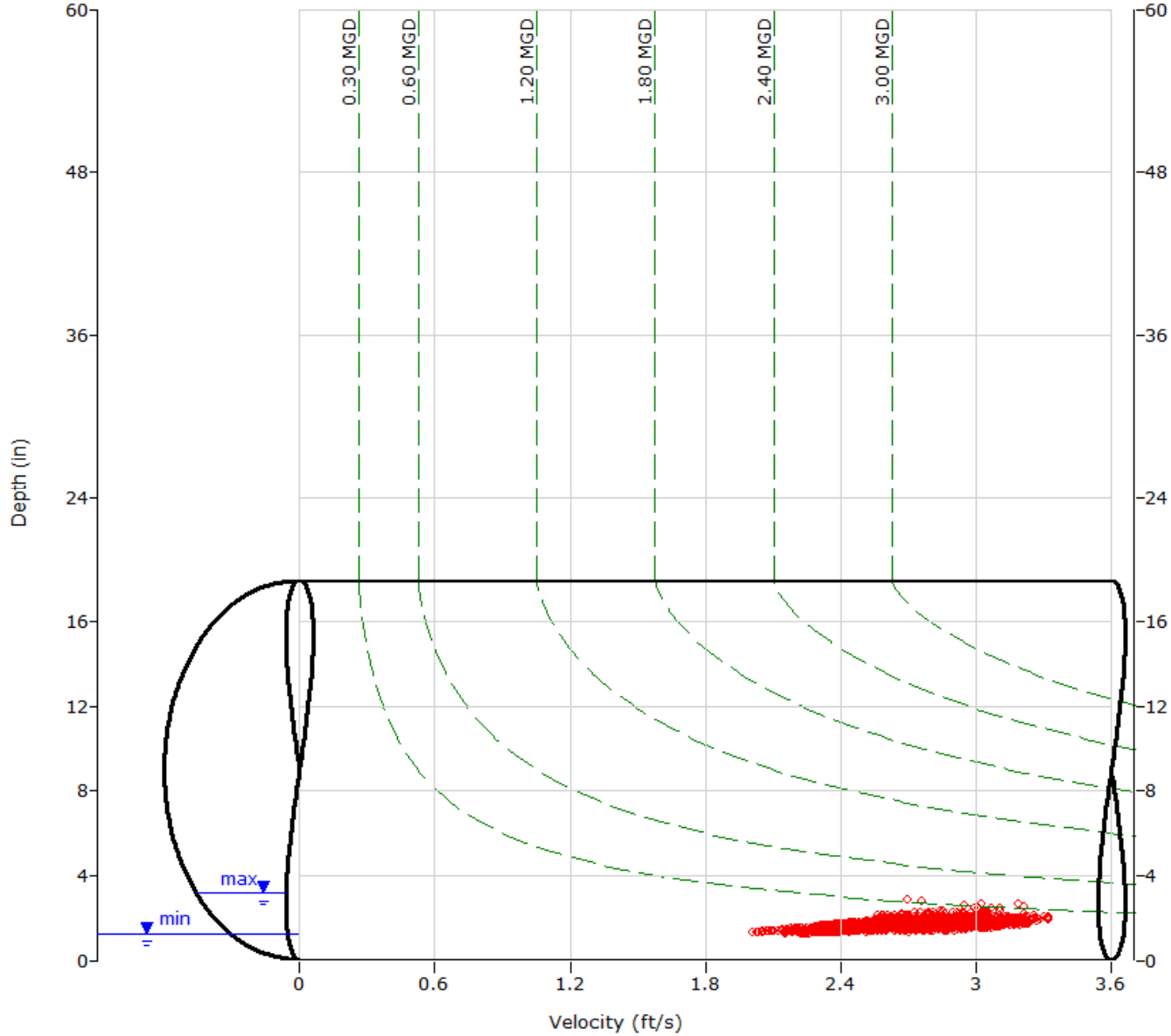
Pipe Height
18.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



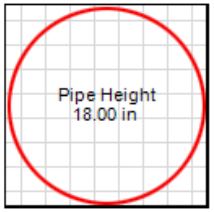
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM08

Flow Monitor

Enfield_FM08

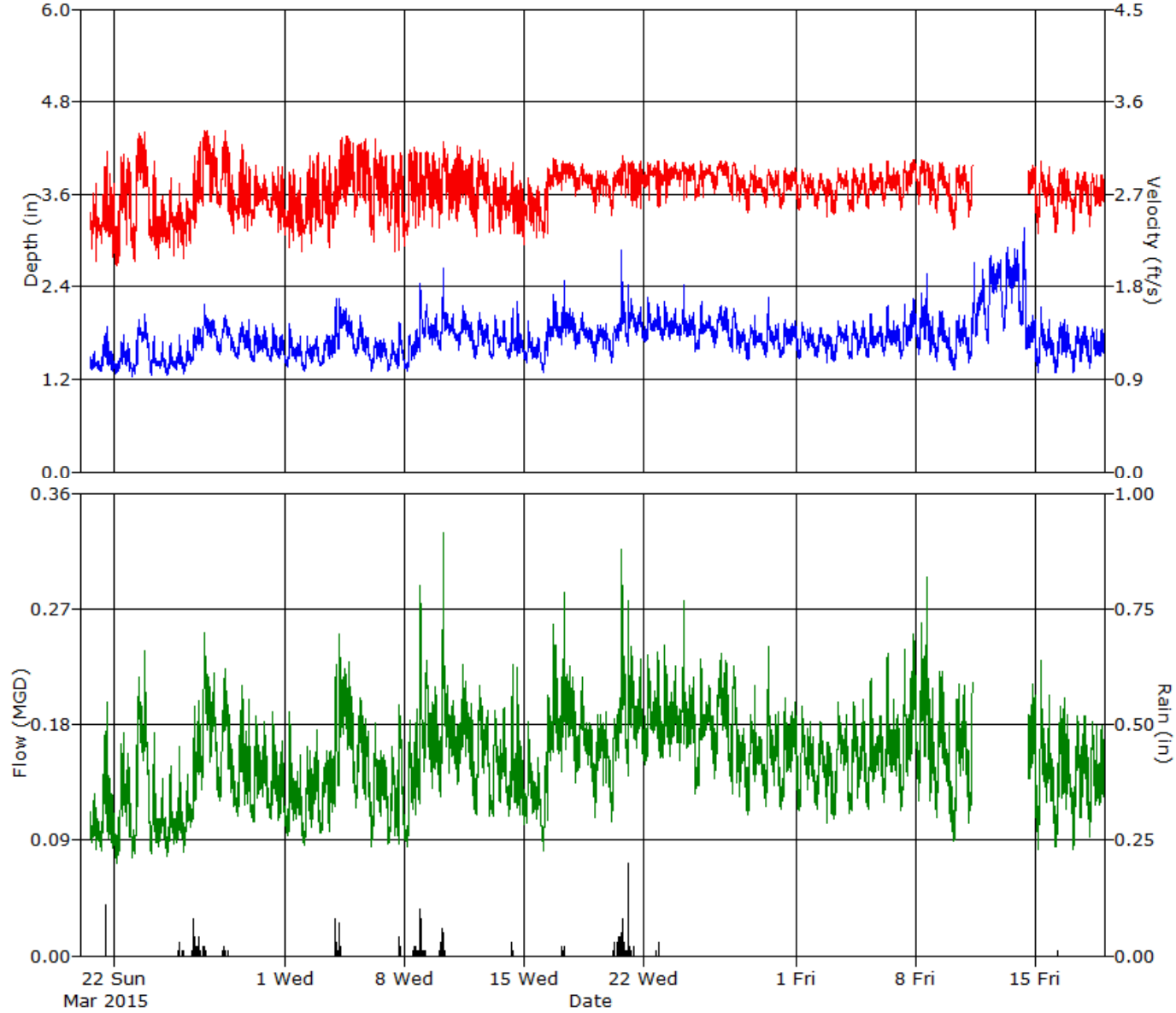


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM08, Pipe Height: 18 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	16:00	1.32	19:45	1.56	1.40	23:00	2.05	22:45	2.81	2.42	23:00	0.083	19:45	0.126	0.100	0.043	
3/21/2015	04:15	1.30	14:15	1.88	1.47	22:30	2.09	14:15	3.11	2.50	07:00	0.082	14:15	0.197	0.112	0.112	0.19
3/22/2015	02:45	1.27	13:00	1.77	1.46	03:15	2.01	12:45	3.09	2.59	03:15	0.072	13:00	0.174	0.115	0.115	
3/23/2015	01:15	1.24	19:15	2.05	1.64	05:15	2.05	19:15	3.30	2.81	01:15	0.076	19:15	0.238	0.149	0.149	
3/24/2015	04:15	1.26	08:15	1.76	1.44	15:15	2.07	08:15	3.01	2.45	04:15	0.079	08:15	0.173	0.106	0.106	0.00
3/25/2015	02:30	1.25	19:30	1.78	1.43	11:15	2.10	07:15	2.86	2.44	02:30	0.078	19:30	0.163	0.104	0.104	0.10
3/26/2015	01:30	1.27	16:30	1.87	1.55	02:15	2.08	23:00	3.16	2.56	01:30	0.081	23:00	0.199	0.123	0.123	0.37
3/27/2015	02:45	1.58	07:00	2.17	1.84	05:00	2.59	07:45	3.32	2.98	02:45	0.129	07:00	0.251	0.184	0.184	0.22
3/28/2015	04:45	1.53	11:30	2.03	1.75	22:15	2.40	12:15	3.32	2.83	04:45	0.121	12:15	0.224	0.163	0.163	0.08
3/29/2015	06:00	1.46	21:30	1.97	1.68	00:30	2.32	10:45	3.19	2.68	06:00	0.109	10:45	0.210	0.144	0.144	
3/30/2015	02:45	1.43	08:00	1.90	1.63	00:45	2.40	07:00	2.98	2.67	02:45	0.104	08:00	0.186	0.137	0.137	
3/31/2015	04:15	1.44	07:00	1.92	1.60	15:15	2.33	13:45	2.96	2.64	15:15	0.105	07:00	0.190	0.133	0.133	
4/1/2015	04:00	1.36	07:00	1.92	1.54	23:30	2.14	12:00	2.94	2.52	23:30	0.094	07:00	0.190	0.120	0.120	
4/2/2015	04:00	1.31	06:45	1.76	1.53	13:00	2.22	23:00	3.11	2.62	04:00	0.086	20:15	0.176	0.124	0.124	
4/3/2015	01:00	1.37	23:45	2.25	1.60	14:00	2.19	14:15	3.07	2.60	01:00	0.095	23:45	0.227	0.132	0.132	0.37
4/4/2015	02:45	1.60	05:15	2.25	1.89	01:45	2.50	14:30	3.27	2.91	02:45	0.132	05:15	0.251	0.186	0.186	0.34
4/5/2015	23:30	1.45	09:30	2.03	1.67	02:15	2.48	17:00	3.23	2.87	23:30	0.112	09:30	0.200	0.154	0.154	
4/6/2015	01:45	1.30	07:30	1.74	1.55	05:00	2.23	06:45	3.23	2.76	01:45	0.085	06:45	0.181	0.133	0.133	
4/7/2015	01:30	1.30	17:15	1.94	1.53	10:00	2.14	18:00	3.10	2.67	15:45	0.087	17:15	0.195	0.127	0.127	0.18
4/8/2015	03:15	1.30	22:30	2.44	1.61	03:15	2.30	14:15	3.15	2.78	03:15	0.085	22:30	0.288	0.143	0.143	0.68
4/9/2015	15:15	1.64	07:15	2.18	1.85	15:45	2.38	07:00	3.11	2.83	15:45	0.130	06:45	0.230	0.176	0.176	0.13
4/10/2015	02:45	1.58	06:30	2.64	1.88	00:30	2.38	06:00	3.21	2.82	02:45	0.123	06:15	0.329	0.181	0.181	0.34
4/11/2015	04:00	1.57	09:45	2.15	1.83	02:15	2.44	03:00	3.17	2.85	02:15	0.133	09:45	0.227	0.174	0.174	
4/12/2015	04:15	1.47	10:15	2.07	1.74	05:45	2.29	10:00	3.13	2.77	23:45	0.109	10:15	0.210	0.157	0.157	
4/13/2015	02:45	1.47	08:00	2.03	1.71	15:45	2.32	15:30	2.95	2.65	05:00	0.108	21:00	0.193	0.146	0.146	
4/14/2015	02:45	1.46	14:30	2.21	1.67	23:00	2.29	07:45	3.00	2.62	02:45	0.109	07:45	0.227	0.141	0.141	0.07
4/15/2015	03:30	1.42	06:30	1.96	1.59	00:00	2.21	07:00	2.85	2.57	00:00	0.103	07:00	0.182	0.127	0.127	
4/16/2015	04:00	1.28	18:00	2.29	1.73	04:00	2.28	18:00	3.05	2.73	04:00	0.082	18:00	0.258	0.156	0.156	
4/17/2015	05:00	1.65	09:15	2.47	1.89	05:00	2.73	06:30	3.02	2.91	05:00	0.143	09:15	0.283	0.187	0.187	0.11
4/18/2015	01:30	1.60	09:30	2.06	1.78	01:30	2.69	09:30	3.00	2.84	01:30	0.134	09:30	0.217	0.167	0.167	
4/19/2015	04:00	1.44	20:00	1.91	1.72	04:00	2.51	20:00	2.93	2.79	04:00	0.108	20:00	0.190	0.156	0.156	
4/20/2015	04:15	1.42	17:45	2.87	1.84	04:15	2.49	19:30	3.07	2.83	04:15	0.104	17:45	0.317	0.175	0.175	0.96
4/21/2015	02:00	1.63	03:00	2.42	1.94	20:00	2.56	08:30	3.02	2.86	02:00	0.140	03:00	0.276	0.191	0.191	0.41
4/22/2015	01:45	1.68	07:00	2.27	1.89	21:15	2.57	20:15	3.02	2.88	01:45	0.148	20:15	0.236	0.184	0.184	0.09
4/23/2015	04:15	1.71	06:30	2.20	1.88	00:15	2.59	06:30	3.03	2.89	04:15	0.154	06:30	0.241	0.184	0.184	
4/24/2015	03:30	1.70	08:15	2.42	1.88	08:45	2.65	08:15	3.01	2.90	03:30	0.152	08:15	0.276	0.184	0.184	
4/25/2015	01:30	1.55	09:30	2.21	1.83	01:30	2.64	08:15	3.02	2.86	01:30	0.126	08:15	0.231	0.175	0.175	
4/26/2015	04:00	1.62	14:15	2.16	1.90	04:00	2.71	14:15	3.02	2.91	04:00	0.138	14:15	0.235	0.189	0.189	
4/27/2015	15:30	1.54	08:00	2.11	1.78	15:30	2.63	08:00	3.01	2.83	15:30	0.124	08:00	0.226	0.166	0.166	
4/28/2015	02:30	1.45	12:45	2.02	1.72	02:30	2.53	12:45	2.98	2.78	02:30	0.109	12:45	0.210	0.155	0.155	
4/29/2015	04:30	1.49	07:15	2.26	1.73	04:30	2.57	08:15	2.94	2.80	04:30	0.116	07:15	0.240	0.158	0.158	
4/30/2015	01:45	1.48	08:15	1.97	1.73	01:45	2.56	08:15	2.96	2.79	01:45	0.114	08:15	0.201	0.158	0.158	
5/1/2015	03:00	1.47	07:45	1.93	1.70	03:00	2.55	07:45	2.94	2.77	03:00	0.112	07:45	0.194	0.152	0.152	
5/2/2015	18:00	1.41	08:45	1.87	1.66	18:00	2.48	08:45	2.90	2.74	18:00	0.103	08:45	0.183	0.145	0.145	
5/3/2015	04:15	1.43	09:45	1.95	1.69	04:15	2.50	09:45	2.95	2.76	04:15	0.106	09:45	0.197	0.151	0.151	
5/4/2015	02:15	1.46	20:45	1.96	1.70	02:15	2.54	20:45	2.95	2.76	02:15	0.111	20:45	0.199	0.152	0.152	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	04:30	1.48	08:00	2.05	1.72	04:30	2.56	08:00	2.99	2.78	04:30	0.114	08:00	0.215	0.155	0.155	
5/6/2015	03:00	1.51	07:15	2.16	1.76	03:00	2.59	07:15	3.02	2.81	03:00	0.119	07:15	0.235	0.162	0.162	
5/7/2015	02:00	1.47	20:15	2.25	1.82	02:00	2.55	20:15	3.03	2.85	02:00	0.112	20:15	0.250	0.174	0.174	
5/8/2015	03:30	1.52	14:00	2.57	1.86	03:30	2.60	06:30	3.03	2.87	03:30	0.121	14:00	0.295	0.181	0.181	
5/9/2015	23:15	1.42	08:15	2.08	1.73	23:15	2.49	08:15	3.00	2.79	23:15	0.104	08:15	0.221	0.157	0.157	
5/10/2015	03:15	1.32	11:15	2.03	1.69	03:15	2.36	11:15	2.99	2.75	03:15	0.089	11:15	0.212	0.151	0.151	
5/11/2015	02:00	1.41	10:00	2.72	2.00	02:00	2.48	06:30	2.99	2.67	02:00	0.103	06:30	0.213	0.134	0.038	
5/12/2015	04:45	1.67	09:00	2.80	2.36												
5/13/2015	02:30	1.83	07:30	2.91	2.45												
5/14/2015	23:45	1.44	07:30	3.17	1.97	23:45	2.51	19:30	2.99	2.82	23:45	0.108	19:30	0.212	0.163	0.076	
5/15/2015	03:30	1.28	07:15	2.13	1.65	03:30	2.31	07:15	3.02	2.72	03:30	0.083	07:15	0.229	0.143	0.143	
5/16/2015	02:30	1.29	17:15	1.97	1.63	02:30	2.33	17:15	2.96	2.70	02:30	0.085	17:15	0.201	0.141	0.141	0.01
5/17/2015	05:00	1.28	10:15	1.89	1.64	05:00	2.31	10:15	2.92	2.71	05:00	0.083	10:15	0.186	0.141	0.141	
5/18/2015	04:00	1.34	07:00	1.87	1.62	04:00	2.39	07:00	2.90	2.70	04:00	0.092	07:00	0.183	0.139	0.139	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			8.574	4.65
Avg	1.74	2.75	0.153	

Site Commentary

Site Information

Enfield_FM09	
Pipe Dimensions (in.)	Circular (15.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM09 indicate this location functioned in free flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	1.35	2.06	0.079
Minimum	0.35	0.29	0.001
Maximum	2.54	3.56	0.316
Time of Minimum	5/14/2015 2:45 AM	5/14/2015 2:45 AM	5/14/2015 2:45 AM
Time of Maximum	4/21/2015 2:45 AM	4/21/2015 2:45 AM	4/21/2015 2:45 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

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Site Report

FM Initials: IC

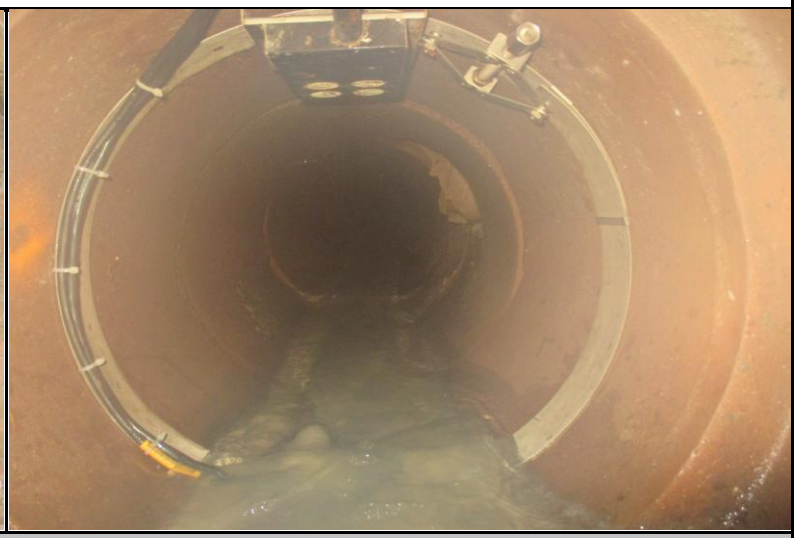
Project Name: ENFIELD, CT

Site Name:	ENFIELD_FM09	Meter Type:	FLOWSHARK	Monitor S/N:	20604	Manhole #:	
Address / Location:	2 COTTAGE GREEN (IN SIDEWALK)			Map Page #:			
				Pipe Height:	15 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	15 Inches		
				Phone Number:	N/A		

Investigation Information:		Manhole Information:		
Date/Time of Investigation:	March 18, 2015	Manhole Depth:	15 Feet	
Site Hydraulics:		Manhole Material / Condition:	Brick	Good
		Active Drop Connections?		
Upstream Input: (L/S, P/S)		Pipe Material / Condition:	RC	Good
Upstream Manhole:		Mini System Character:		
Downstream Manhole:		**Telephone Information:**		
Depth of Flow (Wet Dof):	2 0.38	Access Pole #:	N/A	
Range (Air Dof):	13 0.38	Distance From Manhole:	N/A Feet	
Peak Velocity:	1.09 fps	Road Cut Length:	N/A Feet	
Silt:	0 Inches	Trench Length:	N/A Feet	

Other Information:

N 41° 59' 52.4" W 72° 36' 11.6"



Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 10210 PO 1.0" ULTRA PO 1.25" FAIRLY CLEAR WATER VELOCITY SET BACKWARDS DUE TO DOWNSTREAM INSTALL

SCATTERGRAPH REPORT

Enfield_FM09

Flow Monitor

Enfield_FM09

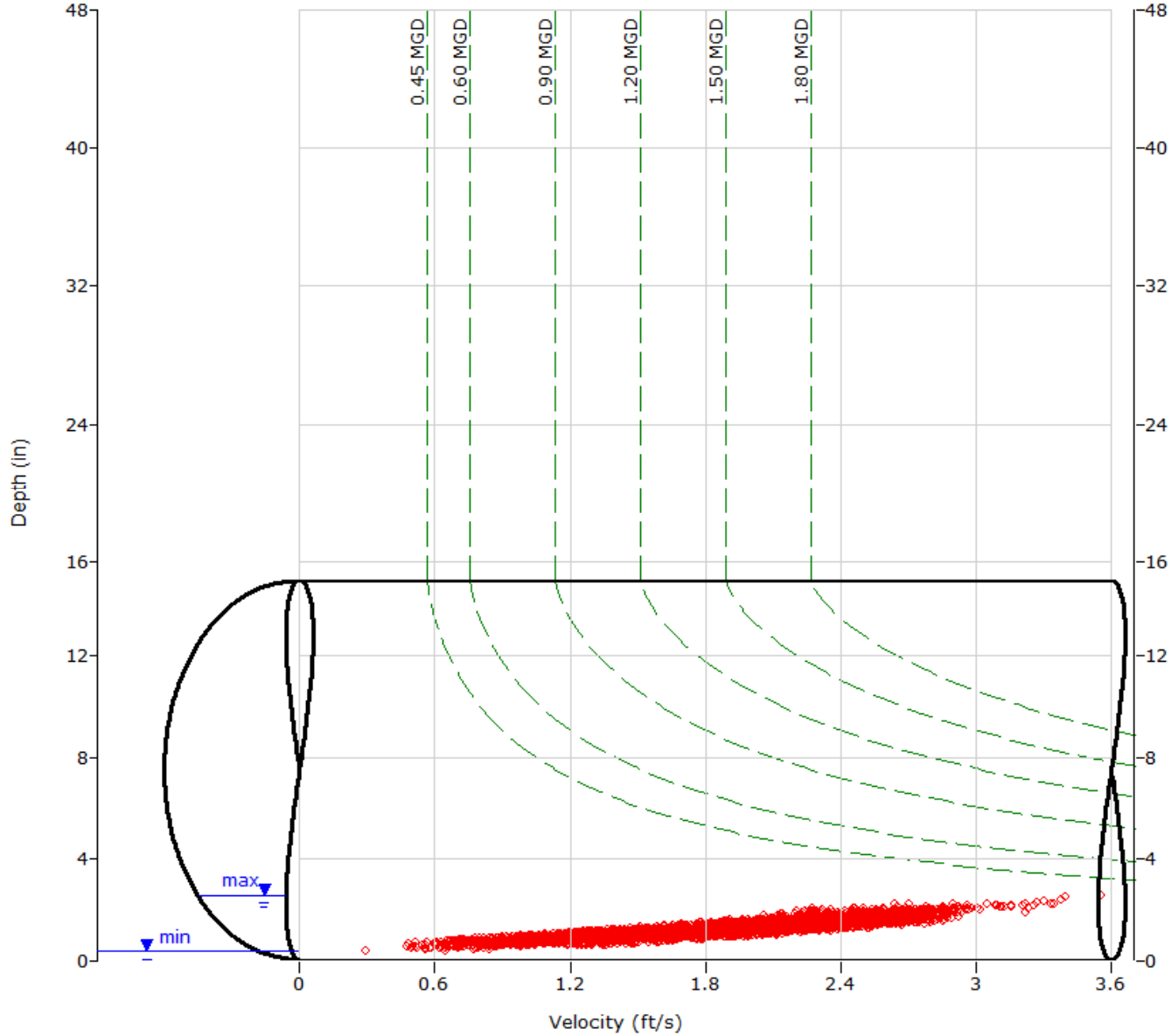
Pipe Height
15.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



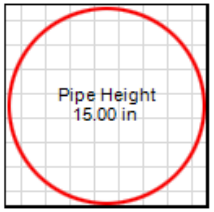
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM09

Flow Monitor

Enfield_FM09

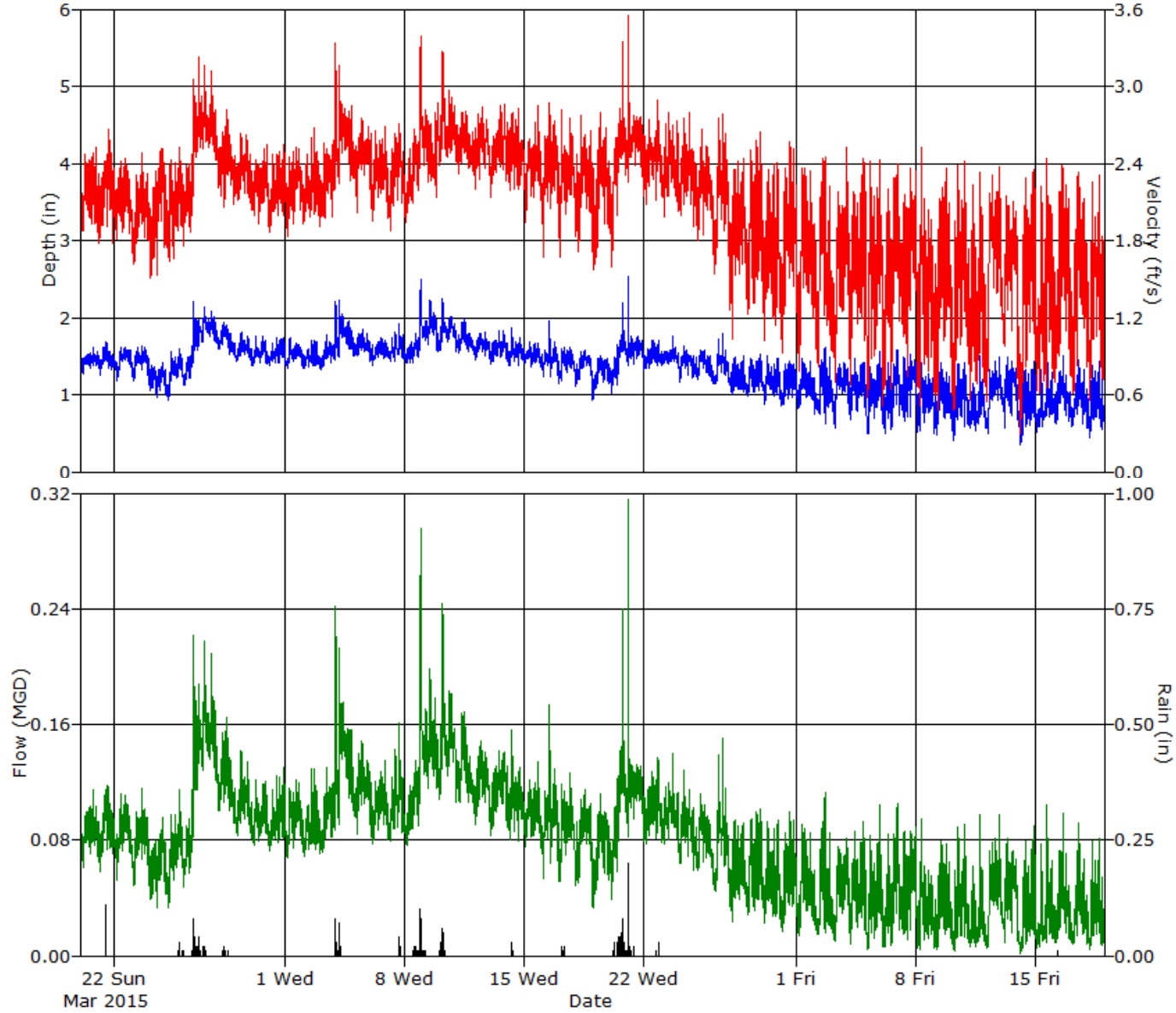


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM09, Pipe Height: 15 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	05:15	1.27	18:00	1.62	1.44	00:45	1.83	23:00	2.53	2.15	05:15	0.061	18:00	0.115	0.084	0.084	
3/21/2015	04:45	1.25	12:30	1.69	1.47	02:45	1.77	16:45	2.66	2.18	04:45	0.058	13:15	0.118	0.087	0.087	0.19
3/22/2015	04:15	1.18	09:00	1.62	1.46	04:15	1.81	16:00	2.44	2.14	04:15	0.052	09:00	0.112	0.085	0.085	
3/23/2015	03:15	1.18	14:45	1.63	1.43	04:00	1.62	14:45	2.48	2.02	04:00	0.048	14:45	0.116	0.078	0.078	
3/24/2015	13:00	0.97	00:30	1.47	1.24	03:15	1.51	17:45	2.51	2.04	13:00	0.033	20:00	0.096	0.064	0.064	0.00
3/25/2015	05:00	0.92	19:00	1.60	1.27	05:30	1.63	19:00	2.53	2.08	05:00	0.034	19:00	0.115	0.068	0.068	0.10
3/26/2015	01:15	1.12	16:00	2.21	1.48	01:15	1.75	22:45	3.22	2.33	01:15	0.047	16:00	0.222	0.098	0.098	0.37
3/27/2015	04:30	1.68	06:30	2.13	1.87	22:30	2.43	06:45	3.16	2.70	22:15	0.121	06:45	0.218	0.155	0.155	0.22
3/28/2015	18:30	1.53	10:00	1.93	1.73	09:45	2.06	13:15	2.82	2.44	23:45	0.092	13:15	0.164	0.124	0.124	0.08
3/29/2015	03:15	1.44	11:15	1.81	1.59	05:00	2.11	09:30	2.64	2.35	05:00	0.083	10:00	0.142	0.106	0.106	
3/30/2015	03:00	1.37	06:45	1.76	1.53	12:00	1.94	22:30	2.55	2.24	04:45	0.076	06:45	0.122	0.095	0.095	
3/31/2015	03:15	1.37	12:15	1.74	1.54	02:45	1.86	22:15	2.55	2.21	03:30	0.072	22:15	0.131	0.095	0.095	
4/1/2015	04:30	1.34	08:00	1.73	1.52	05:00	1.84	16:30	2.52	2.22	05:00	0.068	16:30	0.122	0.094	0.094	
4/2/2015	04:00	1.34	13:00	1.70	1.48	02:00	1.93	18:00	2.67	2.21	04:00	0.068	18:00	0.129	0.090	0.090	
4/3/2015	02:45	1.33	23:30	2.21	1.56	01:45	1.91	23:30	3.33	2.30	01:45	0.070	23:30	0.242	0.103	0.103	0.37
4/4/2015	03:45	1.48	05:00	2.22	1.77	03:45	2.24	04:45	3.16	2.59	03:45	0.091	04:45	0.213	0.137	0.137	0.34
4/5/2015	23:30	1.45	12:45	1.84	1.63	06:15	2.02	11:00	2.75	2.46	06:15	0.084	11:00	0.148	0.115	0.115	
4/6/2015	03:15	1.37	15:00	1.73	1.56	04:00	1.95	20:30	2.69	2.34	04:00	0.077	20:30	0.135	0.103	0.103	
4/7/2015	04:00	1.44	17:00	1.92	1.60	04:15	1.88	17:00	2.71	2.32	04:00	0.079	17:00	0.160	0.105	0.105	0.18
4/8/2015	03:30	1.41	23:15	2.50	1.62	01:15	1.94	23:15	3.39	2.36	03:30	0.076	23:15	0.295	0.112	0.112	0.68
4/9/2015	21:45	1.57	11:15	2.23	1.86	20:30	2.13	00:00	3.01	2.54	08:30	0.116	11:15	0.198	0.144	0.144	0.13
4/10/2015	00:00	1.56	05:45	2.25	1.83	01:00	2.38	05:45	3.27	2.68	01:15	0.108	05:45	0.244	0.149	0.149	0.34
4/11/2015	04:15	1.54	11:30	1.99	1.71	05:15	2.32	14:15	2.81	2.56	19:00	0.106	11:30	0.169	0.129	0.129	
4/12/2015	04:30	1.45	17:30	1.81	1.63	03:00	2.20	12:45	2.84	2.54	03:00	0.091	11:30	0.148	0.119	0.119	
4/13/2015	01:45	1.40	13:15	1.83	1.60	01:15	2.13	20:15	2.86	2.51	01:15	0.083	13:15	0.142	0.114	0.114	
4/14/2015	16:45	1.37	07:30	1.87	1.55	03:45	2.19	16:15	2.83	2.47	16:45	0.080	07:30	0.156	0.107	0.107	0.07
4/15/2015	11:00	1.36	08:30	1.69	1.51	02:15	1.94	20:00	2.84	2.37	02:15	0.076	20:00	0.134	0.099	0.099	
4/16/2015	04:15	1.24	12:15	1.95	1.46	03:45	1.67	12:15	2.87	2.36	03:45	0.053	12:15	0.174	0.094	0.094	
4/17/2015	01:45	1.15	09:15	1.61	1.43	03:45	1.67	05:30	2.82	2.31	01:45	0.051	16:30	0.126	0.089	0.089	0.11
4/18/2015	01:15	1.11	14:15	1.58	1.39	05:15	1.71	08:45	2.77	2.25	01:15	0.049	14:15	0.115	0.083	0.083	
4/19/2015	00:30	0.92	11:00	1.50	1.29	01:45	1.57	10:45	2.80	2.19	01:45	0.033	10:45	0.112	0.073	0.073	
4/20/2015	04:00	1.01	19:30	2.19	1.44	03:15	1.59	19:30	3.35	2.38	04:00	0.039	19:30	0.240	0.096	0.096	0.96
4/21/2015	02:00	1.38	02:45	2.54	1.60	02:00	2.25	02:45	3.56	2.59	02:00	0.082	02:45	0.316	0.118	0.118	0.41
4/22/2015	00:45	1.33	12:00	1.71	1.50	03:15	2.08	20:00	2.89	2.45	03:15	0.078	20:00	0.137	0.101	0.101	0.09
4/23/2015	02:15	1.37	18:00	1.75	1.49	05:00	1.99	12:00	2.79	2.37	06:15	0.077	18:00	0.140	0.097	0.097	
4/24/2015	04:00	1.17	08:45	1.63	1.42	22:00	1.91	16:45	2.80	2.30	22:00	0.060	08:45	0.128	0.088	0.088	
4/25/2015	05:00	1.20	09:15	1.58	1.39	04:15	1.80	10:00	2.66	2.22	05:15	0.059	09:15	0.112	0.082	0.082	
4/26/2015	04:30	1.14	15:00	1.80	1.35	03:45	1.54	15:00	2.78	2.13	06:15	0.045	15:00	0.150	0.077	0.077	
4/27/2015	05:00	0.99	20:15	1.50	1.22	05:00	1.03	21:30	2.44	1.87	05:00	0.023	09:30	0.093	0.058	0.058	
4/28/2015	02:45	0.98	19:45	1.52	1.22	02:15	1.22	20:45	2.65	1.90	02:15	0.029	20:45	0.102	0.060	0.060	
4/29/2015	02:30	0.87	07:00	1.50	1.19	02:45	1.03	19:45	2.40	1.81	02:45	0.023	22:00	0.094	0.055	0.055	
4/30/2015	02:30	0.86	13:15	1.44	1.16	04:15	0.93	13:15	2.56	1.83	04:15	0.017	13:15	0.100	0.053	0.053	
5/1/2015	02:00	0.82	07:15	1.46	1.12	02:15	0.78	11:15	2.37	1.69	02:15	0.014	07:15	0.091	0.048	0.048	
5/2/2015	16:30	0.62	15:30	1.62	1.07	06:00	0.82	15:30	2.44	1.59	06:00	0.015	15:30	0.113	0.043	0.043	
5/3/2015	05:30	0.57	17:00	1.41	1.09	06:00	0.70	21:30	2.53	1.53	05:30	0.010	21:30	0.081	0.042	0.042	
5/4/2015	03:15	0.67	08:45	1.46	1.09	03:15	0.67	21:30	2.44	1.60	03:15	0.008	21:30	0.093	0.043	0.043	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	03:45	0.50	19:45	1.56	1.01	03:45	0.58	20:00	2.43	1.53	03:45	0.005	19:45	0.104	0.039	0.039	
5/6/2015	04:15	0.50	20:00	1.58	1.02	00:30	0.51	22:30	2.39	1.55	02:45	0.007	22:30	0.106	0.041	0.041	
5/7/2015	08:15	0.66	14:30	1.52	1.14	10:45	0.74	14:45	2.36	1.70	10:45	0.011	23:00	0.089	0.049	0.049	
5/8/2015	00:45	0.52	07:30	1.41	0.95	04:30	0.51	07:30	2.52	1.42	04:30	0.005	07:30	0.095	0.033	0.033	
5/9/2015	05:15	0.47	11:00	1.41	0.94	06:45	0.49	17:30	2.36	1.44	05:15	0.005	11:00	0.079	0.034	0.034	
5/10/2015	04:15	0.40	20:30	1.41	0.93	04:00	0.48	20:30	2.42	1.43	06:00	0.004	20:30	0.091	0.033	0.033	
5/11/2015	12:00	0.54	18:00	1.51	0.82	04:15	0.56	18:00	2.33	1.36	04:15	0.006	18:00	0.097	0.025	0.025	
5/12/2015	04:30	0.50	20:15	1.49	1.01	03:00	0.55	20:15	2.38	1.63	03:00	0.005	20:15	0.097	0.041	0.041	
5/13/2015	04:00	0.56	09:00	1.48	1.03	23:15	0.72	05:30	2.14	1.54	04:00	0.009	09:00	0.081	0.039	0.039	
5/14/2015	02:45	0.35	20:45	1.43	0.88	02:45	0.29	21:00	2.35	1.46	02:45	0.001	20:45	0.090	0.032	0.032	
5/15/2015	01:15	0.51	15:15	1.54	0.86	04:15	0.61	15:15	2.44	1.36	01:15	0.005	15:15	0.105	0.028	0.028	
5/16/2015	05:15	0.62	14:30	1.51	0.97	03:30	0.69	12:15	2.38	1.50	05:15	0.009	14:30	0.098	0.035	0.035	0.01
5/17/2015	23:45	0.57	11:00	1.45	0.92	05:00	0.61	11:00	2.33	1.51	23:45	0.008	11:00	0.091	0.033	0.033	
5/18/2015	03:30	0.44	16:15	1.43	0.85	04:00	0.56	17:45	2.30	1.38	04:00	0.004	16:15	0.081	0.028	0.028	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			4.749	4.65
Avg	1.35	2.06	0.079	

Site Commentary

Site Information

Enfield_FM10	
Pipe Dimensions (in.)	Circular (27.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM10 indicate this location functioned under typical open channel flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	7.48	1.11	0.659
Minimum	4.88	0.46	0.146
Maximum	9.83	1.53	1.181
Time of Minimum	5/17/2015 6:30 AM	5/16/2015 5:30 AM	5/16/2015 5:30 AM
Time of Maximum	4/5/2015 12:00 PM	4/11/2015 12:15 PM	3/28/2015 11:15 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

a division of ADS LLC.

Site Report

FM Initials:	IC
Project Name:	ENFIELD, CT

Site Name:	ENFIELD_FM10	Meter Type:	FLOWSHARK	Monitor S/N:	16086	Manhole #:	
Address / Location:	101 POST OFFICE ROAD ***DETAIL NEEDED***			Map Page #:			
				Pipe Height:	27 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	27 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:			
Date/Time of Investigation:	March 18, 2015	8:00 AM	Manhole Depth:	27 Feet		
Site Hydraulics:			Manhole Material / Condition:	Brick		Good
			Active Drop Connections?			
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	RC		Good
Upstream Manhole:			Mini System Character:	RESIDENTIAL		
Downstream Manhole:			**Telephone Information:**			
Depth of Flow (Wet Dof):	9.25 +/- 0.38		Access Pole #:	N/A		
Range (Air Dof):	18 +/- 0.38		Distance From Manhole:	N/A Feet		
Peak Velocity:	1.53 fps		Road Cut Length:	N/A Feet		
Silt:	0 Inches		Trench Length:	N/A Feet		

Other Information:

N 41° 57' 52.0" W 72° 34' 50.7"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS S/N 79963 PO 1.0" ULTRA PO 1.25"

SCATTERGRAPH REPORT

Enfield_FM10

Flow Monitor

Enfield_FM10

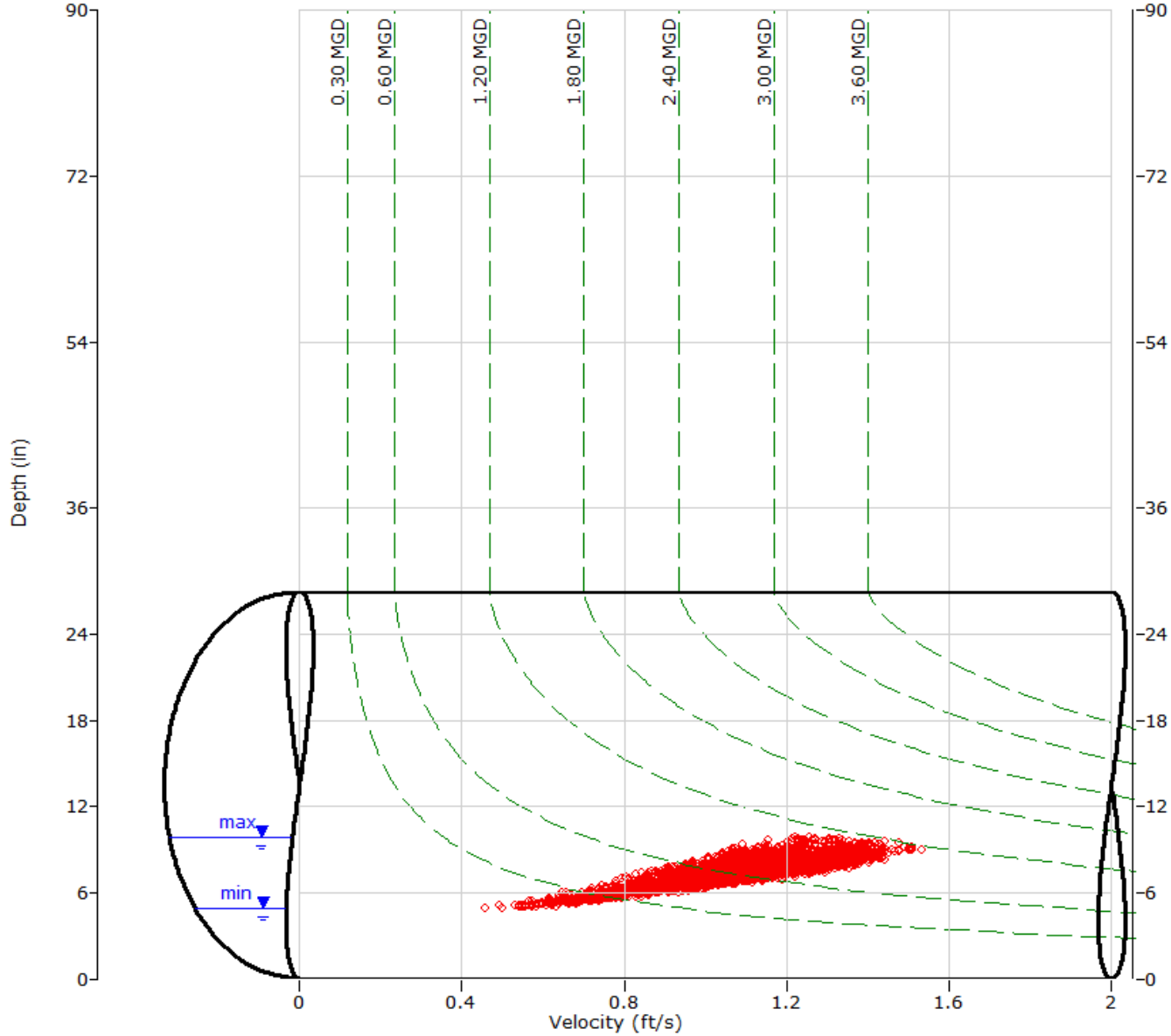
Pipe Height
27.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



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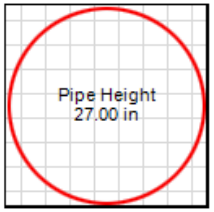
HYDROGRAPH REPORT

Enfield_FM10

Flow Monitor

Enfield_FM10

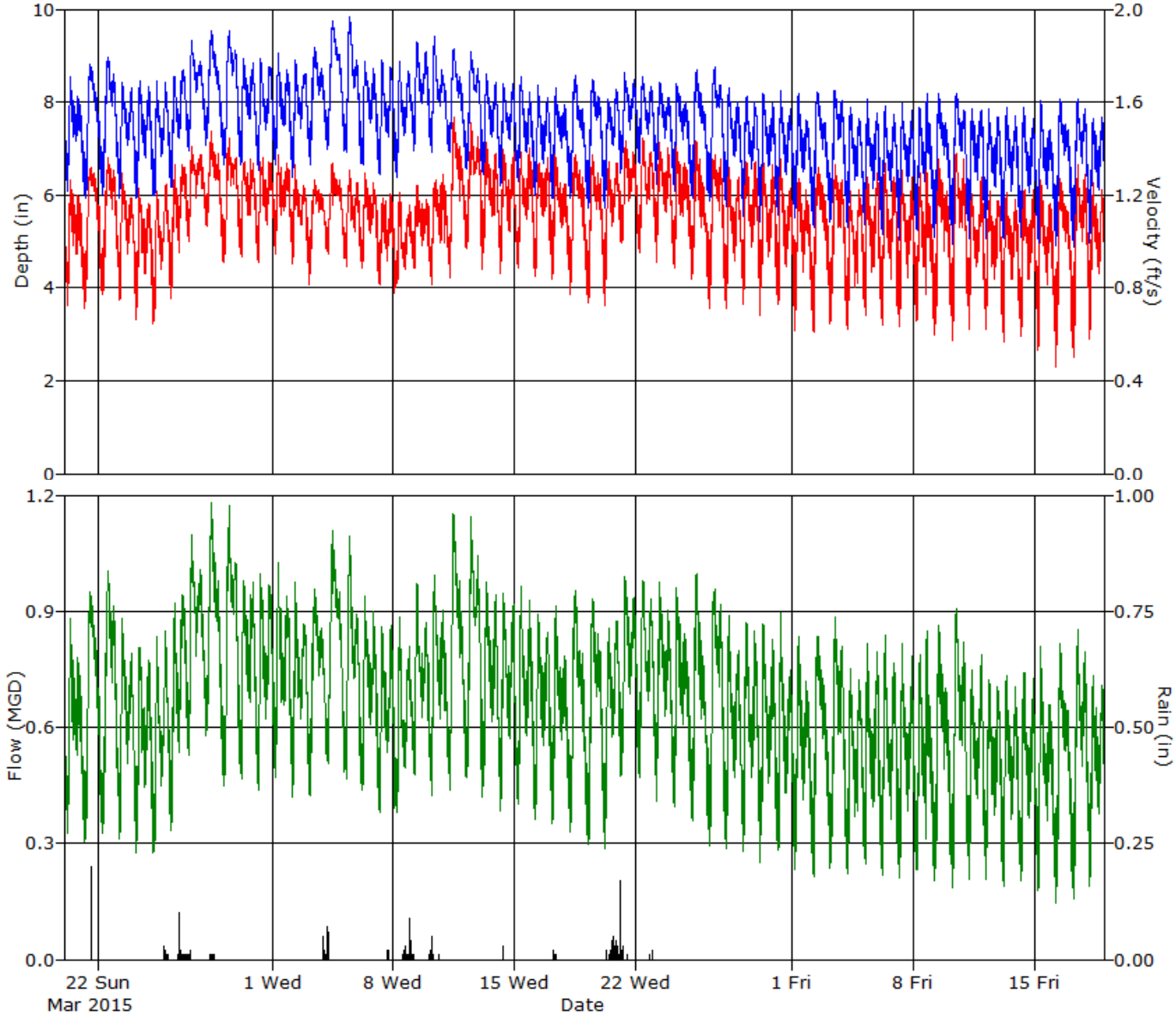


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM10, Pipe Height: 27 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	05:30	6.09	08:15	8.55	7.50	04:30	0.72	09:15	1.27	1.04	05:30	0.325	09:15	0.880	0.615	0.615	
3/21/2015	05:45	5.94	12:15	8.80	7.68	04:45	0.71	14:15	1.32	1.11	04:45	0.305	12:15	0.948	0.684	0.684	0.21
3/22/2015	05:30	6.01	12:30	8.97	7.76	05:30	0.77	13:30	1.36	1.12	05:30	0.328	13:30	1.005	0.702	0.702	
3/23/2015	05:00	5.92	09:00	8.43	7.48	05:00	0.75	08:30	1.30	1.07	05:00	0.311	08:30	0.882	0.631	0.631	
3/24/2015	03:30	5.92	08:30	8.44	7.38	03:30	0.66	08:15	1.23	1.01	03:30	0.277	08:15	0.807	0.581	0.581	0.00
3/25/2015	04:45	5.98	08:30	8.46	7.39	03:30	0.65	22:00	1.25	1.01	03:30	0.275	21:00	0.848	0.585	0.585	0.09
3/26/2015	03:15	6.16	21:00	8.70	7.69	03:15	0.75	09:15	1.33	1.11	03:15	0.333	20:00	0.943	0.684	0.684	0.32
3/27/2015	05:30	6.95	08:30	9.31	8.36	04:30	1.00	09:00	1.41	1.26	04:45	0.528	09:00	1.096	0.864	0.864	0.17
3/28/2015	05:00	7.08	12:45	9.54	8.43	06:30	1.07	11:15	1.48	1.28	05:00	0.577	11:15	1.181	0.882	0.882	0.07
3/29/2015	05:15	6.65	12:45	9.54	8.32	05:15	0.91	12:45	1.44	1.22	05:15	0.448	12:45	1.172	0.838	0.838	
3/30/2015	04:45	6.66	08:45	8.92	8.03	05:45	0.93	18:45	1.35	1.20	05:45	0.466	09:15	0.978	0.778	0.778	
3/31/2015	04:45	6.53	08:00	8.93	7.95	04:45	0.91	11:30	1.36	1.19	04:45	0.436	08:00	0.998	0.762	0.762	
4/1/2015	04:30	6.65	08:30	9.04	7.94	05:15	0.94	09:00	1.37	1.21	04:30	0.472	09:00	1.025	0.767	0.767	
4/2/2015	04:30	6.38	08:30	8.89	7.94	04:30	0.90	08:00	1.33	1.15	04:30	0.418	08:45	0.973	0.730	0.730	
4/3/2015	04:15	6.64	11:15	9.16	8.22	02:30	0.81	11:30	1.26	1.12	04:15	0.423	11:30	0.956	0.750	0.750	0.19
4/4/2015	05:15	6.99	11:45	9.73	8.60	06:00	0.94	12:30	1.34	1.18	06:00	0.507	11:45	1.108	0.839	0.839	0.35
4/5/2015	06:45	6.93	12:00	9.83	8.44	06:45	0.89	10:45	1.30	1.13	06:45	0.466	10:45	1.095	0.782	0.782	
4/6/2015	06:00	6.65	08:45	8.88	7.95	04:00	0.89	09:00	1.30	1.11	05:00	0.438	09:00	0.938	0.709	0.709	
4/7/2015	05:00	6.44	08:15	8.90	7.81	05:00	0.81	19:45	1.21	1.03	05:00	0.382	20:45	0.862	0.643	0.643	0.15
4/8/2015	05:30	6.37	08:30	8.88	7.80	02:00	0.78	08:45	1.21	0.99	05:30	0.379	08:45	0.884	0.619	0.619	0.63
4/9/2015	04:45	6.95	08:45	9.29	8.33	04:30	0.89	08:45	1.24	1.07	05:30	0.477	08:45	0.973	0.724	0.724	0.10
4/10/2015	04:30	6.92	08:30	9.41	8.22	04:30	0.81	20:30	1.29	1.11	04:30	0.422	08:30	0.994	0.740	0.740	0.31
4/11/2015	06:30	6.92	12:30	9.14	8.12	06:30	0.84	12:15	1.53	1.24	06:30	0.439	11:00	1.152	0.820	0.820	
4/12/2015	04:45	6.55	11:00	9.08	8.04	05:30	0.97	11:30	1.51	1.28	04:45	0.470	11:30	1.145	0.835	0.835	
4/13/2015	04:30	6.43	09:30	8.60	7.70	02:30	0.88	08:45	1.43	1.22	02:30	0.421	09:30	0.976	0.744	0.744	
4/14/2015	04:45	6.19	08:30	8.40	7.59	04:45	0.86	08:45	1.39	1.19	04:45	0.383	08:45	0.947	0.713	0.713	0.05
4/15/2015	04:45	6.30	08:45	8.53	7.48	04:45	0.89	20:45	1.40	1.18	04:45	0.404	08:45	0.965	0.694	0.694	
4/16/2015	05:00	5.99	08:45	8.37	7.32	05:00	0.85	22:30	1.36	1.17	05:00	0.362	08:15	0.891	0.669	0.669	
4/17/2015	03:45	5.94	09:00	8.31	7.34	03:45	0.84	08:15	1.37	1.15	03:45	0.351	09:00	0.914	0.655	0.655	0.11
4/18/2015	05:30	5.92	12:00	8.56	7.46	05:15	0.77	11:30	1.37	1.15	05:30	0.328	11:45	0.952	0.677	0.677	
4/19/2015	06:15	5.72	11:30	8.48	7.43	06:00	0.74	12:15	1.37	1.13	06:15	0.296	12:15	0.932	0.663	0.663	
4/20/2015	05:15	5.72	21:00	8.28	7.34	05:15	0.72	11:30	1.34	1.14	05:15	0.287	22:30	0.876	0.654	0.654	0.84
4/21/2015	03:00	6.48	08:45	8.62	7.81	03:45	0.99	09:30	1.43	1.25	03:00	0.474	08:45	0.991	0.777	0.777	0.36
4/22/2015	05:00	6.67	08:45	8.55	7.76	05:00	0.95	09:30	1.44	1.24	05:00	0.470	09:00	0.980	0.762	0.762	0.05
4/23/2015	04:15	6.22	08:30	8.41	7.60	04:15	0.91	08:30	1.43	1.23	04:15	0.407	08:30	0.975	0.734	0.734	
4/24/2015	04:45	6.09	08:15	8.39	7.51	05:45	0.89	08:15	1.41	1.19	05:45	0.395	08:15	0.960	0.704	0.704	
4/25/2015	06:45	5.93	11:45	8.68	7.53	04:30	0.84	11:00	1.43	1.17	06:45	0.360	12:45	0.997	0.698	0.698	
4/26/2015	06:00	5.87	12:45	8.75	7.59	06:00	0.71	13:15	1.37	1.14	06:00	0.294	12:45	0.958	0.690	0.690	
4/27/2015	05:15	5.75	08:15	8.31	7.32	05:15	0.71	08:15	1.32	1.08	05:15	0.286	08:15	0.887	0.618	0.618	
4/28/2015	04:45	5.55	09:15	8.11	7.14	04:45	0.73	08:15	1.34	1.12	04:45	0.278	08:15	0.870	0.621	0.621	
4/29/2015	04:30	5.41	08:15	8.18	7.14	04:30	0.68	09:30	1.34	1.11	04:30	0.250	08:15	0.868	0.613	0.613	
4/30/2015	04:45	5.57	08:30	8.23	7.04	03:45	0.73	08:30	1.35	1.07	03:45	0.281	08:30	0.897	0.581	0.581	
5/1/2015	03:45	5.52	08:45	8.17	6.98	03:45	0.62	08:45	1.27	1.04	03:45	0.232	08:45	0.834	0.557	0.557	
5/2/2015	06:00	5.30	11:15	8.21	7.10	06:00	0.61	13:15	1.32	1.06	06:00	0.216	12:45	0.834	0.588	0.588	
5/3/2015	04:45	5.41	12:15	8.25	7.14	04:45	0.65	12:15	1.33	1.06	04:45	0.238	12:15	0.884	0.595	0.595	
5/4/2015	05:15	5.30	08:45	7.88	6.89	05:15	0.62	21:00	1.22	0.99	05:15	0.222	09:30	0.751	0.524	0.524	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	05:30	5.34	08:30	8.05	6.86	05:30	0.68	21:45	1.30	1.06	05:30	0.245	08:30	0.817	0.554	0.554	
5/6/2015	04:45	5.16	09:00	7.90	6.81	04:45	0.64	09:00	1.34	1.05	04:45	0.219	09:00	0.837	0.544	0.544	
5/7/2015	05:00	5.04	08:45	7.96	6.82	05:00	0.63	09:00	1.30	1.03	05:00	0.209	08:45	0.815	0.538	0.538	
5/8/2015	06:00	5.24	18:45	8.19	6.78	04:15	0.66	18:30	1.30	1.01	04:30	0.232	18:45	0.848	0.521	0.521	
5/9/2015	05:45	5.08	10:45	8.17	6.94	05:30	0.60	11:15	1.35	1.05	05:45	0.203	11:15	0.864	0.564	0.564	
5/10/2015	06:00	4.95	11:15	8.18	6.99	05:45	0.57	11:15	1.38	1.08	06:00	0.185	11:15	0.906	0.590	0.590	
5/11/2015	05:15	5.07	09:00	7.85	6.88	05:15	0.62	22:00	1.28	1.02	05:15	0.208	22:00	0.788	0.535	0.535	
5/12/2015	05:30	5.07	08:30	7.85	6.79	05:15	0.62	10:45	1.21	0.99	05:30	0.208	08:30	0.723	0.513	0.513	
5/13/2015	05:15	5.07	09:00	7.87	6.75	05:15	0.57	09:15	1.21	0.98	05:15	0.189	09:15	0.733	0.502	0.502	
5/14/2015	04:45	5.09	08:15	7.89	6.73	04:30	0.59	10:00	1.22	0.99	04:30	0.204	08:30	0.740	0.506	0.506	
5/15/2015	05:30	4.98	08:45	8.03	6.72	04:00	0.53	08:45	1.26	0.98	04:00	0.177	08:45	0.809	0.500	0.500	
5/16/2015	05:30	4.90	11:30	8.06	6.83	05:30	0.46	11:15	1.27	0.99	05:30	0.146	11:15	0.816	0.523	0.523	
5/17/2015	06:30	4.88	12:15	8.05	6.89	06:30	0.50	12:15	1.33	1.03	06:30	0.158	12:15	0.854	0.551	0.551	
5/18/2015	04:30	4.96	21:30	7.67	6.71	04:30	0.58	09:15	1.25	1.01	04:30	0.189	09:15	0.734	0.512	0.512	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			39.548	4.00
Avg	7.48	1.11	0.659	

Site Commentary

Site Information

Enfield_FM11	
Pipe Dimensions (in.)	Circular (15.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM11 indicate this location functioned under typical open channel flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	4.42	0.91	0.182
Minimum	2.87	0.46	0.049
Maximum	6.62	1.34	0.365
Time of Minimum	4/20/2015 3:45 AM	4/20/2015 3:45 AM	4/20/2015 3:45 AM
Time of Maximum	3/25/2015 7:30 AM	3/27/2015 7:00 AM	4/5/2015 10:45 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

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a division of ADS LLC.

Site Report

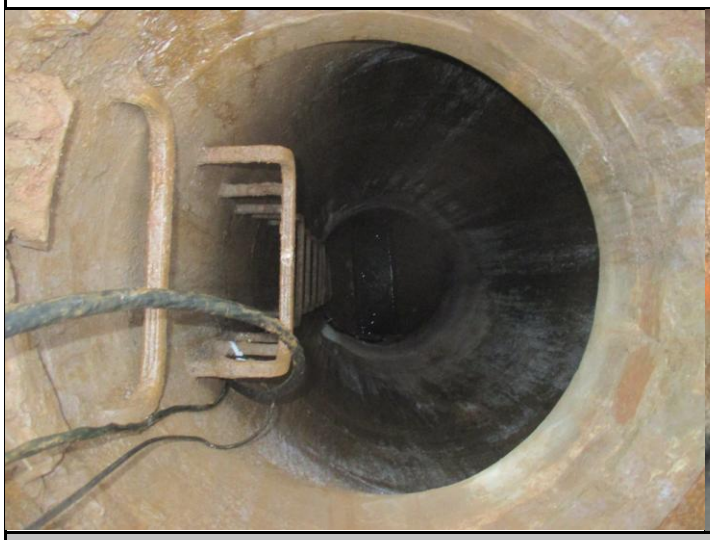
FM Initials:	IC
Project Name:	ENFIELD, CT

Site Name:	ENFIELD_FM11	Meter Type:	FLOWSHARK	Monitor S/N:	16230	Manhole #:	
Address / Location:	67 POST ROAD			Map Page #:			
				Pipe Height:	15 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	15 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 18, 2015	1:20 PM	Manhole Depth:	27 Feet	
Site Hydraulics:	SLOW, SMOOTH FLOW		Manhole Material / Condition:	Brick	Good
			Active Drop Connections?		
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	RC	Good
Upstream Manhole:			Mini System Character:	RESIDENTIAL	
Downstream Manhole:			**Telephone Information:**		
Depth of Flow (Wet Dof):	5 +/- 0.38		Access Pole #:	N/A	
Range (Air Dof):	10 +/- 0.38		Distance From Manhole:	N/A Feet	
Peak Velocity:	0.87 fps		Road Cut Length:	N/A Feet	
Silt:	0 Inches		Trench Length:	N/A Feet	

Other Information:

N 41° 58' 07.3" W 72° 34' 41.2"



Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

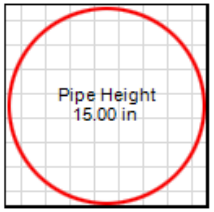
PRESS S/N 82196 (82194) PO 2.0" ULTRA PO 1.50" VEL @ 6:30

SCATTERGRAPH REPORT

Enfield_FM11

Flow Monitor

Enfield_FM11

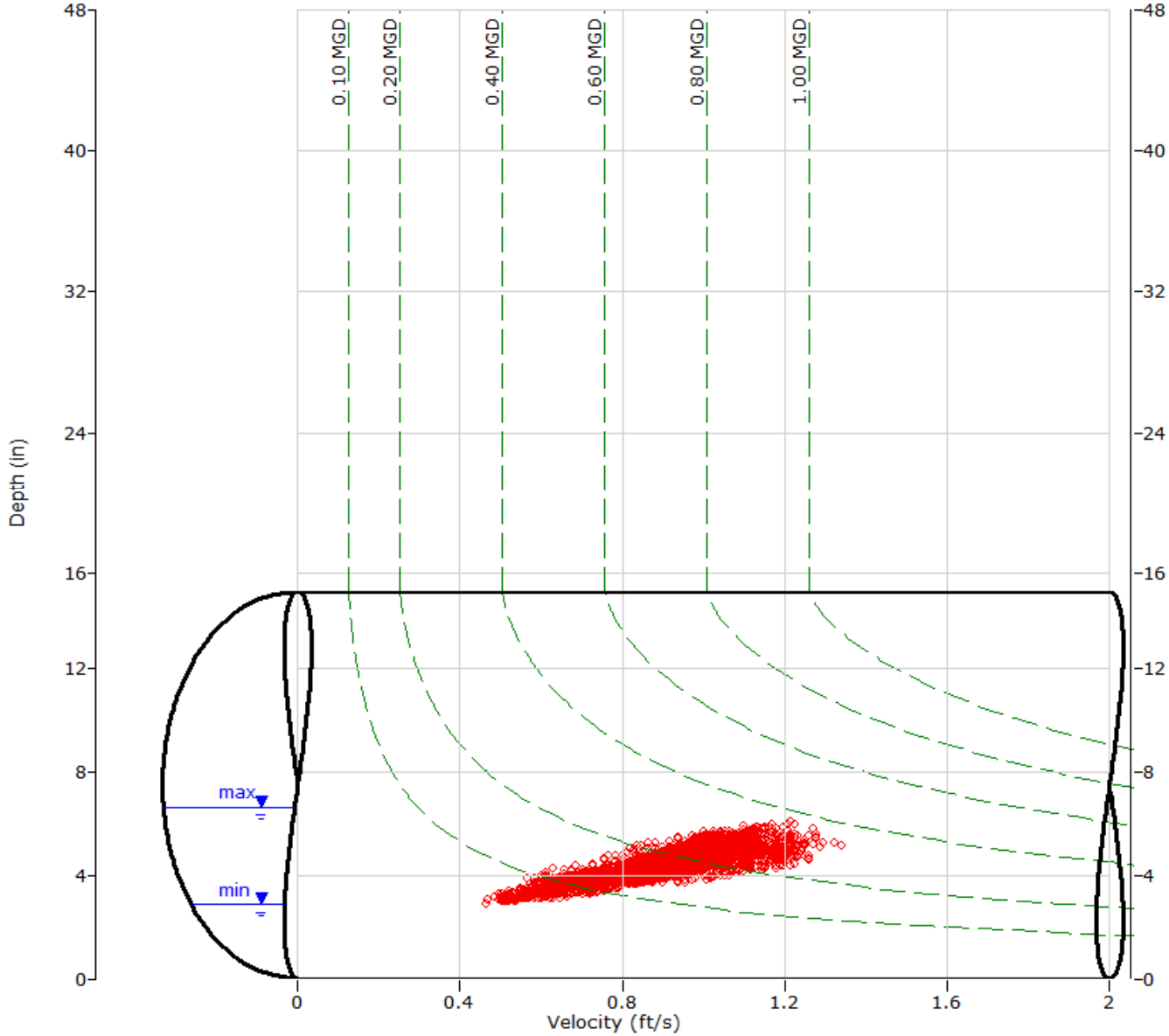


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



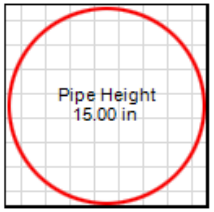
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM11

Flow Monitor

Enfield_FM11

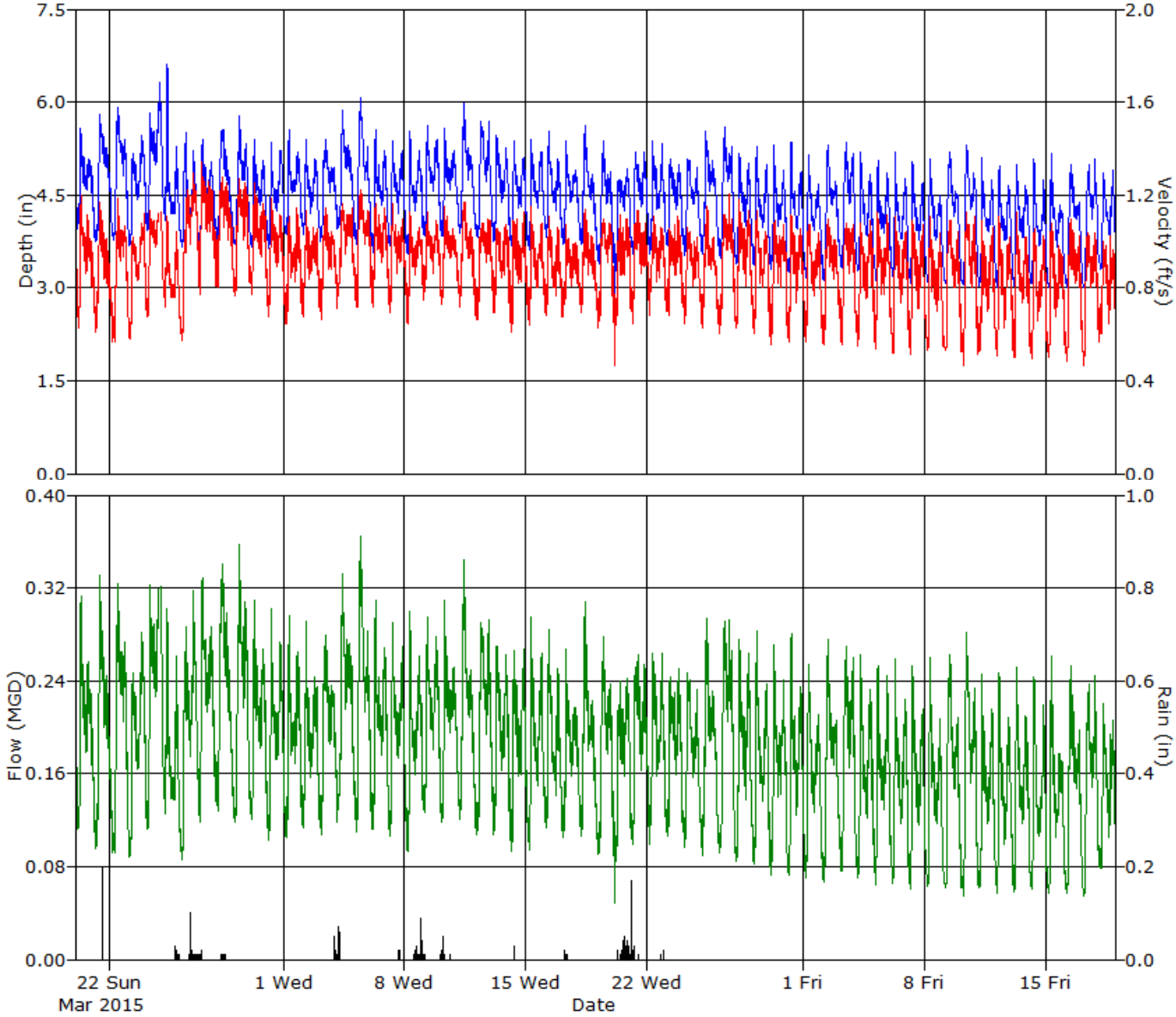


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM11, Pipe Height: 15 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	03:30	3.95	07:00	5.57	4.72	04:45	0.63	08:00	1.20	0.93	03:30	0.113	08:00	0.312	0.203	0.203	
3/21/2015	04:00	3.76	10:45	5.79	4.77	04:30	0.61	10:45	1.17	0.88	04:30	0.095	10:45	0.330	0.197	0.197	0.21
3/22/2015	04:30	3.77	11:45	5.92	4.84	03:00	0.57	11:30	1.19	0.89	03:00	0.092	11:30	0.323	0.204	0.204	
3/23/2015	03:00	3.68	20:15	5.47	4.62	03:45	0.58	20:15	1.08	0.87	03:00	0.088	20:15	0.282	0.185	0.185	
3/24/2015	03:30	3.94	20:30	6.32	5.14	03:30	0.67	07:45	1.13	0.97	03:30	0.112	07:45	0.322	0.233	0.211	0.00
3/25/2015	04:30	4.08	07:30	6.62	4.64	04:30	0.72	06:45	1.11	0.87	04:30	0.126	06:45	0.302	0.183	0.183	0.09
3/26/2015	04:30	3.65	09:30	5.51	4.38	04:30	0.57	20:00	1.30	0.99	04:30	0.086	20:00	0.318	0.196	0.196	0.32
3/27/2015	04:00	3.70	08:00	5.40	4.51	04:30	0.77	07:00	1.34	1.11	04:30	0.118	08:00	0.329	0.227	0.227	0.17
3/28/2015	04:30	3.76	11:00	5.56	4.65	05:15	0.80	11:30	1.28	1.08	05:15	0.128	12:00	0.341	0.230	0.230	0.07
3/29/2015	04:45	3.70	10:45	5.78	4.62	06:15	0.76	10:45	1.27	1.06	04:45	0.118	10:45	0.358	0.224	0.224	
3/30/2015	04:15	3.67	07:45	5.39	4.47	04:45	0.77	09:00	1.25	1.02	04:45	0.121	07:45	0.309	0.205	0.205	
3/31/2015	04:00	3.63	07:30	5.35	4.47	04:30	0.67	07:15	1.19	0.96	04:00	0.103	07:30	0.302	0.193	0.193	
4/1/2015	04:00	3.87	07:45	5.56	4.61	03:15	0.65	19:00	1.14	0.91	04:00	0.105	07:45	0.296	0.190	0.190	
4/2/2015	04:30	3.86	07:15	5.39	4.55	03:15	0.67	07:15	1.13	0.92	03:15	0.114	07:15	0.291	0.190	0.190	
4/3/2015	04:00	3.76	11:15	5.39	4.64	04:15	0.67	10:00	1.14	0.93	04:15	0.108	10:00	0.279	0.198	0.198	0.19
4/4/2015	03:15	3.95	10:45	5.86	4.84	03:15	0.71	10:30	1.16	0.99	03:15	0.119	10:30	0.332	0.224	0.224	0.35
4/5/2015	05:45	3.71	10:45	6.06	4.80	05:45	0.72	11:00	1.22	1.01	05:45	0.110	10:45	0.365	0.227	0.227	
4/6/2015	04:30	3.58	07:45	5.55	4.52	04:45	0.72	07:45	1.16	0.98	03:15	0.112	07:45	0.310	0.201	0.201	
4/7/2015	03:30	3.68	07:30	5.38	4.51	04:15	0.69	07:15	1.16	0.95	04:15	0.107	07:30	0.290	0.193	0.193	0.15
4/8/2015	05:30	3.55	07:45	5.54	4.50	04:15	0.65	07:45	1.12	0.93	04:15	0.093	07:45	0.299	0.189	0.189	0.63
4/9/2015	04:15	3.85	08:00	5.61	4.72	02:45	0.75	07:45	1.12	0.96	03:15	0.127	08:00	0.295	0.209	0.209	0.10
4/10/2015	04:30	3.84	07:30	5.57	4.72	02:45	0.73	07:30	1.15	0.96	03:15	0.119	07:30	0.309	0.207	0.207	0.31
4/11/2015	05:15	3.89	10:15	5.97	4.82	04:15	0.72	10:15	1.17	0.95	04:15	0.121	10:15	0.344	0.213	0.213	
4/12/2015	05:15	3.81	20:30	5.69	4.78	03:15	0.67	19:15	1.10	0.93	03:15	0.107	20:30	0.293	0.207	0.207	
4/13/2015	03:30	3.75	07:30	5.46	4.62	03:30	0.69	19:30	1.07	0.92	03:30	0.107	07:15	0.269	0.193	0.193	
4/14/2015	03:45	3.68	07:45	5.38	4.53	03:30	0.61	21:15	1.12	0.91	03:30	0.093	21:15	0.268	0.186	0.186	0.05
4/15/2015	04:30	3.61	07:30	5.39	4.53	04:15	0.64	07:30	1.15	0.89	04:15	0.095	07:30	0.295	0.184	0.184	
4/16/2015	04:00	3.82	07:30	5.54	4.58	04:15	0.68	07:45	1.11	0.89	04:15	0.114	07:45	0.284	0.185	0.185	
4/17/2015	04:00	3.70	07:45	5.38	4.51	02:00	0.67	08:00	1.07	0.88	04:00	0.105	07:45	0.267	0.178	0.178	0.11
4/18/2015	05:15	3.70	09:45	5.62	4.52	04:30	0.69	09:45	1.14	0.91	04:30	0.106	09:45	0.309	0.187	0.187	
4/19/2015	05:00	3.40	11:15	5.38	4.36	03:30	0.63	12:30	1.10	0.92	04:30	0.090	11:15	0.279	0.180	0.180	
4/20/2015	03:45	2.87	21:00	4.91	4.26	03:45	0.46	10:45	1.12	0.90	03:45	0.049	19:30	0.242	0.172	0.172	0.84
4/21/2015	03:45	3.54	08:00	5.19	4.50	04:15	0.65	09:45	1.13	0.93	04:15	0.099	11:15	0.262	0.190	0.190	0.36
4/22/2015	04:15	3.55	07:15	5.37	4.48	03:15	0.68	09:45	1.11	0.93	03:15	0.099	07:15	0.264	0.187	0.187	0.05
4/23/2015	04:15	3.69	07:45	5.08	4.46	06:00	0.68	18:45	1.11	0.91	04:15	0.106	20:00	0.251	0.183	0.183	
4/24/2015	03:45	3.53	08:30	5.07	4.41	03:15	0.65	07:45	1.06	0.89	04:00	0.096	08:30	0.246	0.177	0.177	
4/25/2015	04:00	3.54	09:15	5.53	4.53	05:00	0.63	10:30	1.15	0.89	05:00	0.090	10:30	0.293	0.185	0.185	
4/26/2015	05:00	3.49	11:00	5.60	4.55	03:45	0.60	17:45	1.21	0.92	04:00	0.092	17:45	0.293	0.193	0.193	
4/27/2015	02:45	3.39	07:15	5.16	4.29	02:45	0.63	07:45	1.18	0.92	02:45	0.084	07:45	0.275	0.176	0.176	
4/28/2015	04:15	3.37	07:45	5.29	4.25	04:30	0.60	07:45	1.13	0.89	04:30	0.082	07:45	0.283	0.169	0.169	
4/29/2015	03:15	3.30	07:30	5.30	4.23	03:15	0.56	08:30	1.09	0.89	03:15	0.072	07:30	0.271	0.168	0.168	
4/30/2015	03:45	3.26	07:30	5.36	4.17	03:45	0.57	07:15	1.12	0.88	03:45	0.072	07:45	0.280	0.164	0.164	
5/1/2015	03:15	3.16	07:30	5.15	4.10	03:30	0.57	08:15	1.07	0.85	03:30	0.070	07:30	0.254	0.154	0.154	
5/2/2015	04:15	3.13	11:15	5.31	4.25	04:15	0.56	10:15	1.10	0.87	04:15	0.067	11:15	0.275	0.166	0.166	
5/3/2015	05:15	3.33	11:30	5.36	4.39	06:15	0.56	11:00	1.08	0.89	04:45	0.076	11:45	0.269	0.178	0.178	
5/4/2015	03:45	3.27	07:45	5.19	4.12	04:15	0.55	20:30	1.09	0.85	04:15	0.071	07:45	0.263	0.156	0.156	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	05:00	3.13	07:30	5.05	4.08	05:00	0.54	07:15	1.12	0.87	05:00	0.065	07:30	0.253	0.156	0.156	
5/6/2015	04:00	3.18	07:45	5.19	4.06	03:30	0.52	07:00	1.11	0.84	03:30	0.065	07:45	0.259	0.151	0.151	
5/7/2015	04:15	3.08	07:30	5.03	4.05	04:00	0.51	07:15	1.09	0.84	04:00	0.061	07:15	0.253	0.149	0.149	
5/8/2015	04:30	3.09	07:15	5.08	4.01	04:00	0.53	07:45	1.11	0.81	04:00	0.063	07:15	0.260	0.143	0.143	
5/9/2015	04:45	3.08	10:15	5.19	4.15	04:45	0.53	10:00	1.09	0.83	04:45	0.062	10:00	0.262	0.155	0.155	
5/10/2015	05:45	3.05	11:00	5.30	4.20	06:00	0.47	09:15	1.12	0.85	06:00	0.054	11:00	0.282	0.163	0.163	
5/11/2015	04:15	3.03	07:45	5.10	4.03	02:30	0.51	07:30	1.09	0.82	04:15	0.062	07:30	0.246	0.146	0.146	
5/12/2015	04:15	3.00	07:45	4.97	3.99	04:15	0.50	07:30	1.11	0.81	04:15	0.057	07:30	0.246	0.141	0.141	
5/13/2015	04:00	3.02	08:00	4.99	4.02	03:00	0.50	08:30	1.12	0.81	04:00	0.058	08:00	0.251	0.144	0.144	
5/14/2015	04:30	3.07	07:30	5.08	3.97	05:15	0.50	08:00	1.05	0.80	04:45	0.060	07:45	0.243	0.138	0.138	
5/15/2015	04:15	3.00	07:30	5.16	3.92	04:15	0.50	07:30	1.08	0.80	04:15	0.057	07:30	0.261	0.138	0.138	
5/16/2015	06:15	3.00	10:15	4.99	4.01	06:00	0.49	10:15	1.10	0.82	06:15	0.057	10:15	0.253	0.147	0.147	
5/17/2015	04:45	3.00	20:15	5.08	4.12	04:00	0.47	10:30	1.03	0.82	04:00	0.054	20:15	0.245	0.152	0.152	
5/18/2015	03:15	3.31	20:45	4.89	4.08	01:30	0.57	18:00	1.03	0.80	04:15	0.078	07:30	0.220	0.143	0.143	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			10.882	4.00
Avg	4.42	0.91	0.182	

Site Commentary

Site Information

Enfield_FM12	
Pipe Dimensions (in.)	Circular (21.00 in H)
Silt (in.)	0.00

Overview

A review of the hydrograph and scattergraph for Enfield_FM12 indicate this location functioned in free flow conditions during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location.

Daily longtables displaying final quantities are also provided.

Observations

Average flow depth, velocity, and quantity data observed during Friday, March 20, 2015 to Monday, May 18, 2015 , along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	Depth (in)	Velocity (ft/s)	Quantity (MGD)
Average	3.55	1.76	0.313
Minimum	2.45	1.21	0.129
Maximum	4.81	2.24	0.593
Time of Minimum	5/18/2015 4:45 AM	5/14/2015 5:30 AM	5/13/2015 3:45 AM
Time of Maximum	4/5/2015 11:30 AM	4/4/2015 12:15 PM	4/5/2015 11:30 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Graphical data reports are based on an hourly average.

.

Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in table below.

Percent Uptime	
Depth (in)	100
Velocity (ft/s)	100
Quantity (MGD)	100

ADS ENVIRONMENTAL SERVICES®

a division of ADS LLC.

Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_FM12	Meter Type:	FLOWSHARK	Monitor S/N:	30420	Manhole #:	
Address / Location:	ACROSS BRIDGE FROM SOUTH MAPLE STREET PUMP STATION SEE BELOW**USE COORDINATES**			Map Page #:			
				Pipe Height:	21 Inches		
Access:	Walk (Wooded)	Type of System:	SANITARY	Pipe Width:	21 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:			
Date/Time of Investigation:	March 17, 2015	2:00 PM	Manhole Depth:	27 Feet		
Site Hydraulics:	FAST, SMOOTH FLOW		Manhole Material / Condition:	Brick		Good
			Active Drop Connections?			
Upstream Input: (L/S, P/S)			Pipe Material / Condition:	RC		Good
Upstream Manhole:			Mini System Character:	OTHER		
Downstream Manhole:			**Telephone Information:**			
Depth of Flow (Wet Dof):	4 +/- 0.38		Access Pole #:	N/A		
Range (Air Dof):	17 +/- 0.38		Distance From Manhole:	N/A Feet		
Peak Velocity:	2.13 fps		Road Cut Length:	N/A Feet		
Silt:	0 Inches		Trench Length:	N/A Feet		

Other Information:

N 41° 58' 54.1" W 72° 32' 23.8"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Doppler Standard Ring and Crank Installation	Trunk		X		
Sensors / Devices:	Ultra, Velocity, Pressure (Non I.S.)	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

*****WALK UP TRAIL, RIGHT AT FORK, ORANGE TAPE *** PRESS S/N 10297 PO 0.5" ULTRA PO 1.25"**

SCATTERGRAPH REPORT

Enfield_FM12

Flow Monitor

Enfield_FM12

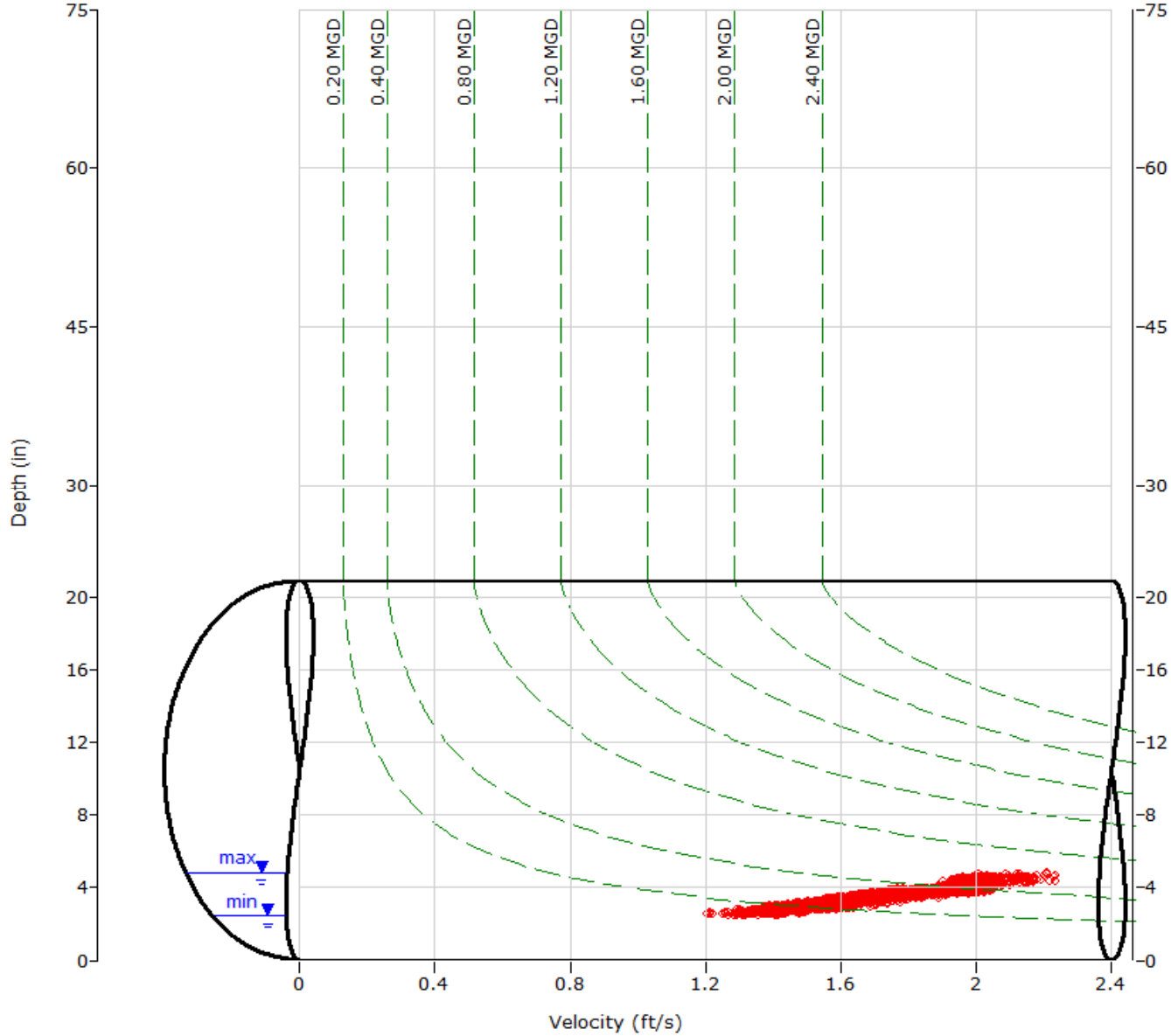
Pipe Height
21.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



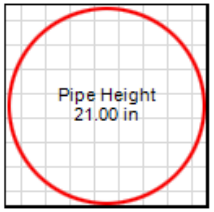
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_FM12

Flow Monitor

Enfield_FM12

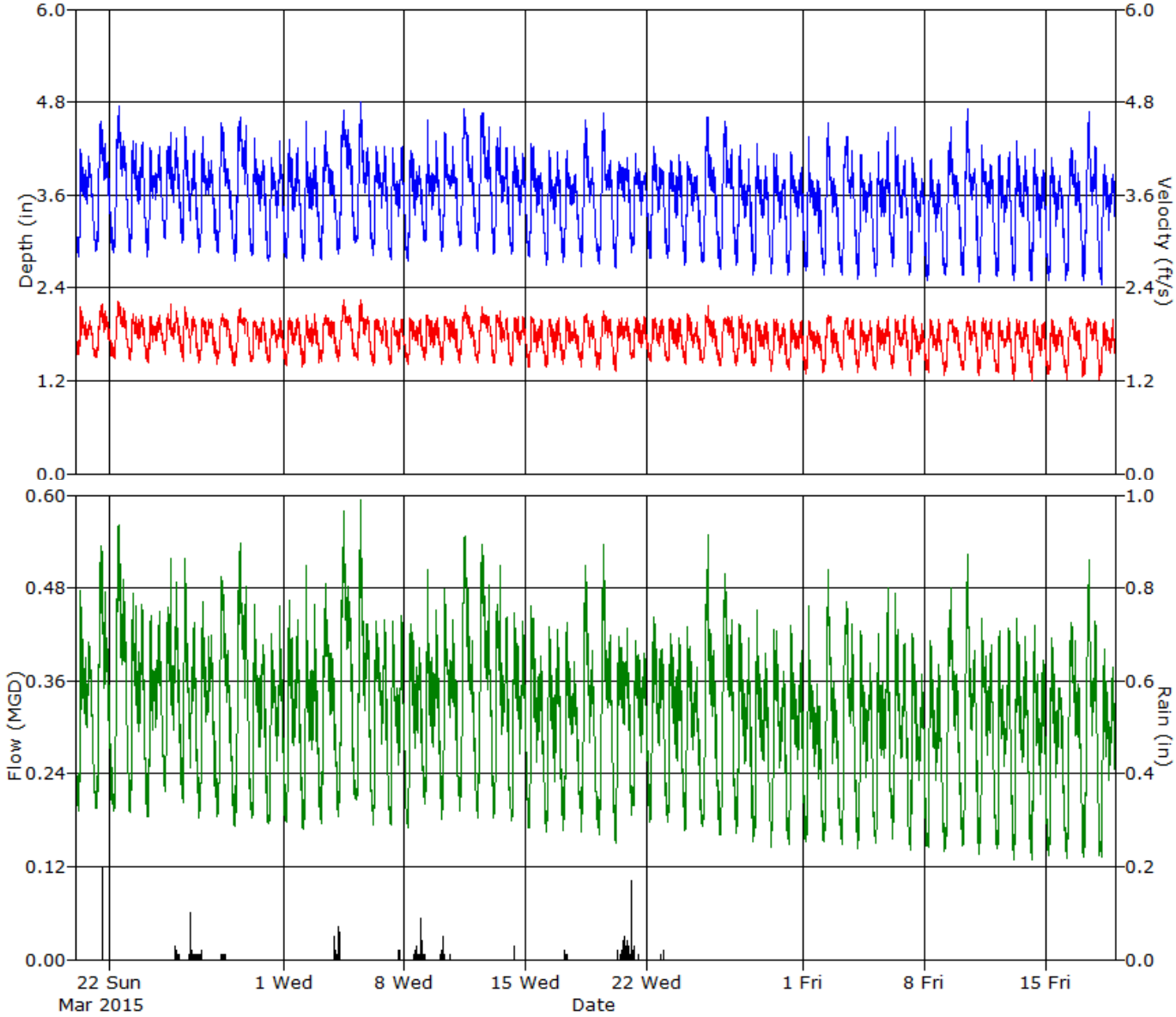


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth
- Velocity
- Quantity
- Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_FM12, Pipe Height: 21 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015	04:15	2.81	07:15	4.19	3.56	03:00	1.55	07:15	2.16	1.82	05:00	0.192	07:15	0.476	0.323	0.323	
3/21/2015	04:00	2.88	11:00	4.56	3.70	05:45	1.50	12:45	2.19	1.83	06:00	0.195	11:00	0.535	0.346	0.346	0.21
3/22/2015	04:30	2.86	12:00	4.75	3.78	06:15	1.49	11:30	2.23	1.87	06:00	0.192	12:15	0.562	0.366	0.366	
3/23/2015	03:45	2.86	07:45	4.30	3.65	04:45	1.47	07:45	2.07	1.82	04:45	0.191	07:45	0.474	0.334	0.334	
3/24/2015	04:15	2.80	20:30	4.23	3.63	05:30	1.43	20:00	2.05	1.79	04:30	0.184	21:30	0.449	0.328	0.328	0.00
3/25/2015	04:15	3.04	12:15	4.41	3.73	04:30	1.55	12:15	2.18	1.85	04:30	0.216	12:15	0.518	0.351	0.351	0.09
3/26/2015	04:30	2.98	07:45	4.47	3.65	05:30	1.45	08:15	2.15	1.82	05:30	0.202	07:45	0.518	0.335	0.335	0.32
3/27/2015	03:00	2.86	08:30	4.35	3.61	03:30	1.43	08:15	2.01	1.80	03:30	0.182	08:30	0.463	0.325	0.325	0.17
3/28/2015	06:00	2.86	10:15	4.53	3.65	03:30	1.41	12:15	2.06	1.79	04:00	0.185	10:15	0.495	0.331	0.331	0.07
3/29/2015	06:00	2.74	12:15	4.61	3.74	03:45	1.39	12:15	2.13	1.81	06:00	0.171	12:15	0.538	0.351	0.351	
3/30/2015	04:45	2.82	08:30	4.33	3.56	05:00	1.44	20:45	2.02	1.76	04:45	0.183	08:30	0.458	0.312	0.312	
3/31/2015	03:00	2.74	19:15	4.30	3.51	04:30	1.43	20:00	2.02	1.75	04:00	0.176	19:15	0.457	0.305	0.305	
4/1/2015	04:15	2.78	08:15	4.32	3.57	04:00	1.40	08:15	2.02	1.77	04:00	0.177	08:15	0.464	0.316	0.316	
4/2/2015	03:45	2.74	08:30	4.55	3.53	03:00	1.37	20:00	2.07	1.74	03:15	0.169	08:30	0.509	0.306	0.306	
4/3/2015	04:15	2.77	11:00	4.42	3.61	01:30	1.43	11:00	2.04	1.80	04:15	0.175	11:00	0.486	0.326	0.326	0.19
4/4/2015	04:30	2.84	12:15	4.69	3.81	03:45	1.45	12:15	2.24	1.86	04:30	0.185	12:15	0.579	0.368	0.368	0.35
4/5/2015	02:45	2.98	11:30	4.81	3.75	06:45	1.47	12:00	2.24	1.84	05:30	0.207	11:30	0.593	0.355	0.355	
4/6/2015	04:30	2.82	08:00	4.22	3.59	04:30	1.40	21:00	2.02	1.78	04:30	0.174	20:00	0.439	0.321	0.321	
4/7/2015	05:00	2.77	20:30	4.23	3.53	04:30	1.42	09:15	2.01	1.75	05:00	0.174	20:00	0.444	0.307	0.307	0.15
4/8/2015	04:15	2.75	08:15	4.18	3.56	04:45	1.42	07:30	2.01	1.76	04:15	0.171	08:15	0.433	0.312	0.312	0.63
4/9/2015	03:45	3.00	08:00	4.56	3.64	03:15	1.47	07:00	2.04	1.79	03:15	0.201	08:00	0.504	0.327	0.327	0.10
4/10/2015	04:15	2.88	07:30	4.40	3.67	04:15	1.42	07:30	2.02	1.80	04:15	0.182	07:30	0.479	0.333	0.333	0.31
4/11/2015	04:15	2.94	10:30	4.72	3.78	04:00	1.43	13:00	2.17	1.83	04:00	0.192	13:00	0.546	0.356	0.356	
4/12/2015	04:45	2.87	12:45	4.66	3.79	04:45	1.43	11:15	2.16	1.83	04:45	0.183	11:30	0.537	0.359	0.359	
4/13/2015	03:15	2.84	12:00	4.48	3.66	03:00	1.43	12:00	2.09	1.80	03:15	0.183	12:00	0.508	0.333	0.333	
4/14/2015	04:30	2.83	07:30	4.22	3.57	03:15	1.39	13:00	2.02	1.77	04:30	0.178	07:30	0.447	0.315	0.315	0.05
4/15/2015	04:15	2.81	07:30	4.27	3.54	04:00	1.37	07:15	2.02	1.76	04:00	0.171	07:30	0.457	0.309	0.309	
4/16/2015	03:45	2.69	07:30	4.17	3.50	04:00	1.38	21:30	2.02	1.74	04:30	0.165	07:30	0.430	0.301	0.301	
4/17/2015	03:45	2.73	08:45	4.17	3.51	03:45	1.41	08:15	2.02	1.74	03:45	0.167	08:45	0.436	0.302	0.302	0.11
4/18/2015	05:30	2.67	10:30	4.56	3.59	04:15	1.38	12:00	2.07	1.77	04:15	0.165	10:30	0.508	0.321	0.321	
4/19/2015	05:30	2.72	11:00	4.65	3.56	06:15	1.34	11:00	2.09	1.78	06:00	0.162	11:00	0.536	0.320	0.320	
4/20/2015	04:15	2.66	20:15	4.09	3.55	04:15	1.32	13:00	2.01	1.75	04:15	0.151	20:15	0.428	0.310	0.310	0.84
4/21/2015	02:45	2.85	08:15	4.14	3.55	02:45	1.48	19:45	2.03	1.76	02:45	0.187	08:15	0.412	0.310	0.310	0.36
4/22/2015	03:30	2.78	10:00	4.22	3.57	04:30	1.44	11:00	2.02	1.77	03:30	0.178	10:00	0.443	0.315	0.315	0.05
4/23/2015	04:30	2.79	20:45	4.11	3.51	04:45	1.44	20:00	2.02	1.75	04:30	0.178	08:00	0.420	0.304	0.304	
4/24/2015	04:00	2.70	08:15	4.02	3.49	05:15	1.42	08:15	2.07	1.75	04:00	0.167	08:15	0.430	0.301	0.301	
4/25/2015	05:00	2.73	10:15	4.61	3.58	04:15	1.43	12:00	2.17	1.77	05:15	0.171	12:00	0.549	0.320	0.320	
4/26/2015	06:15	2.64	11:30	4.55	3.60	04:15	1.40	14:45	2.02	1.78	04:15	0.161	11:15	0.498	0.325	0.325	
4/27/2015	04:00	2.69	08:45	4.24	3.44	03:45	1.39	10:00	2.04	1.72	03:45	0.162	08:00	0.433	0.292	0.292	
4/28/2015	03:15	2.57	07:45	4.26	3.44	02:00	1.40	07:15	2.00	1.72	03:15	0.152	07:45	0.451	0.291	0.291	
4/29/2015	04:00	2.58	07:30	4.14	3.44	04:00	1.33	08:00	1.99	1.72	04:00	0.145	07:30	0.426	0.291	0.291	
4/30/2015	03:30	2.56	07:30	4.16	3.44	04:00	1.34	07:45	2.00	1.71	04:00	0.148	07:30	0.432	0.289	0.289	
5/1/2015	04:45	2.63	07:45	4.36	3.40	03:30	1.29	08:00	1.97	1.68	04:45	0.152	07:45	0.456	0.280	0.280	
5/2/2015	04:45	2.56	11:30	4.54	3.49	02:30	1.30	10:15	2.04	1.72	04:45	0.152	10:15	0.503	0.300	0.300	
5/3/2015	05:15	2.57	11:15	4.35	3.52	06:15	1.35	11:30	2.01	1.73	05:15	0.149	12:00	0.462	0.308	0.308	
5/4/2015	04:15	2.52	08:00	4.12	3.41	03:45	1.31	07:45	1.99	1.69	03:15	0.143	08:00	0.424	0.283	0.283	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	05:15	2.55	21:00	4.40	3.43	04:15	1.35	21:00	2.03	1.71	04:45	0.150	21:00	0.481	0.289	0.289	
5/6/2015	03:30	2.68	07:30	4.47	3.49	03:30	1.36	20:30	2.05	1.73	03:30	0.157	07:30	0.473	0.299	0.299	
5/7/2015	02:45	2.56	07:30	4.08	3.38	04:00	1.27	07:45	2.02	1.68	04:00	0.141	07:30	0.420	0.277	0.277	
5/8/2015	04:45	2.50	09:15	4.06	3.35	05:15	1.31	20:15	2.00	1.69	05:15	0.144	08:30	0.411	0.276	0.276	
5/9/2015	04:45	2.56	13:00	4.48	3.49	03:15	1.27	11:45	2.00	1.72	03:15	0.139	13:00	0.481	0.302	0.302	
5/10/2015	06:00	2.56	11:45	4.71	3.55	05:00	1.35	11:30	2.03	1.73	05:00	0.146	11:45	0.523	0.310	0.310	
5/11/2015	04:15	2.48	08:15	4.25	3.49	03:45	1.27	09:00	2.01	1.73	04:15	0.136	08:15	0.440	0.301	0.301	
5/12/2015	03:45	2.55	21:30	4.15	3.42	05:45	1.31	20:45	2.01	1.69	03:45	0.144	20:45	0.428	0.286	0.286	
5/13/2015	03:15	2.50	08:00	4.30	3.43	03:45	1.21	07:45	1.99	1.69	03:45	0.129	08:00	0.441	0.287	0.287	
5/14/2015	04:00	2.49	08:00	4.19	3.36	05:30	1.21	08:45	2.00	1.67	05:30	0.130	08:00	0.431	0.276	0.276	
5/15/2015	03:30	2.49	08:15	4.09	3.38	03:30	1.28	08:00	2.00	1.67	03:30	0.133	07:30	0.415	0.277	0.277	
5/16/2015	03:15	2.49	11:00	4.21	3.43	05:45	1.21	11:30	2.02	1.70	05:45	0.131	11:00	0.436	0.290	0.290	
5/17/2015	03:45	2.50	11:45	4.68	3.52	03:15	1.26	11:15	2.02	1.71	03:45	0.132	11:45	0.516	0.306	0.306	
5/18/2015	04:45	2.45	08:45	4.00	3.38	02:30	1.21	20:45	2.00	1.66	04:45	0.133	08:45	0.401	0.277	0.276	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			18.766	4.00
Avg	3.55	1.76	0.313	

Site Commentary

Site Information

Enfield_GWG1

Overview

The hydrograph for the ground water gauge location Enfield_GWG1 shows depth levels recorded during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 .

Daily longtables displaying final quantities are also provided.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in the table below.

Percent Uptime	
Depth (in)	66

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Site Report

FM Initials:	IC
Project Name:	ENFIELD, CT

Site Name:	ENFIELD_GWG1	Meter Type:	FLOWSHARK	Monitor S/N:	21611	Manhole #:	
Address / Location:	NORTH RIVER STREET			Map Page #:			
				Pipe Height:	100 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	0.5 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:			
Date/Time of Investigation:	March 24, 2015	8:00 AM	Manhole Depth:	9 Feet		
Site Hydraulics:			Manhole Material / Condition:	Brick		Good
			Active Drop Connections?			
Upstream Input: (L/S, P/S)			Pipe Material / Condition:			
Upstream Manhole:			Mini System Character:	COMMERCIAL		
Downstream Manhole:			**Telephone Information:**			
Depth of Flow (Wet Dof):	+/-		Access Pole #:	N/A		
Range (Air Dof):	+/-		Distance From Manhole:	N/A Feet		
Peak Velocity:	fps		Road Cut Length:	N/A Feet		
Silt:	Inches		Trench Length:	N/A Feet		

Other Information:

N 41° 59' 57.1" W 72° 36' 16.3"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	GROUND WATER GAUGE	Trunk		X		
Sensors / Devices:	PRESSURE	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

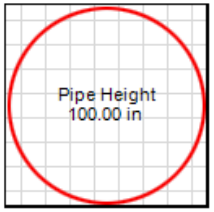
PRESS SN 77912 PO 14" ***NO GROUND WATER AT TIME OF INSTALL***

SCATTERGRAPH REPORT

Enfield_GWG1

Flow Monitor

Enfield_GWG1

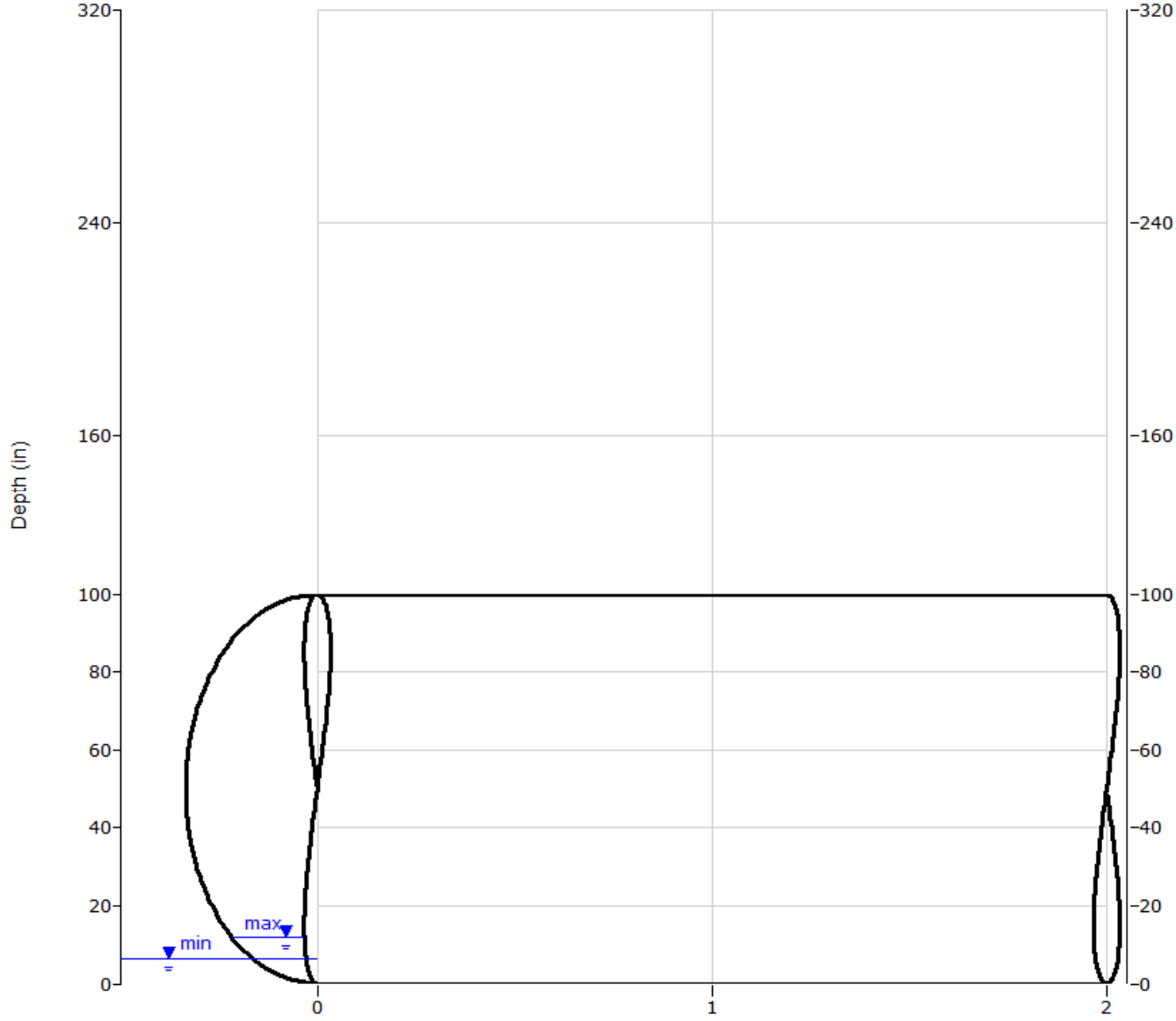


Report Period

3/20/2015
To
5/18/2015

Legend

- Depth -
- Iso-Q™
- Silt
- Min-Max Depth



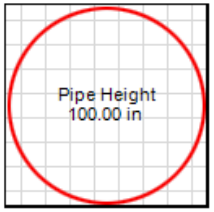
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_GWG1

Flow Monitor

Enfield_GWG1

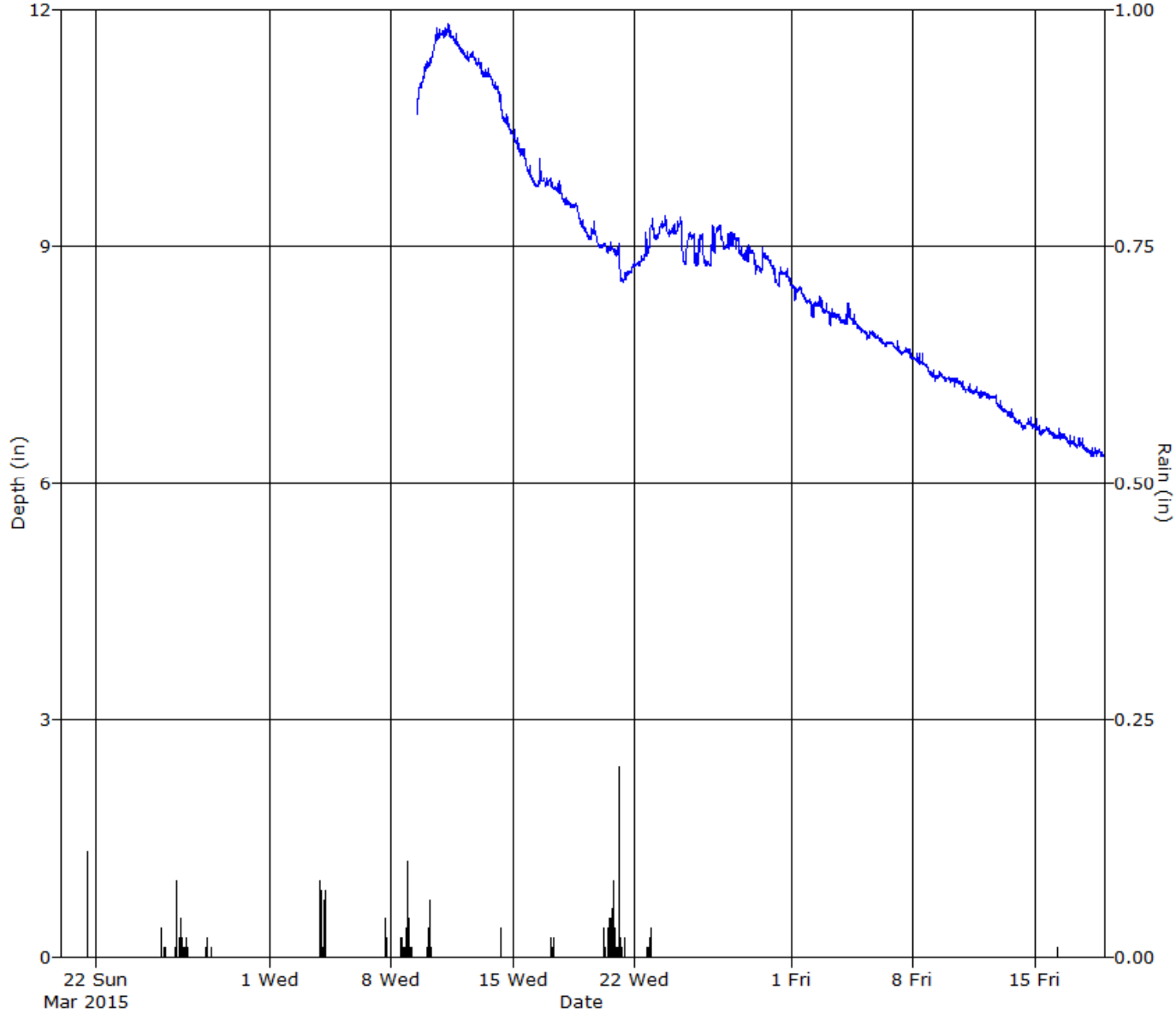


Report Period

3/20/2015
To
5/18/2015

Legend

Depth
Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_GWG1, Pipe Height: 100 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015																	
3/21/2015																	0.19
3/22/2015																	
3/23/2015																	
3/24/2015																	0.00
3/25/2015																	0.10
3/26/2015																	0.37
3/27/2015																	0.22
3/28/2015																	0.08
3/29/2015																	
3/30/2015																	
3/31/2015																	
4/1/2015																	
4/2/2015																	
4/3/2015																	0.37
4/4/2015																	0.34
4/5/2015																	
4/6/2015																	
4/7/2015																	0.18
4/8/2015																	0.68
4/9/2015	12:00	10.68	23:45	11.28	11.04												0.13
4/10/2015	01:00	11.25	16:00	11.76	11.51												0.34
4/11/2015	23:45	11.48	06:15	11.81	11.64												
4/12/2015	23:30	11.29	00:00	11.50	11.40												
4/13/2015	23:15	10.99	01:45	11.38	11.17												
4/14/2015	21:00	10.42	01:15	11.03	10.68												0.07
4/15/2015	23:00	9.91	02:30	10.48	10.18												
4/16/2015	08:00	9.75	14:15	10.10	9.82												
4/17/2015	23:30	9.54	05:45	9.87	9.72												0.11
4/18/2015	23:15	9.25	02:30	9.62	9.48												
4/19/2015	22:15	9.00	00:30	9.34	9.15												
4/20/2015	22:15	8.88	15:15	9.06	8.98												0.96
4/21/2015	08:15	8.55	02:15	9.03	8.69												0.41
4/22/2015	00:00	8.73	23:15	9.27	8.90												0.09
4/23/2015	04:30	9.08	18:00	9.39	9.21												
4/24/2015	22:15	8.77	15:15	9.37	9.12												
4/25/2015	14:45	8.75	05:00	9.17	9.01												
4/26/2015	06:45	8.75	11:45	9.27	8.99												
4/27/2015	23:45	8.91	12:30	9.18	9.05												
4/28/2015	22:45	8.65	14:00	9.01	8.89												
4/29/2015	06:30	8.67	09:30	8.99	8.79												
4/30/2015	07:30	8.49	00:15	8.74	8.61												
5/1/2015	22:45	8.28	00:00	8.51	8.42												
5/2/2015	06:30	8.10	16:00	8.36	8.23												
5/3/2015	06:30	7.99	00:45	8.27	8.12												
5/4/2015	22:30	7.94	07:30	8.28	8.06												

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	08:30	7.82	00:45	7.97	7.89												
5/6/2015	22:15	7.71	00:45	7.87	7.77												
5/7/2015	22:45	7.57	03:45	7.80	7.67												
5/8/2015	22:30	7.39	06:30	7.65	7.52												
5/9/2015	21:00	7.29	05:15	7.43	7.36												
5/10/2015	21:45	7.19	01:15	7.34	7.28												
5/11/2015	21:00	7.09	06:30	7.26	7.16												
5/12/2015	23:00	6.96	03:45	7.16	7.08												
5/13/2015	22:15	6.76	01:45	7.05	6.88												
5/14/2015	07:30	6.68	19:45	6.83	6.75												
5/15/2015	09:30	6.61	03:30	6.82	6.67												
5/16/2015	22:45	6.51	10:30	6.69	6.59												0.01
5/17/2015	23:15	6.40	01:30	6.61	6.49												
5/18/2015	07:45	6.34	12:00	6.45	6.39												

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Rain (in)
Total		4.65
Avg	8.63	

Site Commentary

Site Information

Enfield_GWG2

Overview

The hydrograph for the ground water gauge location Enfield_GWG2 shows depth levels recorded during the monitoring period of Friday, March 20, 2015 to Monday, May 18, 2015 .

Daily longtables displaying final quantities are also provided.

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Data Quality

Data uptime observed during the Friday, March 20, 2015 to the Monday, May 18, 2015 monitoring period is provided in the table below.

Percent Uptime	
Depth (in)	91

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Site Report

FM Initials:	IC
Project Name:	ENFIELD, CT

Site Name:	ENFIELD_GWG2	Meter Type:	FLOWSHARK	Monitor S/N:	20923	Manhole #:	
Address / Location:	41 BACON ROAD			Map Page #:			
				Pipe Height:	160 Inches		
Access:	DRIVE	Type of System:	SANITARY	Pipe Width:	0.5 Inches		
				Phone Number:	N/A		

Investigation Information:			Manhole Information:			
Date/Time of Investigation:	March 24, 2015	11:15 AM	Manhole Depth:	13 Feet		
Site Hydraulics:			Manhole Material / Condition:	Brick		Good
			Active Drop Connections?			
Upstream Input: (L/S, P/S)			Pipe Material / Condition:			
Upstream Manhole:			Mini System Character:	RESIDENTIAL		
Downstream Manhole:			**Telephone Information:**			
Depth of Flow (Wet Dof):	+/-		Access Pole #:	N/A		
Range (Air Dof):	+/-		Distance From Manhole:	N/A Feet		
Peak Velocity:	fps		Road Cut Length:	N/A Feet		
Silt:	Inches		Trench Length:	N/A Feet		

Other Information:

N 42° 00' 51.5" W 72° 31' 46.3"

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	GROUND WATER GAUGE	Trunk		X		
Sensors / Devices:	PRESSURE	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

Additional Site Information / Comments:

PRESS SN 783542 PO 17.75" -6.00 EO

SCATTERGRAPH REPORT

Enfield_GWG2

Flow Monitor

Enfield_GWG2

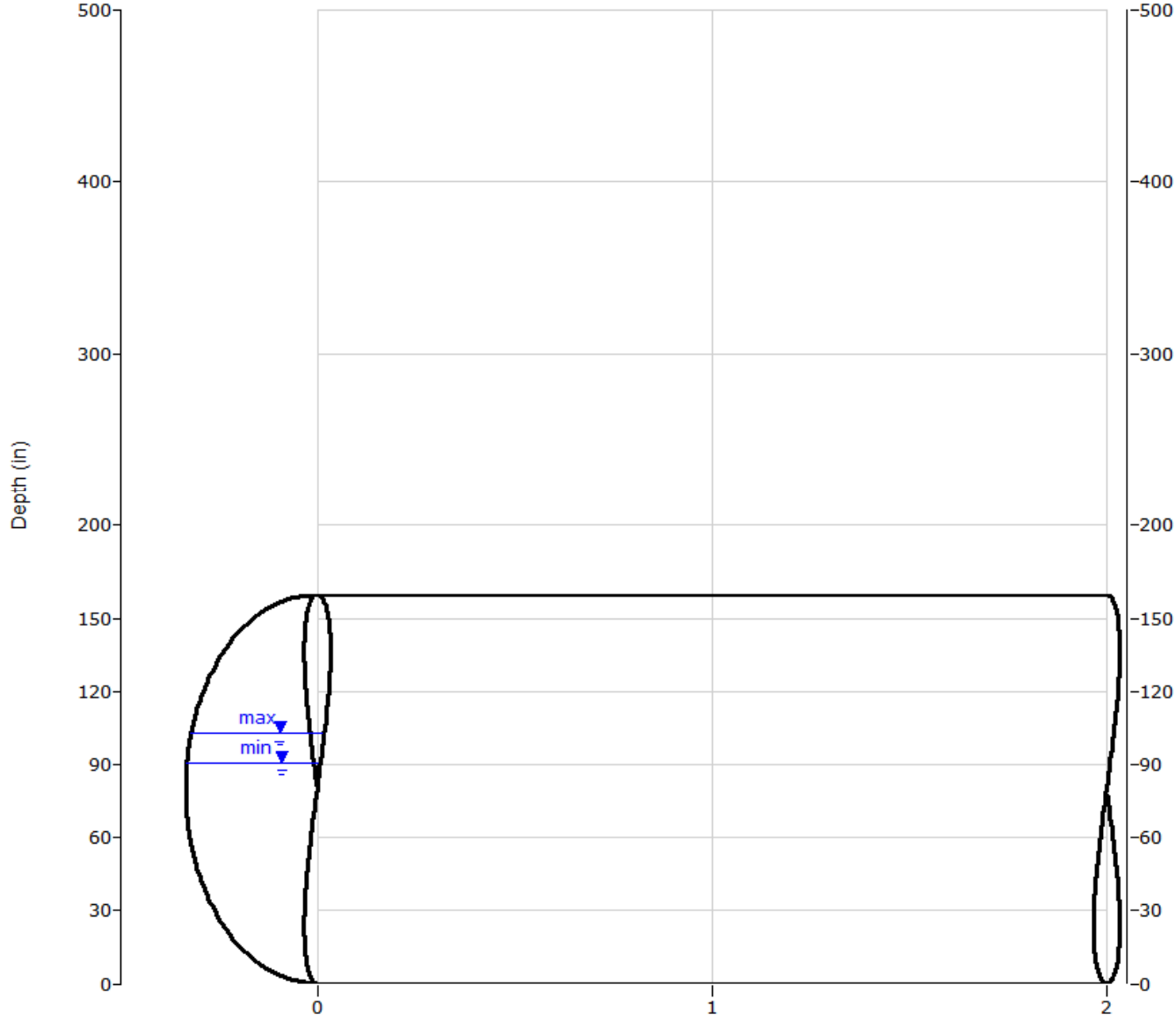
Pipe Height
160.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

- Depth -
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

Enfield_GWG2

Flow Monitor

Enfield_GWG2

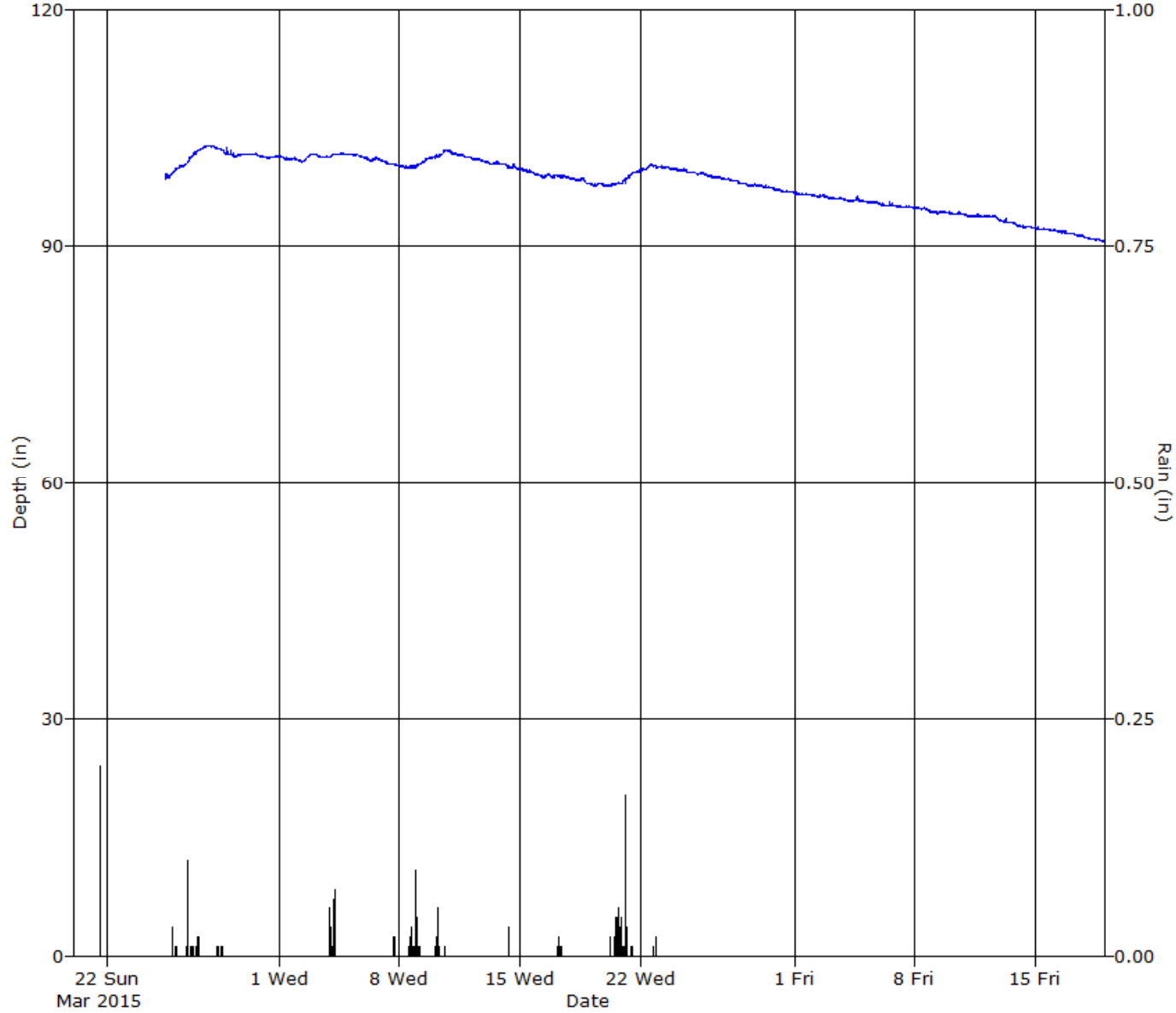
Pipe Height
160.00 in

Report Period

3/20/2015
To
5/18/2015

Legend

Depth
Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_GWG2, Pipe Height: 160 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015																	
3/21/2015																	0.21
3/22/2015																	
3/23/2015																	
3/24/2015																	0.00
3/25/2015	08:45	98.39	23:30	99.82	99.09												0.09
3/26/2015	00:15	99.73	23:30	101.67	100.45												0.32
3/27/2015	00:15	101.40	18:00	102.75	102.29												0.17
3/28/2015	23:45	101.68	00:00	102.66	102.26												0.07
3/29/2015	07:15	101.29	04:45	102.07	101.56												
3/30/2015	22:15	101.29	14:15	101.79	101.59												
3/31/2015	07:45	101.09	00:00	101.40	101.25												
4/1/2015	10:15	100.90	00:15	101.40	101.09												
4/2/2015	07:30	100.53	21:30	101.69	101.09												
4/3/2015	12:45	101.19	01:00	101.69	101.34												0.19
4/4/2015	00:00	101.30	13:45	101.79	101.66												0.35
4/5/2015	22:45	101.10	02:00	101.69	101.46												
4/6/2015	07:15	100.72	01:00	101.19	100.97												
4/7/2015	20:45	100.12	00:00	100.90	100.41												0.15
4/8/2015	09:30	99.82	00:00	100.22	100.03												0.63
4/9/2015	00:00	100.03	22:45	101.20	100.79												0.10
4/10/2015	01:00	101.10	17:30	102.17	101.72												0.31
4/11/2015	22:45	101.19	00:00	101.97	101.54												
4/12/2015	23:45	100.53	01:15	101.20	100.97												
4/13/2015	23:30	100.31	14:45	100.72	100.47												
4/14/2015	23:45	99.73	00:00	100.41	100.07												0.05
4/15/2015	21:15	99.05	00:00	99.82	99.44												
4/16/2015	06:15	98.68	16:45	99.15	98.89												
4/17/2015	23:30	98.39	02:45	98.96	98.79												0.11
4/18/2015	23:30	97.89	15:15	98.66	98.32												
4/19/2015	07:30	97.61	00:00	97.98	97.79												
4/20/2015	00:30	97.51	23:15	98.27	97.85												0.84
4/21/2015	02:45	97.99	23:45	99.73	98.99												0.36
4/22/2015	00:45	99.55	14:45	100.31	99.95												0.05
4/23/2015	21:15	99.73	05:45	100.22	99.95												
4/24/2015	20:45	99.25	12:00	99.93	99.53												
4/25/2015	22:30	98.77	00:00	99.35	99.14												
4/26/2015	20:45	98.38	00:00	98.96	98.69												
4/27/2015	23:15	97.89	02:15	98.56	98.23												
4/28/2015	18:30	97.51	00:15	97.98	97.72												
4/29/2015	21:00	97.02	00:15	97.69	97.35												
4/30/2015	21:30	96.63	01:45	97.20	96.93												
5/1/2015	23:30	96.34	02:00	96.91	96.53												
5/2/2015	23:00	96.05	00:15	96.44	96.31												
5/3/2015	20:00	95.76	00:45	96.23	96.01												
5/4/2015	21:15	95.56	15:00	96.33	95.79												

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015	21:00	95.35	00:00	95.74	95.51												
5/6/2015	21:00	94.98	11:30	95.55	95.16												
5/7/2015	21:00	94.69	00:30	95.08	94.96												
5/8/2015	21:15	94.30	00:00	94.97	94.67												
5/9/2015	09:00	94.01	01:15	94.39	94.29												
5/10/2015	21:15	93.90	13:15	94.39	94.10												
5/11/2015	21:15	93.61	13:45	94.10	93.81												
5/12/2015	21:45	93.14	08:45	93.90	93.59												
5/13/2015	23:30	92.54	06:15	93.50	92.94												
5/14/2015	22:15	92.25	00:30	92.63	92.48												
5/15/2015	19:00	91.96	00:45	92.53	92.13												
5/16/2015	21:00	91.56	01:45	92.14	91.78												
5/17/2015	21:45	90.99	00:15	91.57	91.36												
5/18/2015	21:15	90.60	00:00	90.99	90.84												

Report Summary For The Period 3/20/2015 - 5/18/2015

	Depth (in)	Rain (in)
Total		4.00
Avg	98.03	

Rainfall data

The rainfall measured at Enfield_RG1 from March 20, 2015 to May 18, 2015 is 4.65 inches.

Date / Time	Maximum Rainfall (in.)
4/21/2015 2:45 AM	0.20

ADS ENVIRONMENTAL SERVICES®

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Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_RG1	Meter Type:	FLOWSHARK	Monitor S/N:	20742	Manhole #:	
Address / Location:	566 ENFIELD STREET (BEHIND AMERICAN LEGION) ***NEED TOWN KEY***			Map Page #:			
				Pipe Height:	N/A		
Access:	Roof	Type of System:	SANITARY	Pipe Width:	N/A		
				Phone Number:	N/A		

Access Map N

Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 17, 2015	11:30 AM	Manhole Depth:	N/A	Feet
Site Hydraulics:	N/A		Manhole Material / Condition:	N/A	
			Active Drop Connections?		
Upstream Input: (L/S, P/S)	N/A		Pipe Material / Condition:	N/A	
Upstream Manhole:	N/A		Mini System Character:		
Downstream Manhole:	N/A		**Telephone Information:**		
Depth of Flow (Wet Dof):	N/A	+/-	Access Pole #:	N/A	
Range (Air Dof):	N/A	+/-	Distance From Manhole:	N/A	Feet
Peak Velocity:	N/A	fps	Road Cut Length:	N/A	Feet
Silt:	N/A	Inches	Trench Length:	N/A	Feet

Other Information:

N 42° 00' 28.7" W 72° 35' 43.9"

Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Rain Gauge	Trunk		X		
Sensors / Devices:	Rain Gauge Tipping Bucket	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

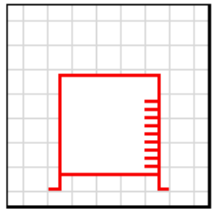
Additional Site Information / Comments:

HYDROGRAPH REPORT

Enfield_RG1

Rain Gauge

Enfield_RG1

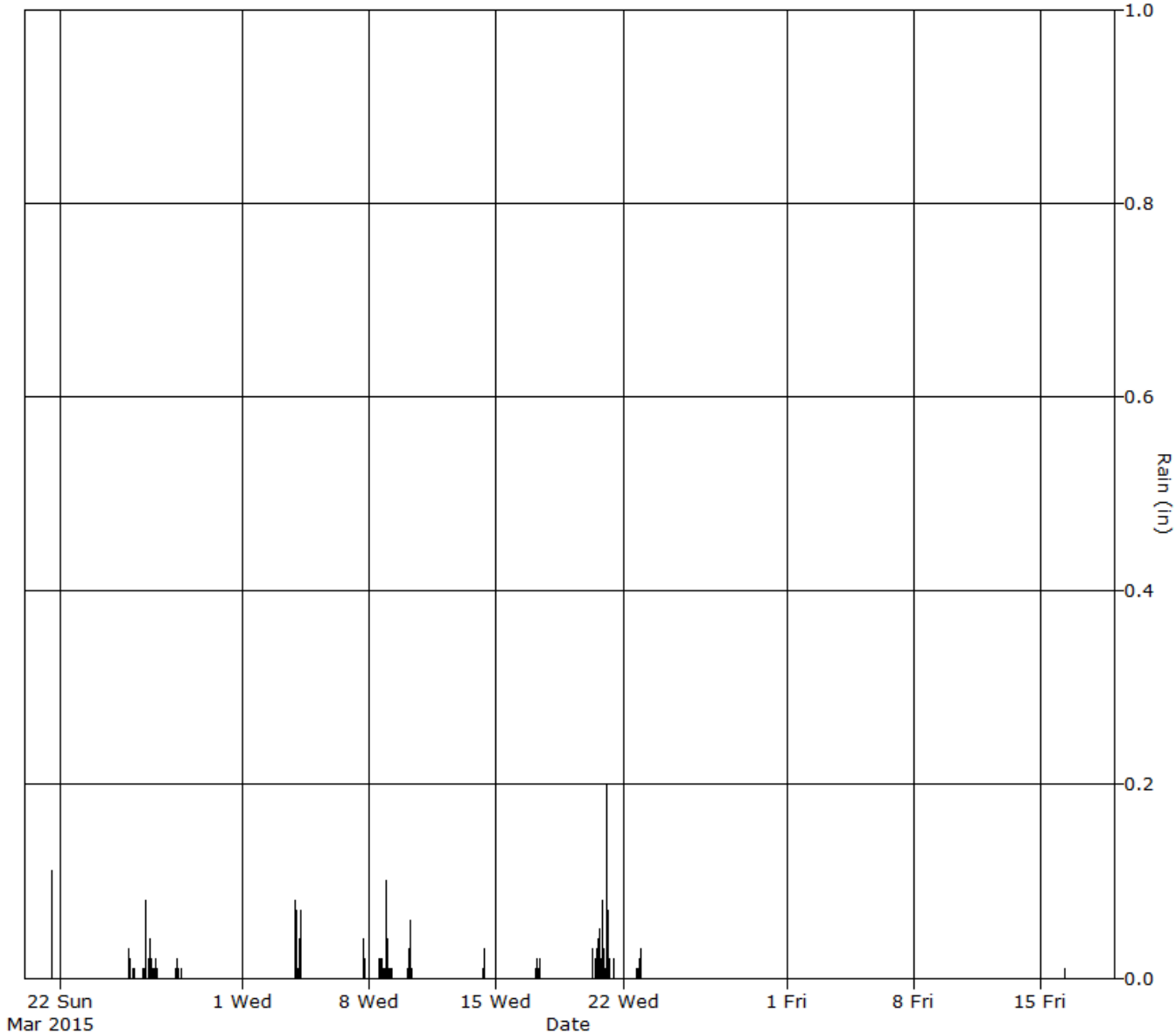


Report Period

3/20/2015
To
5/18/2015

Legend

Rain



Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_RG1, Pipe Height:

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015																	
3/21/2015																	0.19
3/22/2015																	
3/23/2015																	
3/24/2015																	0.00
3/25/2015																	0.10
3/26/2015																	0.37
3/27/2015																	0.22
3/28/2015																	0.08
3/29/2015																	
3/30/2015																	
3/31/2015																	
4/1/2015																	
4/2/2015																	
4/3/2015																	0.37
4/4/2015																	0.34
4/5/2015																	
4/6/2015																	
4/7/2015																	0.18
4/8/2015																	0.68
4/9/2015																	0.13
4/10/2015																	0.34
4/11/2015																	
4/12/2015																	
4/13/2015																	
4/14/2015																	0.07
4/15/2015																	
4/16/2015																	
4/17/2015																	0.11
4/18/2015																	
4/19/2015																	
4/20/2015																	0.96
4/21/2015																	0.41
4/22/2015																	0.09
4/23/2015																	
4/24/2015																	
4/25/2015																	
4/26/2015																	
4/27/2015																	
4/28/2015																	
4/29/2015																	
4/30/2015																	
5/1/2015																	
5/2/2015																	
5/3/2015																	
5/4/2015																	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015																	
5/6/2015																	
5/7/2015																	
5/8/2015																	
5/9/2015																	
5/10/2015																	
5/11/2015																	
5/12/2015																	
5/13/2015																	
5/14/2015																	
5/15/2015																	
5/16/2015																	0.01
5/17/2015																	
5/18/2015																	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Rain (in)
Total	4.65
Avg	

Rainfall data

The rainfall measured at Enfield_RG2 from March 20, 2015 to May 18, 2015 is 4.00 inches.

Date / Time	Maximum Rainfall (in.)
3/21/2015 1:00 PM	0.20

ADS ENVIRONMENTAL SERVICES®

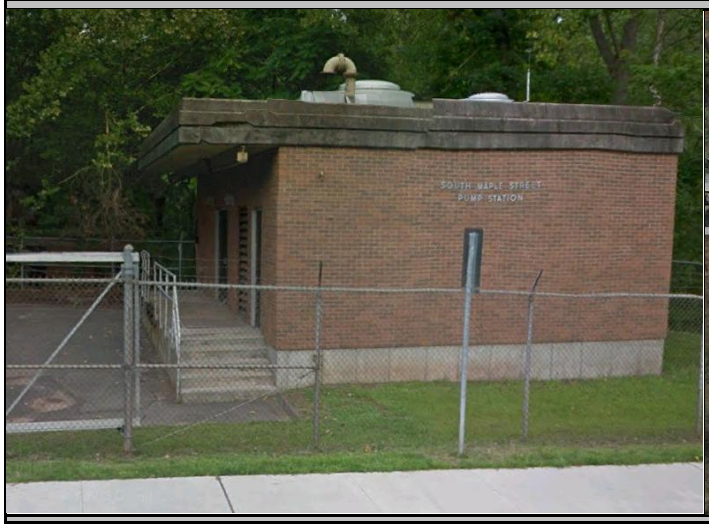
a division of ADS LLC.

Site Report

FM Initials: IC

Project Name: ENFIELD, CT

Site Name:	ENFIELD_RG2	Meter Type:	FLOWSHARK	Monitor S/N:	20853	Manhole #:	
Address / Location:	55 SOUTH MAPLE STREET (AT PUMP STATION) ***NEED KEY***			Map Page #:			
				Pipe Height:	N/A		
Access:	Roof	Type of System:	SANITARY	Pipe Width:	N/A		
				Phone Number:	N/A		



Investigation Information:			Manhole Information:		
Date/Time of Investigation:	March 17, 2015	1:00 PM	Manhole Depth:	N/A	Feet
Site Hydraulics:	N/A		Manhole Material / Condition:	N/A	
			Active Drop Connections?		
Upstream Input: (L/S, P/S)	N/A		Pipe Material / Condition:	N/A	
Upstream Manhole:	N/A		Mini System Character:		
Downstream Manhole:	N/A		**Telephone Information:**		
Depth of Flow (Wet Dof):	N/A	+/-	Access Pole #:	N/A	
Range (Air Dof):	N/A	+/-	Distance From Manhole:	N/A	Feet
Peak Velocity:	N/A	fps	Road Cut Length:	N/A	Feet
Silt:	N/A	Inches	Trench Length:	N/A	Feet

Other Information:

N 42° W 72°

Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Rain Gauge	Trunk		X		
Sensors / Devices:	Rain Gauge Tipping Bucket	Lift/Pump Station		X		
Surcharge Height:		WWTP		X		
Rain Gauge Zone:		Other		X		

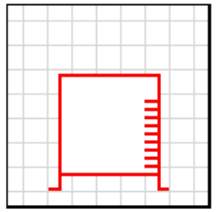
Additional Site Information / Comments:

HYDROGRAPH REPORT

Enfield_RG2

Rain Gauge

Enfield_RG2

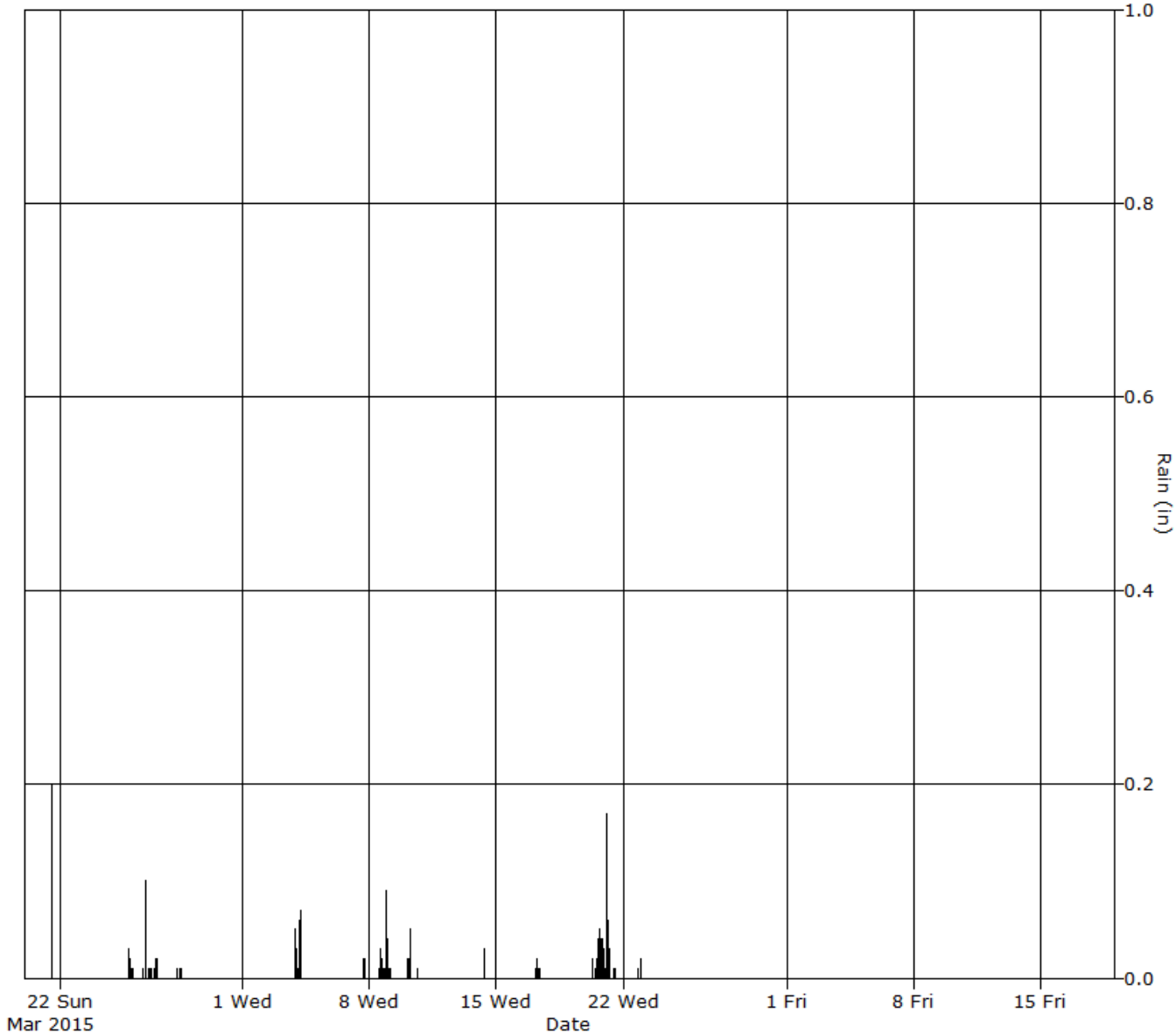


Report Period

3/20/2015
To
5/18/2015

Legend

Rain



Daily Tabular Report For The Period 3/20/2015 - 5/18/2015

Enfield_RG2, Pipe Height:

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
3/20/2015																	
3/21/2015																	0.21
3/22/2015																	
3/23/2015																	
3/24/2015																	0.00
3/25/2015																	0.09
3/26/2015																	0.32
3/27/2015																	0.17
3/28/2015																	0.07
3/29/2015																	
3/30/2015																	
3/31/2015																	
4/1/2015																	
4/2/2015																	
4/3/2015																	0.19
4/4/2015																	0.35
4/5/2015																	
4/6/2015																	
4/7/2015																	0.15
4/8/2015																	0.63
4/9/2015																	0.10
4/10/2015																	0.31
4/11/2015																	
4/12/2015																	
4/13/2015																	
4/14/2015																	0.05
4/15/2015																	
4/16/2015																	
4/17/2015																	0.11
4/18/2015																	
4/19/2015																	
4/20/2015																	0.84
4/21/2015																	0.36
4/22/2015																	0.05
4/23/2015																	
4/24/2015																	
4/25/2015																	
4/26/2015																	
4/27/2015																	
4/28/2015																	
4/29/2015																	
4/30/2015																	
5/1/2015																	
5/2/2015																	
5/3/2015																	
5/4/2015																	

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
5/5/2015																	
5/6/2015																	
5/7/2015																	
5/8/2015																	
5/9/2015																	
5/10/2015																	
5/11/2015																	
5/12/2015																	
5/13/2015																	
5/14/2015																	
5/15/2015																	
5/16/2015																	
5/17/2015																	
5/18/2015																	

Report Summary For The Period 3/20/2015 - 5/18/2015

	Rain (in)
Total	4.00
Avg	

APPENDIX E: COLLECTION SYSTEM HYDRAULIC MODELING REPORT

Collection System Hydraulic Modeling Report

Facilities Plan - Appendix E

1699 King Street | Suite 406
Enfield, CT 06082
855-347-6788

227363.02

Town of Enfield

July 2015

woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

TABLE OF CONTENTS

SECTION **PAGE NO.**

1. INTRODUCTION 1-1

1.1 Background 1-1
1.1.1 Scope of Modeling Work 1-1
1.2 Sanitary Sewer Evaluation Survey 1-1
1.2.1 Manhole Surveying 1-1
1.2.2 Flow Monitoring 1-1

2. HYDRAULIC MODEL DEVELOPMENT 2-1

2.1 Model Geometry and Input Data 2-1
2.1.1 Assumptions 2-3
2.2 Wastewater Flow Components 2-4
2.2.1 Sanitary Flow or Base Wastewater Flow (BWF) 2-6
2.2.2 Base Infiltration (BI) 2-7
2.2.3 Rainfall-Derived Inflow and Infiltration (RDII) 2-9
2.3 Wet Weather Data 2-10
2.3.1 Metered Rainfall Data 2-10
2.3.2 Synthetic Storm Data 2-11
2.4 Model Calibration & Validation 2-12
2.4.1 Sanitary Flow 2-13
2.4.2 Dry Day Flow 2-13
2.4.3 Wet Weather Flow 2-14
2.4.4 Calibration Plots 2-17

3. MODEL RESULTS 3-1

3.1 Collection System Capacity Analysis 3-1
3.1.1 Connecticut River Interceptor 3-1
3.1.2 Hazard Avenue Interceptor 3-1
3.1.3 South Maple Interceptor 3-2
3.2 Recommendations 3-2

TABLES

Table 2-1: Model Friction Factors 2-3
Table 2-2: Pump Station Model Input 2-3
Table 2-3: BWF Model Inputs 2-6
Table 2-4: Assumed BI Rates by Interceptor 2-9
Table 2-5: Storm Events 2-11
Table 2-6: Synthetic Storm Summary 2-12

FIGURES

Figure 2-1: Collection System Model 2-2
Figure 2-2: Typical Wastewater Flow Components 2-4
Figure 2-3: Flow Metering Basins 2-5
Figure 2-4: Residential Diurnal Flow Curve 2-7
Figure 2-5: Regional Groundwater Levels 2-8
Figure 2-6: Dry Vs. Wet Weather I/I 2-8
Figure 2-7: RTK Curve Fitting Method Example 2-10
Figure 2-8: Flow Metering Rainfall 2-11
Figure 2-9: 10-Year 24-Hour (4.7-Inch) Synthetic Storm 2-12
Figure 2-10: Modeled Flow to WPCF – 10-Year 24-Hour Synthetic Storm 2-14
Figure 2-11: Modeled Flow to WPCF – April 20, 2015 Storm 2-15
Figure 2-12: Modeled Flow to WPCF – 100-Year 24-Hour Synthetic Storm 2-16
Figure 2-13: Enfield WPCF Flow Exceedance Probability 2010-2013 2-17
Figure 2-14: Modeled Peak Flow Vs Observed Peak Flow 2-18
Figure 2-15: Modeled Average Daily Flow Vs Observed Average Daily Flow 2-18

APPENDICES

Appendix A: Model Input Data
Appendix B: Interceptor Profiles
Appendix C: Model Surcharging Plans
Appendix D: Calibration Curves

1. INTRODUCTION

1.1 BACKGROUND

The Town of Enfield owns and operates a 10 million gallon per day (MGD) Water Pollution Control Facility (WPCF) and the associated sanitary sewer collection system. The collection system consists of approximately 210 miles of sewer pipes, sixteen pump stations, and two inverted siphons, which serves residential, municipal, commercial and industrial users. Approximately 97% of the Town's nearly 45,000 residents are connected to the collection system, while the remainders utilize on-site subsurface disposal systems. The WPCF is located adjacent to the Connecticut River along the western border of the Town, and treats an average of 5.2 MGD, which is discharged to the river.

1.1.1 Scope of Modeling Work

As part of the Town of Enfield's facilities planning process, the Connecticut Department of Energy and Environmental Protection (DEEP) has required the Town to develop a hydraulic model of the collection system to identify potential existing and future capacity concerns or hydraulic deficiencies. Bentley's SewerGEMS® software was utilized for the collection system evaluation of main line interceptor pipes, using existing data from the Town's geodatabase.

1.2 SANITARY SEWER EVALUATION SURVEY

In order to accurately model a sewer system, the existing conditions and geometry of that sewer must be established. In general, the Town's existing GIS geodatabase contained the required information. However, additional data was necessary to complete the sewer model due to a lack of existing records of the Thomponsville area of the sewer. Therefore, a manhole survey was included as part of the Sanitary Sewer Evaluation Survey (SSES) to collect manhole and pipe invert elevations and update the geodatabase. Existing plans were referenced to correct inaccurate data within the geodatabase as appropriate. The Enfield SSES consisted of field work including manhole inspections, manhole surveying, flow monitoring, closed circuit television (CCTV) inspection, and smoke testing. Manhole survey and flow monitoring results were directly used in the development of the collection system model.

1.2.1 Manhole Surveying

SDE Civil & Environmental Engineering was subcontracted to complete the manhole surveying work of the Thompsonville area. Manhole and pipe invert depths were measured from the manhole rim for every pipe connected to the manhole in tenth of a foot increments. The center of manhole covers were horizontally located using GPS coordinates. Vertical rim elevations were not collected via GPS methods due to poor accuracy. On average maximum vertical elevation accuracy was calculated to within 1 meter, which is insufficient for use in a sewer modeling program.

1.2.2 Flow Monitoring

ADS Environmental Services were subcontracted to perform the flow monitoring work. As part of the flow monitoring program ADS installed 12 flow meters, 2 rain gages, and 2 groundwater gages throughout the Enfield collection system. Data used in this model was collected from March 17 to May 13, 2015. Flow monitoring allows for the quantification of inflow and infiltration (I/I) and compare it to base wastewater flow or sanitary flow. Quantifying the fraction of flow composed of I/I and the influence of precipitation on I/I were used to calibrate the model. Woodard & Curran identified 12 metering basins to target for flow monitoring based on suspected locations of I/I.

2. HYDRAULIC MODEL DEVELOPMENT

A hydraulic model was used to assess the hydraulic capacity of the wastewater collection system and its performance under both real storm events and 100-year storms. The capacity of the wastewater collection system was assessed using Bentley's SewerGEMS V8i modeling software. The SewerGEMS modeling software was selected because it provides dynamic model simulations, has the capability to model each source of wastewater (using varying flow patterns), and can be integrated with ArcGIS. Furthermore, SewerGEMS integrates a scenarios and alternatives analysis to provide modeling capabilities for existing conditions and future conditions. The model was run dynamically to account for rainfall-derived infiltration and inflow (RDII).

2.1 MODEL GEOMETRY AND INPUT DATA

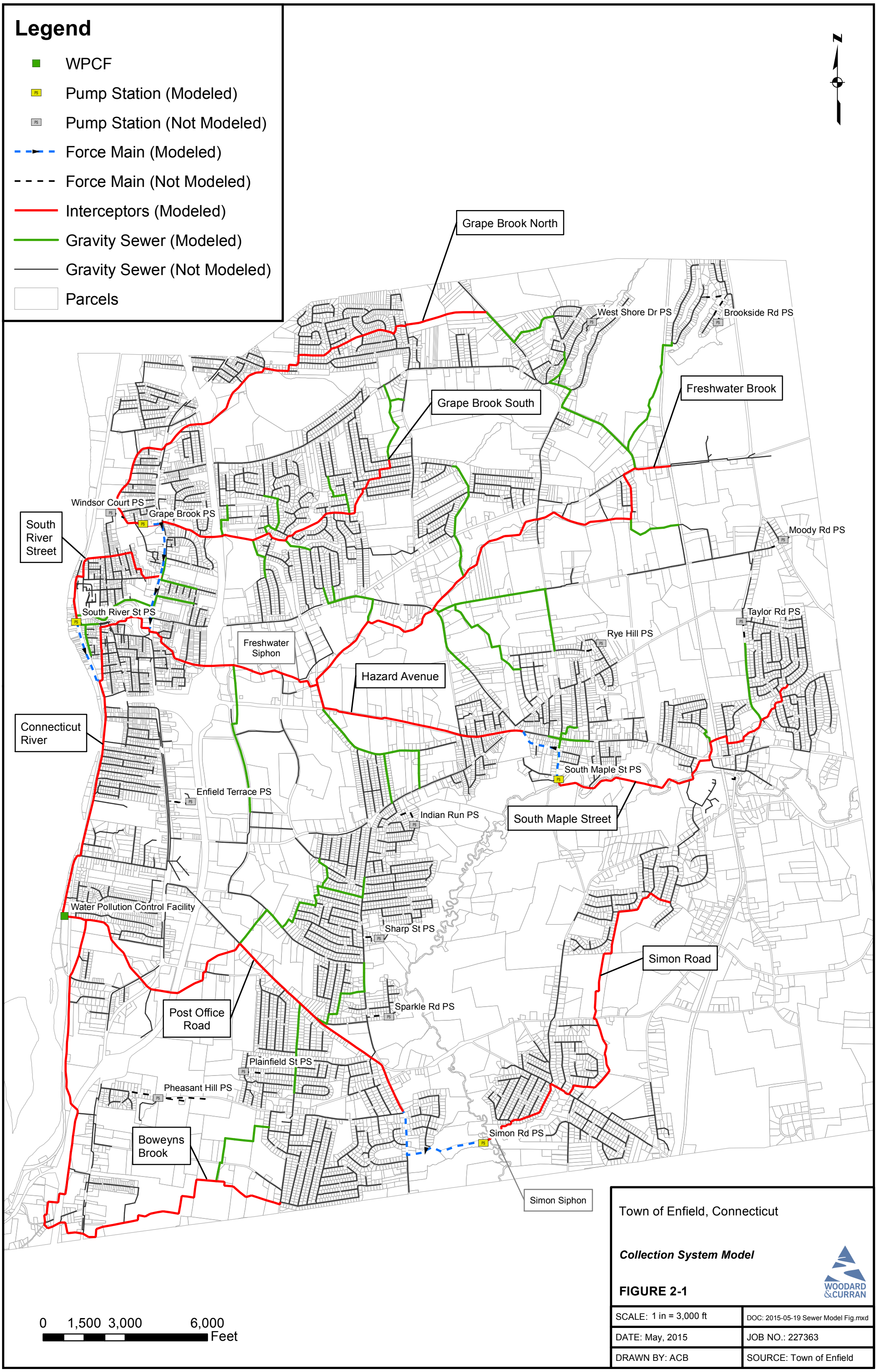
The Town's existing GIS geodatabase contains geometry of the sewer system including pipe locations, length, material, diameter, inverts, and manhole locations and elevations. While the location, approximate length, and diameters of pipes in the Thompsonville area are known, manhole and pipe elevations are not. Results from the SSES, specifically depths to manhole and pipes inverts, were used to update the geodatabase.

Pipe and manhole invert elevations were calculated by subtracting the invert depth from the manhole rim elevation. Manhole rim elevations were estimated assuming rim elevations were equivalent to ground surface elevation. Rim elevations were interpolated from 2-foot contours obtained from the Connecticut Department of Energy and Environmental Protection (DEEP) GIS database. DEEP contour data was provided in the NAVD 1988 coordinate system. A correction factor of 0.75 feet was added to convert to the NGVD 1929 coordinate system used in the Enfield geodatabase, which is an approximation of the vertical difference between the two coordinate systems in the town of Enfield. Additional corrections to existing data were made where necessary using as-built plan and profile sheets provided by the Town.

The SewerGEMS model was not developed to evaluate every individual pipe and manhole in the Enfield system. Instead, the model was focused on the major interceptor gravity pipes, pump stations and force mains. The complete Enfield collection system is shown in Figure 2-1, with the modeled portions shown in color. Woodard & Curran has identified 10 major interceptor gravity lines within the Enfield system, including the Grape Brook North, Grape Brook South, Freshwater Brook, South River Street, South Maple Street, Hazard Avenue, Connecticut River, Simon Road, Boweyns Brook and Post Office Road interceptors. Each interceptor is shown in red on Figure 2-1. Additional gravity pipes were added to the model, shown in green, to allow for more accurate distribution of flows among the interceptors.

SewerGEMS utilizes Manning's equation to calculate capacity of pipe elements. Sewer pipes and manholes were assumed to be good condition and free of obstructions. However, it should be noted that CCTV inspection of the Thompsonville area of the collection system has shown that many pipes contain significant amounts of sand and debris, which greatly increases the potential for sewer blockage, surcharge, and overflow. The model has not been calibrated to account for increased pipe roughness or reduced pipe diameters due to buildup of solids in the collection system.

Individual pipes in the model were assigned Manning's friction factor (n) values based on the pipe material in the geodatabase. Table 2-1 shows the pipe materials contained in the Enfield system and appropriate friction factor values. Energy losses through manholes were modeled using the energy equation. For simplification, a conservative loss coefficient of 0.65 was assumed for all manholes and pressure junctions in the model. This loss coefficient is appropriate for bends along the infrastructure between 45 and 90 degrees.



Town of Enfield, Connecticut

Collection System Model

FIGURE 2-1

WOODARD &CURRAN

SCALE: 1 in = 3,000 ft	DOC: 2015-05-19 Sewer Model Fig.mxd
DATE: May, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield

Table 2-1: Model Friction Factors

Pipe Material	Manning's Friction Factor (n)[1]
Asbestos Concrete	0.013
Ductile Iron	0.013
Poly Vinyl Chloride	0.009
Reinforced Concrete	0.013
Vitrified Clay	0.014
Unknown Material[2]	0.014
Other Material[2]	0.014

1. Coefficients taken from the Isco Open Channel Flow Measurement Handbook and the Civil Engineering Reference Manual for the PE Exam.
2. Pipes of unknown or other material assumed to have friction factor equal to roughest known material in the Enfield collection system, vitrified clay.

The four largest pump stations were configured in the model: Grape Brook, Simon Road, South Maple Street, and South River Street pump stations, using available plan, profile and nameplate data. Model inputs included ground elevations, invert elevations, wetwell dimensions, on/off elevations, and pump operating points. Each pump is defined by a pump curve, initial status (on or off), and the wetwell elevations at which the pump turns on and off. At the start of each simulation all pumps were initially set to off. Table 2-2 summarizes the pump design points for each modeled pump station and whether a variable frequency drive (VFD) is utilized.

Pump stations equipped with VFDs are typically operated to maintain a constant water level in the wetwell, but SewerGEMS does not have the built in capability to model variable speed pumps. Attempts were made to artificially model variable speed pumps by setting the pump on/off elevations close together, thereby increasing the frequency of pump operation and more closely simulating constant pumping conditions. This method however appeared to introduce large continuity errors, which are the result of inconsistencies with the volume of load into the modeled system compared to the volume of flow out of the system. In order to minimize error propagation pump on and off elevations were set to more typical values within the operational range of each wetwell. Pump on and off elevations were set 3 feet apart for Simon Road, Grape Brook, and South River Street pump stations, while South Maple Street pump station was set to 2.5 feet.

Table 2-2: Pump Station Model Input

Pump Station	VFD	Rated Capacity (gpm)	TDH (ft)
Grape Brook	Yes	3600	85
Simon Road	No	800	77
South Maple Street	No	1550	156
South River Street	Yes	2843	56.6

2.1.1 Assumptions

- Inverted Siphons - Two siphons within the collection system were modeled, including the Freshwater Brook and Simon siphons, however SewerGEMS does not provide for inverted siphon simulation. A best approximation of inverted siphon conditions is accomplished by manually setting the total siphon pipe length to account for vertical distance and using bolted manhole covers, which prevent manhole overflow and

maintain above atmospheric pressure conditions. The Freshwater brook siphon consists of a 16-inch, a 12-inch and an 8-inch barrel, while the Simon siphon consists of two 12-inch barrels and a single 8-inch barrel. To be conservative, each siphon was modeled assuming the 8-inch barrel was clogged and out of service. Additionally, the Freshwater brook siphon was modeled as two 12-inch barrels for simplicity.

- Missing Invert Data – The SSES provided most of the missing invert data required to model the Thompsonville area of town. However, not all manholes contained in the geodatabase were located, and subsequently the inverts were not entered into the database. Any missing inverts on the interceptor lines were linearly interpolated from the nearest upstream and downstream manholes with known inverts, assuming constant slopes from both manholes.

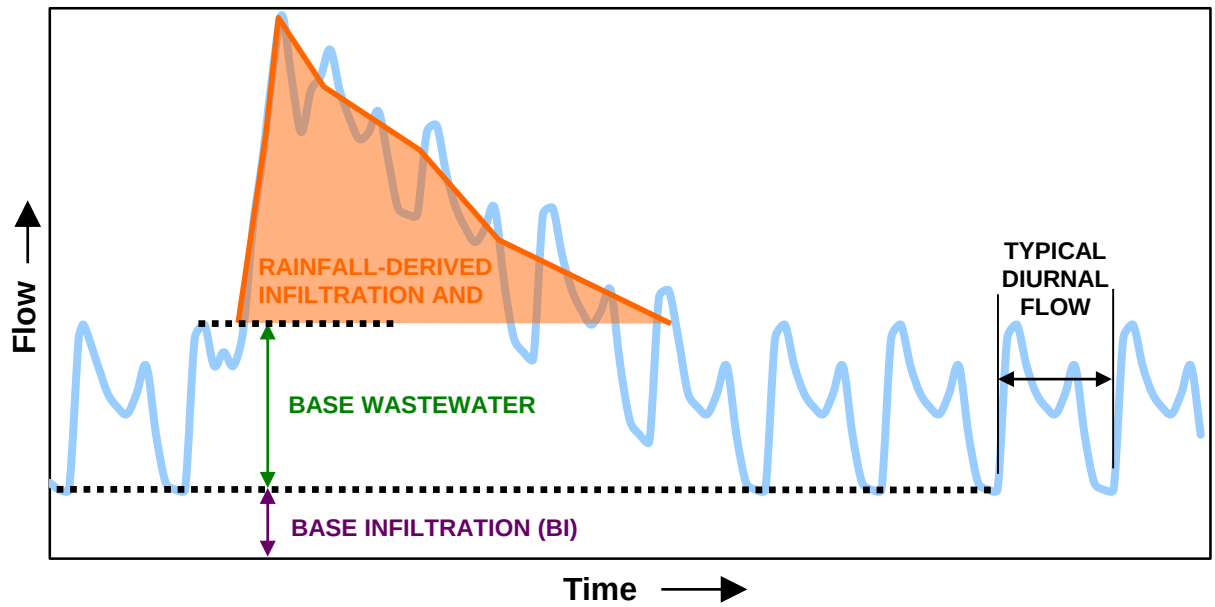
- Contour Interpolation Error – Errors were encountered when calculating the manhole rim elevations due to limitations in the contour source data. The 2-foot contour data was developed from a 10-foot digital elevation model (DEM), which likely introduced a loss in resolution. Erroneous manhole inverts resulting in negative slopes were corrected via linear interpolation between upstream and downstream manholes assuming constant slope.

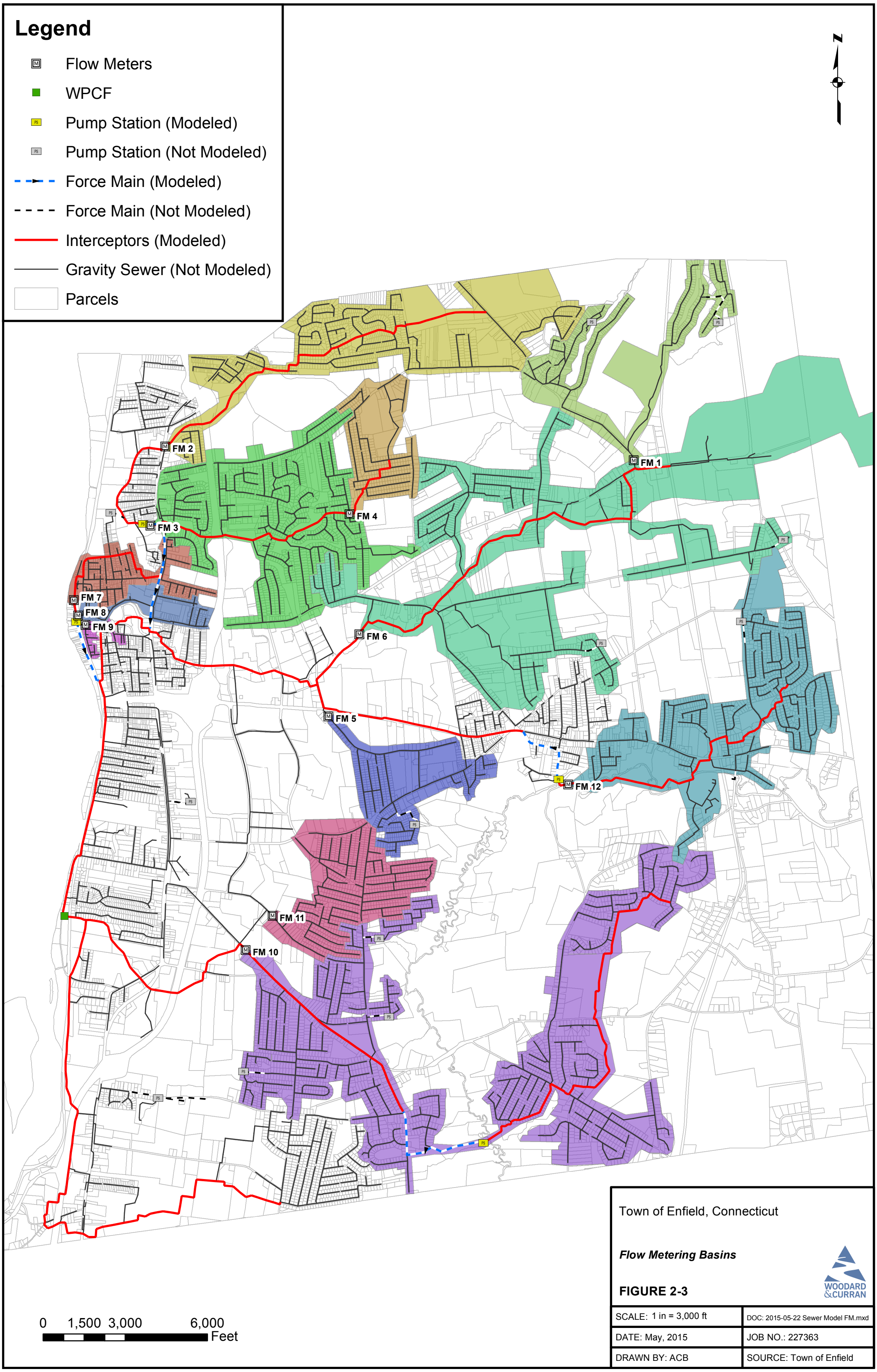
- Rainfall and Metered Basins – Rainfall was not modeled throughout the entire collection system due to a lack of global flow monitoring data. I/I induced by precipitation must be quantified through flow monitoring with wet and dry weather events. Therefore, rainfall and RDII was only modeled in basins where flow meters were installed.

2.2 WASTEWATER FLOW COMPONENTS

Wastewater flow in a sewer system consists of three components: Base Wastewater Flow (BWF), Base Infiltration (BI), and RDII as shown in Figure 2-2. A detailed summary of estimated loading used in the model is included in Appendix A. The collection system flow monitoring program results were used as the baseline of comparison for all three flow components. Figure 2-3 includes the delineation of subareas that were developed for the flow metering program. An overview of flow estimates for each component is included in the following section with descriptions of each.

Figure 2-2: Typical Wastewater Flow Components





Town of Enfield, Connecticut

Flow Metering Basins

FIGURE 2-3

WOODARD &CURRAN

SCALE: 1 in = 3,000 ft	DOC: 2015-05-22 Sewer Model FM.mxd
DATE: May, 2015	JOB NO.: 227363
DRAWN BY: ACB	SOURCE: Town of Enfield

2.2.1 Sanitary Flow or Base Wastewater Flow (BWF)

BWF consists of wastewater produced by residential, commercial, industrial, municipal, and institutional sources and does not include extraneous flows associated with I/I. Enfield's collection system serves primarily residential customers who generate approximately 50% of the average daily flow, based on the flows and loads analysis (F&LA). The second most significant source of sanitary flow is the five prisons in Enfield and Somers at approximately 14% of the average. Commercial, industrial and municipal together comprise 11%. The remaining 25% of flow consists of I/I.

For the sewer model, BWF loading was applied from residential, commercial, industrial, municipal and institutional flow sources. Table 2-3 summarizes the unit and absolute flow values used to apply sanitary loading to the model. Average flow from the five prisons located in Enfield and Somers for the year 2013, 747,838 gpd, were applied to a single manhole on Shaker Road, SMH-2972, located on the Freshwater Brook interceptor.

Residential unit loading was based on annual residential water consumption data from 2010 through 2012, divided by Enfield's population. The unit load of 66 gpd/capita was applied to parcels based on the number of bedrooms contained in each parcel. Number of bedrooms per parcel was retrieved from the Town assessor's data. Loads from each parcel were applied to the model using the nearest node method, where the manholes located closest to each parcel received associated sanitary flow. For parcels with greater than two bedrooms, 45 gpd was assigned for each additional bedroom over two. The assessor's data contained number of bedrooms for single and multi-family houses but not the total number for other residential properties, such as condominiums and apartments. Parcels in this category were identified through town zoning maps and the total number of bedrooms per parcel was estimated based on the number of units or occupancy listed in the Town's online Vision database[1]. The total estimated number of bedrooms per multiunit parcel is listed in Appendix A.

Commercial, industrial and municipal parcels were loaded based on building square footage at a unit rate of 0.043 gpd per square foot (sqft). This loading rate was modified from the Connecticut Public Health Code[2] design flow rate of 0.1 gpd/sqft to more closely model actual flows generated in Enfield. The total BWF load applied was approximately 4.2 MGD, a slightly conservative estimate, as the F&LA indicated that BWF to the WPCF is approximately 4.0 MGD based on data from 2010 through 2013 MGD. Building area was retrieved from the Enfield assessor's data.

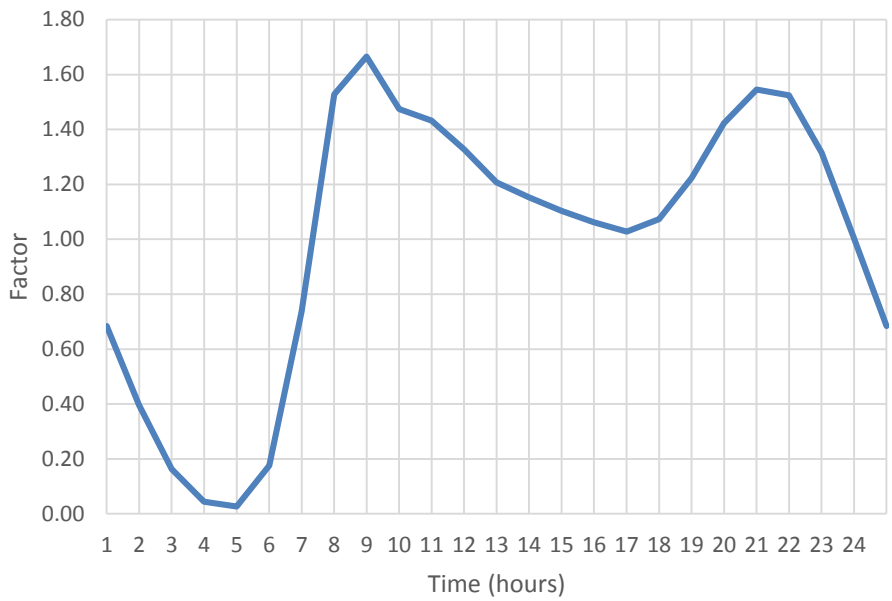
Table 2-3: BWF Model Inputs

Load Source	Flow	Reference
Residential	66 gpd/bedroom ≤ 2 bedrooms 45 gpd per additional bedroom	Enfield Water Use Data, Enfield Assessor's Data
Commercial	0.043 gpd/sqft	Modified from Connecticut DPH Technical Standards[1]
Industrial	0.043 gpd/sqft	
Municipal	0.043 gpd/sqft	
Institutional	747,838 gpd	Prison Flow Records

[1] http://gis.vgsi.com/enfieldct/ Accessed June 2015.
[2] Connecticut Public Health Code. "On-site Sewage Disposal Regulations and Technical Standards for Subsurface Sewage Disposal Systems". January 2011. Table 4, pg. 24.

All sanitary flows were applied using a time dependent loading factor based on a diurnal curve, as shown in Figure 2-4. The diurnal curve simulates real-world water usage patterns and was based on an example pattern[3] and the dry day diurnal curves generated in ADS Environmental Services' Sliicer™ software using the flow monitoring data. Only weekday data was used in the calculation of the dry day curves. Generally, weekend water usage differs in that residents wake later in the day and the late morning flow peak shifts several hours ahead accordingly. The shown curve was calculated as the weighted average of all 12 flow meter diurnal curves. Weights were based on the overall volume of flow originating from each basin, greater weights being assigned to larger flows.

Figure 2-4: Residential Diurnal Flow Curve



2.2.2 Base Infiltration (BI)

BI represents the extraneous fraction of wastewater flow that originates from groundwater during dry weather conditions. BI typically enters sewer infrastructure through pipe and manhole defects such as cracks, offset joints and root intrusions. Rates of BI depend on factors such as local groundwater level, condition of sewer infrastructure, and capacity of the pipes. Figure 2-5 shows regional USGS groundwater data for Mansfield, CT and Granville, MA (the two USGS sites closest to Enfield) from January 1, 2010 to May 17, 2015. As shown in the figure groundwater levels typically vary by season, with higher groundwater in the spring and lower in the summer months. BI typically follows a similar pattern where BI increases as groundwater rises.

[3] Metcalf & Eddy Wastewater Engineering Treatment and Reuse. Fourth Edition. 2003. McGraw Hill. Figure 3-4, pg. 180.

Figure 2-5: Regional Groundwater Levels

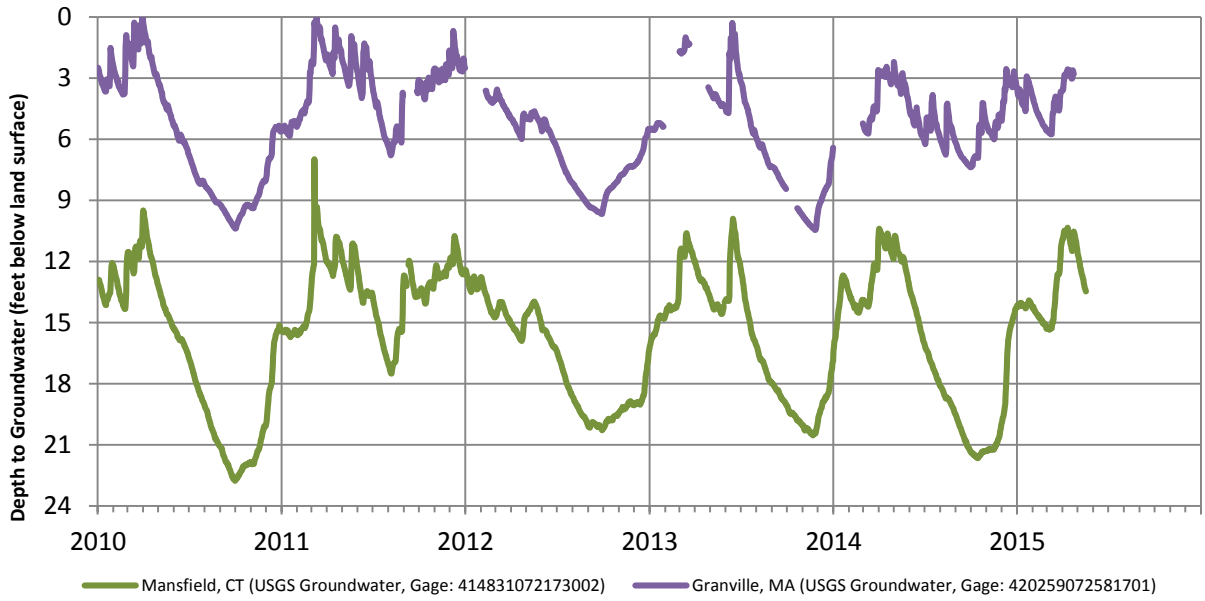
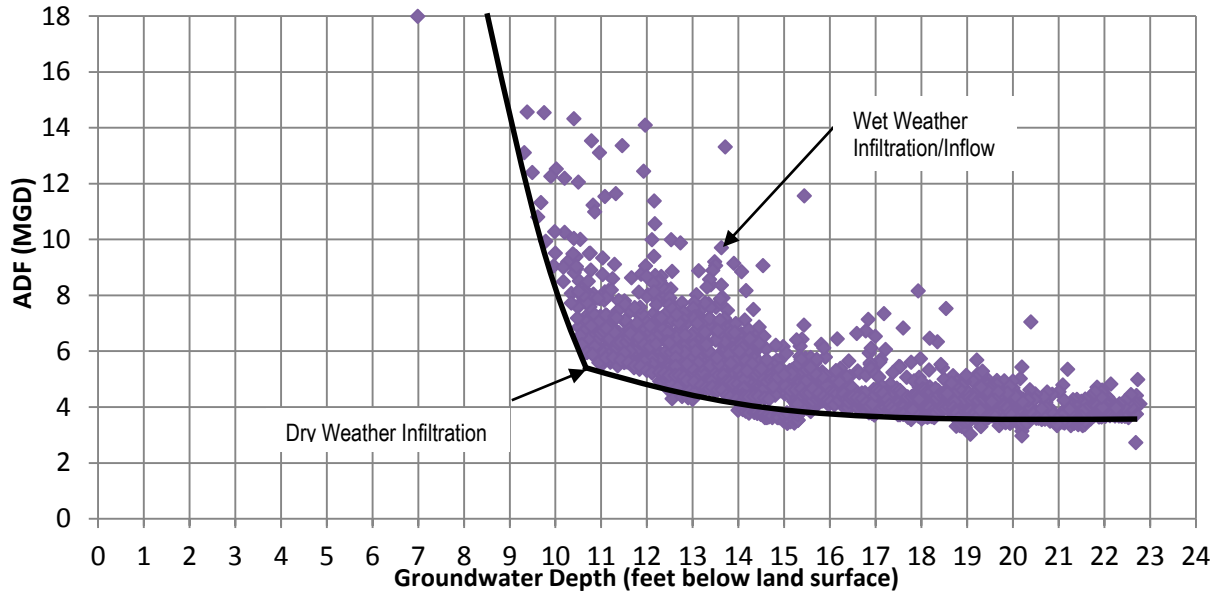


Figure 2-6 shows Average Daily Flow (ADF) plotted versus groundwater depth between January 1, 2010 and May 31, 2015. The black lines on the figure, which vary by local groundwater level, represent the relationship between dry weather BI and groundwater depth. The points well above this line represent periods with rainfall that include RDII and not strictly BI. As groundwater level rises ADF also gradually increases. Groundwater levels below 16 to 17 feet appear to have little influence on ADF. The inflection point between 10 and 11 feet of groundwater appears to be the depth above which flow is dramatically influenced by both groundwater and rainfall, or where RDII becomes most significant.

Figure 2-6: Dry Vs. Wet Weather I/I



For this study, assumed BI rates were applied to all pipes modeled within the system. Table 2-4 summarizes the applied BI rates by interceptor, the magnitude of which was scaled based on pipe material and suspected sources of I/I, identified during the SSES. BI rates are dependent on pipe surface area, which is a function of both length and diameter. TR-16[4] identifies 250 to 500 gpd/idm as an appropriate range of infiltration rates due to normal aging of piping systems.

Table 2-4: Assumed BI Rates by Interceptor

Interceptor	Rate (gpd/idm)	Rate (gpd/ft^2)
Simon Road	280	0.2
Post Office Road	560	0.4
Boweyns Brook	560	0.4
South Maple Street	560	0.4
Hazard Avenue	560	0.4
Freshwater Brook	560	0.4
Connecticut River	980	0.7
South River Street	980	0.7
Grape Brook North	980	0.7
Grape Brook South	980	0.7

2.2.3 Rainfall-Derived Inflow and Infiltration (RDII)

RDII consists of extraneous flows that enter the sewer system due to direct inflow of rainwater and increases in groundwater level due to rainfall. RDII is quantified through the RTK method, named for the R, T, and K parameters, which represent ratio of rainfall entering into pipes, time to peak, and recession coefficient, respectively. RTK values are derived from flow monitoring data on a metered basin basis. This is a dynamic method for estimating RDII and is linearly scalable based on the amount of rainfall or storm event size.

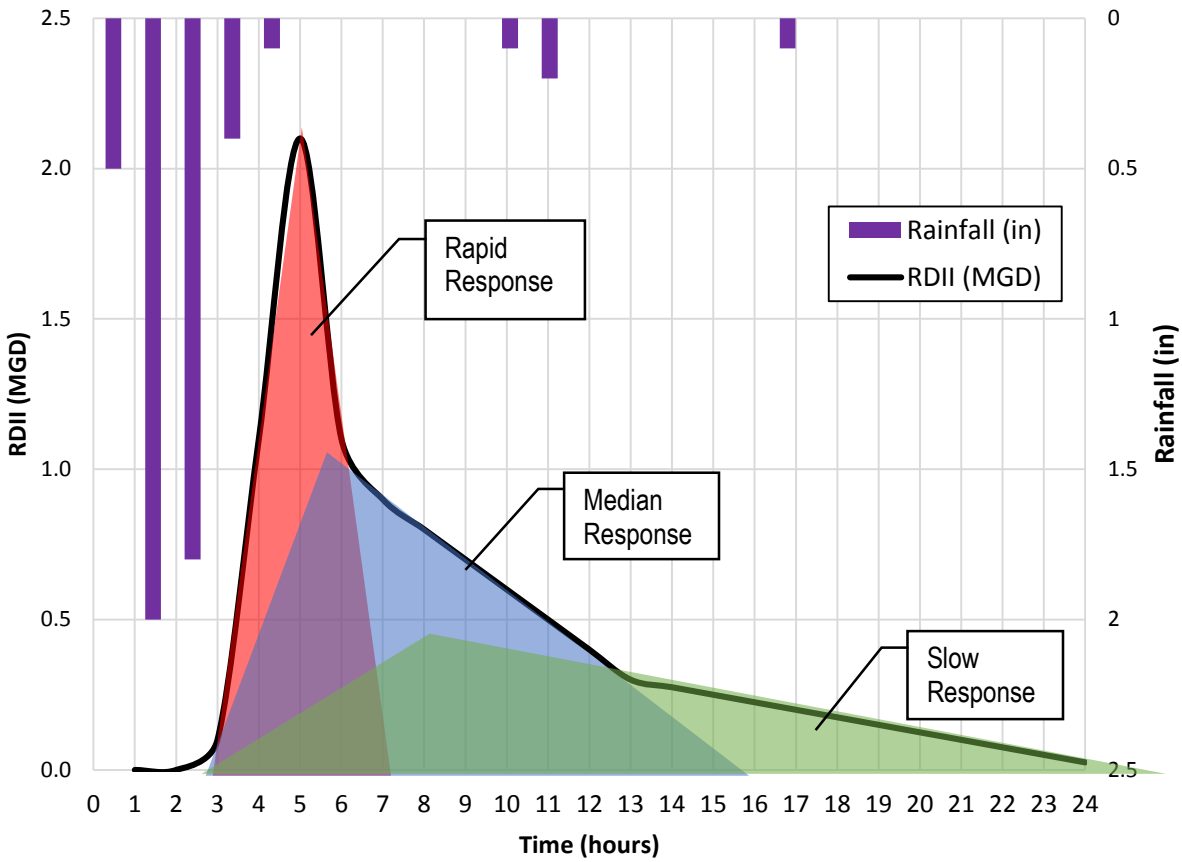
The RTK method is based on curve fitting three triangular unit hydrographs to a hydrograph with a visible reaction to RDII obtained through flow metering. Figure 2-7 illustrates curve fitting with the RTK method using an artificial RDII response hydrograph to precipitation. R, T and K parameters for each of the three triangular unit hydrographs are defined for each unit rainfall over the one unit time. Therefore, there is one set of R, T and K values for each triangle, and three sets of RTK values per RDII hydrograph. Each triangle represents RDII that reacts quickly, median, and slowly to rainfall. Each storm recorded during the flow monitoring period produces a unique set of RTK values. For the model, an average set of RTK values were calculated for each meter basin based on all three storms.

A theoretical method to estimate RTK parameters does not exist. These parameters must be determined empirically for each metering basin based on a comparison of measured rainfall data to measured wet weather sewer flow. ADS'

[4] TR-16 Guides for the Design of Wastewater Treatment Works. 2011 Edition. Section 2.2.3.3.

Sliicer software was used to analyze the flow monitoring data, determine dry and wet weather flows, and calculate the appropriate RTK parameters for each metering basin.

Figure 2-7: RTK Curve Fitting Method Example

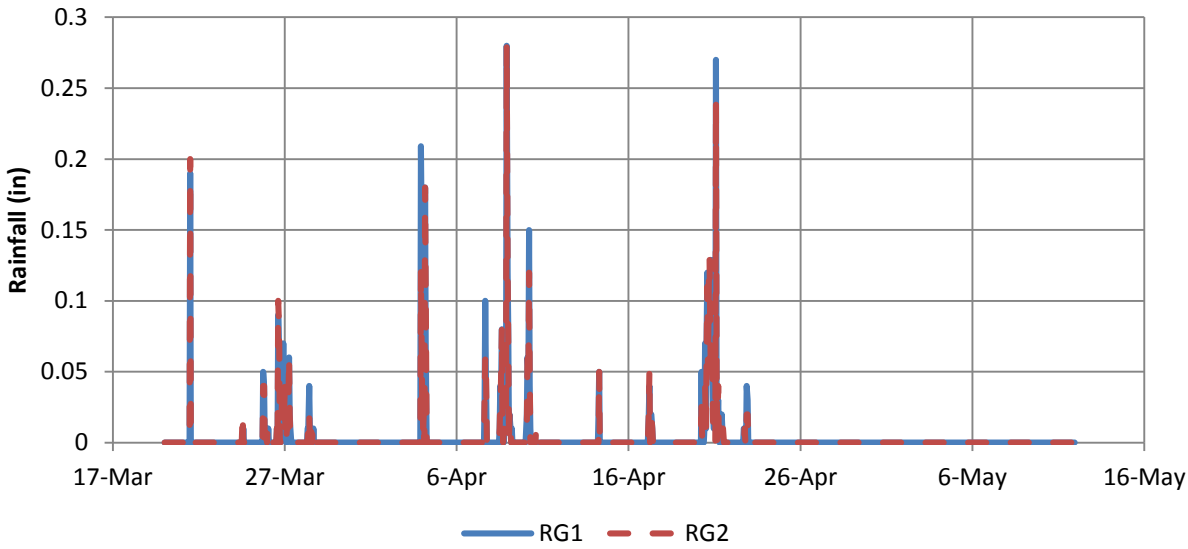


2.3 WET WEATHER DATA

2.3.1 Metered Rainfall Data

Figure 2-8 shows the rainfall data collected throughout the flow metering study from both Rain Gage #1 (RG1) and Rain Gage #2 (RG2). Four storms significant enough for analysis were identified from these data and are summarized in Table 2-5. The values given in Table 2-5 are averages of both RG1 and RG2.

Figure 2-8: Flow Metering Rainfall



Of the four storms identified only two provided total volumes of greater than one inch of rainfall, April 8 and 20, 2015, while none had a peak intensity of more than 0.3 inches per hour. For the Sliicer analysis of the flow metering data, the March 27, 2015 storm was thrown out due to delayed RDII reactions, likely resulting from snowmelt. Overall, none of the storms recorded during the flow monitoring study contributed significant RDII to any of the flow metering basins.

Table 2-5: Storm Events

Storm Event	Total Rainfall (in)	Peak Intensity (in/hr)	Comments
3/27/2015	0.53	0.10	Delayed flow reaction due to snow melt
4/03/2015	0.63	0.19	
4/08/2015	1.10	0.28	
4/20/2015	1.34	0.26	

2.3.2 Synthetic Storm Data

For modeling purposes, synthetic storms were applied to aid in identifying capacity issues. Synthetic storm data for Hartford County was retrieved from the NOAA Rainfall Frequency Atlas[5] in inches of total rainfall. Figure 2-9 shows a 10-year synthetic storm as cumulative and instantaneous precipitation over a 24-hour period. The SCS Type II 24-hour dimensionless curve, a built in design storm in SewerGEMS, was used to construct the synthetic storms as a function of total rainfall depth. Each of the synthetic storms used in the model are summarized in Table 2-6. Peak intensities were calculated as the maximum value of the hourly moving average of the unit rainfall.

[5] Technical Paper No. 40. "Rainfall Frequency Atlas for the United States for Durations from 30 Minutes to 24 Hours and Return Periods of 1 to 100 Years." U.S. Department of Commerce. May 1961.

Figure 2-9: 10-Year 24-Hour (4.7-Inch) Synthetic Storm

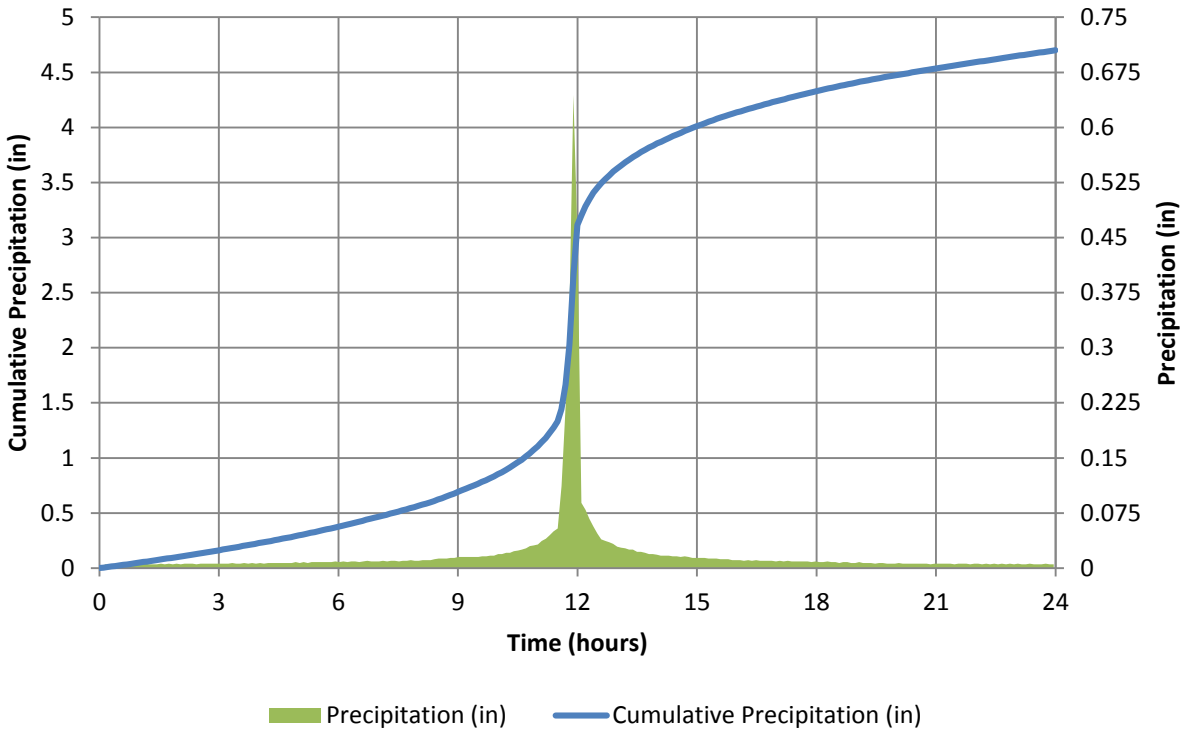


Table 2-6: Synthetic Storm Summary

Return Event	Duration (hrs)	Total Rainfall (in)	Peak Intensity (in/hr)
1-Year	24	2.6	1.18
2-Year	24	3.2	1.45
10-Year	24	4.7	2.13
25-Year	24	5.5	2.50
100-Year	24	6.9	3.13

2.4 MODEL CALIBRATION & VALIDATION

The model was run for 72-hour simulations under three differing loading conditions:

1. Sanitary Flow – BWF only
2. Dry Day Flow – including BWF and BI
3. Wet Weather Flow – including BWF, BI and RDII
    a. RDII as recorded April 20, 2015 rainfall

b. RDII as recorded April 8, 2015 rainfall

c. RDII as recorded April 3, 2015 rainfall

d. RDII as synthetic 2-year storm

e. RDII as synthetic 10-year storm

f. RDII as synthetic 25-year storm

g. RDII as synthetic 100-year storm

All three loading scenarios were run in tenth of an hour time steps. Trial and error showed the least amount of continuity error was introduced to the model with this length of time step. Both longer and shorter time steps appeared to increase the overall continuity error. The total continuity errors for wet weather flow, dry day flow and sanitary flow loading conditions were 0.1%, 11.8% and 14.6%, respectively. Bentley recommends that a continuity error of less than 10% is desirable for flow model accuracy.

72-hour simulations allow for the establishment of regular diurnal patterns and avoid anomalous spikes in flow that may appear during the first few hours of simulation, and show delayed reactions to RDII after storms end. Calibration curves for each flow metering basin (FM1 through FM12) were developed and are shown in Appendix D. Each calibration curve shows the average metered dry weekday curve, exported from Sliicer and shown in purple, plotted against the modeled sanitary, dry day, and synthetic 10-year wet weather flows. Ideally, the dry day flow curve (green) would overlap the metered flow curve (purple).

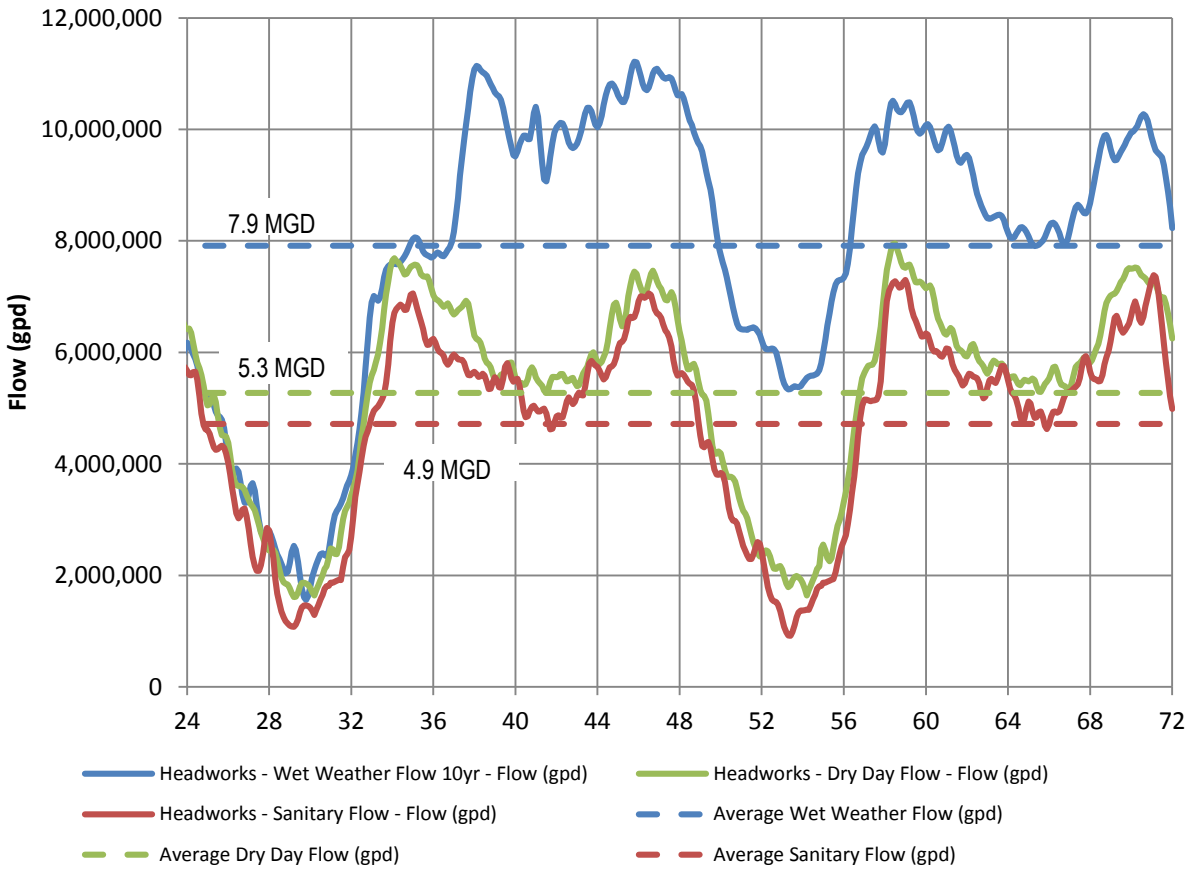
2.4.1 Sanitary Flow

Figure 2-10 shows the modeled flow to the WPCF as sanitary flow, dry day flow and wet weather flow, along with the average of each. The model predicts an average sanitary flow of approximately 4.9 MGD, whereas Woodard & Curran estimated, through F&LA, approximately 4.0 MGD. Given that the total sanitary load applied to the model (3.96 MGD) is essentially equal to that calculated through the F&LA (3.95 MGD), it follows that error in the model must account for the difference. The fraction of sanitary flow that originates from commercial, industrial and municipal sources was assigned based on building square footage, as discussed in Section 2.2.1. The CT DPH design standard of 0.1 gpd/sqft was modified to 0.043 gpd/sqft based on the total volume of modeled flow compared to that of the F&LA. Using the loading rate of 0.1 gpd/sqft yielded a commercial, industrial and municipal average sanitary flow of 1.4 MGD, compared to 0.6 MGD with a 0.043 gpd/sqft loading rate, the latter of which agrees with the F&LA.

2.4.2 Dry Day Flow

Modeled BI was calibrated by comparing the model input flow with that calculated in the F&LA. An initial best guess of infiltration rates per surface area of pipe was made and iteratively modified until the model input agreed with the F&LA estimate, the results of which are summarized in Table 2-4. The resulting total error in modeled BI was small. As shown in Figure 2-10 the average dry day flow is approximately 5.3 MGD. Subtracting the average sanitary flow of 4.9 MGD yields a model BI output of approximately 0.4 MGD. Compared to the F&LA average total infiltration of 0.5 MGD, which leaves an error of about 100,000 gpd.

Figure 2-10: Modeled Flow to WPCF – 10-Year 24-Hour Synthetic Storm

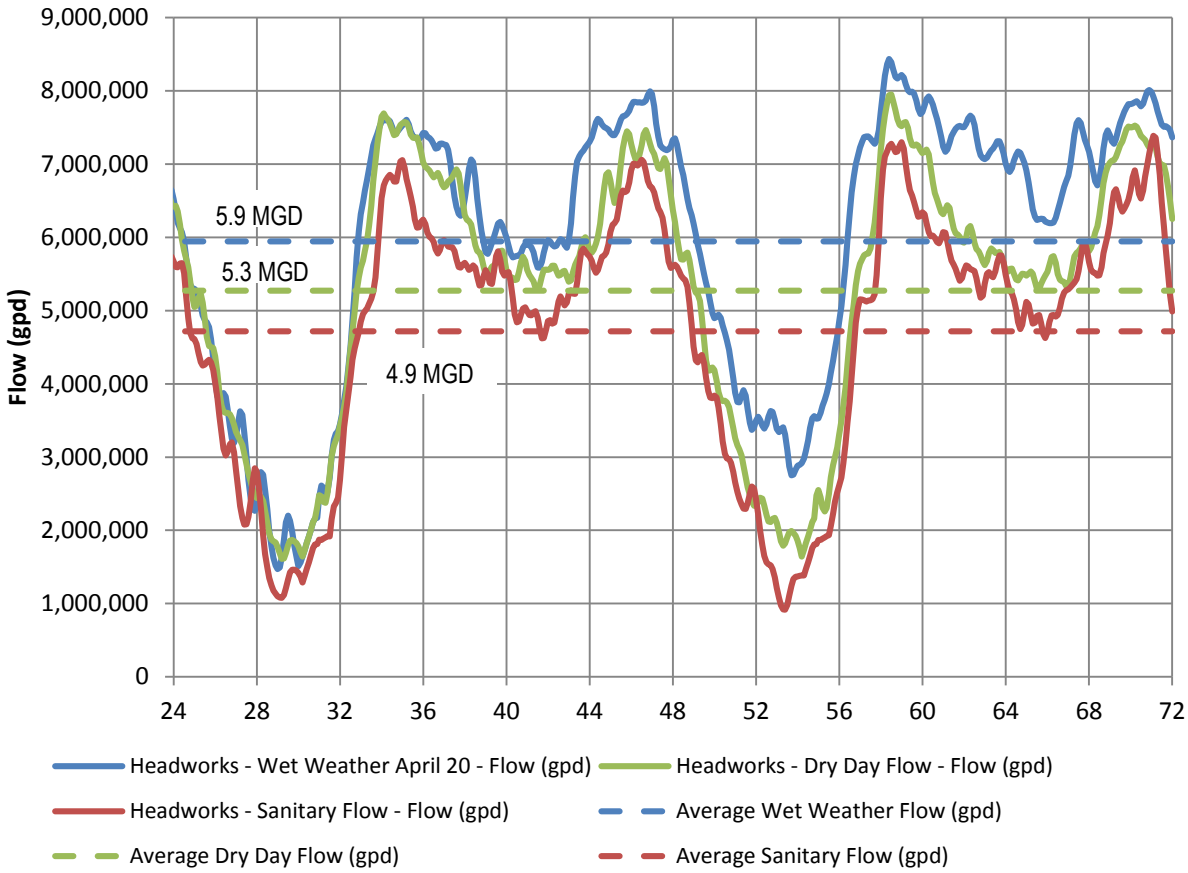


2.4.3 Wet Weather Flow

Wet weather flow was simulated using the empirically derived RTK values and applying synthetic storm data as well as on-site storm data collected during the flow-monitoring period. All storm data was applied during day two of model of operation (24 to 48 hours). Figure 2-10 shows the modeled WPCF wet weather flow in blue with a 10-Year 24-Hour synthetic storm. By definition, a 10-year storm has a 10% chance of occurring in any given year and is a conservative loading scenario designed to identify potential surcharging or overflow events.

Figure 2-11 shows the identically loaded model output but with rainfall data collected from the April 20, 2015 storm applied. The April 20 storm was approximately a 1-month 24-hour storm and produced the greatest volume of rainfall during the flow-monitoring period. The magnitude of this storm was much less significant than the synthetic storms, with a peak intensity an order of magnitude less in each case. Despite this, the model predicts a noticeable increase in average WPCF flow of approximately 0.6 MGD over the average dry day flow.

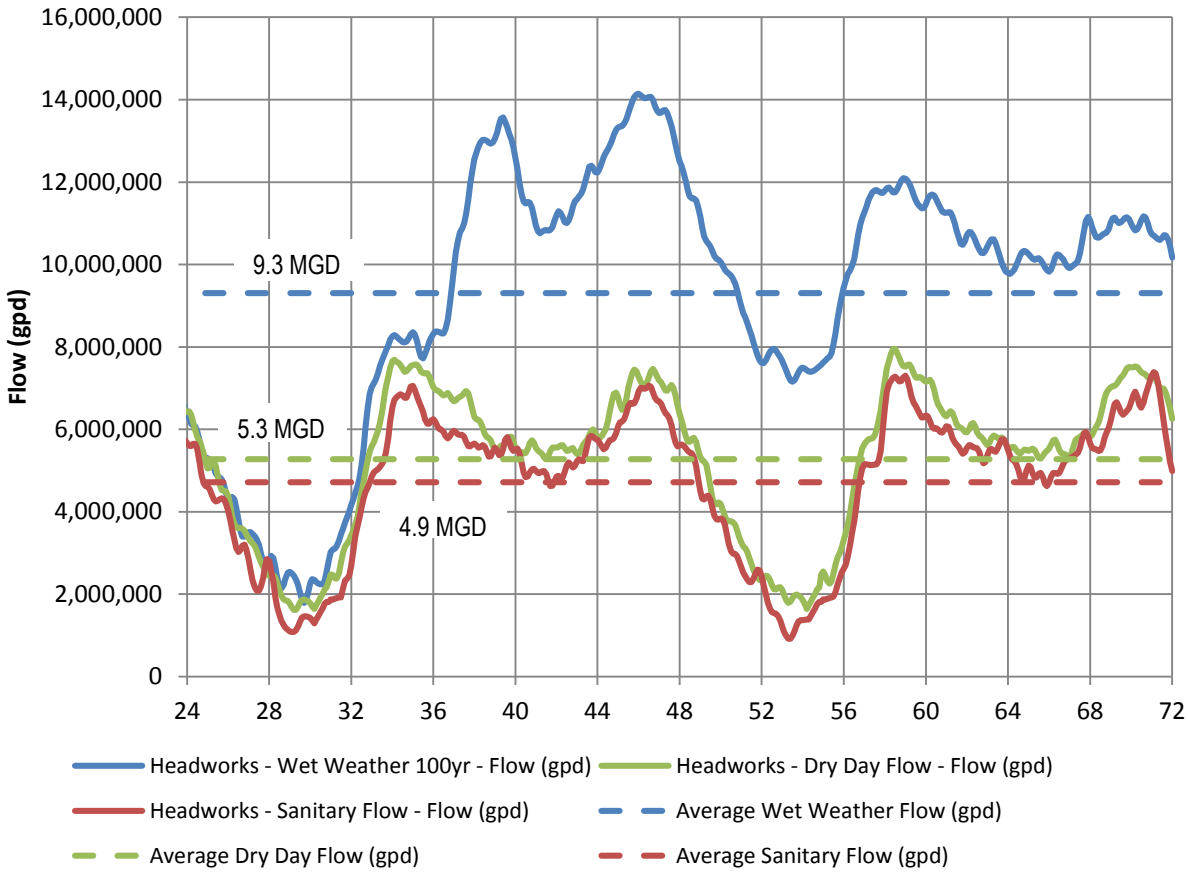
Figure 2-11: Modeled Flow to WPCF – April 20, 2015 Storm



One problem that may exist with the collected rain data is that no high intensity storm events were recorded, nor any high volume events. As shown in Figure 2-9, the synthetic storms feature a high intensity, short duration peak which accounts for nearly half of the total rainfall. None of the recorded storms shown in Table 2-5 have similar well defined peaks, but instead feature a flatter more randomized pattern.

Figure 2-12 also shows the WPCF model output, but loaded with a synthetic 100-year storm, yielding an average WPCF wet weather flow of approximately 9.3 MGD. Figure 2-13 shows four years of daily WPCF flow data, from 2010 through 2013, plotted against exceedance probability. The exceedance probability of 9.3 MGD is 97.58%, or is exceeded only on 2.42% of days in the four-year data period. In short, 9.3 MGD has a 0.61% probability of being exceeded each year. A 100-year storm has a 1% chance of occurring in any given year, which shows that the modeled WPCF 100-year wet weather flow output of 9.3 MGD is actually closer to a real world 200-year storm (0.5% probability of occurring each year).

Figure 2-12: Modeled Flow to WPCF – 100-Year 24-Hour Synthetic Storm

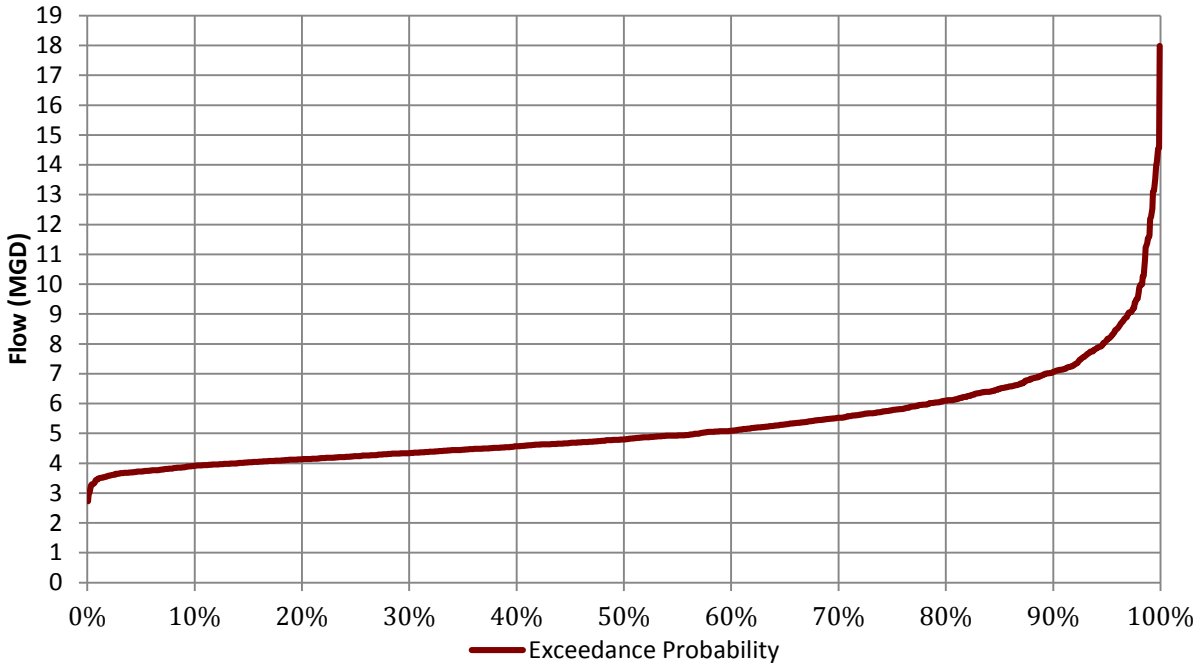


Similarly, the 10-Year storm WPCF wet weather average flow of 7.9 MGD appears to be an overestimate of the expected impact of rainfall on WPCF flow. The exceedance probability of 7.9 MGD is 94.29%, or exceeded on 5.71% of days in four years, or a 1.43% chance per year; hence, the modeled 10-year storm has an effect closer to that of a 70-year storm on the collection system flow.

Given that the synthetic storm rainfall volumes have been established for Hartford County, it follows that the over estimates of WPCF flow from the model are likely resultant from poorly calibrated RTK values. As shown in Figures 2-10, 11 and 12, the flow reaction to RDII is large and appears to take much longer than 48 hours to dissipate. This slow normalization of flow after storms is likely due to an oversized recession coefficient in the RTK value sets.

Alternately, the linear nature of RTK value calculation may not account for the physical limitations of how much RDII may enter collection system piping. The volume of RDII that may enter pipes cannot exceed their capacity. The existing RTK values were calculated from the metered rainfall events and used to estimate RDII for synthetic storms of significantly greater rainfall volume. As such, it is likely that the overestimation occurs because of the linear extrapolation of RDII from small storm events to large events without taking into account the physical limits of pipe capacity.

Figure 2-13: Enfield WPCF Flow Exceedance Probability 2010-2013



2.4.4 Calibration Plots

Calibration plots were compiled to compare the observed versus the modeled WPCF flows during storms recorded over the flow monitoring program. Figures 2-14 and 2-15 compare the peak and average daily WPCF flows, respectively. The horizontal axis represents modeled flow, while the vertical axis represents observed WPCF flow. The black line shows all points where the observed and modeled flows agree. Points below the line indicate an overestimate of modeled flow, while points above the line indicate an underestimate, with greater distance from the line indicating more error. Shown in Figure 2-14, the modeled and observed peak WPCF flow for the April 20 storm agree well, with an error of only 0.68%. The remaining modeled flows range between approximately 5 and 19%.

One source of error that is that only rainfall in metered basins can be included in the model. Approximately two thirds of the collection system was metered, with each basin having unique RTK characteristics calculated. The remaining third of the system could only be used to model rainfall through additional flow monitoring, or by assuming RTK values, which is not considered good practice.

Figure 2-14: Modeled Peak Flow Vs Observed Peak Flow

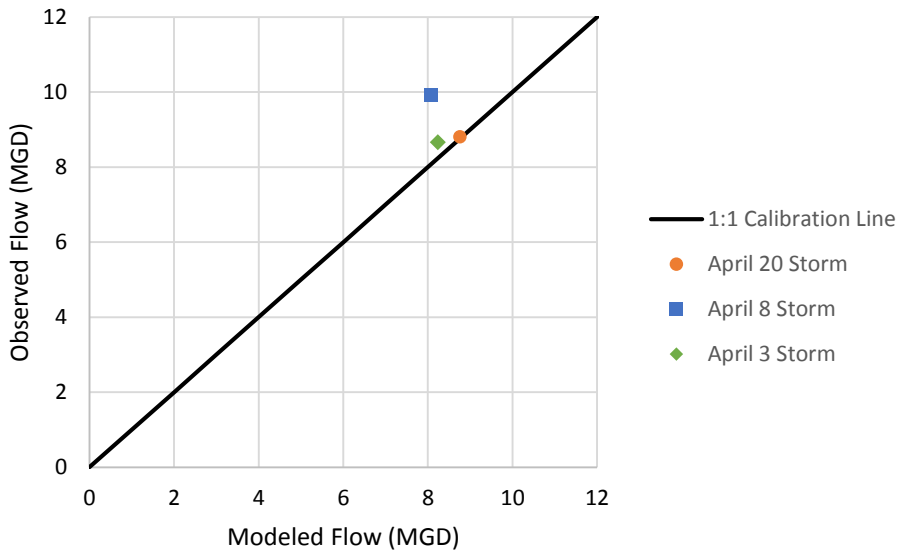
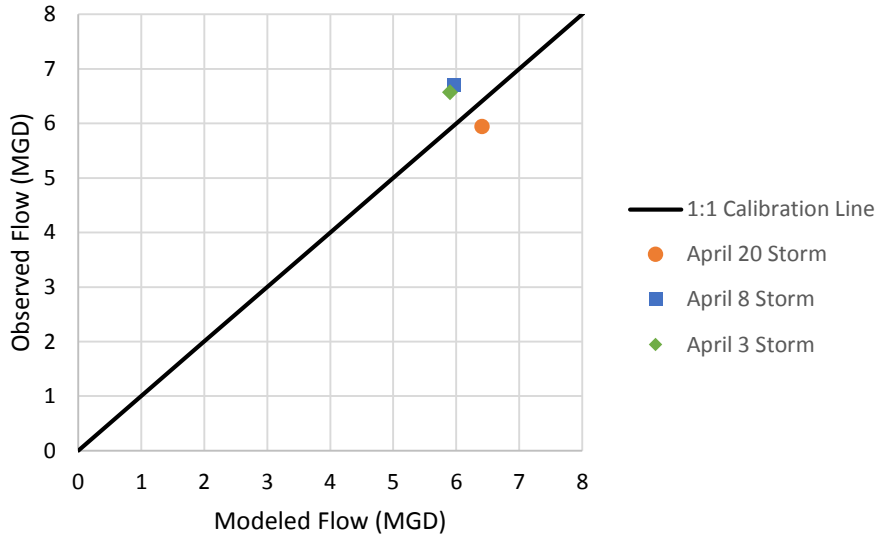


Figure 2-15: Modeled Average Daily Flow Vs Observed Average Daily Flow



3. MODEL RESULTS

3.1 COLLECTION SYSTEM CAPACITY ANALYSIS

Woodard & Curran noted several areas of concern in terms of capacity from the collection system hydraulic model. The pipes and manholes in the system most likely to experience surcharging or overflows during high flow events, respectively, were noted during each simulation. Appendix B shows the complete profile of each of the 10 interceptors as modeled in the wet weather 10-year synthetic storm loading condition at hour 34 of the simulation. Appendix C shows complete plan views of the modeled sewer system for the 2, 10, 25 and 100-year synthetic storm loading conditions. Gravity sewer pipes are green and where red are predicted to surcharge at least one time step during the simulation. Two particular locations within the Enfield collection system were predicted to experience surcharging under heavy RDII loading conditions, a 24-inch pipe restriction along the Connecticut River interceptor and a section of 15-inch pipe at the South River pump station force main exit. Several other locations were predicted to surcharge, but upon investigation were affected by anomalous spikes in flow within the first 24 hours of the simulation and are not considered potential capacity concerns.

3.1.1 Connecticut River Interceptor

The Connecticut River interceptor primarily consists of 30 to 36-inch reinforced concrete pipe. However, a 24-inch pipe is installed between the transition from 30 to 36-inch pipe adjacent to Bridge Lane. A profile showing the 24-inch pipe surcharging under moderate rainfall is shown in Appendix B, where the 24-inch pipe has the pipe ID SWR-4466 and lies between manholes SMH-4464 and SMH-523.

At the estimated slope, SWR-4466 has a capacity of approximately 4.3 MGD, almost 1 MGD less than the average daily WPCF flow. The pipe surcharge occurs during a peak flow period, on the second morning of the simulation, which lines up with the typical peak flow in a diurnal flow pattern. The upstream manhole (SMH-4464) is about 15 feet deep and is unlikely to overflow.

The major concern with surcharging of SWR-4466 is the residential development on Meetinghouse Lane. The nearest upstream manhole inverts are about 5 to 6 feet above that of SMH-4464, therefore surcharging of that manhole has the potential of causing sewage backups into residences, assuming the homes have basement fixtures and the water rises around 10 feet above the SMH-4464 invert.

3.1.2 Hazard Avenue Interceptor

Along the Hazard Avenue interceptor, downstream of the South Maple Street pump station force main exit, lies approximately 1,444 feet of 15-inch diameter pipe, with capacities ranging from 4.2 to 7.5 MGD, depending on the slope. The flow monitoring study showed that on average approximately 300,000 to 400,000 gallons of wastewater are flowing to the South Maple pump station through the South Maple Street interceptor per dry day. Including the entire South Maple Street pump station service area the dry day flow is expected to average around 500,000 gpd. Assuming a peak maximum day flow of four times the average daily flow (see Figure 2-1 of TR-16) the peak flow expected to the pump station is about 2 MGD, less than half the minimum capacity of the Hazard Avenue interceptor. Therefore, the surcharging in the model must be due to pumped flows exceeding the receiving gravity sewer capacity.

The design flow of the pumps is 2.2 MGD, also less than the capacity of the pipes. Also of concern is the South River pump station force main diameter, which is 16 inches and larger than the 15-inch gravity sewer it connects to. A pressurized pipe entering a smaller gravity sewer pipe may introduce extra energy loss, resulting in the frequent surcharging seen in the model. However, capacity doesn't appear to be a serious concern since the South River pump station service area is nearly built out to capacity. Although the 15-inch pipes appear to have adequate capacity, sufficient energy losses could also result in surcharging, which if even temporary, may result in hydrogen sulfide

deterioration or accumulation of solids. Excessive solids or damaged manhole structures have the potential to cause backups and sanitary sewer overflows.

3.1.3 South Maple Interceptor

Although the model predicted no surcharging of the South Maple Interceptor, a pipe diameter constriction exists that should be noted. East of the South Maple Street pump station, the interceptor diameter reduces from 21-inch to 15-inch. Capacity of a pipe depends on diameter and slope, larger diameter and steeper slopes providing greater capacity. A 15-inch pipe (TRNS-3681) downstream of the Cooper Street connection to the South Maple Interceptor receives all flows from the South Maple Street interceptor, with a slope of 0.013 and has a capacity of approximately 5 MGD. The capacity of this 15-inch pipe should be adequate assuming there are no excessive increases in I/I upstream of the pipe. Given the WPCF flow rarely rises above 10 MGD and the flow through the South Maple Interceptor is typically less than one tenth of the total plant flow, it is safe to assume that wet weather flows through TRNS-3681 are unlikely to exceed its capacity. Historically, the Enfield collection system has not had sanitary overflows except as a result of clogs from vandalism or lack of maintenance.

3.2 RECOMMENDATIONS

The final recommendations of the study include the following:

- Verify the diameter and slope of SWR-4466, on the Connecticut River Interceptor. At the current estimated slope this pipe has a capacity of about 4.3 MGD. The flow monitoring study revealed that the majority of I/I in the Enfield collection system flows through this pipe as well as approximately two thirds of the average daily flow. The existing 24-inch pipe is predicted to cause surcharging under moderate loading conditions. Under heavy wet weather loads the potential exists for sewage backups into nearby homes. Woodard & Curran recommends replacing SWR-4466 with a 36-inch pipe if the capacity of the existing pipe is found to be inadequate.

- Investigate the Hazard Avenue 15-inch pipe restriction at the South River pump station force main exit for evidence of surcharging. Woodard & Curran recommends replacing the 1,444 feet of 15-inch diameter pipe with 18-inch pipe if significant evidence of surcharging, hydrogen sulfide deterioration, or accumulation of solids exists.

- Refine and calibrate the existing draft collection system hydraulic model to better model flow meter data and WPCF flow conditions. Calibration of the model will include updating RDII components, specifically RTK values, and comparing the predicted results to corresponding WPCF flow data.

APPENDIX A: MODEL INPUT DATA

- RTK Values
- Condominium and Apartment Bedroom Estimation
- Sanitary Loading

RTK Values

Meter	rTotal	r1	t1	k1	r2	t2	k2	r3	t3	k3
FM01	0.0011	1	1.74	0	3.95	3.48	0.0102	10	8	0.0011
FM02	0.0003	1	1	0.0003	3	2.45	0.0023	8.18	7.09	0.0003
FM03	0.0012	1.36	1.36	0.0018	3.56	2.56	0.0104	10	8	0.0012
FM04	0.0005	1.26	1.26	0.001	4.04	3.04	0.0112	10	8	0.0005
FM05	0.0003	1	1.3	0.0003	4	3.2	0.0029	10	8	0.0003
FM06	0.0002	2	1.8	0.0006	4.6	4	0.0031	10	5.61	0.0002
FM07	0.00193	1	1	0.00124	3.46	3.23	0.0069	6.91	6	0.00193
FM08	0.0078	1	1.2	0.0037	3	2.64	0.0554	10	8	0.0078
FM09	0.0258	1	1.21	0.0137	3.84	2	0.1578	10	8	0.0258
FM10	0.0006	1.4	1.62	0.0011	3.36	2	0.0138	10	8	0.0006
FM11	0	1.3	1	0.0003	3	2.41	0.0042	8.36	7.18	0
FM12	0	1	1.28	0.0002	3	2.44	0.0013	8.25	7.13	0

Residential Bedroom Estimation

Condo / Apartment	Parcel ID	Units	Occupancy (sum of all buildings)	Bedrooms/Unit	Unit Bedrooms	Occupancy Bedrooms	Total Bedrooms
Bigelow Commons	7-31		479		0	479	479
Brooksize Village	59-99	36		2	72	0	72
The Meadows	61-187	120		2	240	0	240
Mayfield Apartments	79-94	32		2	64	0	64
Heritage Farms	77-81	28		2	56	0	56
Hampton Chase	77-63	12		1	12	0	12
The Laurels	81-86	128		2	256	0	256
Ashmead Commons	77-58	64		2	128	0	128
Candlewood	76-108	112		2	224	0	224
Elm Meadows	64-3	62		2	124	0	124
Fox Hill Lane	64-93		168		0	168	168
Georgetown/Bradley Cir	64-89	154		2	308	0	308
Quail Hollow	75-1	56		2	112	0	112
Oldfield	74-121	105		2	210	0	210
Still Meadow	65-78	16		2	32	0	32
Enfield Terrace	19-235		75		0	75	75
The Hamlet	18-270	102		2	204	0	204

Condo / Apartment	Parcel ID	Units	Occupancy (sum of all buildings)	Bedrooms/Unit	Unit Bedrooms	Occupancy Bedrooms	Total Bedrooms
Gatewood	11-54		209		0	209	209
Woodgate Cir	18-13		209		0	209	209
Carriage House	52-420	46		2	92	0	92
Wynwood	69-265	87		2	174	0	174
Vintner Pl	68-67	28		2	56	0	56
Daro Dr	68-87		91		0	91	91
Nutmeg Village	88-114	16		2	32	0	32
Abbewood Dr	102-87	44		2	88	0	88
Scitico Street Condo	110-355	17		2	34	0	34
601 Hazard Ave	110-14		40		0	40	40
Meacham Dr	111-245	35		1	35	0	35
Maple Heights	82-16	45		2	90	0	90
Windsor Ct	30-17		41		0	41	41
						Sum	**3,955**

Sanitary Loading

MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-101	6,255	SMH-2523	5,622	SMH-3548	552	SMH-3872	1,109
SMH-1022	6,594	SMH-2524	7,923	SMH-3549	840	SMH-3877	355
SMH-1026	6,084	SMH-2525	5,820	SMH-3550	1,914	SMH-3877	222
SMH-1032	4,050	SMH-2545	3,114	SMH-3551	5,082	SMH-388	62
SMH-1036	5,574	SMH-2624	30	SMH-3555	132	SMH-388	177
SMH-107	2,615	SMH-2636	4,761	SMH-3556	63	SMH-3881	276
SMH-107	33,411	SMH-2636	2,280	SMH-3556	177	SMH-3881	1,071
SMH-1077	521	SMH-2777	1,860	SMH-3557	399	SMH-3901	446
SMH-1077	8,526	SMH-2780	2,547	SMH-3558	1,386	SMH-3901	756
SMH-1083	9,321	SMH-2785	2,766	SMH-3559	13,902	SMH-3902	2,279
SMH-1084	1,290	SMH-2796	271	SMH-3560	7,602	SMH-3906	333
SMH-1085	1,548	SMH-2796	1,371	SMH-3563	8,352	SMH-3907	1,596
SMH-1107	84	SMH-2799	5,823	SMH-3564	2,508	SMH-3908	354
SMH-1107	1,152	SMH-28	3,015	SMH-3565	3,593	SMH-3909	354
SMH-1108	207	SMH-2804	103	SMH-3566	457	SMH-3910	486
SMH-1110	451	SMH-2804	2,523	SMH-3567	1,350	SMH-3911	399
SMH-1110	132	SMH-2810	118	SMH-3568	260	SMH-3913	869
SMH-1112	2,130	SMH-2810	5,238	SMH-3569	1,439	SMH-3914	1,004
SMH-1115	1,287	SMH-2837	5,409	SMH-3570	121	SMH-3917	222
SMH-1117	222	SMH-2856	12	SMH-3571	861	SMH-3920	31
SMH-1118	177	SMH-2856	5,970	SMH-3574	3,566	SMH-3921	4,365
SMH-1119	1,971	SMH-2862	1,815	SMH-3575	1,905	SMH-3937	3,417
SMH-1120	354	SMH-2894	2,307	SMH-3575	441	SMH-3938	2,792
SMH-1121	1,204	SMH-2945	2,178	SMH-3576	725	SMH-3938	222
SMH-1121	399	SMH-2946	328	SMH-3576	177	SMH-3941	3,977
SMH-1122	86	SMH-2946	975	SMH-3577	3,010	SMH-3944	222
SMH-1123	4,166	SMH-2947	965	SMH-3578	2,398	SMH-3945	222
SMH-1125	354	SMH-2947	4,827	SMH-3580	1,980	SMH-3948	3,344
SMH-1126	843	SMH-2952	885	SMH-3583	1,590	SMH-3948	132
SMH-1127	2,148	SMH-2965	666	SMH-3584	1,272	SMH-3949	5,454
SMH-1128	1,860	SMH-2969	1,846	SMH-3585	132	SMH-3949	132
SMH-1129	489	SMH-2970	57	SMH-3586	8,475	SMH-3954	2,916
SMH-1130	13,478	SMH-2971	720	SMH-3588	4,878	SMH-3954	531
SMH-1130	576	SMH-2972	19,635	SMH-3589	3,060	SMH-3955	354
SMH-1154	2,211	SMH-2972	747,838	SMH-3590	11,631	SMH-3959	878
SMH-1155	1,284	SMH-2976	177	SMH-3591	2,619	SMH-3959	4,347
SMH-1156	172	SMH-2977	198	SMH-3592	9,498	SMH-3977	1,455

MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-1156	1,107	SMH-2978	177	SMH-3593	222	SMH-3978	499
SMH-1157	310	SMH-2979	354	SMH-3595	12,804	SMH-3979	138
SMH-1157	444	SMH-2985	1,197	SMH-3596	12,606	SMH-3986	1,197
SMH-1158	277	SMH-2987	934	SMH-3597	802	SMH-3987	5,670
SMH-1159	292	SMH-2990	134	SMH-3597	177	SMH-3988	85
SMH-1160	79	SMH-2992	457	SMH-3600	3,458	SMH-3988	4,521
SMH-1168	240	SMH-2993	177	SMH-3600	12,183	SMH-3989	96
SMH-1168	16,932	SMH-2994	1,016	SMH-3604	7,575	SMH-3989	399
SMH-1178	6,595	SMH-2995	177	SMH-3604	354	SMH-3990	309
SMH-1178	10,287	SMH-2996	354	SMH-3605	77	SMH-4005	1,107
SMH-1190	2,790	SMH-2997	708	SMH-3610	7,959	SMH-4012	4,332
SMH-1190	25,548	SMH-2998	1,239	SMH-3610	222	SMH-4014	177
SMH-1262	18,312	SMH-2999	4,212	SMH-3611	798	SMH-4015	1,020
SMH-1278	1,062	SMH-3000	165	SMH-3611	621	SMH-4016	3,372
SMH-1287	3,498	SMH-3000	2,586	SMH-3612	1,773	SMH-4018	1,461
SMH-1288	104	SMH-3001	399	SMH-3613	1,773	SMH-4019	1,152
SMH-1288	1,659	SMH-3002	267	SMH-3614	1,551	SMH-4067	8,679
SMH-1291	708	SMH-3008	13,749	SMH-3615	1,767	SMH-4068	4,240
SMH-1292	1,061	SMH-3030	1,329	SMH-3616	1,905	SMH-4069	10,220
SMH-1292	8,133	SMH-3031	1,596	SMH-3617	1,596	SMH-4071	5,054
SMH-1293	611	SMH-3032	1,661	SMH-3618	399	SMH-4072	22,001
SMH-1293	2,439	SMH-3032	1,638	SMH-3619	9,222	SMH-4075	6,375
SMH-1294	354	SMH-3038	489	SMH-3620	9,447	SMH-4076	874
SMH-1307	177	SMH-3040	11,748	SMH-3622	545	SMH-4077	193
SMH-1322	32,901	SMH-3041	342	SMH-3622	468	SMH-4129	6,375
SMH-1342	3,586	SMH-3041	399	SMH-3623	177	SMH-4130	2,079
SMH-1342	486	SMH-3043	806	SMH-3624	4,248	SMH-4131	2,721
SMH-1343	453	SMH-3043	1,839	SMH-3627	30,495	SMH-4132	2,625
SMH-1344	531	SMH-3047	366	SMH-3630	967	SMH-4133	2,748
SMH-1345	1,683	SMH-3047	6,408	SMH-3636	1,141	SMH-4134	118
SMH-1346	2,964	SMH-3088	1,638	SMH-3637	1,190	SMH-4134	222
SMH-1347	1,284	SMH-3102	14,211	SMH-3644	576	SMH-4136	902
SMH-1348	2,054	SMH-3104	3,321	SMH-3645	399	SMH-4136	177
SMH-1350	2,700	SMH-3105	753	SMH-3646	132	SMH-4137	3,222
SMH-1351	3,495	SMH-3106	354	SMH-3647	947	SMH-4138	2,532
SMH-1352	2,037	SMH-3107	125	SMH-3647	267	SMH-4139	3,861
SMH-1353	1,950	SMH-3107	1,020	SMH-3648	726	SMH-4140	6,719
SMH-1356	661	SMH-3108	226	SMH-3649	1,243	SMH-4140	13,665
SMH-1356	31,305	SMH-3108	399	SMH-3649	399	SMH-4223	3,588

MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-1357	3,630	SMH-3109	576	SMH-3650	3,753	SMH-4225	21,804
SMH-1358	3,408	SMH-3110	840	SMH-3650	621	SMH-4259	13,902
SMH-1404	33,732	SMH-3117	1,326	SMH-3651	604	SMH-4271	14,619
SMH-1417	1,461	SMH-3118	1,215	SMH-3653	177	SMH-4278	10,404
SMH-1418	2,700	SMH-3119	1,989	SMH-3655	4,830	SMH-4279	9,971
SMH-1419	2,214	SMH-3120	3,027	SMH-3656	531	SMH-4279	2,532
SMH-1540	708	SMH-3181	613	SMH-3657	4,392	SMH-4388	1,815
SMH-1544	18,060	SMH-3181	4,473	SMH-3658	6,429	SMH-4389	531
SMH-1545	885	SMH-3188	5,445	SMH-3659	399	SMH-4390	177
SMH-1546	354	SMH-3202	1,770	SMH-366	48,540	SMH-4391	2,616
SMH-1547	4,650	SMH-3203	1,107	SMH-3661	552	SMH-4391	354
SMH-1548	177	SMH-3205	1,701	SMH-3662	222	SMH-4397	1,815
SMH-1549	486	SMH-3206	795	SMH-3663	354	SMH-4398	502
SMH-1550	243	SMH-3207	705	SMH-3664	198	SMH-4398	177
SMH-1550	7,422	SMH-3210	972	SMH-3665	177	SMH-4399	4,092
SMH-1592	198	SMH-3211	2,055	SMH-3666	132	SMH-4400	399
SMH-1596	4,047	SMH-3212	633	SMH-3668	531	SMH-4401	66
SMH-1596	1,062	SMH-3212	2,697	SMH-3669	66	SMH-4403	9,295
SMH-1597	1,812	SMH-3213	293	SMH-367	5,451	SMH-4403	66
SMH-1597	2,301	SMH-3222	497	SMH-3670	4,290	SMH-4423	843
SMH-1598	621	SMH-3222	798	SMH-3671	177	SMH-4464	307
SMH-1599	840	SMH-3247	30,378	SMH-3675	132	SMH-4464	7,215
SMH-1600	52	SMH-3247	2,571	SMH-3676	109	SMH-4639	1,195
SMH-1600	177	SMH-3248	246	SMH-3677	2,832	SMH-4639	1,998
SMH-1601	7,923	SMH-3248	930	SMH-3678	753	SMH-4640	216
SMH-1602	190	SMH-3249	309	SMH-3680	7,101	SMH-4640	177
SMH-1602	1,152	SMH-3250	63,030	SMH-3681	177	SMH-4643	334
SMH-1605	1,635	SMH-3257	133	SMH-3682	708	SMH-4644	166
SMH-1621	621	SMH-3258	716	SMH-3683	2,169	SMH-4648	8,754
SMH-1622	177	SMH-3258	1,290	SMH-3685	73	SMH-4650	3,957
SMH-1625	222	SMH-3259	403	SMH-3685	1,950	SMH-4651	2,847
SMH-1626	486	SMH-3259	3,114	SMH-3686	576	SMH-4653	3,120
SMH-1628	177	SMH-3260	1,911	SMH-3687	177	SMH-4658	43
SMH-1635	13,719	SMH-3261	1,146	SMH-369	1,101	SMH-4658	2,895
SMH-165	86	SMH-3261	6,651	SMH-369	3,015	SMH-4659	5,169
SMH-165	1,596	SMH-3262	224	SMH-3690	933	SMH-4660	4,989
SMH-166	2,082	SMH-3262	2,583	SMH-3691	885	SMH-4661	3,735
SMH-167	4,386	SMH-3263	1,442	SMH-3692	753	SMH-4662	1,377
SMH-168	6,735	SMH-3263	5,244	SMH-3693	745	SMH-4663	196

MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-169	6,162	SMH-3264	899	SMH-3693	4,035	SMH-4663	888
SMH-1692	16,632	SMH-3264	3,330	SMH-3695	1,728	SMH-4664	177
SMH-1699	3,184	SMH-3265	444	SMH-3696	41	SMH-4665	247
SMH-1699	27,969	SMH-3266	116	SMH-3696	2,919	SMH-4666	444
SMH-170	5,805	SMH-3266	1,599	SMH-3697	41	SMH-4667	893
SMH-1700	4,170	SMH-3267	609	SMH-3697	1,155	SMH-4667	576
SMH-1701	621	SMH-3267	4,266	SMH-3698	177	SMH-4676	425
SMH-1702	1,509	SMH-3268	7,026	SMH-3699	354	SMH-4676	3,294
SMH-1703	399	SMH-3270	468	SMH-370	344	SMH-4677	1,104
SMH-1704	3,591	SMH-3270	354	SMH-370	3,660	SMH-4677	3,510
SMH-1705	798	SMH-3271	309	SMH-3701	82	SMH-4679	730
SMH-171	6,651	SMH-3313	8,157	SMH-3701	177	SMH-4679	7,995
SMH-173	6,210	SMH-3385	132	SMH-3703	41	SMH-4705	937
SMH-1757	2,568	SMH-3391	46,172	SMH-3703	531	SMH-4705	6,936
SMH-177	9,225	SMH-3391	7,446	SMH-3704	2,484	SMH-4706	3,888
SMH-1838	792	SMH-3392	3,229	SMH-3705	8,337	SMH-4707	891
SMH-1839	52	SMH-3397	7,296	SMH-3707	5,247	SMH-4708	400
SMH-1840	264	SMH-3397	222	SMH-371	5,850	SMH-4708	846
SMH-1841	843	SMH-3401	1,861	SMH-3710	663	SMH-4718	2,349
SMH-1842	3,513	SMH-3401	1,197	SMH-3713	354	SMH-473	295
SMH-1843	9	SMH-3403	132	SMH-3716	177	SMH-473	177
SMH-1843	5,004	SMH-3404	177	SMH-3717	222	SMH-4731	21,597
SMH-1844	5,109	SMH-3405	2,568	SMH-3718	177	SMH-4732	1,013
SMH-1845	3,429	SMH-3406	2,259	SMH-3719	444	SMH-4748	266
SMH-1846	1,596	SMH-3408	413	SMH-372	203	SMH-4748	2,265
SMH-1847	475	SMH-3409	5,532	SMH-372	3,285	SMH-4749	210
SMH-1847	222	SMH-3410	396	SMH-3720	132	SMH-4749	1,512
SMH-1848	399	SMH-3411	885	SMH-3722	66	SMH-4750	227
SMH-1849	2,223	SMH-3412	177	SMH-3723	4,554	SMH-4750	444
SMH-1850	47	SMH-3413	1,815	SMH-3727	10,098	SMH-4752	33
SMH-1851	1,168	SMH-3414	3,474	SMH-3728	198	SMH-4752	399
SMH-1852	532	SMH-3418	36	SMH-3729	105	SMH-4753	4,554
SMH-1853	143	SMH-3418	1,596	SMH-3729	576	SMH-4754	388
SMH-1854	16	SMH-3428	177	SMH-373	407	SMH-4754	264
SMH-1856	50	SMH-3429	1,947	SMH-373	666	SMH-4756	843
SMH-1857	211	SMH-3430	708	SMH-374	7,723	SMH-4801	56
SMH-1858	6,864	SMH-3431	576	SMH-374	1,332	SMH-4813	200
SMH-1859	3,498	SMH-3432	796	SMH-3741	516	SMH-4813	1,782
SMH-1860	2,178	SMH-3436	621	SMH-3741	4,650	SMH-4821	2,661

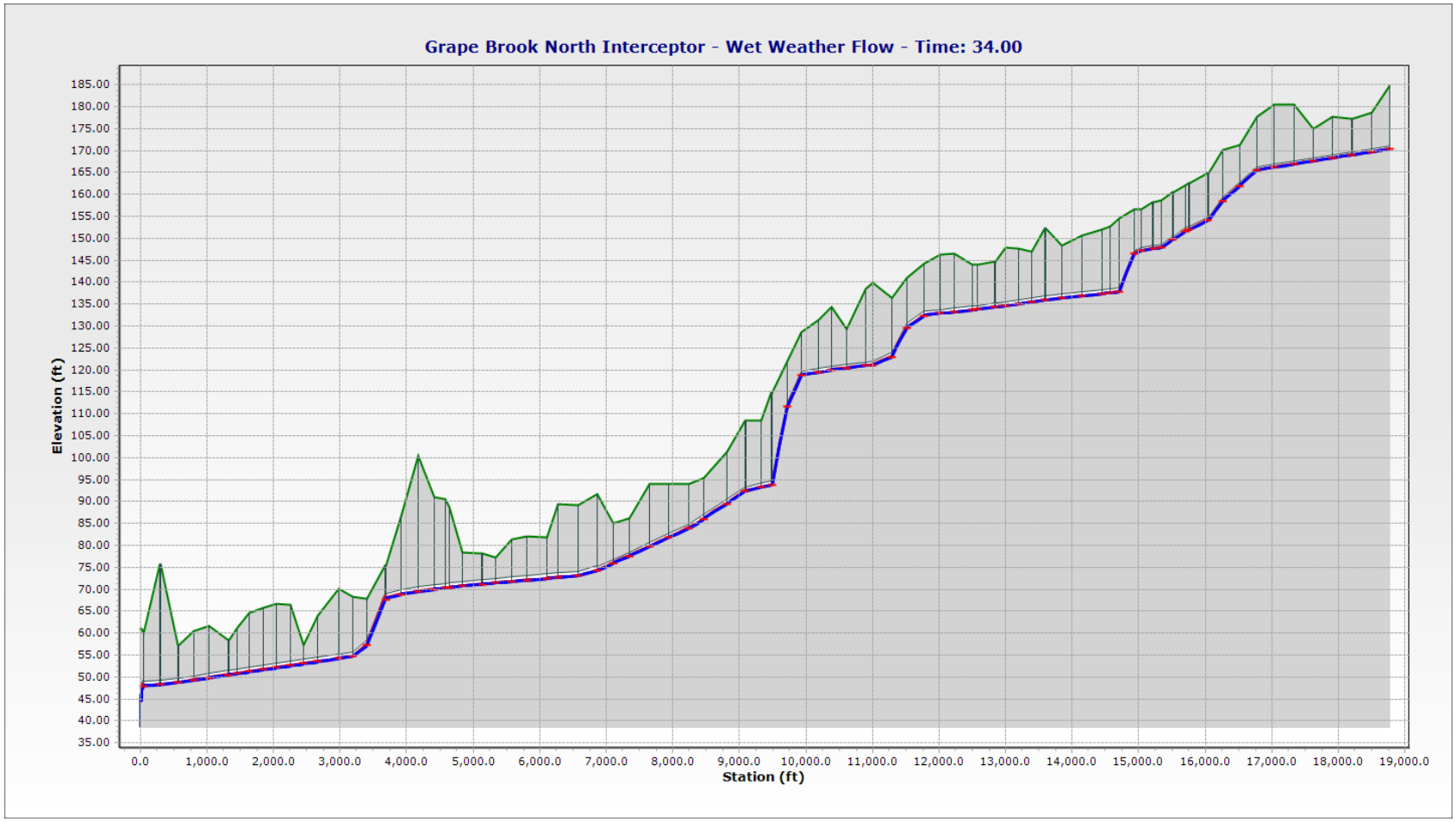
MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-1861	1,122	SMH-3437	262	SMH-3744	708	SMH-4823	1,821
SMH-1865	22	SMH-3437	17,733	SMH-3745	444	SMH-4832	8,566
SMH-1865	936	SMH-3438	316	SMH-3746	4,996	SMH-4835	399
SMH-1867	928	SMH-3438	10,134	SMH-3746	177	SMH-489	3,276
SMH-1867	1,155	SMH-3439	3,363	SMH-3749	531	SMH-516	1,461
SMH-1868	438	SMH-3440	3,141	SMH-3750	868	SMH-521	1,242
SMH-1868	1,551	SMH-3441	222	SMH-3751	267	SMH-522	454
SMH-1869	1,122	SMH-3442	1,374	SMH-3752	1,062	SMH-522	177
SMH-1869	309	SMH-3443	621	SMH-3754	132	SMH-523	7,869
SMH-19	1,950	SMH-3444	264	SMH-3755	975	SMH-524	177
SMH-1910	3,810	SMH-3445	224	SMH-3756	2,034	SMH-526	354
SMH-1910	354	SMH-3445	16,140	SMH-3760	543	SMH-527	708
SMH-1911	132	SMH-3446	1,374	SMH-3760	798	SMH-528	2,877
SMH-1912	222	SMH-3447	600	SMH-3761	132	SMH-529	2,346
SMH-1913	258	SMH-3448	2,372	SMH-3762	177	SMH-530	2,568
SMH-193	53,112	SMH-3448	1,905	SMH-3763	3,918	SMH-531	1,239
SMH-1931	576	SMH-3449	132	SMH-3765	399	SMH-532	663
SMH-1932	399	SMH-3453	177	SMH-3766	698	SMH-573	34
SMH-1933	354	SMH-3456	2,310	SMH-3767	1,020	SMH-573	22,515
SMH-1934	1,629	SMH-3458	68	SMH-3768	3,346	SMH-590	2,086
SMH-1935	226	SMH-3458	444	SMH-3768	177	SMH-590	1,992
SMH-1936	60	SMH-3459	4,950	SMH-3769	178	SMH-591	1,464
SMH-1937	542	SMH-3459	1,725	SMH-3769	3,315	SMH-592	354
SMH-194	2,085	SMH-3460	222	SMH-3771	1,642	SMH-593	354
SMH-1945	484	SMH-3461	222	SMH-3771	666	SMH-595	3,099
SMH-1946	4,630	SMH-3462	5,406	SMH-3772	708	SMH-596	4,074
SMH-1962	2,172	SMH-3463	351	SMH-3773	1,107	SMH-597	186
SMH-1983	2,172	SMH-3463	4,560	SMH-3774	771	SMH-597	2,439
SMH-1995	9,123	SMH-3464	651	SMH-3774	222	SMH-603	1,464
SMH-1996	328	SMH-3464	3,894	SMH-3775	177	SMH-604	1,596
SMH-1996	2,037	SMH-3465	126	SMH-3776	1,436	SMH-605	1,020
SMH-2004	11,574	SMH-3465	2,922	SMH-3776	354	SMH-606	1,773
SMH-2008	8,856	SMH-3466	2,347	SMH-3777	354	SMH-615	354
SMH-2009	708	SMH-3466	5,898	SMH-3778	172	SMH-616	3,105
SMH-2025	4,094	SMH-3467	3,860	SMH-3778	11,661	SMH-617	6,219
SMH-2025	19,713	SMH-3468	1,254	SMH-3779	1,110	SMH-618	2,291
SMH-2031	2,394	SMH-3469	20,249	SMH-3780	4,386	SMH-618	4,335
SMH-2032	1,197	SMH-3470	330	SMH-3781	235	SMH-619	399
SMH-2033	2,217	SMH-3471	397	SMH-3781	2,970	SMH-620	843

MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-2034	2,394	SMH-3472	2,124	SMH-3782	2,264	SMH-621	1,419
SMH-2035	1,065	SMH-3473	64	SMH-3782	7,683	SMH-623	222
SMH-2036	1,239	SMH-3473	3,189	SMH-3784	398	SMH-624	7,920
SMH-2038	354	SMH-3474	348	SMH-3786	461	SMH-625	2,616
SMH-2039	1,551	SMH-3474	6,993	SMH-3787	615	SMH-626	933
SMH-2040	1,995	SMH-3475	1,831	SMH-3787	5,652	SMH-627	222
SMH-2041	3,696	SMH-3475	9,444	SMH-3788	977	SMH-63	12,015
SMH-2042	177	SMH-3476	1,048	SMH-3789	222	SMH-64	4,077
SMH-2047	711	SMH-3476	7,539	SMH-3790	2,052	SMH-646	2,886
SMH-2052	3,105	SMH-3477	178	SMH-3790	3,777	SMH-647	14,625
SMH-2053	2,085	SMH-3477	3,672	SMH-3791	1,300	SMH-648	2,748
SMH-2079	399	SMH-3478	5,883	SMH-3792	337	SMH-649	2,439
SMH-209	978	SMH-3479	135	SMH-3793	473	SMH-650	2,838
SMH-209	23,811	SMH-3479	753	SMH-3794	239	SMH-658	598
SMH-2090	4,338	SMH-3480	1,453	SMH-3795	2,904	SMH-658	20,073
SMH-2091	621	SMH-3480	7,935	SMH-3801	1,065	SMH-671	750
SMH-2092	930	SMH-3481	1,016	SMH-3803	1,020	SMH-672	222
SMH-2093	2,835	SMH-3481	1,686	SMH-3804	1,020	SMH-673	222
SMH-2118	4,405	SMH-3482	15,773	SMH-3805	12,267	SMH-674	5,675
SMH-2118	24,120	SMH-3482	7,881	SMH-3806	2,796	SMH-704	1,863
SMH-2127	1,329	SMH-3483	2,467	SMH-3807	2,928	SMH-705	1,020
SMH-2128	1,461	SMH-3483	798	SMH-3808	1,644	SMH-706	1,950
SMH-2130	2,571	SMH-3484	10,187	SMH-3809	798	SMH-707	8,772
SMH-2131	2,616	SMH-3484	2,298	SMH-3810	666	SMH-708	177
SMH-2132	753	SMH-3485	63	SMH-3811	621	SMH-709	222
SMH-2157	5,844	SMH-3485	3,981	SMH-3812	93	SMH-710	177
SMH-2158	350	SMH-3486	1,152	SMH-3812	8,142	SMH-711	576
SMH-2158	1,947	SMH-3487	840	SMH-3813	444	SMH-712	1,110
SMH-2159	4,836	SMH-3488	177	SMH-3814	222	SMH-713	222
SMH-2160	12,354	SMH-3489	2,418	SMH-3816	531	SMH-714	177
SMH-2161	1,107	SMH-3490	2,793	SMH-3817	2,238	SMH-715	222
SMH-2162	6,861	SMH-3491	708	SMH-3818	663	SMH-716	975
SMH-2179	8,877	SMH-3496	684	SMH-3819	399	SMH-718	12,888
SMH-2191	5,622	SMH-3497	1,503	SMH-3820	666	SMH-719	1,683
SMH-2197	1,770	SMH-3498	2,571	SMH-3821	7,464	SMH-733	28,659
SMH-2206	2,172	SMH-3499	399	SMH-3824	177	SMH-734	5,094
SMH-2212	11,082	SMH-3500	11,196	SMH-3825	399	SMH-735	5,541
SMH-2213	1,377	SMH-3501	1,437	SMH-3826	1,020	SMH-736	4,077
SMH-2214	2,883	SMH-3502	486	SMH-3827	843	SMH-737	1,905

MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-2223	5,406	SMH-3503	2,793	SMH-3828	2,037	SMH-738	399
SMH-2232	16,722	SMH-3504	1,239	SMH-3829	206	SMH-739	6,690
SMH-2270	399	SMH-3505	3,372	SMH-3830	2,706	SMH-740	1,551
SMH-2271	1,083	SMH-3506	3,240	SMH-3831	444	SMH-741	1,686
SMH-2272	3,321	SMH-3507	2,796	SMH-3832	1,776	SMH-742	621
SMH-2275	548	SMH-3508	930	SMH-3833	7,974	SMH-743	399
SMH-2275	17,670	SMH-3509	1,065	SMH-3834	3,588	SMH-745	550
SMH-2278	1,149	SMH-3510	19,470	SMH-3835	4,452	SMH-745	753
SMH-2332	1,958	SMH-3511	177	SMH-3836	20,874	SMH-768	3,778
SMH-2332	7,392	SMH-3512	22,968	SMH-3837	1,242	SMH-768	11,142
SMH-2381	975	SMH-3513	798	SMH-3839	798	SMH-853	7,662
SMH-2383	4,737	SMH-3514	6,864	SMH-3840	1,419	SMH-855	6,513
SMH-2384	5,757	SMH-3515	198	SMH-3841	4,482	SMH-890	2,988
SMH-2385	4,470	SMH-3516	222	SMH-3842	222	SMH-890	27,717
SMH-2386	3,450	SMH-3517	177	SMH-3843	7,173	SMH-93	3,015
SMH-2387	8,409	SMH-3518	12,804	SMH-3844	309	SMH-940	43,788
SMH-2388	1,725	SMH-3520	621	SMH-3845	177	SMH-941	4,695
SMH-2389	3,495	SMH-3521	2,526	SMH-3846	354	SMH-952	70
SMH-2390	1,992	SMH-3522	2,874	SMH-3847	621	SMH-952	1,596
SMH-2400	4,158	SMH-3523	1,638	SMH-3848	843	SMH-963	7
SMH-2401	4,467	SMH-3524	3,807	SMH-3849	4,563	SMH-963	14,763
SMH-2402	4,161	SMH-3525	5,409	SMH-3850	1,686	SMH-969	1,332
SMH-2419	7,395	SMH-3526	7,044	SMH-3851	5,007	SMH-978	1,152
SMH-2430	2,613	SMH-3527	86	SMH-3852	3,456	SMH-986	4,920
SMH-2459	2,388	SMH-3527	3,543	SMH-3854	2,349	SMH-987	5,847
SMH-2460	1,107	SMH-3529	769	SMH-3855	6,426	SMH-988	3,366
SMH-2461	132	SMH-3529	357	SMH-3856	3,699	SMH-989	1,905
SMH-2463	48	SMH-3530	3,422	SMH-3857	1,551	SMH-990	354
SMH-2463	1,416	SMH-3530	2,643	SMH-3858	10,146	WC-1	2,400
SMH-2464	753	SMH-3532	3,504	SMH-3859	132	WC-2	1,402
SMH-2465	309	SMH-3533	5,484	SMH-3860	354	WC-2	8,892
SMH-2466	708	SMH-3534	1,122	SMH-3861	222	WC-3	8,214
SMH-2506	235	SMH-3535	399	SMH-3862	3,900	WC-4	7,266
SMH-2506	2,523	SMH-3536	843	SMH-3866	956	WC-5	218
SMH-2507	3,633	SMH-3537	1,905	SMH-3866	2,853	WC-5	8,349
SMH-2508	157	SMH-3540	1,335	SMH-3867	2,008	WC-6	368
SMH-2508	4,740	SMH-3540	6,198	SMH-3867	579	WC-7	725
SMH-2509	354	SMH-3541	177	SMH-3868	478	WC-7	1,734
SMH-2510	9,870	SMH-3543	253	SMH-3869	464	WC-8	221

MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)	MH ID	Load (gpd)
SMH-2511	708	SMH-3543	402	SMH-3869	6,306	WC-8	2,139
SMH-2512	2,634	SMH-3544	177	SMH-3870	1,668	WC-9	1,440
SMH-2514	885	SMH-3545	5,400	SMH-3870	4,536		

APPENDIX B: INTERCEPTOR PROFILES


Grape Brook North Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
185.00
180.00
175.00
170.00
165.00
160.00
155.00
150.00
145.00
140.00
135.00
130.00
125.00
120.00
115.00
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
0.0
1,000.0
2,000.0
3,000.0
4,000.0
5,000.0
6,000.0
7,000.0
8,000.0
9,000.0
10,000.0
11,000.0
12,000.0
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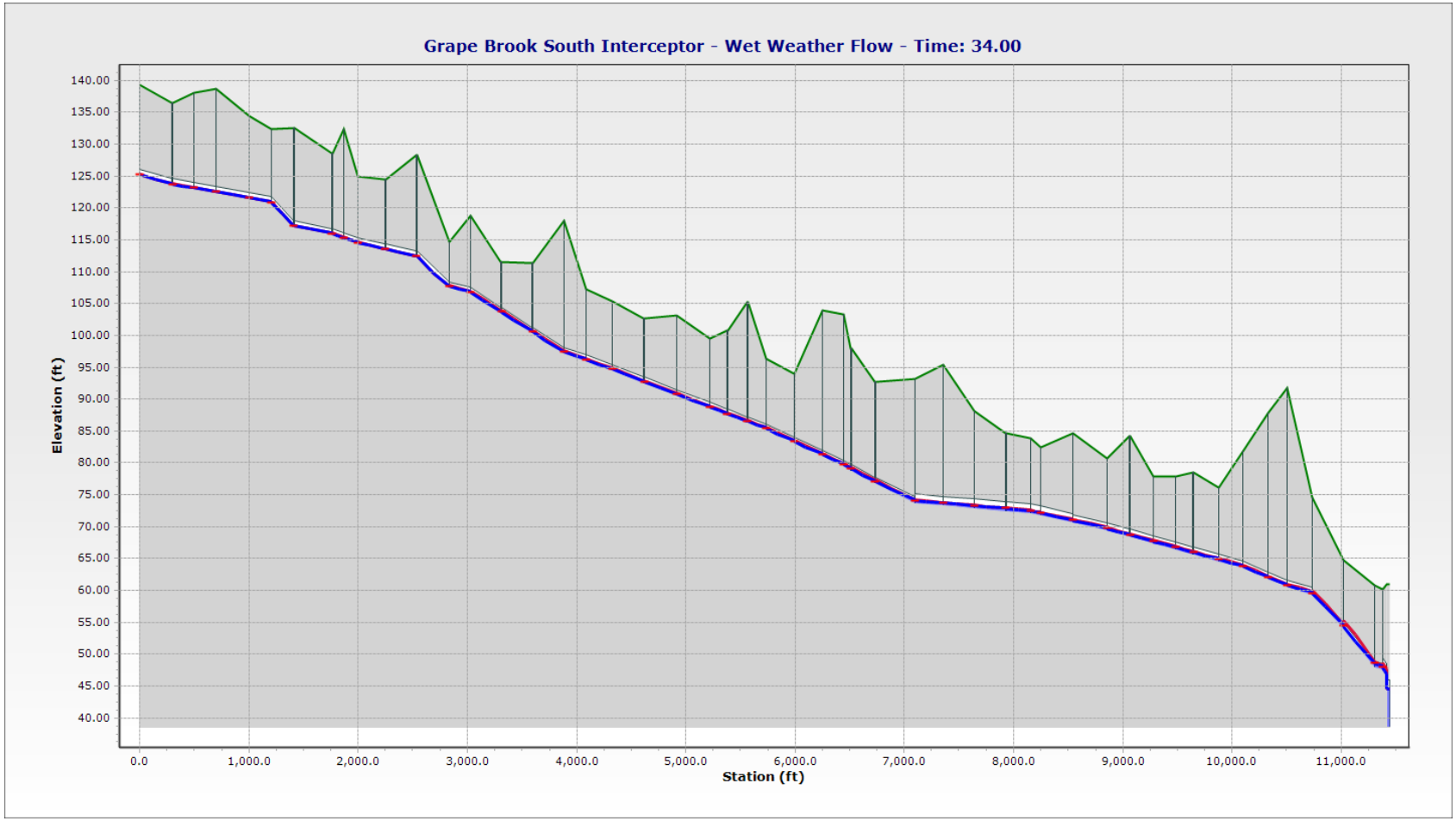
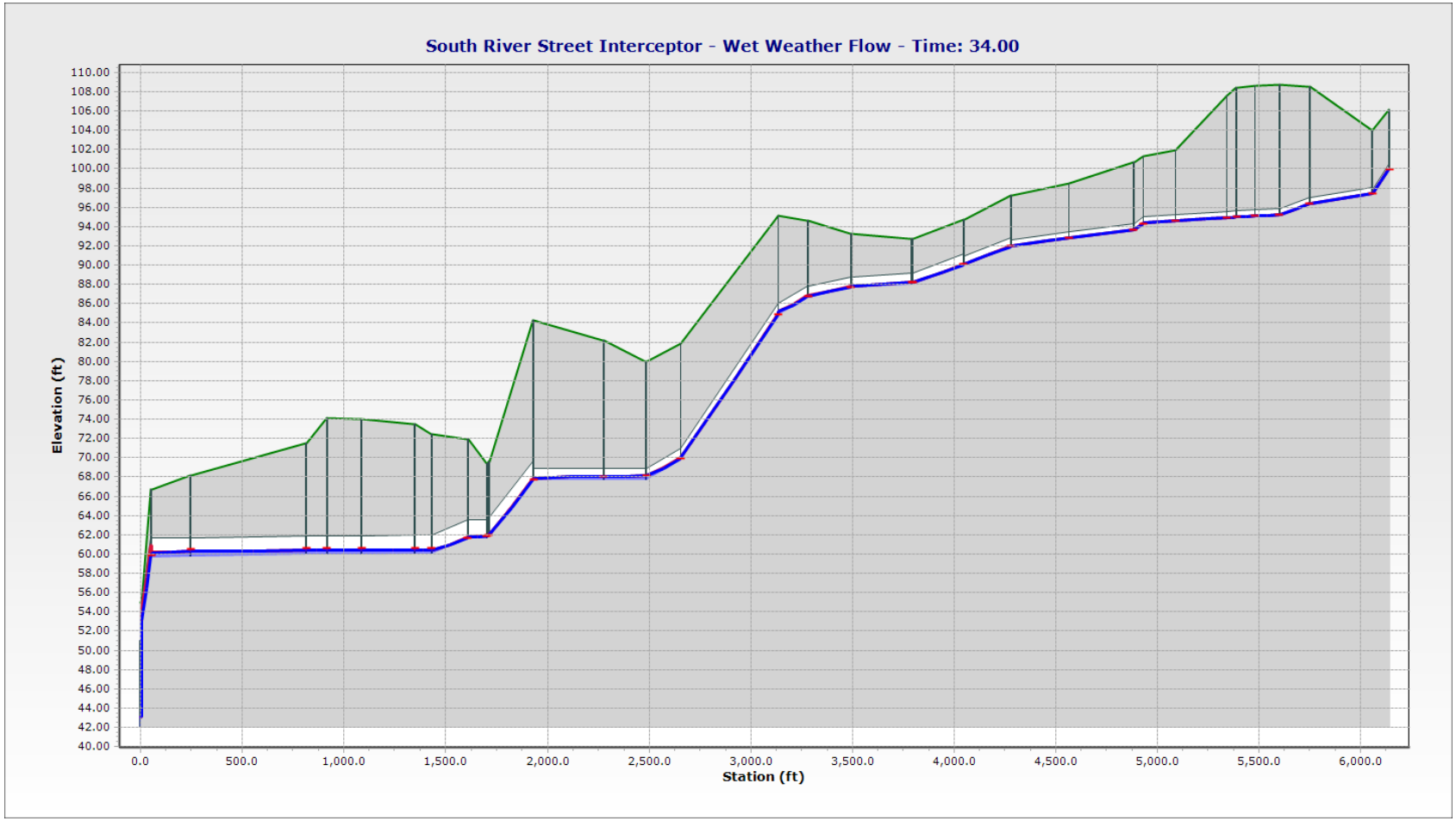
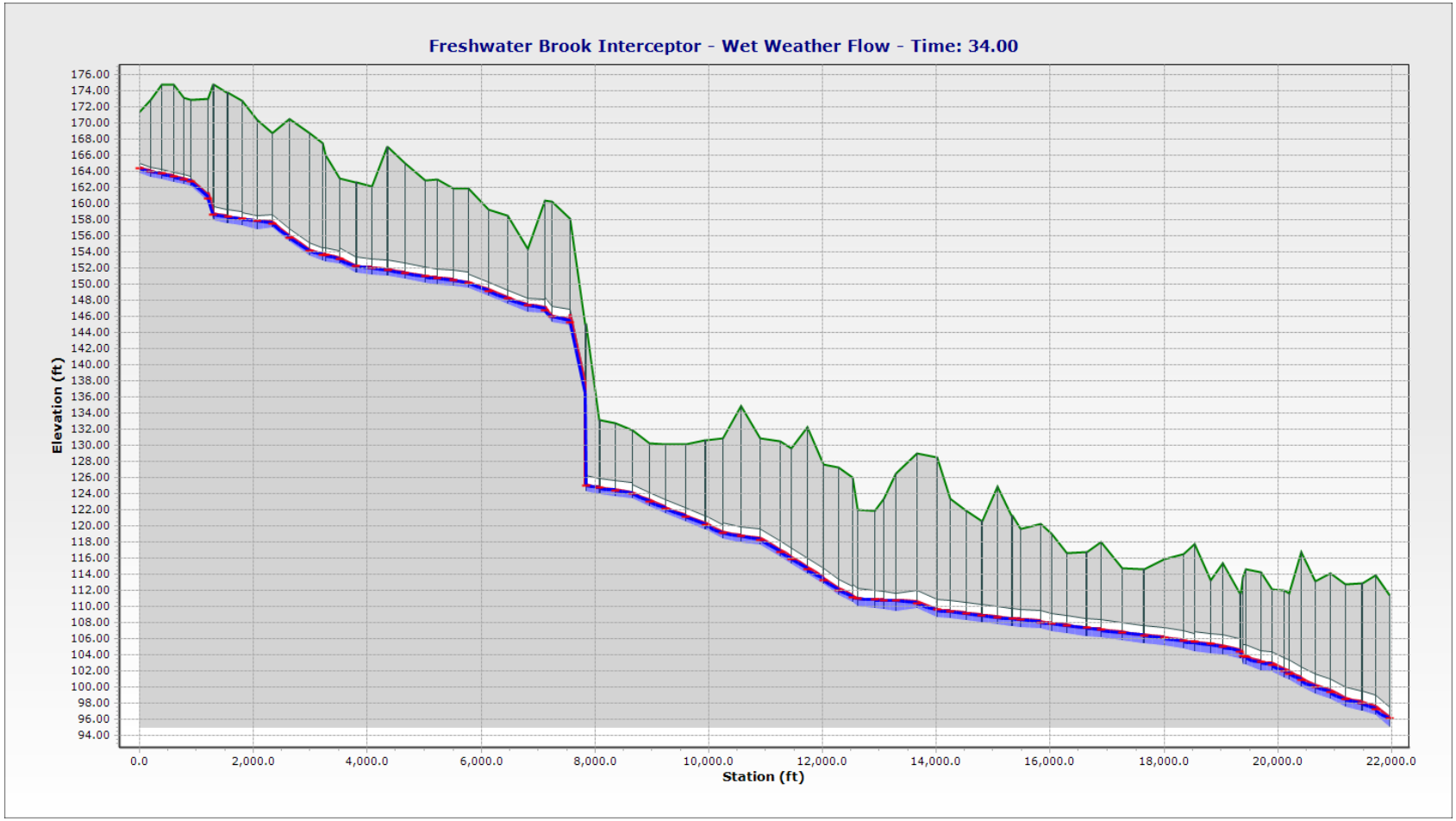
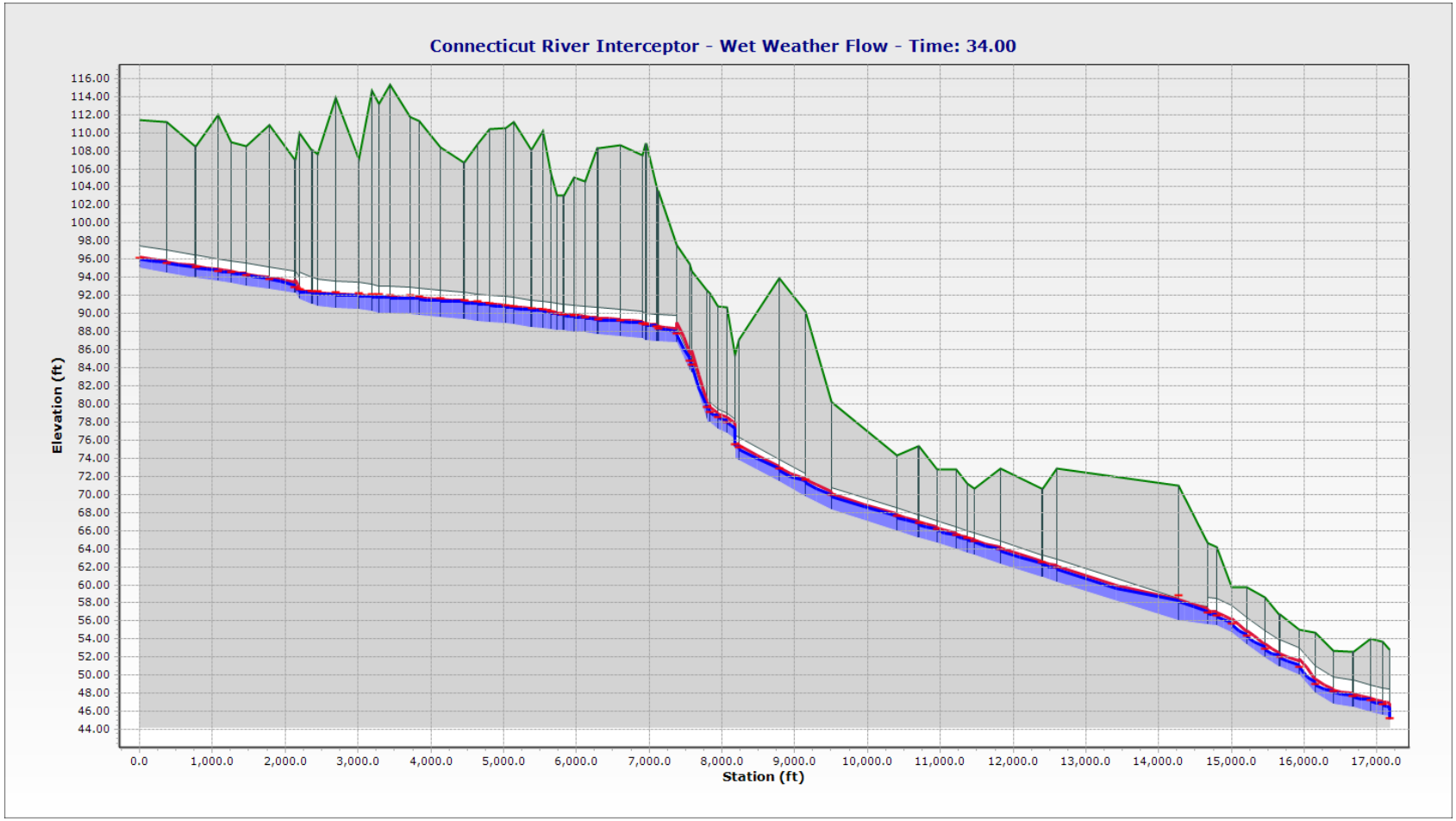
14,000.0
15,000.0
16,000.0
17,000.0
18,000.0
19,000.0
Station (ft)


Grape Brook South Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
140.00
135.00
130.00
125.00
120.00
115.00
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
0.0
1,000.0
2,000.0
3,000.0
4,000.0
5,000.0
6,000.0
7,000.0
8,000.0
9,000.0
10,000.0
11,000.0
Station (ft)


South River Street Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
110.00
108.00
106.00
104.00
102.00
100.00
98.00
96.00
94.00
92.00
90.00
88.00
86.00
84.00
82.00
80.00
78.00
76.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
60.00
58.00
56.00
54.00
52.00
50.00
48.00
46.00
44.00
42.00
40.00
0.0
500.0
1,000.0
1,500.0
2,000.0
2,500.0
3,000.0
3,500.0
4,000.0
4,500.0
5,000.0
5,500.0
6,000.0
Station (ft)


Freshwater Brook Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
176.00
174.00
172.00
170.00
168.00
166.00
164.00
162.00
160.00
158.00
156.00
154.00
152.00
150.00
148.00
146.00
144.00
142.00
140.00
138.00
136.00
134.00
132.00
130.00
128.00
126.00
124.00
122.00
120.00
118.00
116.00
114.00
112.00
110.00
108.00
106.00
104.00
102.00
100.00
98.00
96.00
94.00
0.0
2,000.0
4,000.0
6,000.0
8,000.0
10,000.0
12,000.0
14,000.0
16,000.0
18,000.0
20,000.0
22,000.0
Station (ft)


Connecticut River Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
116.00
114.00
112.00
110.00
108.00
106.00
104.00
102.00
100.00
98.00
96.00
94.00
92.00
90.00
88.00
86.00
84.00
82.00
80.00
78.00
76.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
60.00
58.00
56.00
54.00
52.00
50.00
48.00
46.00
44.00
0.0
1,000.0
2,000.0
3,000.0
4,000.0
5,000.0
6,000.0
7,000.0
8,000.0
9,000.0
10,000.0
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12,000.0
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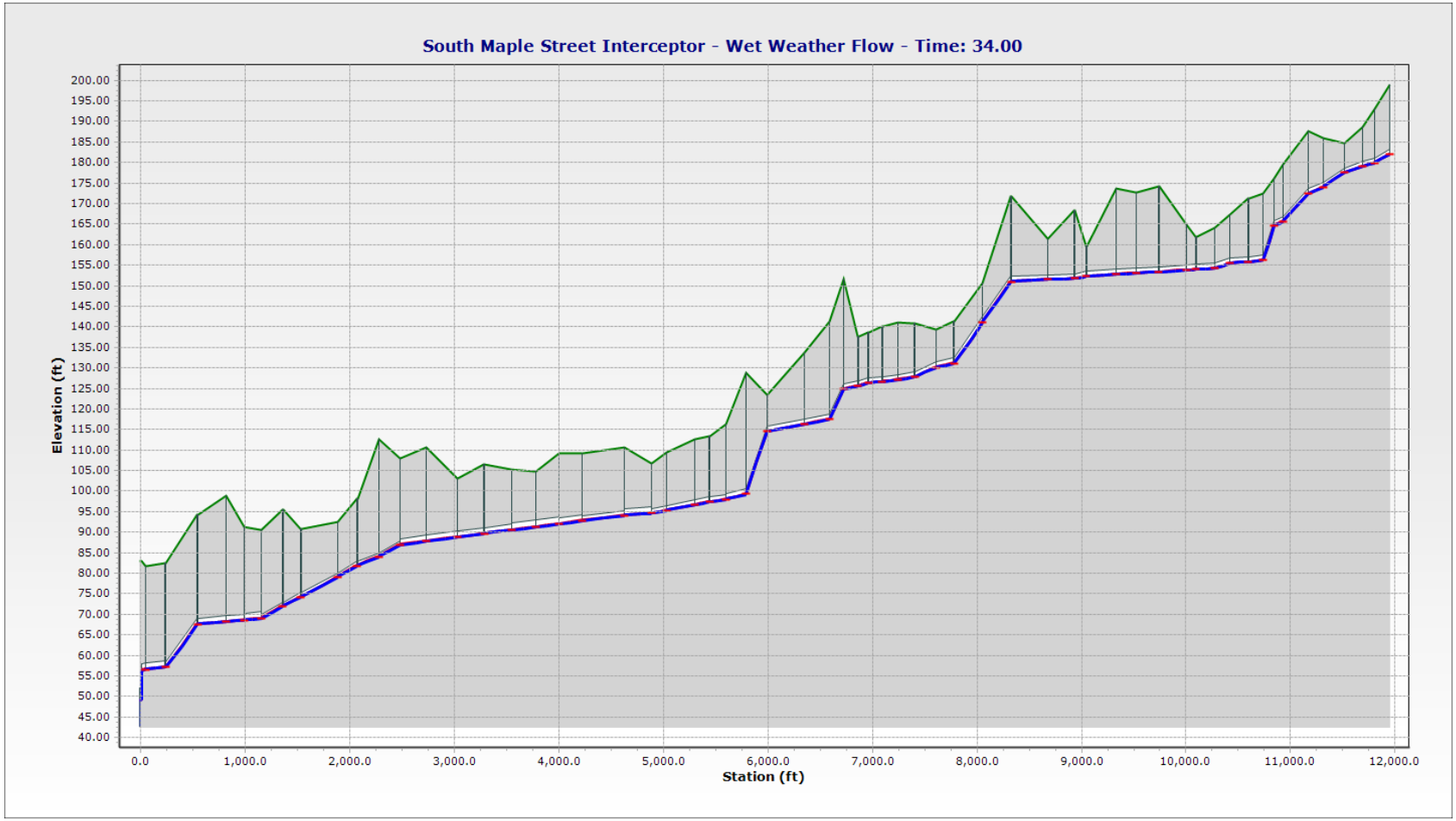
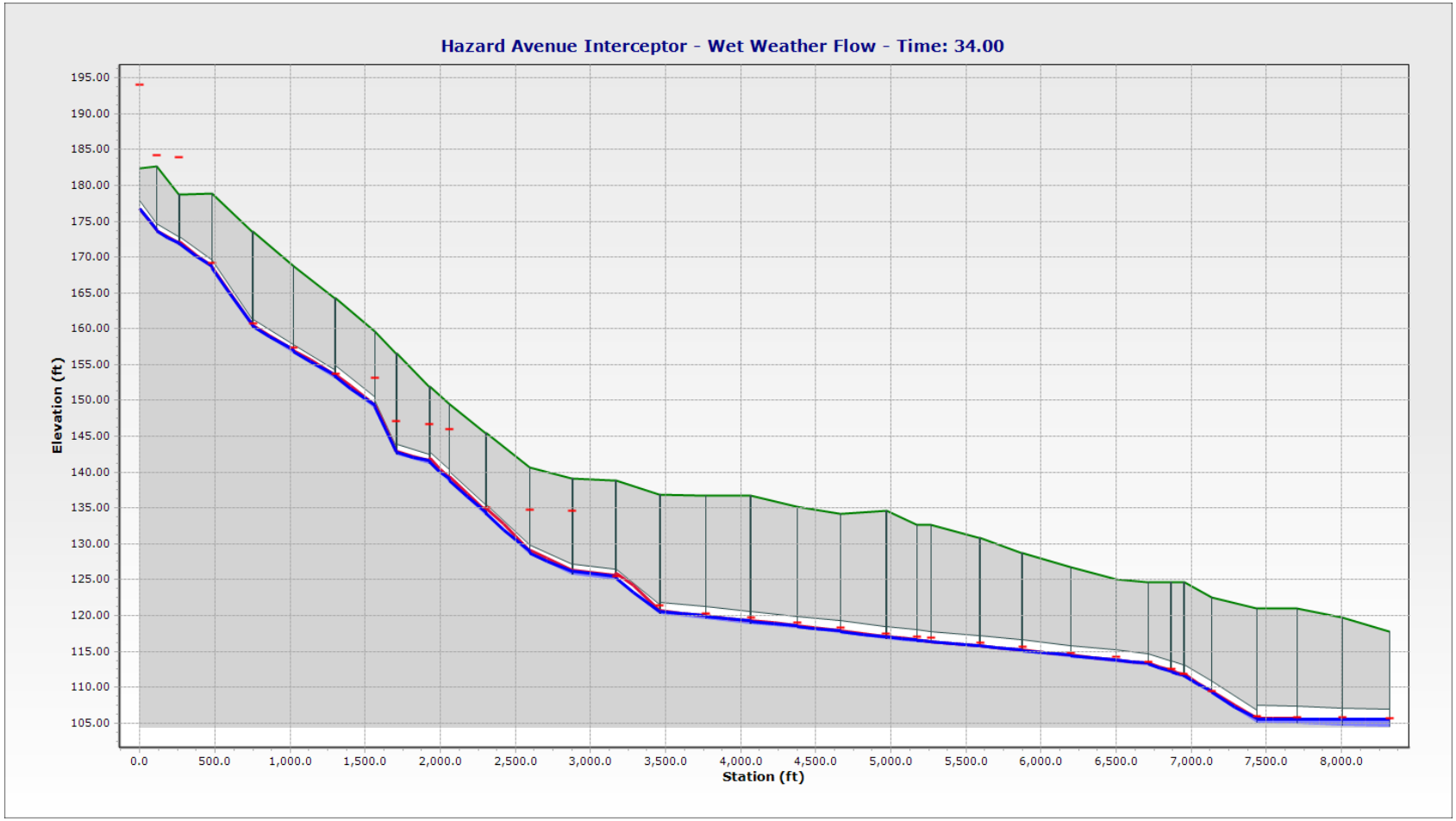
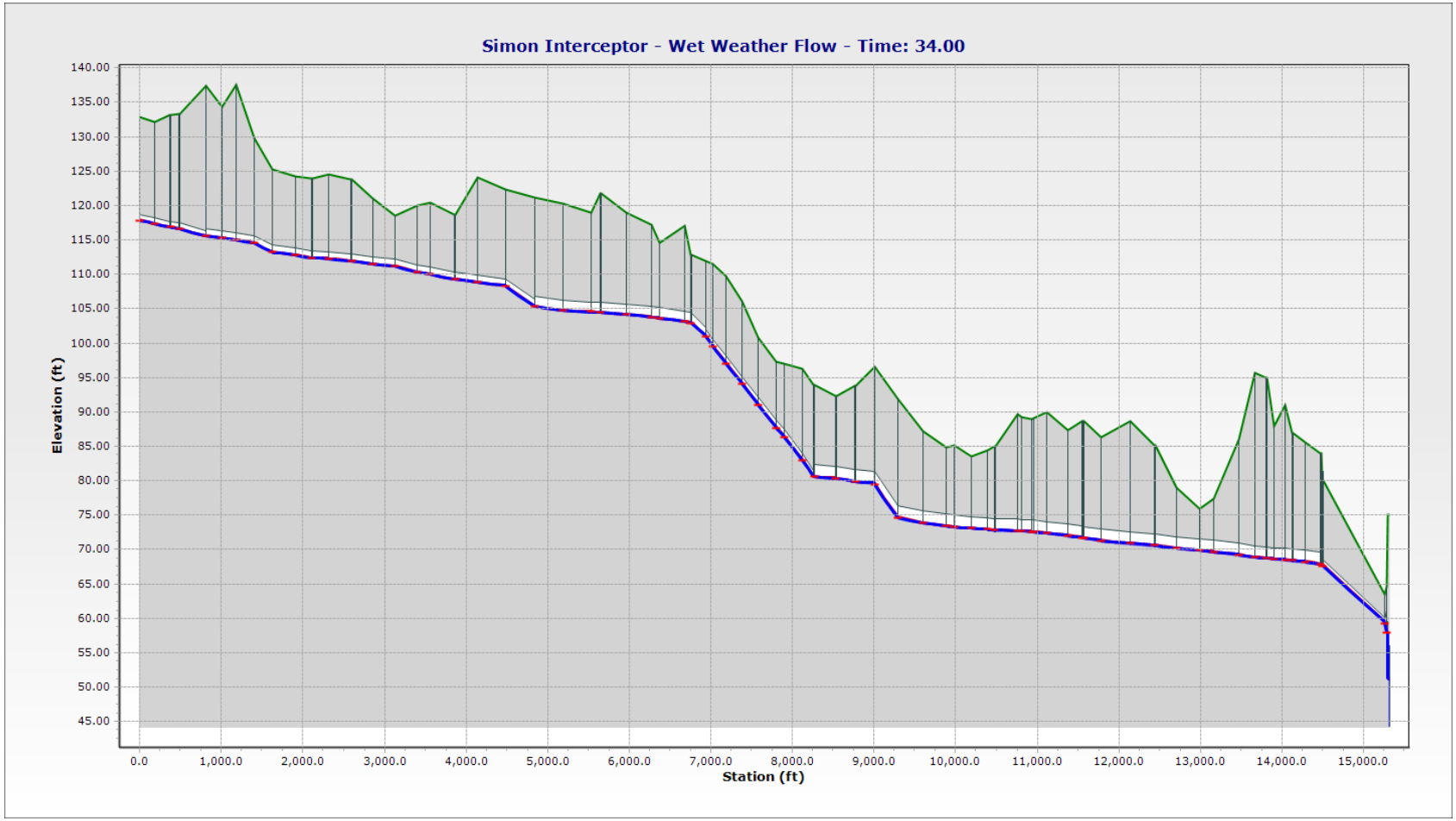
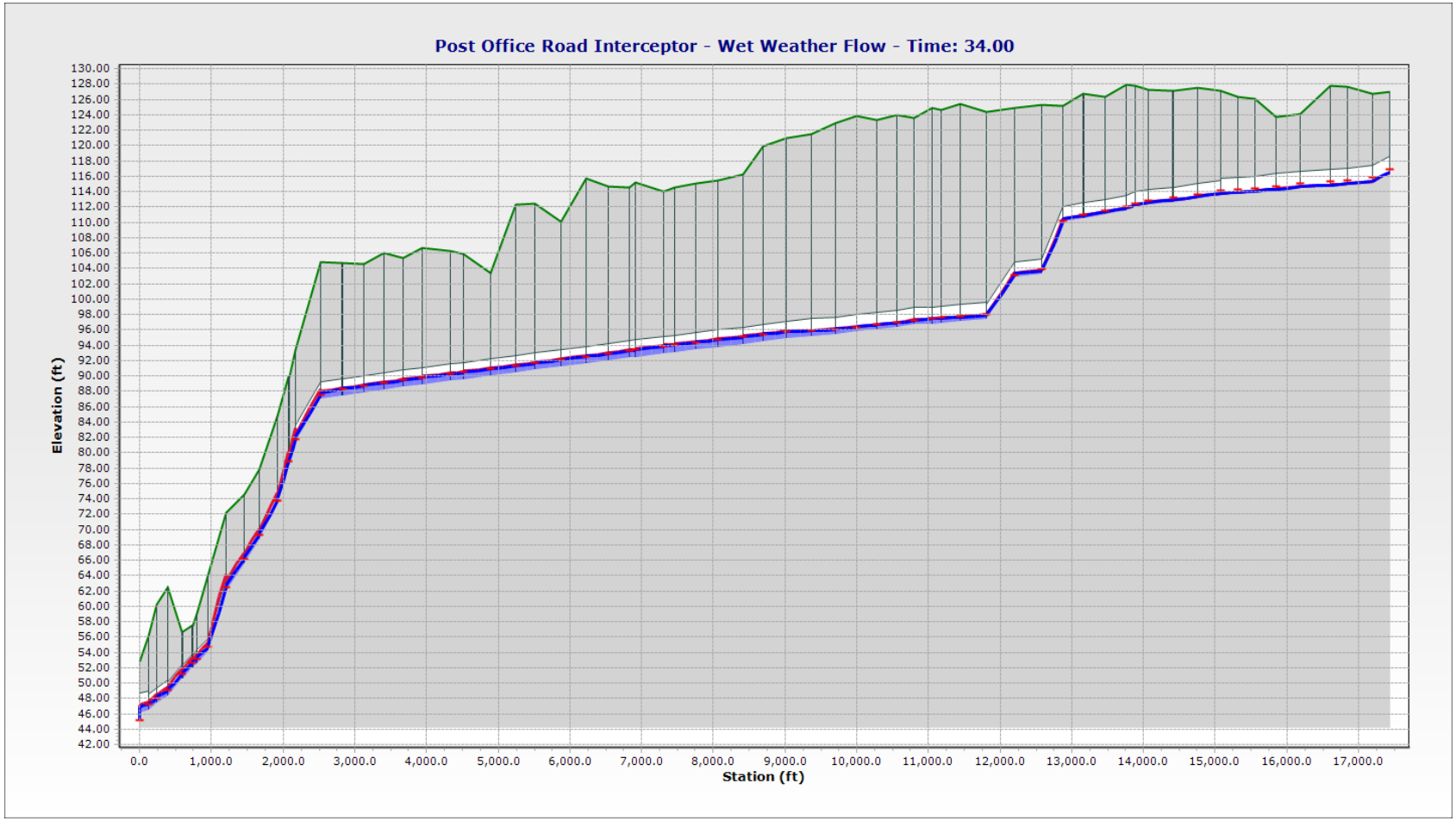
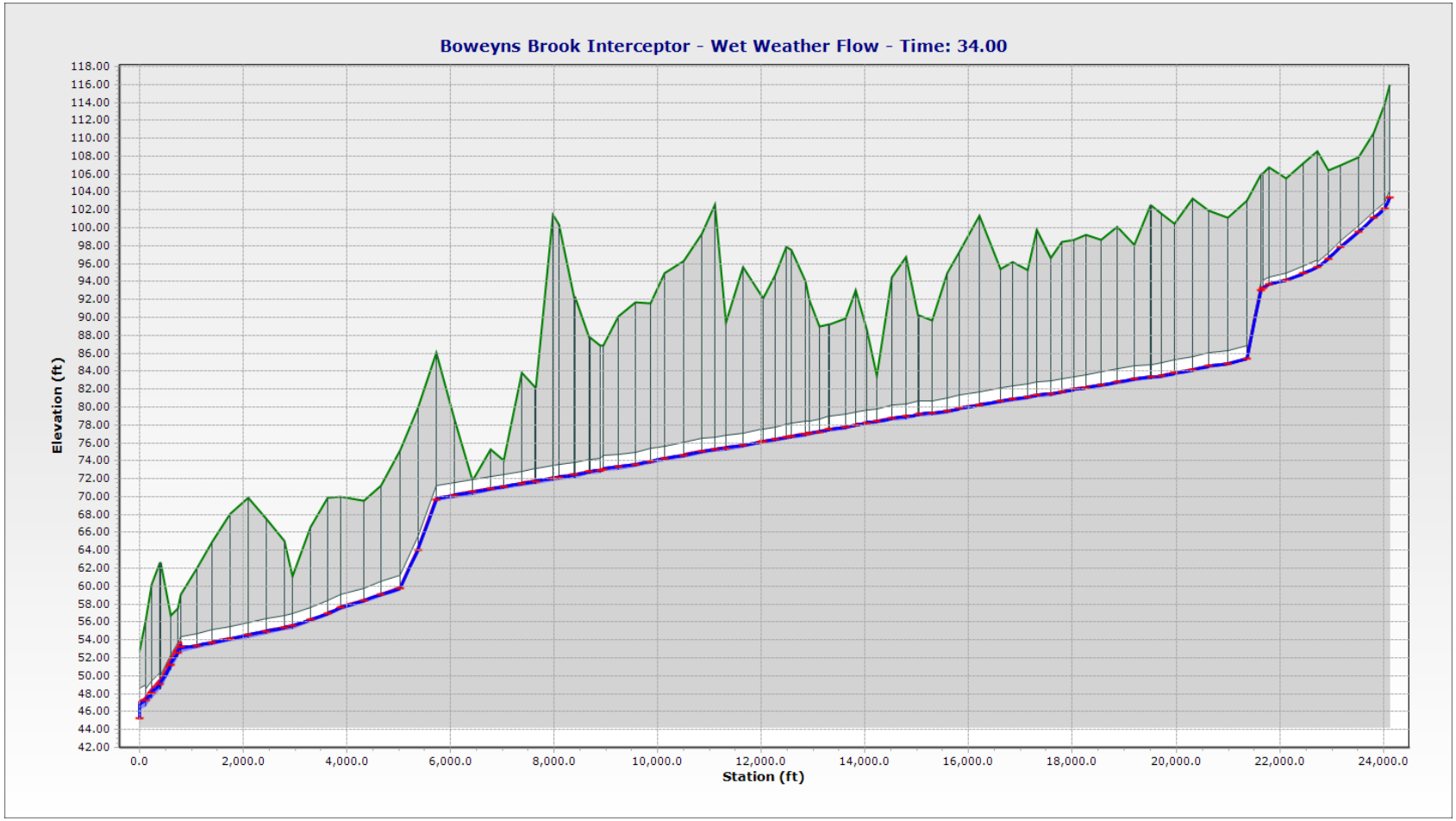
14,000.0
15,000.0
16,000.0
17,000.0
Station (ft)

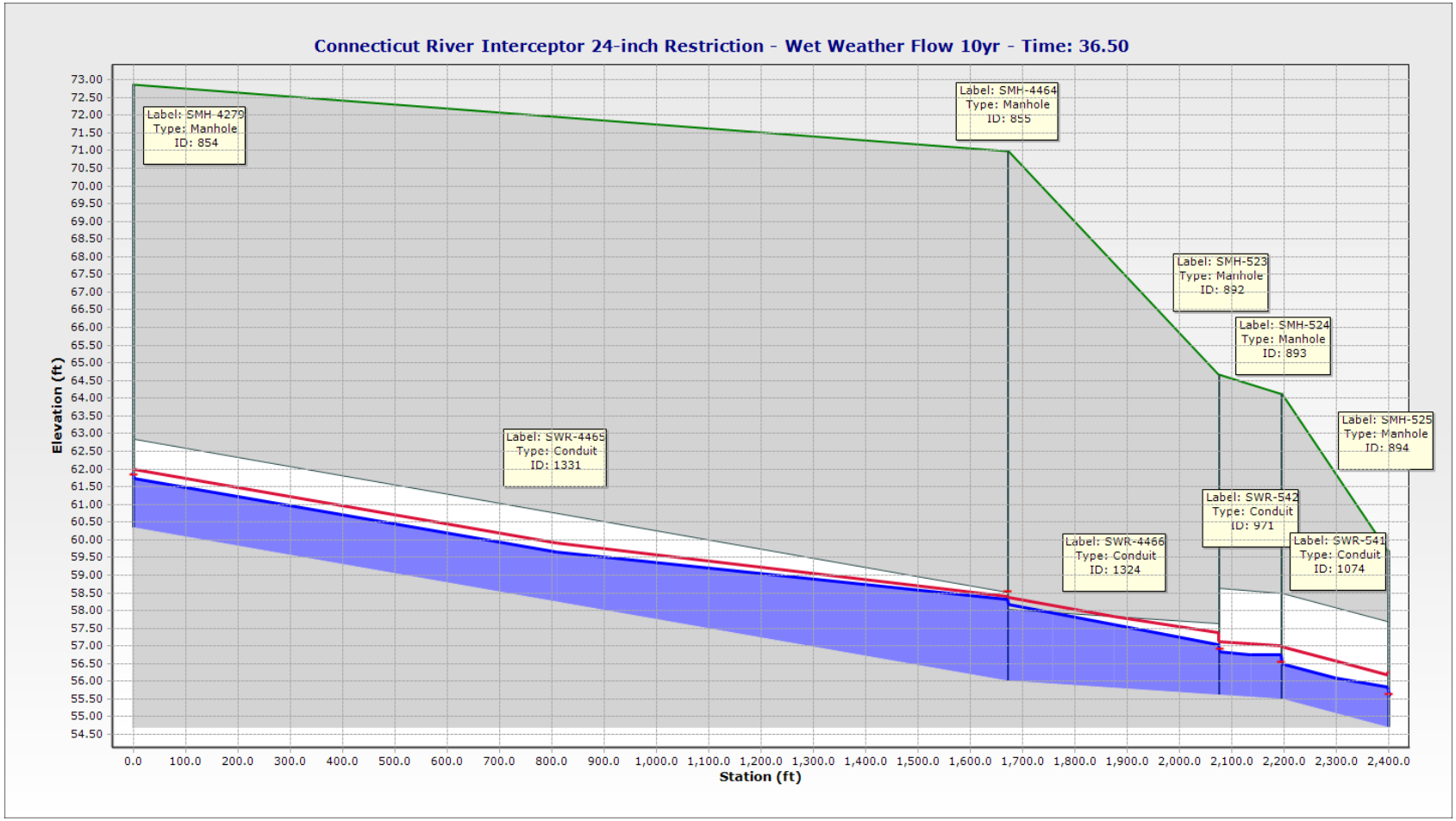

South Maple Street Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
200.00
195.00
190.00
185.00
180.00
175.00
170.00
165.00
160.00
155.00
150.00
145.00
140.00
135.00
130.00
125.00
120.00
115.00
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
0.0
1,000.0
2,000.0
3,000.0
4,000.0
5,000.0
6,000.0
7,000.0
8,000.0
9,000.0
10,000.0
11,000.0
12,000.0
Station (ft)

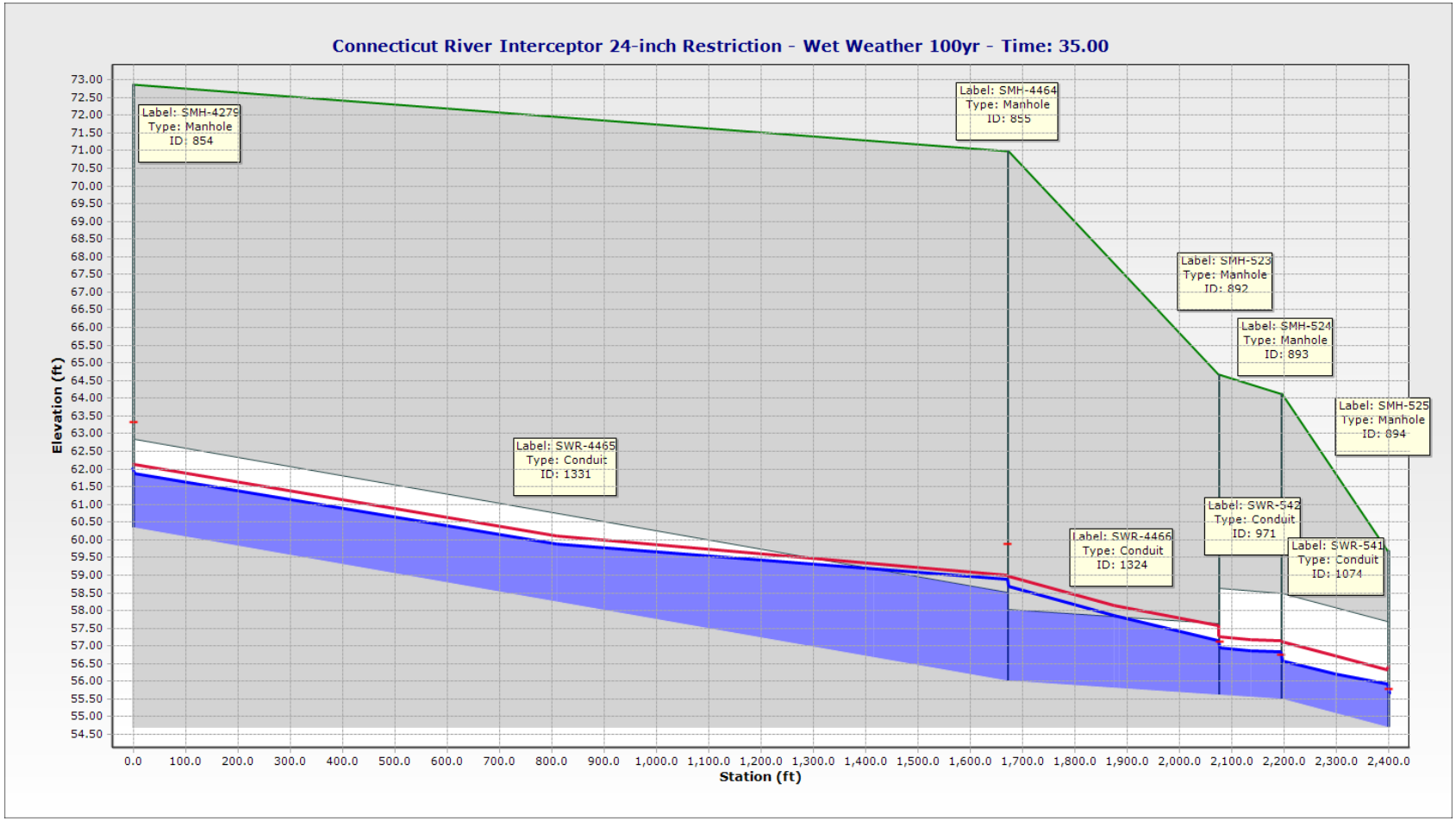

Hazard Avenue Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
195.00
190.00
185.00
180.00
175.00
170.00
165.00
160.00
155.00
150.00
145.00
140.00
135.00
130.00
125.00
120.00
115.00
110.00
105.00
0.0
500.0
1,000.0
1,500.0
2,000.0
2,500.0
3,000.0
3,500.0
4,000.0
4,500.0
5,000.0
5,500.0
6,000.0
6,500.0
7,000.0
7,500.0
8,000.0
Station (ft)


Simon Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
140.00
135.00
130.00
125.00
120.00
115.00
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
0.0
1,000.0
2,000.0
3,000.0
4,000.0
5,000.0
6,000.0
7,000.0
8,000.0
9,000.0
10,000.0
11,000.0
12,000.0
13,000.0
14,000.0
15,000.0
Station (ft)


Post Office Road Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
130.00
128.00
126.00
124.00
122.00
120.00
118.00
116.00
114.00
112.00
110.00
108.00
106.00
104.00
102.00
100.00
98.00
96.00
94.00
92.00
90.00
88.00
86.00
84.00
82.00
80.00
78.00
76.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
60.00
58.00
56.00
54.00
52.00
50.00
48.00
46.00
44.00
42.00
0.0
1,000.0
2,000.0
3,000.0
4,000.0
5,000.0
6,000.0
7,000.0
8,000.0
9,000.0
10,000.0
11,000.0
12,000.0
13,000.0
14,000.0
15,000.0
16,000.0
17,000.0
Station (ft)


Boweyns Brook Interceptor - Wet Weather Flow - Time: 34.00
Elevation (ft)
118.00
116.00
114.00
112.00
110.00
108.00
106.00
104.00
102.00
100.00
98.00
96.00
94.00
92.00
90.00
88.00
86.00
84.00
82.00
80.00
78.00
76.00
74.00
72.00
70.00
68.00
66.00
64.00
62.00
60.00
58.00
56.00
54.00
52.00
50.00
48.00
46.00
44.00
42.00
0.0
2,000.0
4,000.0
6,000.0
8,000.0
10,000.0
12,000.0
14,000.0
16,000.0
18,000.0
20,000.0
22,000.0
24,000.0
Station (ft)


Connecticut River Interceptor 24-inch Restriction - Wet Weather Flow 10yr - Time: 36.50
Elevation (ft)
Station (ft)
Label: SMH-4279
Type: Manhole
ID: 854
Label: SMH-4464
Type: Manhole
ID: 855
Label: SMH-523
Type: Manhole
ID: 892
Label: SMH-524
Type: Manhole
ID: 893
Label: SMH-525
Type: Manhole
ID: 894
Label: SWR-4465
Type: Conduit
ID: 1331
Label: SWR-4466
Type: Conduit
ID: 1324
Label: SWR-542
Type: Conduit
ID: 971
Label: SWR-541
Type: Conduit
ID: 1074


Connecticut River Interceptor 24-inch Restriction - Wet Weather 100yr - Time: 35.00
Elevation (ft)
Station (ft)
Label: SMH-4279
Type: Manhole
ID: 854
Label: SMH-4464
Type: Manhole
ID: 855
Label: SMH-523
Type: Manhole
ID: 892
Label: SMH-524
Type: Manhole
ID: 893
Label: SMH-525
Type: Manhole
ID: 894
Label: SWR-4465
Type: Conduit
ID: 1331
Label: SWR-4466
Type: Conduit
ID: 1324
Label: SWR-542
Type: Conduit
ID: 971
Label: SWR-541
Type: Conduit
ID: 1074

APPENDIX C: MODEL SURCHARGING PLANS

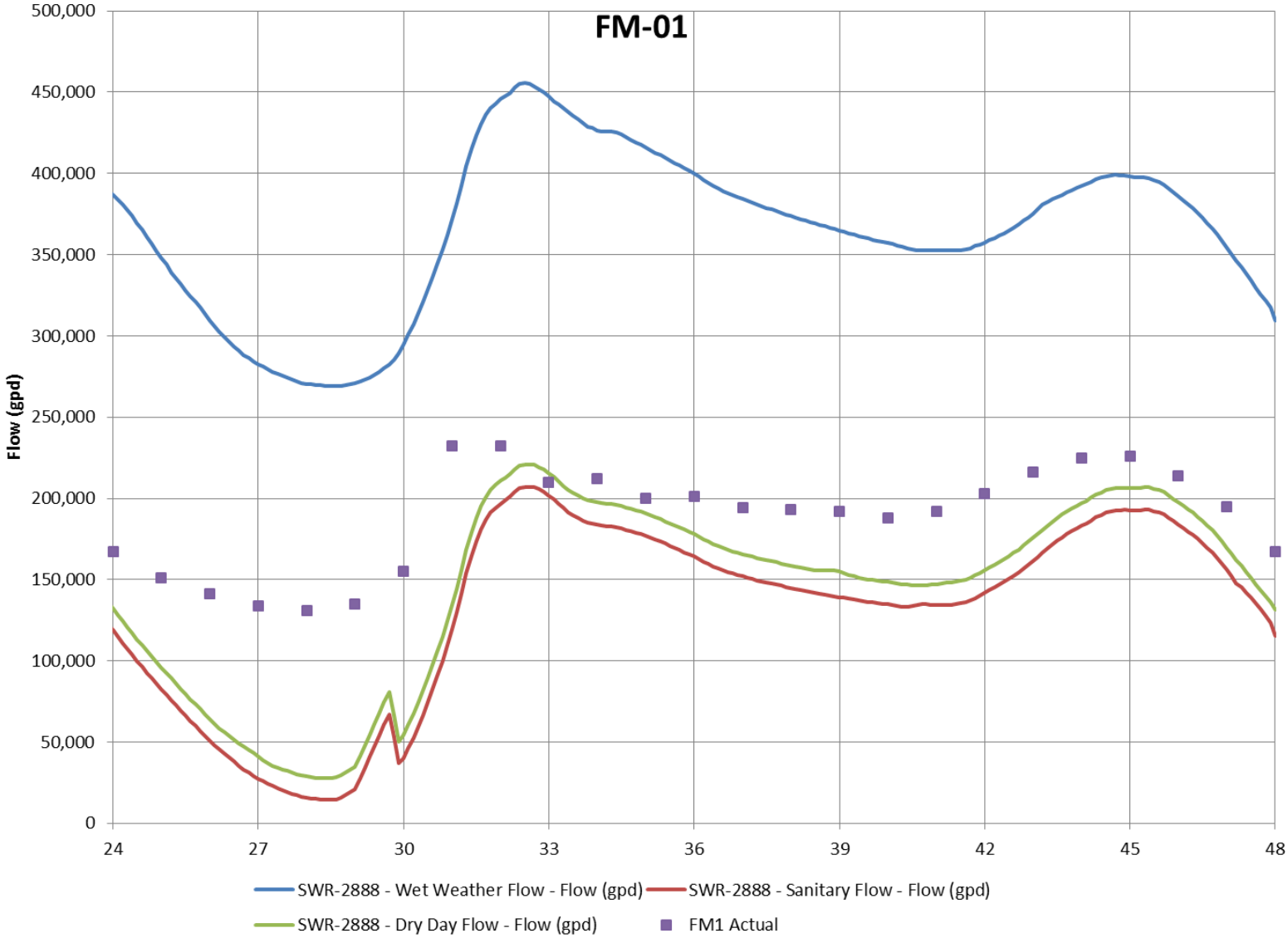
2-Year Storm

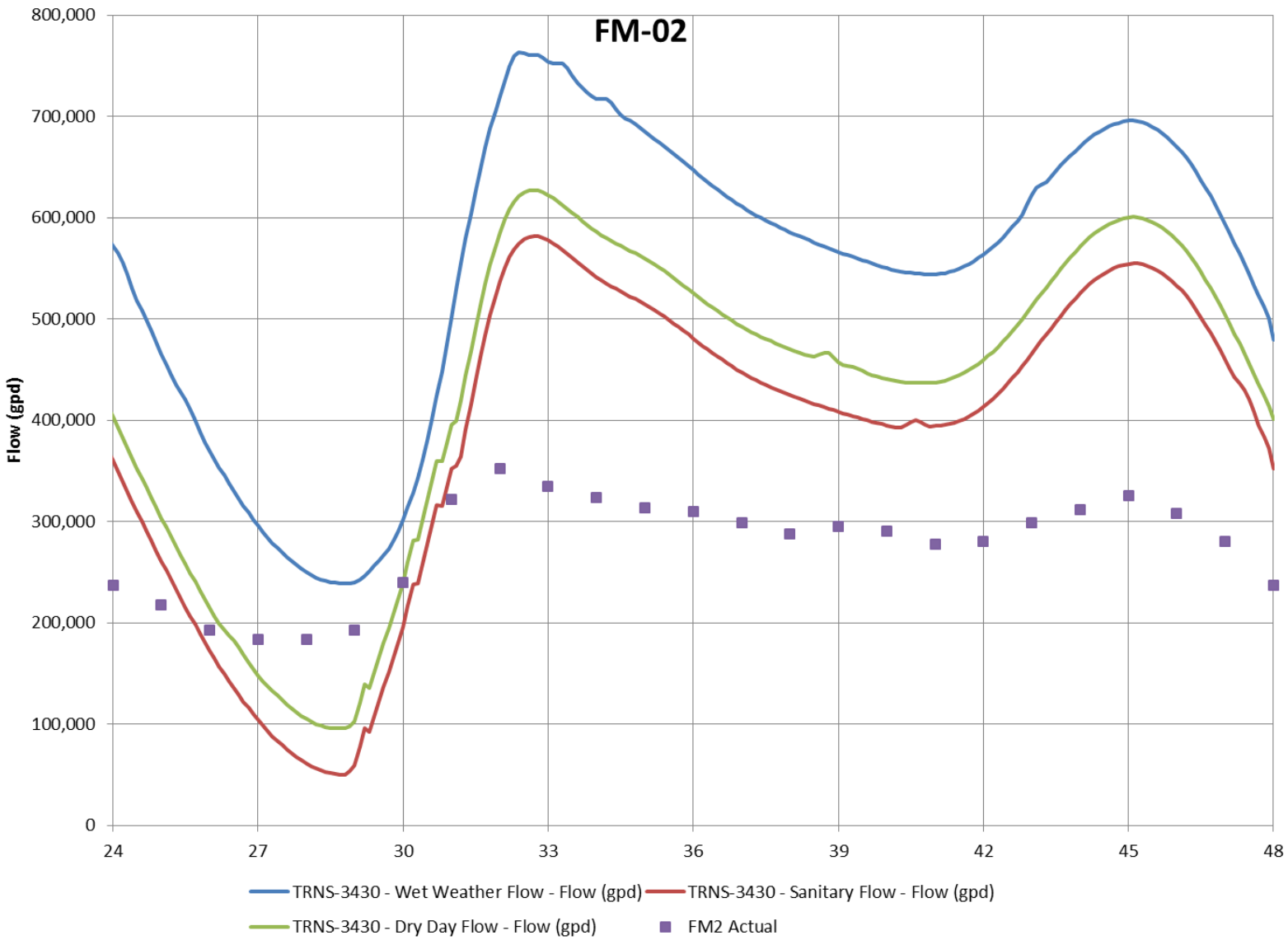
10-Year Storm

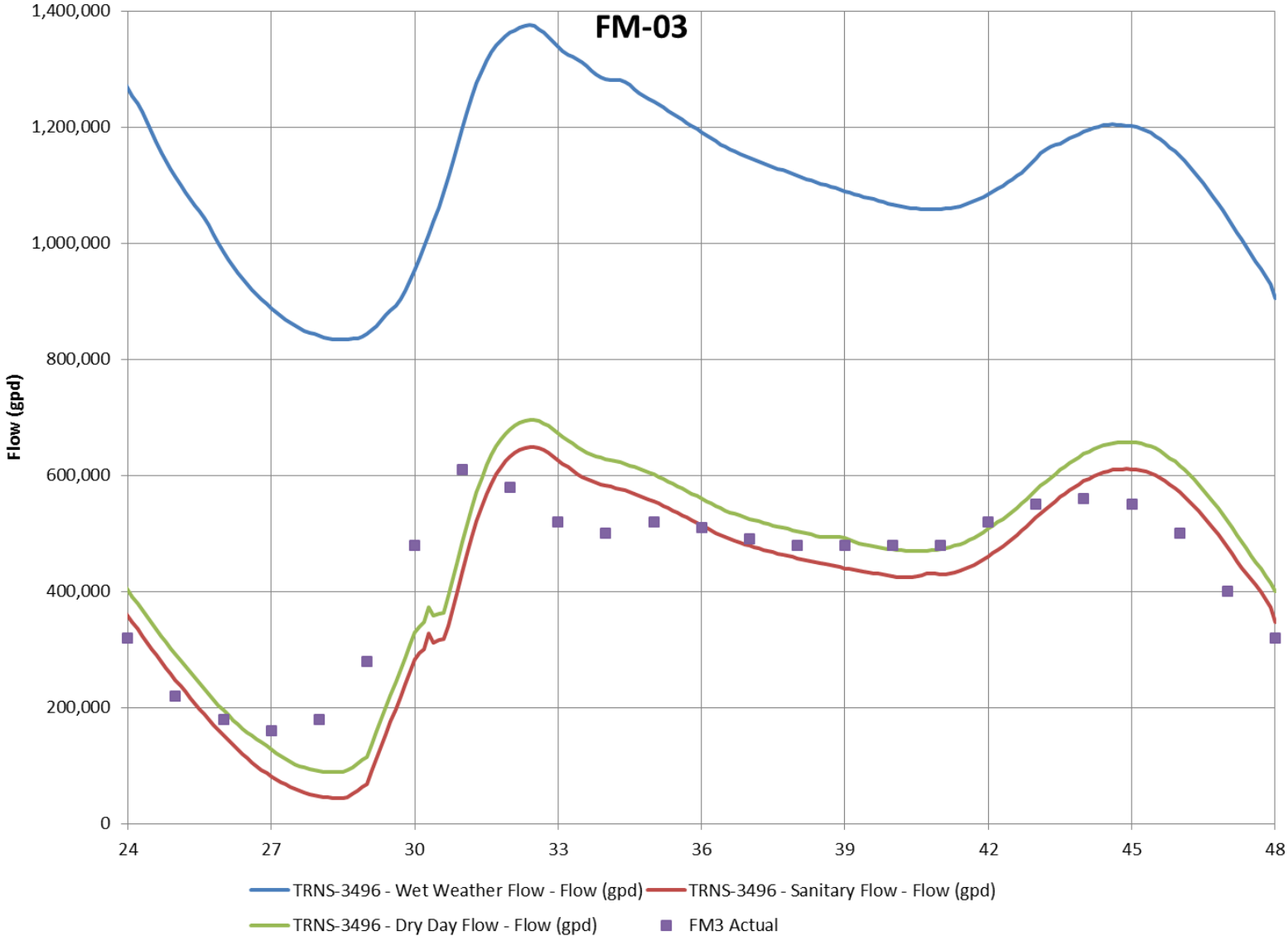
25-Year Storm

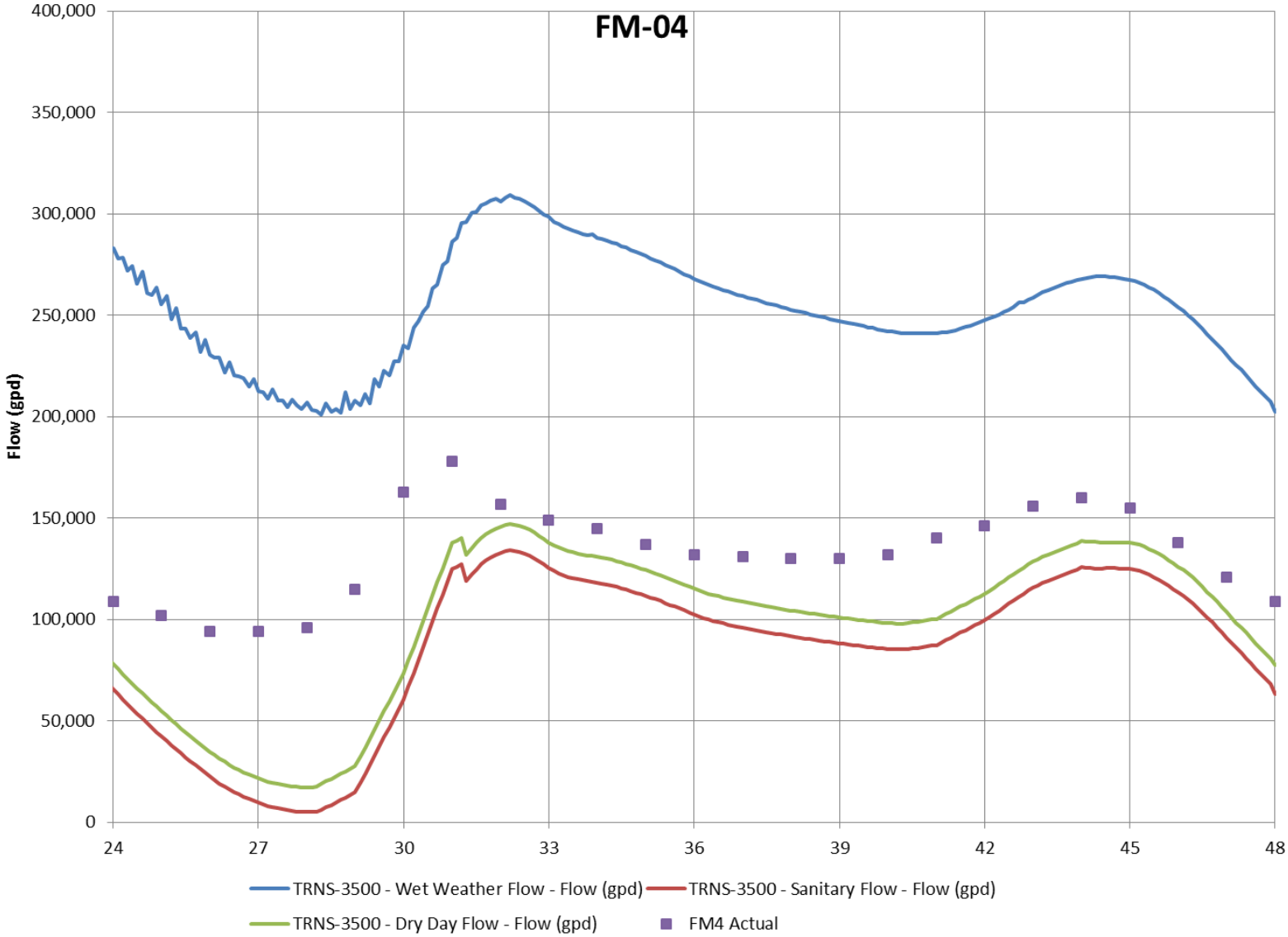
100-Year Storm

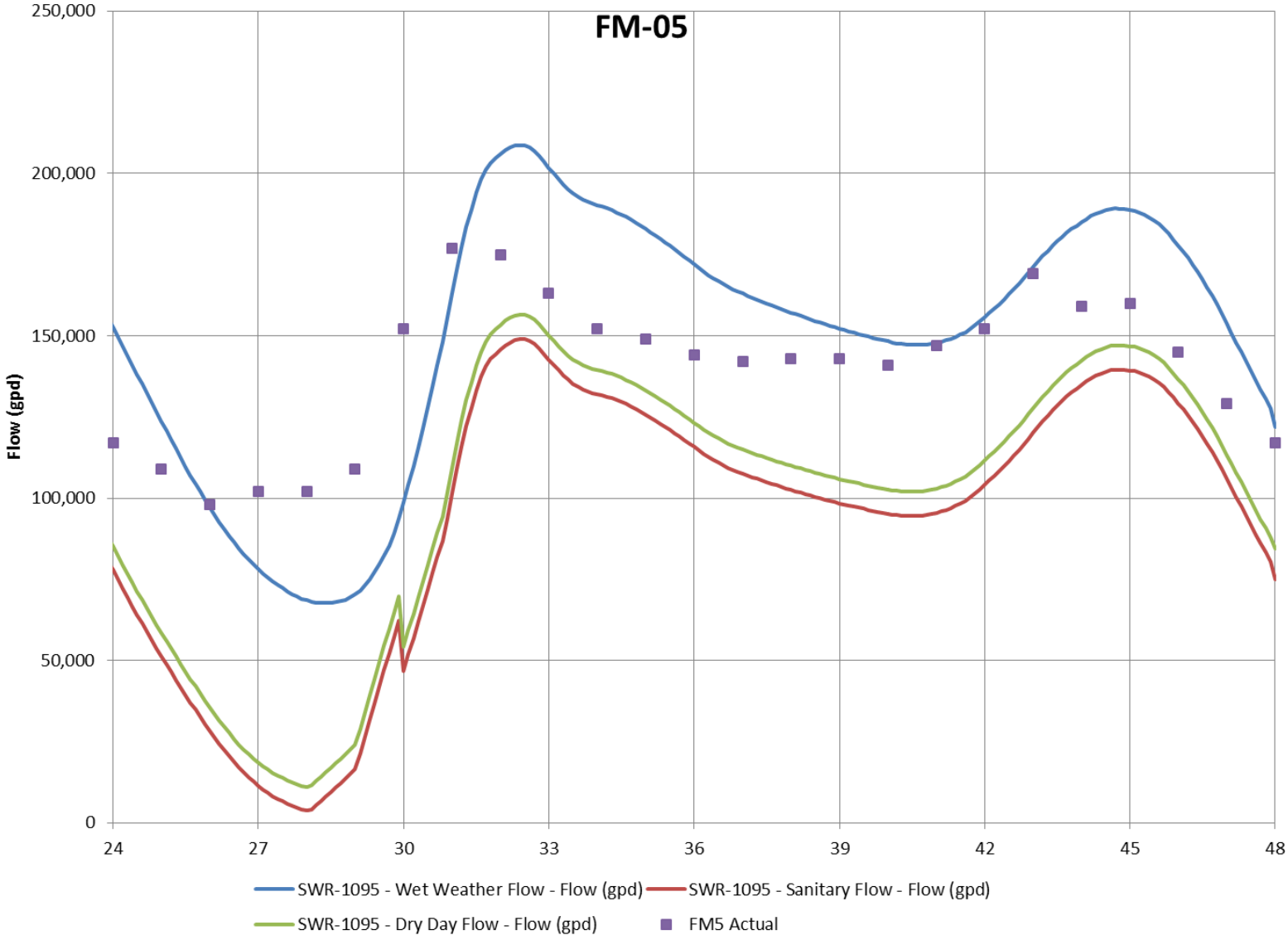
APPENDIX D: CALIBRATION CURVES

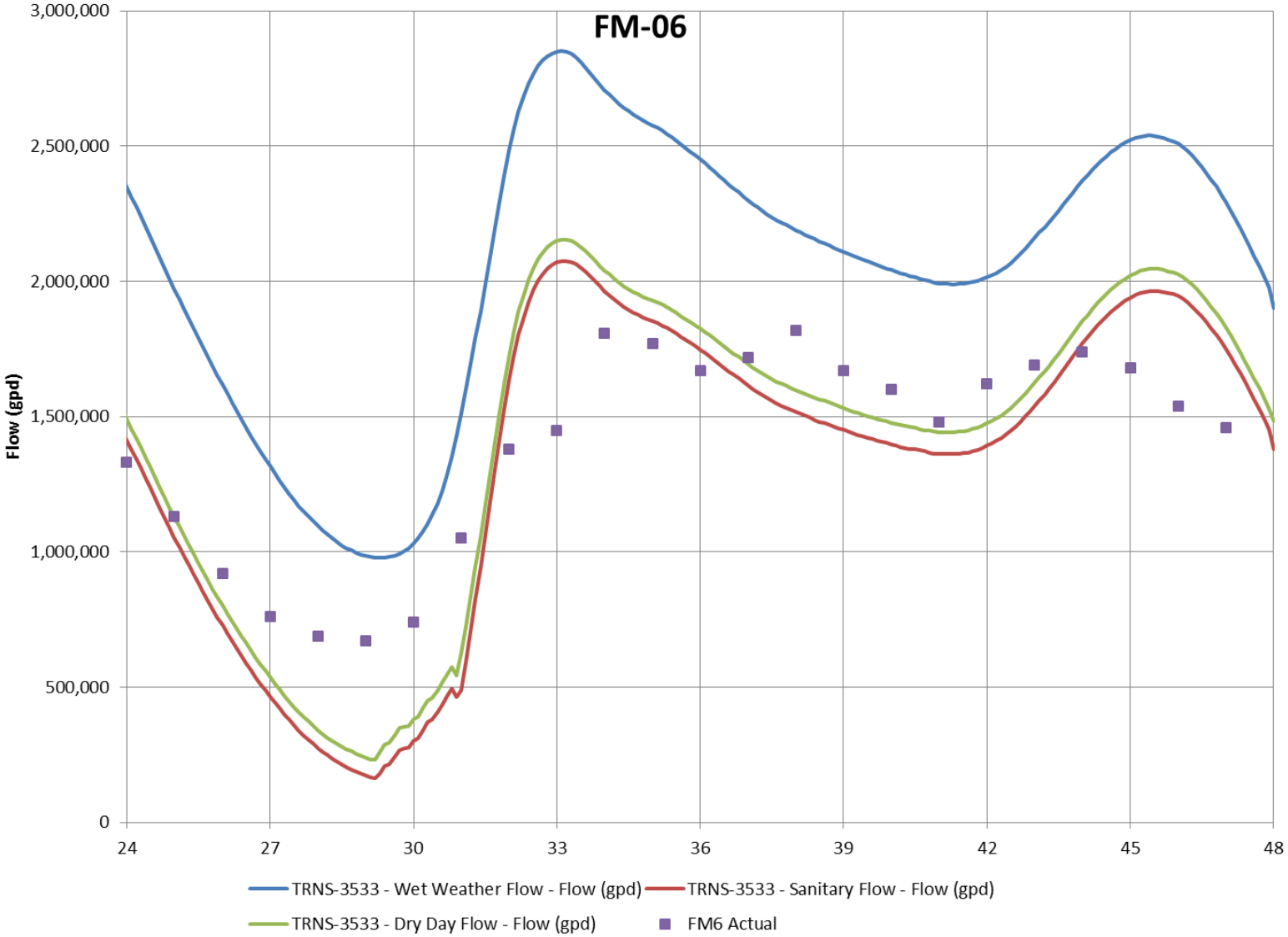

FM-01
Flow (gpd)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
24
27
30
33
36
39
42
45
48
SWR-2888 - Wet Weather Flow - Flow (gpd)
SWR-2888 - Sanitary Flow - Flow (gpd)
SWR-2888 - Dry Day Flow - Flow (gpd)
FM1 Actual

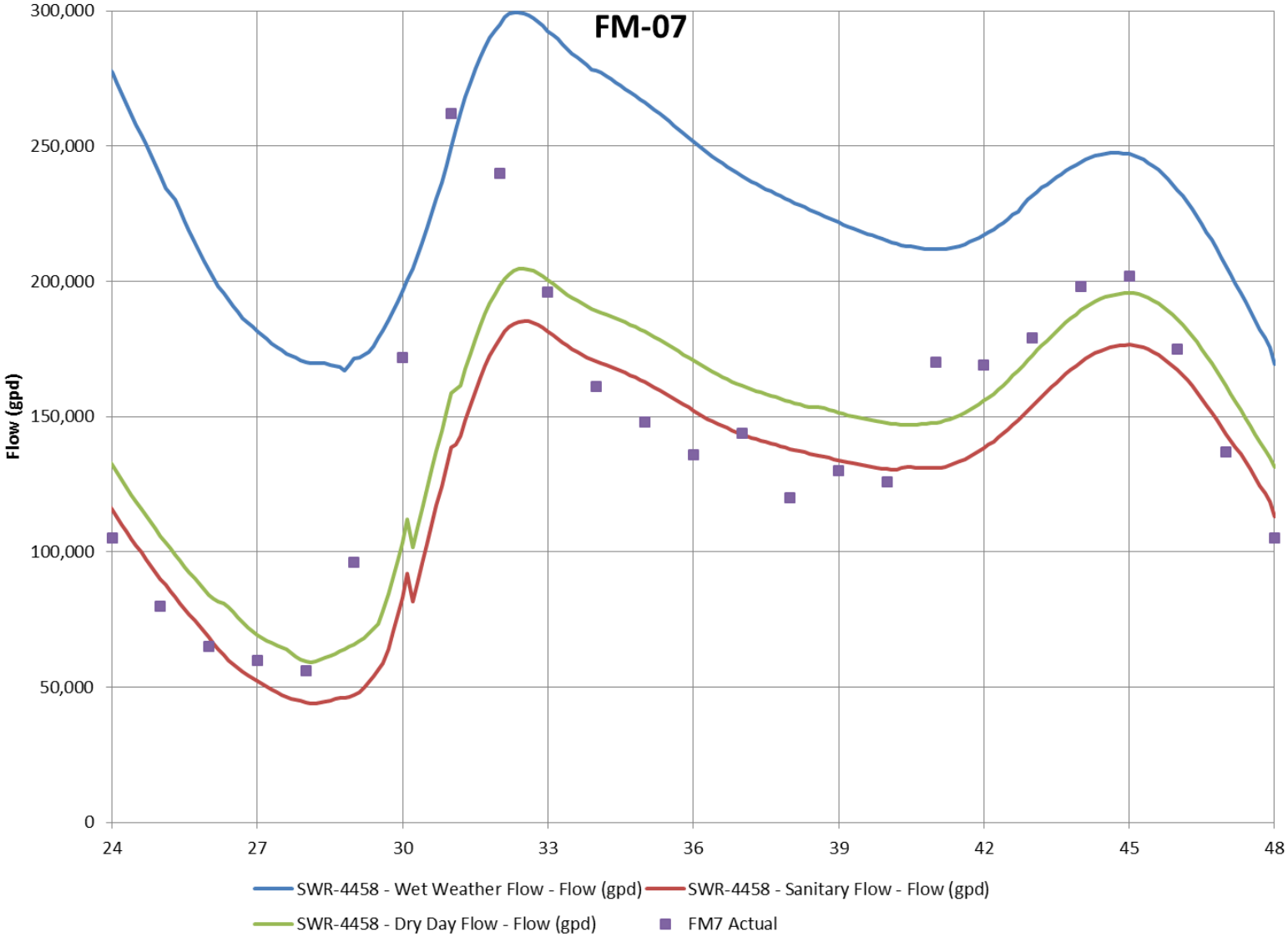

FM-02
Flow (gpd)
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
24
27
30
33
36
39
42
45
48
TRNS-3430 - Wet Weather Flow - Flow (gpd)
TRNS-3430 - Sanitary Flow - Flow (gpd)
TRNS-3430 - Dry Day Flow - Flow (gpd)
FM2 Actual

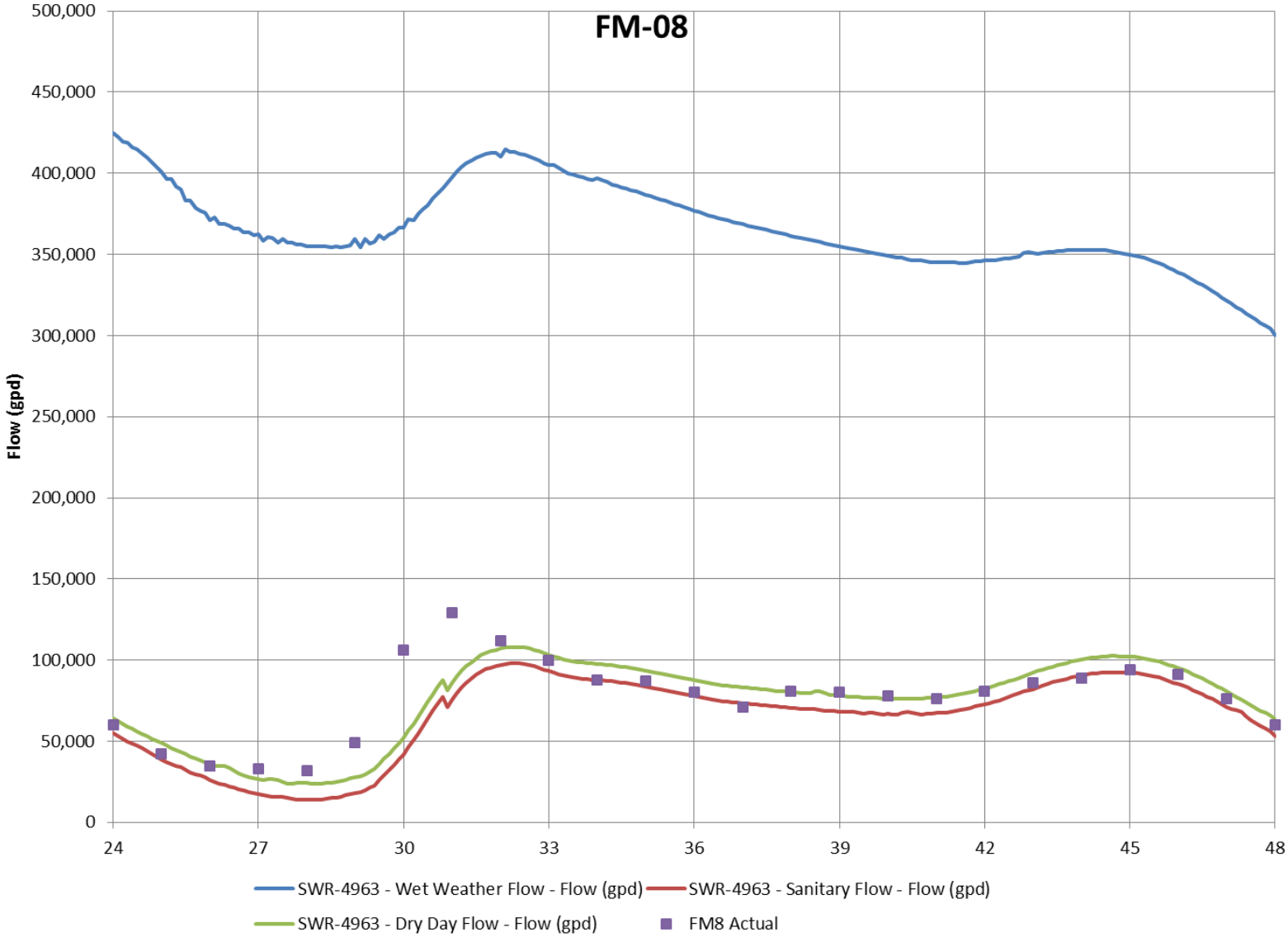

FM-03
Flow (gpd)
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
24
27
30
33
36
39
42
45
48
TRNS-3496 - Wet Weather Flow - Flow (gpd)
TRNS-3496 - Sanitary Flow - Flow (gpd)
TRNS-3496 - Dry Day Flow - Flow (gpd)
FM3 Actual

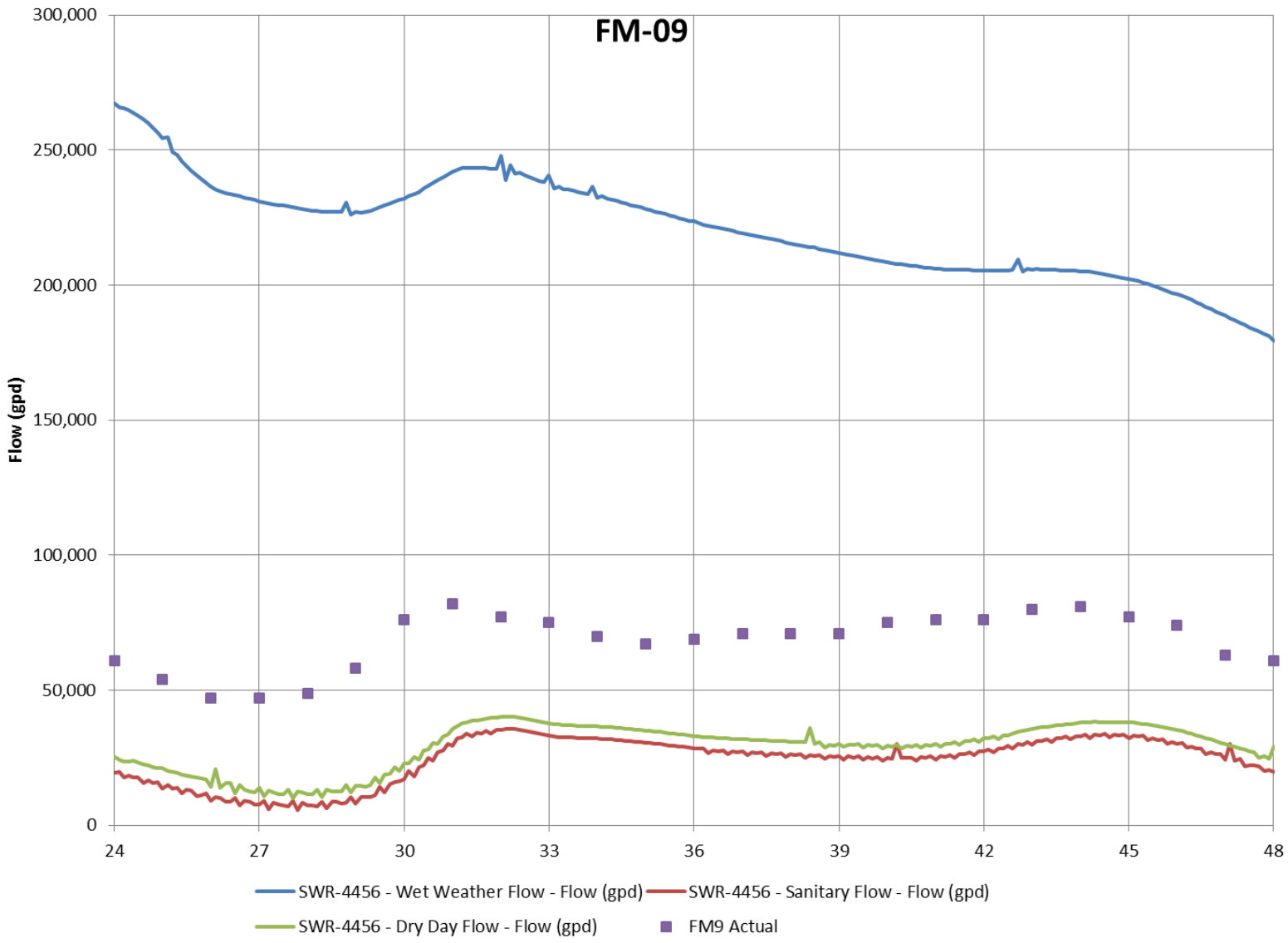

FM-04
Flow (gpd)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
24
27
30
33
36
39
42
45
48
TRNS-3500 - Wet Weather Flow - Flow (gpd)
TRNS-3500 - Sanitary Flow - Flow (gpd)
TRNS-3500 - Dry Day Flow - Flow (gpd)
FM4 Actual

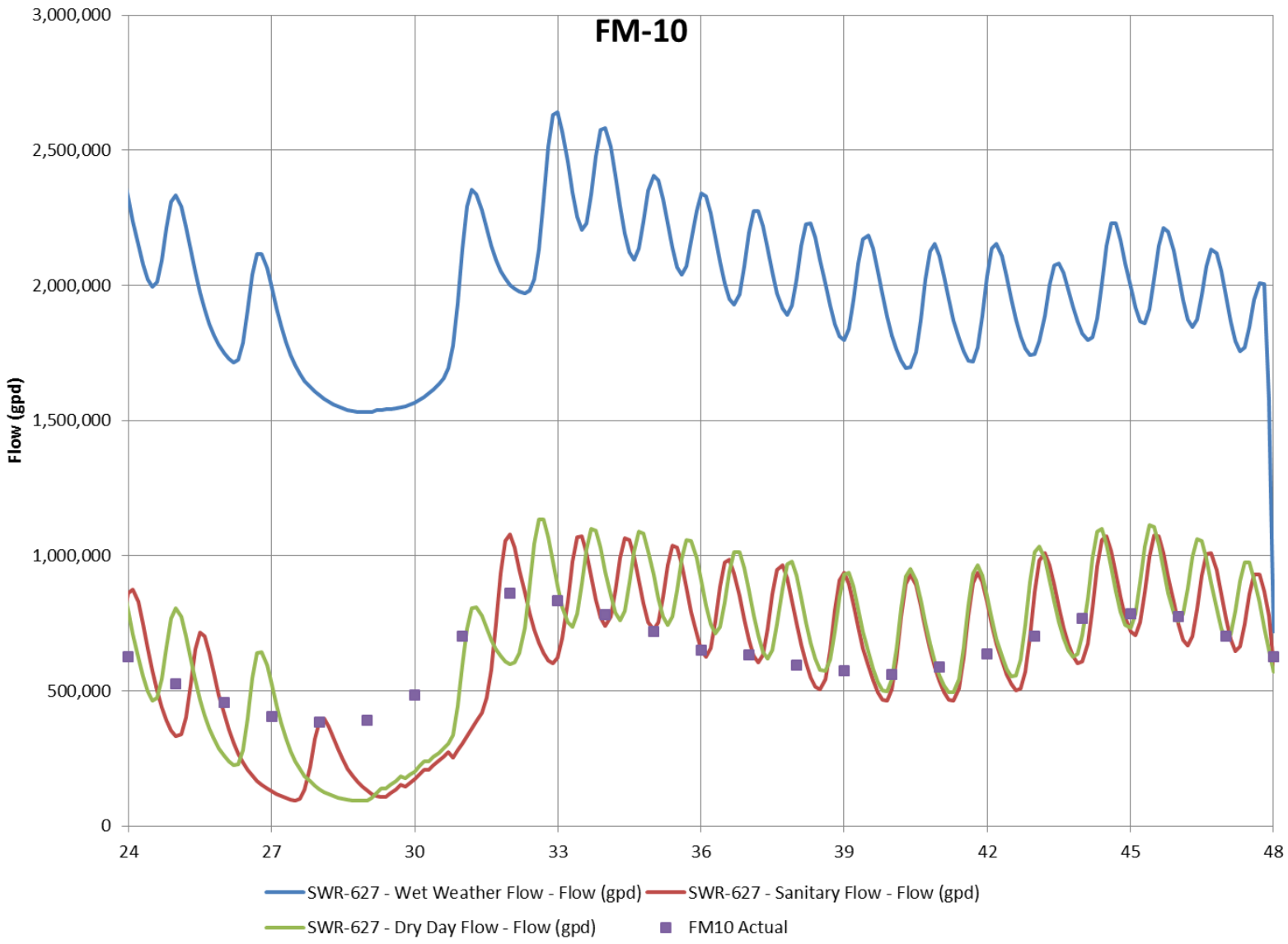

FM-05
250,000
200,000
150,000
100,000
50,000
0
Flow (gpd)
24
27
30
33
36
39
42
45
48
SWR-1095 - Wet Weather Flow - Flow (gpd)
SWR-1095 - Sanitary Flow - Flow (gpd)
SWR-1095 - Dry Day Flow - Flow (gpd)
FM5 Actual

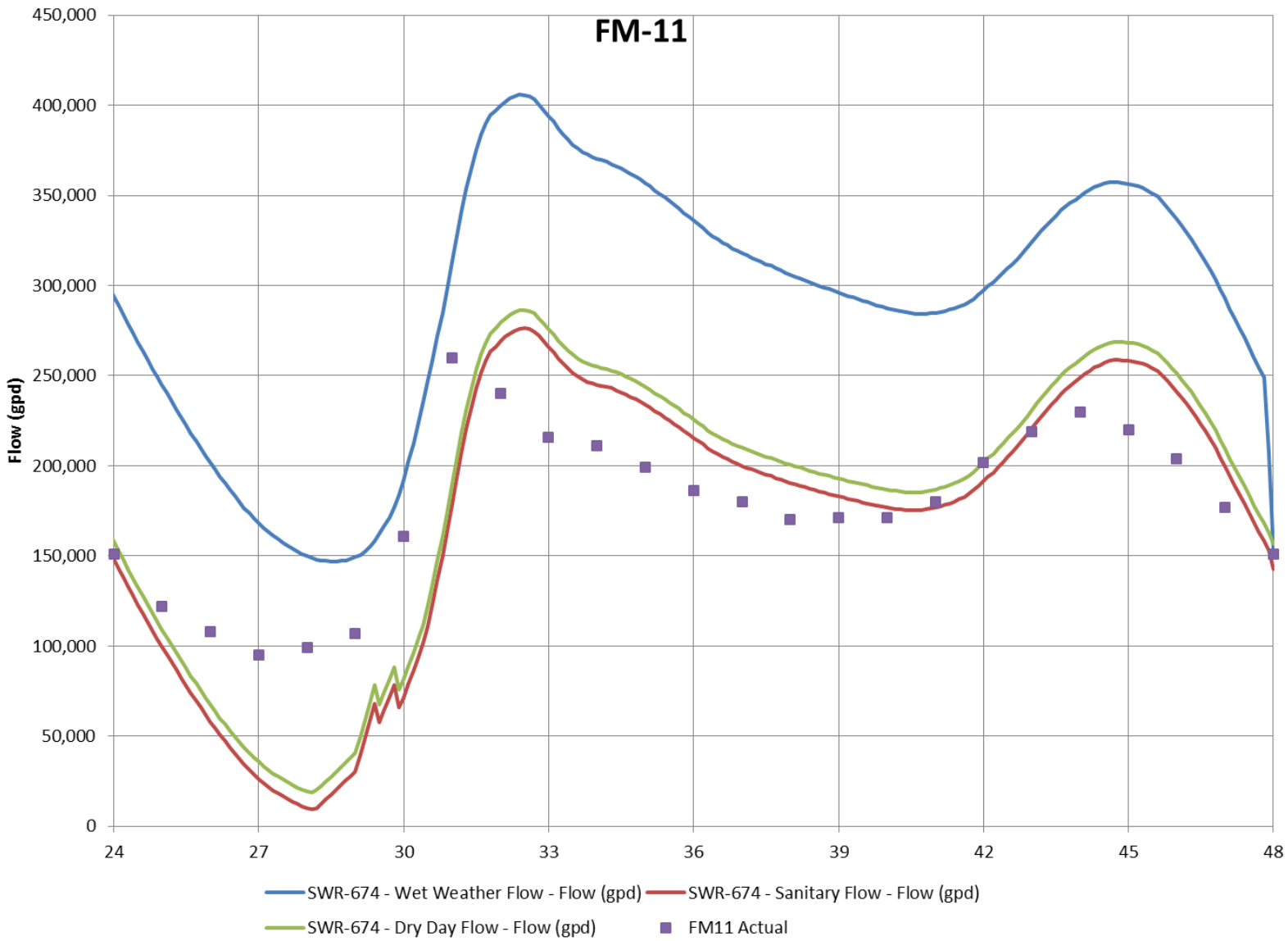

FM-06
Flow (gpd)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
24
27
30
33
36
39
42
45
48
TRNS-3533 - Wet Weather Flow - Flow (gpd)
TRNS-3533 - Sanitary Flow - Flow (gpd)
TRNS-3533 - Dry Day Flow - Flow (gpd)
FM6 Actual

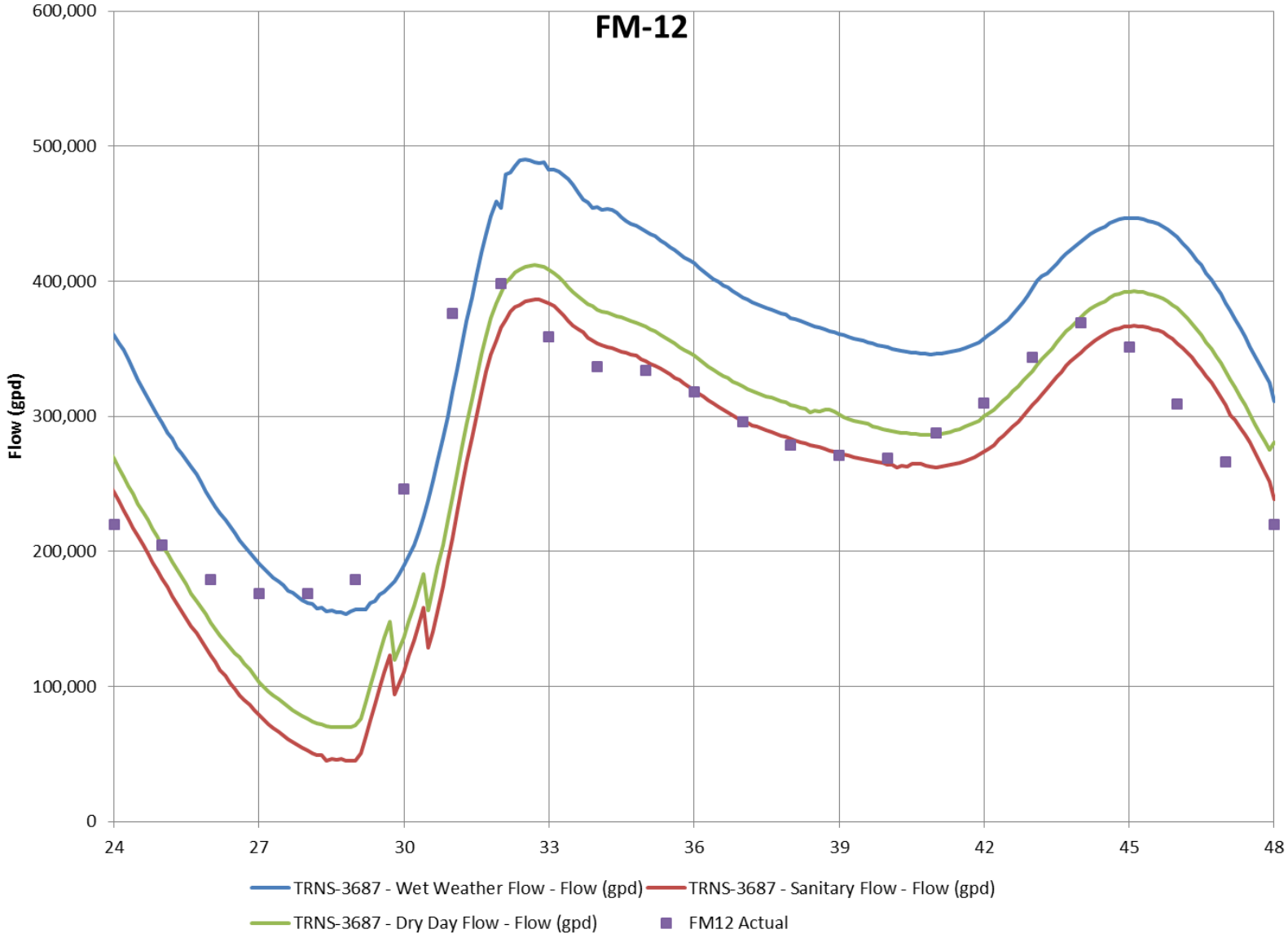

FM-07
Flow (gpd)
300,000
250,000
200,000
150,000
100,000
50,000
0
24
27
30
33
36
39
42
45
48
SWR-4458 - Wet Weather Flow - Flow (gpd)
SWR-4458 - Sanitary Flow - Flow (gpd)
SWR-4458 - Dry Day Flow - Flow (gpd)
FM7 Actual


FM-08
Flow (gpd)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
24
27
30
33
36
39
42
45
48
SWR-4963 - Wet Weather Flow - Flow (gpd)
SWR-4963 - Sanitary Flow - Flow (gpd)
SWR-4963 - Dry Day Flow - Flow (gpd)
FM8 Actual


FM-09
Flow (gpd)
300,000
250,000
200,000
150,000
100,000
50,000
0
24
27
30
33
36
39
42
45
48
SWR-4456 - Wet Weather Flow - Flow (gpd)
SWR-4456 - Sanitary Flow - Flow (gpd)
SWR-4456 - Dry Day Flow - Flow (gpd)
FM9 Actual


FM-10
Flow (gpd)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
24
27
30
33
36
39
42
45
48
SWR-627 - Wet Weather Flow - Flow (gpd)
SWR-627 - Sanitary Flow - Flow (gpd)
SWR-627 - Dry Day Flow - Flow (gpd)
FM10 Actual


FM-11
Flow (gpd)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
24
27
30
33
36
39
42
45
48
SWR-674 - Wet Weather Flow - Flow (gpd)
SWR-674 - Sanitary Flow - Flow (gpd)
SWR-674 - Dry Day Flow - Flow (gpd)
FM11 Actual


FM-12
600,000
500,000
400,000
300,000
200,000
100,000
0
Flow (gpd)
24
27
30
33
36
39
42
45
48
TRNS-3687 - Wet Weather Flow - Flow (gpd)
TRNS-3687 - Sanitary Flow - Flow (gpd)
TRNS-3687 - Dry Day Flow - Flow (gpd)
FM12 Actual

WOODARD
&CURRAN

woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

APPENDIX F: MANHOLE INSPECTION REPORTS

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-516**

Inspection Date: **5/26/2015**

Street Number:

Street: **Gatewood Drive**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **Yes** Cover Type: **Typical** Cover Material: **Ductile Iron**

If Debris, Type: **Roots, Sediment** Cover Condition: **Good** Cover Defects: **None Observed**

If Debris, %: **1** Quantity of Cover Holes: **4** Cover Hole Diameter (in): **2 x 0.5, 2 x 0.75**

Ponding: **No** *If Ponding, Drainage Area (SF):*

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Fair	None Observed	Rust
Corbel:		Precast Concrete	Fair	Staining	None Observed
Cone:		Precast Concrete	Good	Staining	None Observed
Walls:		Precast Concrete	Good	None Observed	None Observed
Bench:		Brick	Good	None Observed	None Observed
Invert:		Brick	Good	None Observed	None Observed

Pipe Joint Connection:	Good	None Observed
Barrel Section Joints Tight:	No	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	11.4	18	Concrete
Inlet 1:	10.3	8	Asbestos Concrete
Inlet 2:	10.4	18	Asbestos Concrete
Inlet 3:	10.3	6	PVC
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-516**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3046**

Inspection Date: **5/26/2015**

Street Number: **146**

Street: **High Street**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **No**

If Debris, Type:

If Debris, %:

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **2**

Ponding: **No**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **0.5**

If Ponding, Drainage Area (SF):

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	Staining	None Observed
Corbel:		Brick	Good	Staining	1 loose brick.
Cone:		Precast Concrete	Good	None Observed	None Observed
Walls:		Precast Concrete	Good	3	Infiltration near Inlet 1, Weeping by Inlet 2.
Bench:		Brick	Good	None Observed	None Observed
Invert:		Brick	Good	None Observed	Inlet 2 some grease buildup.

Pipe Joint Connection:	Fair	0.2
Barrel Section Joints Tight:	Yes	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	9.3	8	Asbestos Concrete
Inlet 1:	9.2	8	Asbestos Concrete
Inlet 2:	7.1	8	Asbestos Concrete
Inlet 3:	8.7	8	Cast Iron
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Infiltation at pipe joint by Inlet 1. Inlet 2 and Inlet 3 are upper and lower parts to a drop connection.

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3046**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3522**

Inspection Date: **5/26/2015**

Street Number:

Street: **Cross-Country**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **Yes**

Groundwater Level (ft): **UNK**

Debris: **No**

If Debris, Type:

If Debris, %:

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **4**

Ponding: **No**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **2 x 1, 2 x 0.5**

If Ponding, Drainage Area (SF):

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Fair	Staining	Rust
Corbel:		N\A	N\A	None Observed	No Corbel Present.
Cone:		Precast Concrete	Good	Staining	Slightly Cracked.
Walls:		Precast Concrete	Fair	1.5	Infiltartion at lowest barrel joint.
Bench:		Brick	Good	None Observed	None Observed
Invert:		Brick	Fair	0.1	Mineral Encrustation
Pipe Joint Connection:			Fair	0.3	
Barrel Section Joints Tight:			No		

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	10.3	18	Concrete
Inlet 1:	8.9	8	PVC
Inlet 2:	10.2	18	Concrete
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Located in woods behind 71 Foxcroft Rd. Wall Infiltraion adjacent to inlet 1. MH well above grade.

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3522**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3783**

Inspection Date: **5/26/2015**

Street Number: **907**

Street: **Enfield Street**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **Yes**

Groundwater Level (ft): **UNK**

Debris: **Yes** Cover Type: **Typical** Cover Material: **Ductile Iron**

If Debris, Type: **Concrete, Sediment** Cover Condition: **Good** Cover Defects: **None Observed**

If Debris, %: **5** Quantity of Cover Holes: **1** Cover Hole Diameter (in): **0.5**

Ponding: **Yes** *If Ponding, Drainage Area (SF):* **2**

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Fair	Staining	Rust
Corbel:		Concrete Block	Good	None Observed	None Observed
Cone:		Precast Concrete	Fair	None Observed	Slightly Pitted.
Walls:		Precast Concrete	Poor	5	Major infiltration, Pitted/worn.
Bench:		Brick	Good	None Observed	None Observed
Invert:			Good	None Observed	None Observed

Pipe Joint Connection:	Fair	Mineral Encrustation
Barrel Section Joints Tight:	No	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	16.2	22	Brick
Inlet 1:	14.7	8	Cast Iron
Inlet 2:	9.6	8	Cast Iron
Inlet 3:	15.5	18	Vitrified Clay
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Inlet 1 and inlet 2 are upper and lower part of a drop connection. Major inflow adjacent to inlet 2. Gasket used to seal barrel sections partially detached, hanging in MH.

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3783**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3999**

Inspection Date: **5/26/2015**

Street Number: **4**

Street: **Yale Court**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **No**

If Debris, Type:

If Debris, %:

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **1**

Ponding: **Yes**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **0.75**

If Ponding, Drainage Area (SF): **3**

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	Staining	None Observed
Corbel:		Brick	Fair	Staining	Deteriorating.
Cone:		Brick	Good	Staining	None Observed
Walls:		Concrete Block	Fair	0.8	Infiltration, runner and weepers.
Bench:		Brick	Fair	0.1	Weeping.
Invert:		Brick	Good	None Observed	None Observed

Pipe Joint Connection:	Good	Staining
Barrel Section Joints Tight:	N\A	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	6.5	8	Vitrified Clay
Inlet 1:	6.2	8	Vitrified Clay
Inlet 2:			
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-3999**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4129**

Inspection Date: **5/26/2015**

Street Number: **54**

Street: **Belmont Avenue**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **No**

If Debris, Type:

If Debris, %:

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **1**

Ponding: **No**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **0.25**

If Ponding, Drainage Area (SF):

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	None Observed	None Observed
Corbel:		Brick	Good	Mineral Encrustation	None Observed
Cone:		Brick	Good	Staining	None Observed
Walls:		Brick	Good	0.3	Heavy mineral encrustation, walls damp.
Bench:		Brick	Poor	Mineral Encrustation	Bricks deteriorated.
Invert:		Brick	Fair	Mineral Encrustation	Sediment and Mineral Deposits
Pipe Joint Connection:			Good	Mineral Encrustation	
Barrel Section Joints Tight:			N\A		

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	7.8	8	Vitrified Clay
Inlet 1:	7.0	8	Vitrified Clay
Inlet 2:	7.3	8	Vitrified Clay
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Wall infililtration located near outlet. Other parts of wall have heavy mineral encrustation, appear damp but no active infiltration at time of inspection.

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4129**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4146**

Inspection Date: **5/26/2015**

Street Number: **9**

Street: **Warrnier Avenue**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **Yes** Cover Type: **Typical** Cover Material: **Ductile Iron**

If Debris, Type: **Sticks, Sendiment** Cover Condition: **Good** Cover Defects: **None Observed**

If Debris, %: **10** Quantity of Cover Holes: **1** Cover Hole Diameter (in): **1**

Ponding: **Yes** *If Ponding, Drainage Area (SF):* **3**

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	Yes	Metal	Good		
Frame:		Ductile Iron	Good	Staining	4 manufactured holes in riser.
Corbel:		Brick	Good	None Observed	None Observed
Cone:		Brick	Good	None Observed	None Observed
Walls:		Brick	Good	None Observed	Fine roots.
Bench:		N\A	N\A	N\A	No Bench Present.
Invert:		N\A	N\A	N\A	No Invert in MH.

Pipe Joint Connection:	Good	None Observed
Barrel Section Joints Tight:	N\A	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	6.6	8	Vitrified Clay
Inlet 1:			
Inlet 2:			
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Starter. Manufactured holes in riser allow inflow to enter structure. 4 inches of standing water on top of 2 in of sediment observed in manhole.

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4146**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4236**

Inspection Date: **5/26/2015**

Street Number: **9**

Street: **Hathaway Avenue**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **Yes**

Groundwater Level (ft): **UNK**

Debris: **Yes**

If Debris, Type: **Sewage**

If Debris, %: **20**

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **2**

Ponding: **No**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **1**

If Ponding, Drainage Area (SF): **10**

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	None Observed	None Observed
Corbel:		Precast Concrete	Fair	Staining	Cracked.
Cone:		Brick	Good	Staining	None Observed
Walls:		Precast Concrete	Good	Staining	None Observed
Bench:		Brick	Good	0.1	Weeping.
Invert:		Brick	Good	None Observed	Outlet slightly higher than channel.

Pipe Joint Connection:	Good	None Observed
Barrel Section Joints Tight:	Yes	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	9.25	8	Vitrified Clay
Inlet 1:	7.2	8	Vitrified Clay
Inlet 2:			
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Cracked corbel with staining all the way down to bench. Sewage and ragging building up in channel. Weeping inflow from bench to left of inlet very slow.

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4236**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4357**

Inspection Date: **5/26/2015**

Street Number: **4**

Street: **Purple Heart Blvd**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **No**

If Debris, Type:

If Debris, %:

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **2**

Ponding: **Yes**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **0.5**

If Ponding, Drainage Area (SF): **9**

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Fair	None Observed	Missing Piece.
Corbel:		Brick	Fair	Staining	Broken bricks, missing mortar.
Cone:		Concrete Block	Good	Staining	Staining includes sediment.
Walls:		Concrete Block	Fair	None Observed	Fine roots.
Bench:		Concrete	Fair	None Observed	Roots.
Invert:		Vitrified Clay	Fair	None Observed	Gap between pipe and channel.
Pipe Joint Connection:			Fair	None Observed	
Barrel Section Joints Tight:			N\A		

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	4.8	8	Vitrified Clay
Inlet 1:	4.7	8	Vitrified Clay
Inlet 2:			
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Inlet has a pipe that connects prior to discharging into manhole (see picture).

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4357**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4362**

Inspection Date: **5/26/2015**

Street Number: **1146**

Street: **Enfield Street**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **Yes** Cover Type: **Typical** Cover Material: **Ductile Iron**

If Debris, Type: **Roots, Sediment** Cover Condition: **Good** Cover Defects: **None Observed**

If Debris, %: **5** Quantity of Cover Holes: **1** Cover Hole Diameter (in): **0.75**

Ponding: **No** *If Ponding, Drainage Area (SF):*

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	None Observed	None Observed
Corbel:		Brick	Good	None Observed	Roots.
Cone:		Precast Concrete	Fair	None Observed	Roots.
Walls:		Precast Concrete	Fair	None Observed	Roots coming in lift holes.
Bench:		Brick	Fair	None Observed	Roots
Invert:		UNK	UNK	None Observed	Invert not visible.

Pipe Joint Connection:	Good	None Observed
Barrel Section Joints Tight:	Yes	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	9.3	8	PVC
Inlet 1:	9.3	8	PVC
Inlet 2:			
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Invert not visible due to roots, sediment and milky colored flow.

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4362**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4675**

Inspection Date: **5/26/2015**

Street Number: **60**

Street: **Tariff Street**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **No**

If Debris, Type:

If Debris, %:

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **3**

Ponding: **Yes**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **1 x 0.5, 2 x 0.25**

If Ponding, Drainage Area (SF): **1**

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	None Observed	Some Rust.
Corbel:		Brick	Good	None Observed	None Observed
Cone:		Brick	Good	None Observed	None Observed
Walls:		Brick	Good	None Observed	None Observed
Bench:		Brick	Poor	None Observed	Broken and missing bricks.
Invert:		Brick	Fair	None Observed	Worn, some missing mortar.

Pipe Joint Connection:	Good	Staining
Barrel Section Joints Tight:	N\A	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	8.6	15	Vitrified Clay
Inlet 1:	3.8	8	Vitrified Clay
Inlet 2:	8.5	12	Vitrified Clay
Inlet 3:	3.8	8	Vitrified Clay
Inlet 4:	8.5	15	Vitrified Clay
Inlet 5:	4.2	8	Vitrified Clay
Inlet 6:			
Inlet 7:			

Comments

Inlet 4 is 6 in AC pipe inside 8 VC. Staining at inlet 3 joint. Recent work done on corbel. Inlet 1 and 5 capped.

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4675**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4742**

Inspection Date: **5/26/2015**

Street Number: **51**

Street: **Church Street**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **Yes**

Groundwater Level (ft): **UNK**

Debris: **Yes** | Cover Type: **Typical** | Cover Material: **Ductile Iron**

If Debris, Type: **Sediment** | Cover Condition: **Fair** | Cover Defects: **Worn Smooth**

If Debris, %: **5** | Quantity of Cover Holes: **1** | Cover Hole Diameter (in): **0.5**

Ponding: **No** | *If Ponding, Drainage Area (SF):*

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	None Observed	None Observed
Corbel:		Brick	Good	None Observed	None Observed
Cone:		Brick	Good	None Observed	None Observed
Walls:		Brick	Good	None Observed	None Observed
Bench:		Brick	Good	None Observed	None Observed
Invert:		Brick	Good	None Observed	None Observed
Pipe Joint Connection:			Good	None Observed	
Barrel Section Joints Tight:			N\A		

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	11.5	15	Vitrified Clay
Inlet 1:	5.7	8	Vitrified Clay
Inlet 2:	11.4	10	Vitrified Clay
Inlet 3:	5.7	8	Vitrified Clay
Inlet 4:	11.5	10	Vitrified Clay
Inlet 5:	5.7	8	Vitrified Clay
Inlet 6:	11.5	8	Vitrified Clay
Inlet 7:	5.7	8	Vitrified Clay

Comments

Inlet 1, 3, 5 and 7 capped with sediment buildup in front of cap (see pictures).

Inspector Initials **CJ/GB**

SDE, Inc.

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4742**

Photos/Defects

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4772**

Inspection Date: **5/26/2015**

Street Number: **86**

Street: **Main Street**

Plan View Outlet ↑

Manhole Observations

Manhole Surcharged: **No**

Surcharge Evidence: **No**

Groundwater Level (ft): **UNK**

Debris: **Yes**

If Debris, Type: **Sewage**

If Debris, %: **5**

Cover Type: **Typical**

Cover Condition: **Good**

Quantity of Cover Holes: **1**

Ponding: **Yes**

Cover Material: **Ductile Iron**

Cover Defects: **None Observed**

Cover Hole Diameter (in): **0.75**

If Ponding, Drainage Area (SF): **3**

	Present	Material	Condition	Inflow/Infiltration (GPM)	Defects
Grade Riser:	No				
Frame:		Ductile Iron	Good	None Observed	None Observed
Corbel:		Brick	Fair	None Observed	Roots.
Cone:		N\A	N\A	N\A	No Cone Present.
Walls:		Brick	Fair	None Observed	Missing Mortar, Roots.
Bench:		N\A	N\A	N\A	No Bench Present.
Invert:		Brick	Good	None Observed	None Observed

Pipe Joint Connection:	Good	None Observed
Barrel Section Joints Tight:	N\A	

Pipe Data

	Rim to Invert (feet)	Diameter (inches)	Pipe Material
Outlet:	5.8	18	Vitrified Clay
Inlet 1:	3	8	Vitrified Clay
Inlet 2:	3.8	24	Brick
Inlet 3:			
Inlet 4:			
Inlet 5:			
Inlet 6:			
Inlet 7:			

Comments

Inlets raised on shelf 2 feet above level of outlet. See pictures for configuration. Corbel material is brick over concrete block. Difficult to get exact depth of inlets due to configuration.

Inspector Initials **CJ/GB**

MANHOLE INSPECTION LOG
Enfield, Connecticut

Manhole ID: **SMH-4772**

Photos/Defects

Inspector Initials **CJ/GB**

APPENDIX G: SMOKE TESTING REPORT

ADS ENVIRONMENTAL SERVICES®

UNDERGROUND INTELLIGENCE®
FOR ENHANCED COLLECTION SYSTEM PERFORMANCE and ENGINEERED SOLUTIONS

WOODARD & CURRAN

Enfield, CT

Smoke Testing Report

July 2015

TABLE OF CONTENTS

Purpose and Scope.....**Section 1**

Procedures.....**Section 2**

Results.....**Section 3**

SECTION 1

PURPOSE AND SCOPE

The purpose of this study was to investigate select areas of the Enfield, CT sanitary sewer system for the purpose of identifying possible sources of excessive Infiltration/Inflow.

Field crews, under the direction of Field Manager Pete Griffen, began the smoke testing on July 22, 2015. All field work was completed on July 30, 2015.

The results of the smoke testing field work are summarized in this report.

SECTION 2

PROCEDURES

Smoke testing was conducted in all line sections within each designated study area. A smoke blower was placed at strategic manholes and smoke, produced by non-toxic smoke candles or liquid smoke, was introduced into the sewer lines. Each smoke test setup was generally two to three manhole reaches in length. Additional smoke candles or liquid smoke were activated, as necessary, to assure sufficient smoke concentration within the smoke test setup. The lines in the upstream and downstream manholes were restricted, as necessary, to concentrate the smoke within the tested sections.

(Smoke blower in action)

Smoke testing was conducted during periods of low groundwater and after sufficient time had elapsed from any rain event, thereby assuring optimum conditions. Prior to initiating smoke testing, police and fire officials were notified daily.

SECTION 3

RESULTS

Smoke testing was performed on a total of approximately 37,358 LF of sanitary sewer within the designated study area.

A **Summary of Smoke Test Findings** which includes the location, description, effective tributary drainage area, design inflow contributed, photographs, and field sketches can be found in **Table 1** of this section.

In developing the **Summary of Smoke Test Findings**, the following assumptions were made:

1) Design inflow was derived using the rational formula with rainfall intensity of 0.87 inches/per hour.

2) Field measured drainage areas were adjusted to effective drainage areas by applying a runoff coefficient of 0.9 for asphalt and rooftops and 0.3 for grass and native soil.

SUSPECT AREAS

During the field work, the crew documented areas that indicated a direct or indirect connection to the sanitary sewer yet did not show a positive result. Examples of suspect findings are roof drains with traps, clogged drains that are in the same area as sewer lines or in areas where roof vents did not show positive smoke.

Further investigation work, such as dyed water flooding, should be considered to determine if these sources actually contribute inflow to the sanitary system. A summary of the suspect findings is included in **Table 2**.

TABLE 1
ENFIELD, CT
SUMMARY OF SMOKE TESTING RESULTS
JULY 2015

DATE	FROM MH	TO MH	SEWER LENGTH (FEET)	LOCATION	FINDINGS	EFFECTIVE DRAINAGE AREA (SQ. FEET)	CALCULATED PEAK INFLOW RATE 0.87 IN/HR (GPD)	PHOTO #	SKETCH #	RECOMMENDATION
7/22/2015	4660	4661		14-16 HARTFORD AVENUE	ROOF LEADER INTO GROUND - PIPES SMOKING	1,000	12,908.54	1,2,3	1	
7/22/2015	4659	4658		49-51 HARTFORD AVENUE	LEFT FRONT PIPE INTO GROUND SMOKING	16	206.54	4	2	
7/22/2015	4658	4653		6-8 LAFAYETTE STREET	REAR ROOF LEADER SMOKING	600	7,745.12	5,6,7	3	
7/22/2015	4650	4648		70-72 WINDSOR STREET	OLD ROOF LEADER PIPES SMOKING	32	413.07	8,9	4	
7/22/2015	4750	4704		99-101 CHURCH STREET	ROOF LEADER PIPES SMOKING	1350	17,426.52	10,11,12, 13,14	5	
7/22/2015	4704	4719		95 CHURCH STREET	OLD ROOF LEADER PIPE SMOKING - SMOKE COMING FROM UNDER FOUNDATION, RIGHT FRONT	16	206.54	15,17	5	
7/22/2015	4704	4719		78 CHURCH STREET	LEFT FRONT ROOF LEADER SMOKING	400	5,163.41	18	5	
7/22/2015	4719	4672		5 WHITWORTH AVENUE	ROOF LEADER SMOKING	600	7,745.12	16	5	
7/22/2015	4653	4651		18 LAFAYETTE STREET	RIGHT REAR & RIGHT FRONT GROUND PIPE SMOKING	32	413.07	19	6	
7/22/2015	4651	4648		27-29 UNION STREET	LEFT FRONT ROOF LEADER INTO GROUND PIPE SMOKING	45	580.88	20	7	
7/22/2015	4651	4648		27 LFAYETTE STREET	LEFT FRONT ROOF LEADER INTO GROUND PIPE SMOKING	900	11,617.68	21	8	
7/22/2015	4648	4647		81 WINDSOR STREET	LEFT FRONT, LEFT REAR GROUND PIPE SMOKING	16	206.54	NONE	8	
7/22/2015	4705	4704		107 CHURCH STREET	RIGHT REAR ROOF LEADER TO GROUND PIPE SMOKING	1600	20,653.66	22	9	
7/22/2015	4705	4704		117-121 CHURCH STREET	LEFT FRONT, RIGHT FRONT GROUND PIPE SMOKING	900	11,617.68	23,24	9	
7/22/2015	4705	4704		135-137 CHURCH STREET	MIDDLE FRONT GROUND PIPE SMOKING	1600	20,653.66	25	9	
7/22/2015	4675	4703		12 MARTIN STREET	RIGHT FRONT ROOF LEADER SMOKING	30	387.26	26	10	
7/22/2015	4676	4708		90 WEST STREET	RIGHT FRONT ROOF LEADER TO GROUND PIPE SMOKING	1600	20,653.66	27	11	
7/22/2015	4672	4670		28 ALDEN STREET	RIGHT FRONT ROOF LEADER INTO FOUNDATION	900	11,617.68	28	12	
7/22/2015	4672	4670		27 ALDEN STREET	LEFT FRONT GROUND PIPE SMOKING	16	206.54	29	12	
7/22/2015				ST. ADALBERTS ALDEN STREET	LEFT FRONT, LEFT MIDDLE ROOF LEADER TO GROUND PIPE SMOKING	2000	25,817.07	30,31		
TOTALS						13,653	176,240.23			

ADS ENVIRONMENTAL SERVICES

TABLE 1
ENFIELD, CT
SUMMARY OF SMOKE TESTING RESULTS
JULY 2015

DATE	FROM MH	TO MH	SEWER LENGTH (FEET)	LOCATION	FINDINGS	EFFECTIVE DRAINAGE AREA (SQ. FEET)	CALCULATED PEAK INFLOW RATE 0.87 IN/HR (GPD)	PHOTO #	SKETCH #	RECOMMENDATION
7/23/2015	4744	3884		68-70 COLLEGE STREET	HOLE IN GROUND IN FRONT OF HOUSE SMOKING - NEXT TO GAS METER	2	25.82	32	13	
7/23/2015	4742	4746		32 CHURCH STREET (BURNT HOUSE)	PIPE ON RIGHT FRONT OF HOUSE SMOKING	16	206.54	33,34	14	
7/23/2015	4741	4773		36 PLEASANT STREET	GUTTERS ON LEFT SIDE OF HOUSE IN GROUND PIPE - SMOKING	200	2,581.71	35,36	15	
7/23/2015	4744	4742		RUSSELL STREET AT COLLEGE STREET	RIGHT REAR ROOF LEADER SMOKING AT GROUND PIPE	3600	46,470.73	37	16	
7/23/2015	4744	4742		63 COLLEGE STREET	MIDDLE REAR ROOF LEADER SMOKING - CONNECTED TO GROUND PIPE	900	11,617.68	38	16	
7/23/2015	4744	4745		32 RUSSELL STREET	LEFT FRONT ROOF LEADER CONNECTED TO GROUND PIPE - SMOKING	2500	32,271.34	39	16	
7/23/2015	4742	4741		36-40 COLLEGE STREET	LEFT SIDE REAR ROOF LEADER SMOKING - CONNECTED TO GROUND PIPE	2500	32,271.34	40	17	
7/23/2015	4742	4741		53 COLLEGE STREET	FRONT LEFT SIDE ROOF LEADER SMOKING - CONNECTED TO GROUND PIPE	650	8,390.55	41	17	
7/23/2015	4742	4722		63-65 CHURCH STREET	RIGHT SIDE GROUND PIPE SMOKING	16	206.54	42	17	
7/23/2015	4742	4722		CHURCH STREET AT WHITWORTH STREET - MINISTRY OF HOPE	SMOKE FROM PARKING LOT DRAIN	1600	20,653.66	43	17	
7/23/2015	4773	3877		22 PLEASANT STREET	LEFT FRONT, LEFT REAR, MIDDLE REAR ROOF LEADERS CONNECTED TO GROUND PIPES - SMOKING	5150	66,478.96	44,45,46	18	
7/23/2015	4754	4753		RIVER ROAD AT MAIN STREET	MIDDLE REAR ROOF LEADER INTO FOUNDATION - SMOKING	900	11,617.68	47	19	
TOTALS						18,034	232,792.52			

ADS ENVIRONMENTAL SERVICES

TABLE 1
ENFIELD, CT
SUMMARY OF SMOKE TESTING RESULTS
JULY 2015

DATE	FROM MH	TO MH	SEWER LENGTH (FEET)	LOCATION	FINDINGS	EFFECTIVE DRAINAGE AREA (SQ. FEET)	CALCULATED PEAK INFLOW RATE 0.87 IN/HR (GPD)	PHOTO #	SKETCH #	RECOMMENDATION
7/29/2015	4749	4750		32 COTTAGE GREEN	RIGHT FRONT ROOF LEADER-HEAVY SMOKE	600	7,745.12	48	20	
					LEFT FRONT ROOF LEADER - LIGHT SMOKE	600	7,745.12	49	20	
					RIGHT REAR ROOF LEADER - HEAVY SMOKE	600	7,745.12	50	20	
7/29/2015	4749	4750		5 COTTAGE GREEN	RIGHT FRONT ROOF LEADER-HEAVY SMOKE	480	6,196.10	51	20	
7/29/2015	4747	T-IN		25-31 COTTAGE GREEN	RIGHT REAR ROOF LEADER - HEAVY SMOKE	480	6,196.10	52	20	
					LEFT REAR ROOF LEADER-HEAVY SMOKE	480	6,196.10	53	20	
					LEFT FRONT ROOF LEADER - HEAVY SMOKE	480	6,196.10	54	20	
7/29/2015	4823	4748		40 THOMPSON COURT	LEFT SIDE CENTER ROOF LEADER - HEAVY SMOKE	320	4,130.73	55	21	
					RIGHT REAR ROOF LEADER - HEAVY SMOKE	320	4,130.73	56	21	
7/29/2015				48 PROSPECT STREET	RIGHT FRONT ROOF LEADER-HEAVY SMOKE	16	206.54	57	22	
7/29/2015				75-77 PROSPECT STREET	LEFT REAR ROOF LEADER-LIGHT SMOKE	200	2,581.71	58	22	
7/29/2015	PLEASE	NOTE	*****	120 PROPECT STREET - AT LUMBER YARD	HEAVY SMOKE COMING FROM ALL CRACKS IN BASEMENT FLOOR			59,60,61, 62	22	
7/29/2015	4750	4749		10-16 COTTAGE GREEN	LEFT REAR ROOF LEADER GROUND PIPE SMOKING	36	464.71	63	23	
7/29/2015	4813	4750		37-43 ASNUNTUCK STREET	LEFT FRONT ROOF LEADER GROUND PIPE SMOKING	16	206.54	64,65	23	
					HOLE IN GROUND ON FRONT LAWN SMOKING	16	206.54	66	23	
7/29/2015	4813	4750		47-53 ASNUNTUCK STREET	LEFT FRONT ROOF LEADER GROUND PIPE SMOKING	18	232.35	67	23	
7/29/2015	4750	4751		ASNUNTUCK STREET - AT BEND IN ROAD BEFORE OVER PASS	3 HOLES IN GROUND SMOKING	9	116.18	68,69	23	
7/29/2015	TEE IN	4747		26-28 COTTAGE GREEN ALLEY	MIDDLE REAR ROOF LEADER SMOKING	200	2,581.71	70	24	
7/29/2015	TEE IN	4747		22 COTTAGE GREEN ALLEY	MIDDLE REAR ROOF LEADER SMOKING	200	2,581.71	71	24	
7/29/2015	TEE IN	4747		12-16 COTTAGE GREEN ALLEY	MIDDLE REAR ROOF LEADER SMOKING	200	2,581.71	72	24	
7/29/2015	TEE IN	4747		8-10 COTTAGE GREEN ALLEY	MIDDLE REAR ROOF LEADER SMOKING	200	2,581.71	73	24	
7/29/2015	TEE IN	4747		5 COTTAGE GREEN ALLEY	MIDDLE REAR ROOF LEADER SMOKING			74,75	24	
7/29/2015	TEE IN	4747		21 COTTAGE GREEN ALLEY	MIDDLE REAR ROOF LEADER SMOKING	200	2,581.71	76,77	24	
7/29/2015	4748	4823		38-36 THOMPSON COURT	RIGHT FRONT ROOF LEADER			78	25	

ADS ENVIRONMENTAL SERVICES

TABLE 1
ENFIELD, CT
SUMMARY OF SMOKE TESTING RESULTS
JULY 2015

DATE	FROM MH	TO MH	SEWER LENGTH (FEET)	LOCATION	FINDINGS	EFFECTIVE DRAINAGE AREA (SQ. FEET)	CALCULATED PEAK INFLOW RATE 0.87 IN/HR (GPD)	PHOTO #	SKETCH #	RECOMMENDATION
7/29/2015	4748	4823		30-34 THOMPSON COURT	LEFT FRONT ROOF LEADER			79	25	
7/29/2015	3257	3258		29 PROSPECT STREET	LEFT SIDE GROUND PIPE - SMOKING			80	22	
7/30/2015	4802	4792		14-20 SPRING STREET	HOLE IN GROUND REAR OF HOUSE - SMOKING	36	464.71	81	27	
7/30/2015				7-9 WALLACE STREET	CENTER FRONT ROOF LEADER SMOKING	24	309.80	82	28	
7/30/2015				6 SULLIVAN AVENUE	SMOKING ROOF LEADERS ALL SIDES	2,025	26,139.78	84,85,86	28	
7/30/2015				HIGH STREET AT SPRING STREET	CATCH BASIN SMOKING	9	116.18	83	27	
7/30/2015	4802	4786		15-23 CROSS STREET	RIGHT FRONT GROUND PIPE - SMOKING	4	51.63	89	26	
7/30/2015	4802	4792		CROSS STREET AT SPRING STREET	SMOKE FROM CATCH BASIN ON CORNER, HOLE BY CATCH BASIN, & CRACK IN SIDE WALK	6,000	77,451.21	87,88,90	26	
7/30/2015	4785	4784		47-49 SPRING STREET	LEFT FRONT GROUND PIPE - SMOKING	16	206.54	91	26	
7/30/2015	4806	4787		SAINT PATRICKS CHURCH PEARL STEET AT HIGH STREET	SMOKE FROM ALL ROOF LEADERS AT CHURCH	19,500	251,716.43	92 THRU 104	29	
7/30/2015	4806	4787		64 PEARL STREET	CATCH BASIN SMOKING IN FRONT OF 64 PEARL STREET	3,000	38,725.61	105	29	
TOTALS						5,671	468,386.20			

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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603.625.1212 * Fax 603.965.7896

Project: ENFIELD CT Project #: _____

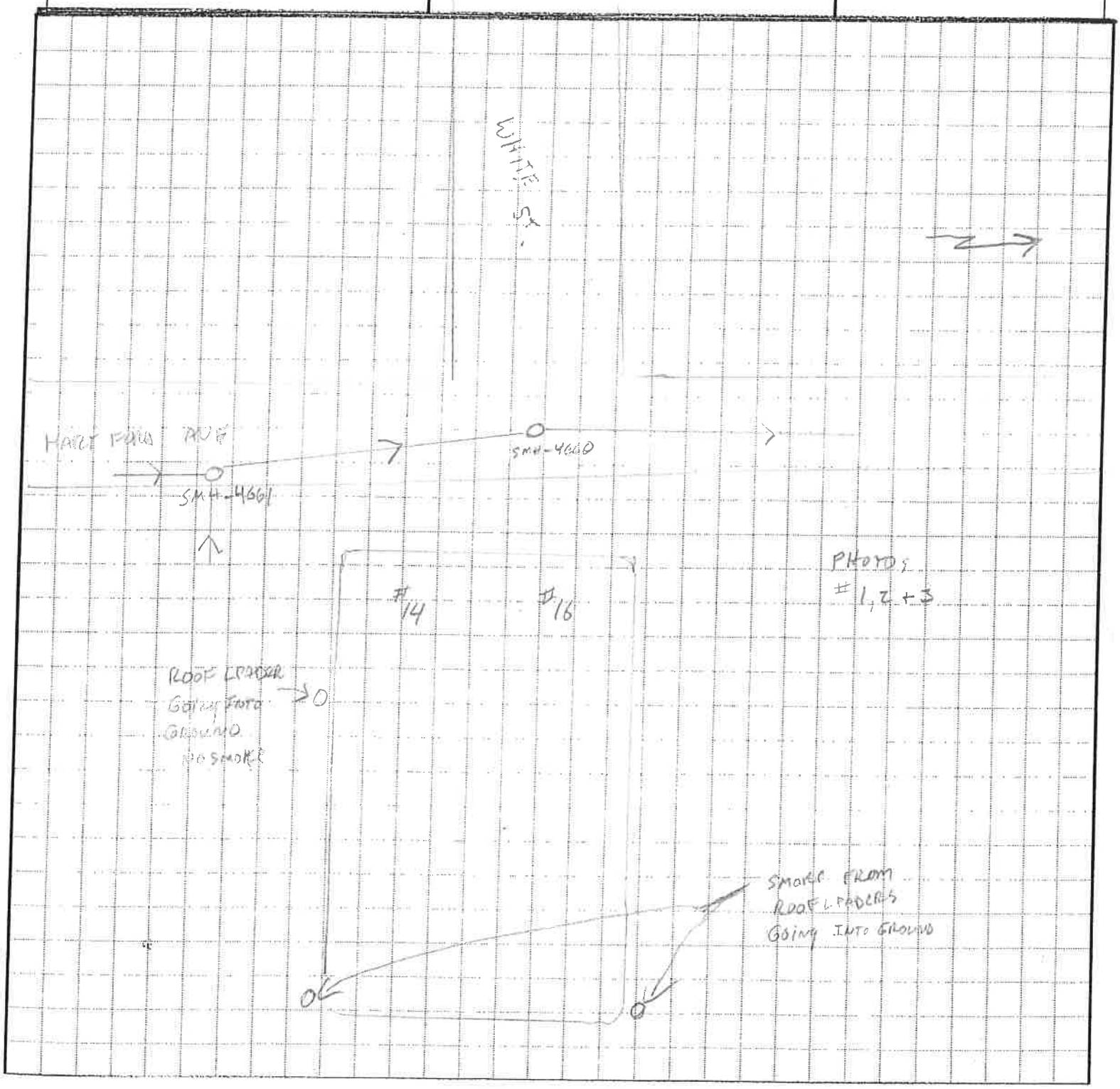
Sketch# #1 Sub _____

Calculated by: P. GRIFFIN Date: 7/27/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

14-16 HARTFORD AVENUE

ROOF LEADER SMOKING

GROUND PIPE SMOKING

GROUND PIPE SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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Project: ENFIELD CT Project #: _____

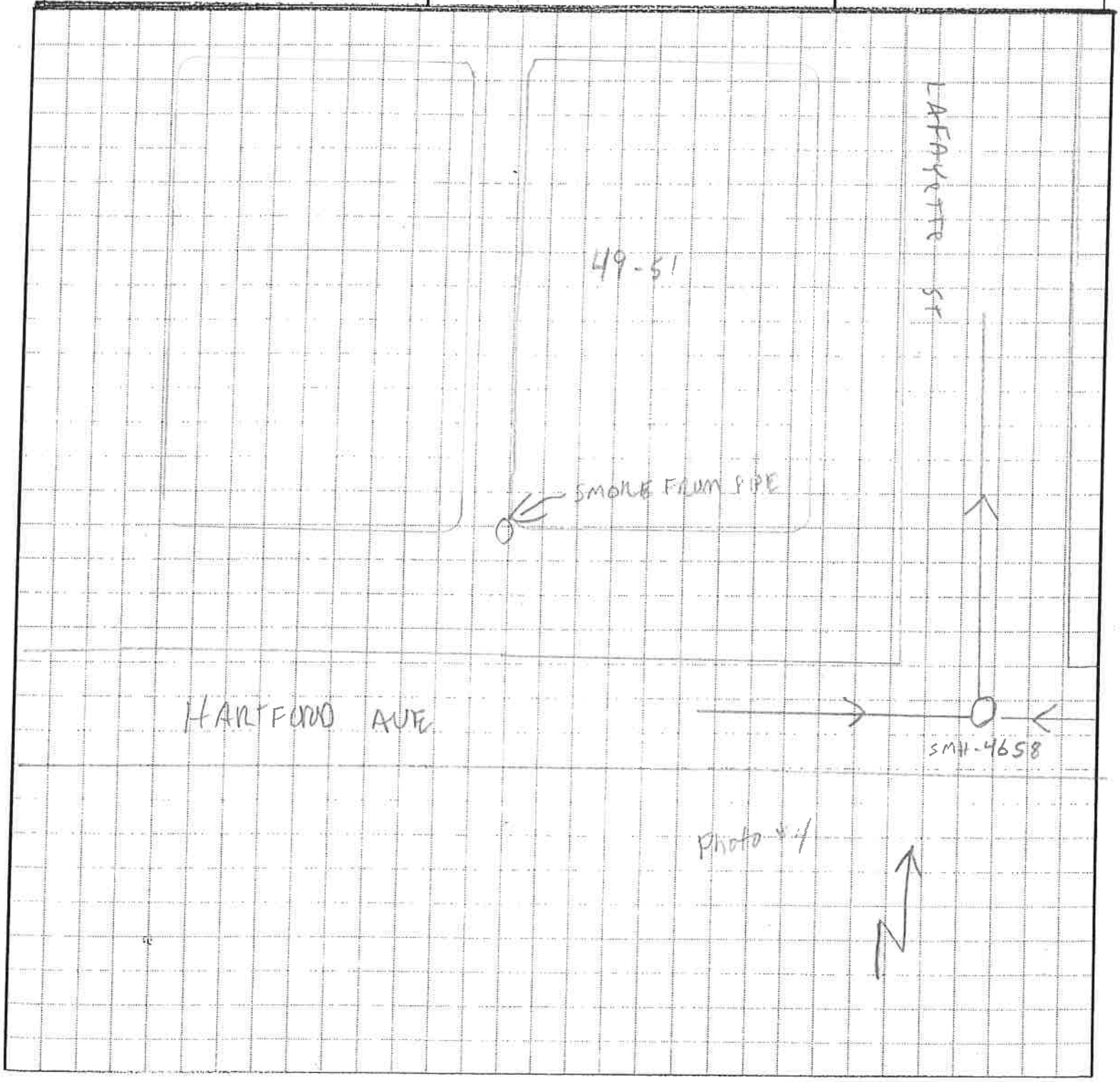
Sketch# #2 Sub _____

Calculated by: P. GRIFFIN Date: 7/22/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
→ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

49-51 HARTFORD AVENUE

OLD ROOF LEADER PIPES SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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603.625.1212 * Fax 603.965.7896

Project: EDFIELD CT Project #: _____

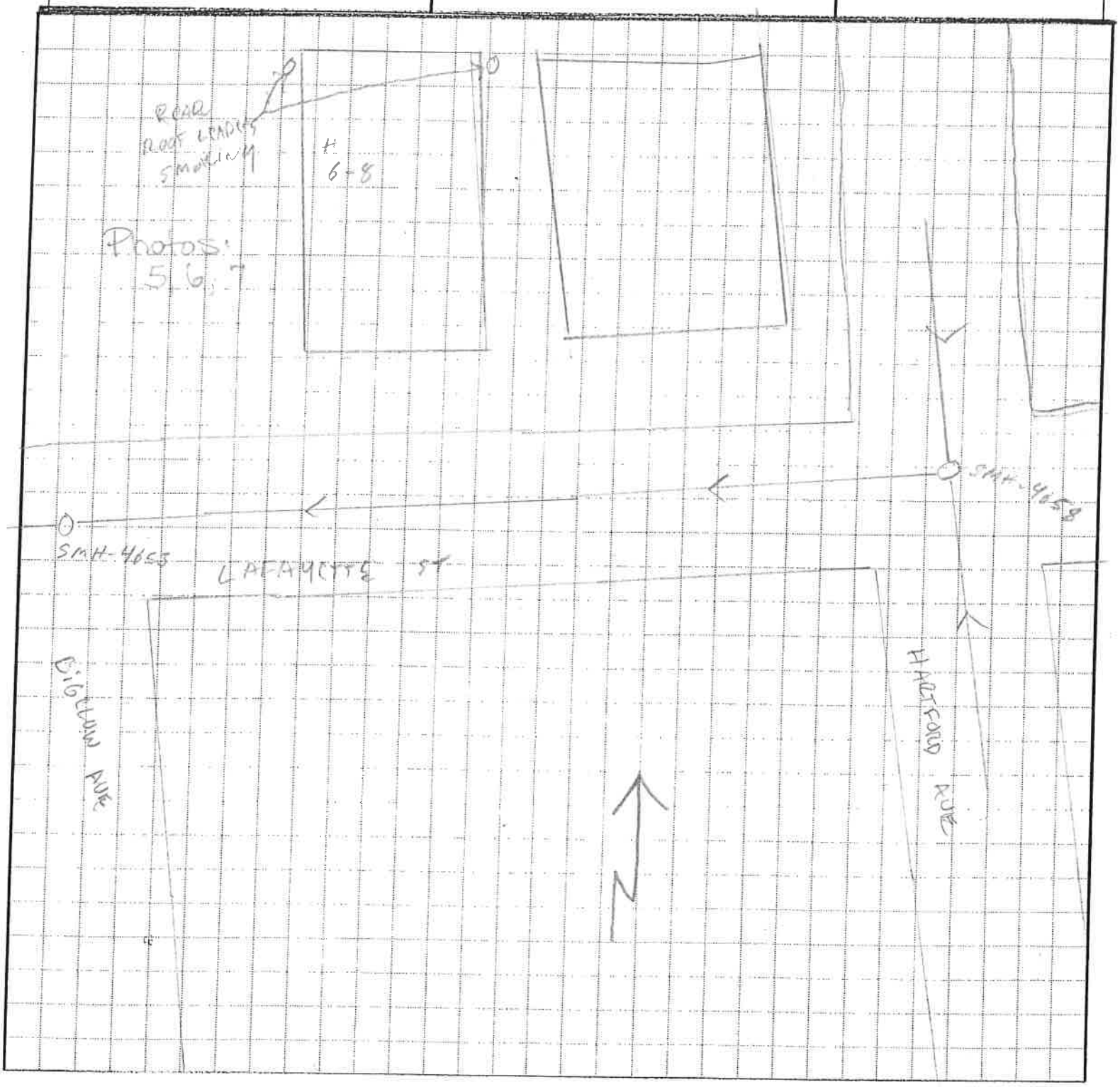
Sketch# 3 Sub _____

Calculated by: P. GRIFFIN Date: 2/22/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
➡ Flow Direction		



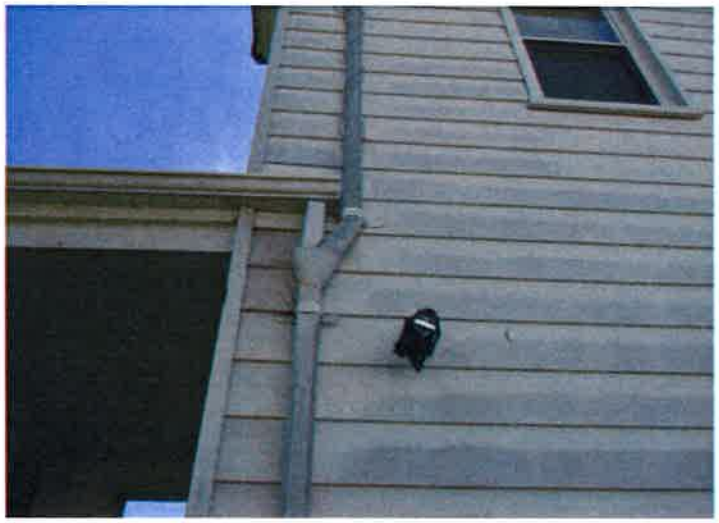
ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

6-8 LAFAYETTE STREET

REAR ROOF LEADERS SMOKING



REAR ROOF LEADERS SMOKING

REAR ROOF LEADERS SMOKING

ADS ENVIRONMENTAL SERVICES

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Project: EDFIELD CT Project #:

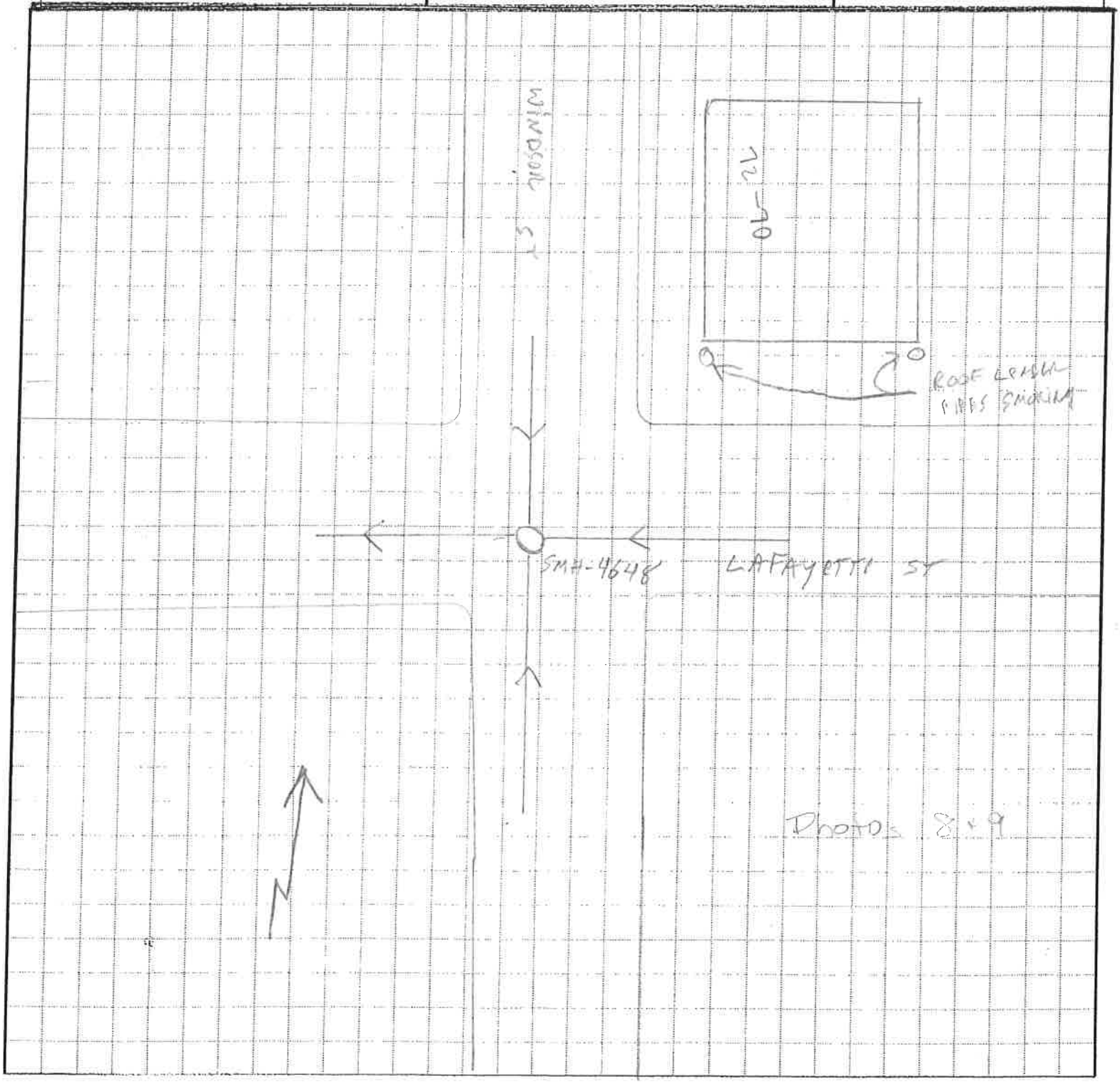
Sketch# 4 Sub

Calculated by: P. GRIFFIN Date: 7/23/15

Checked BY: Date:

FIELD SKETCH LOG (Not to Scale)

Legend:		
Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
Combined Sewer Line		△ Hydrant
Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

70-72 WINDSOR STREET

OLD ROOF LEADER PIPES SMOKING

OLD ROOF LEADER PIPES SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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Project: BRIDGE CT Project #: _____

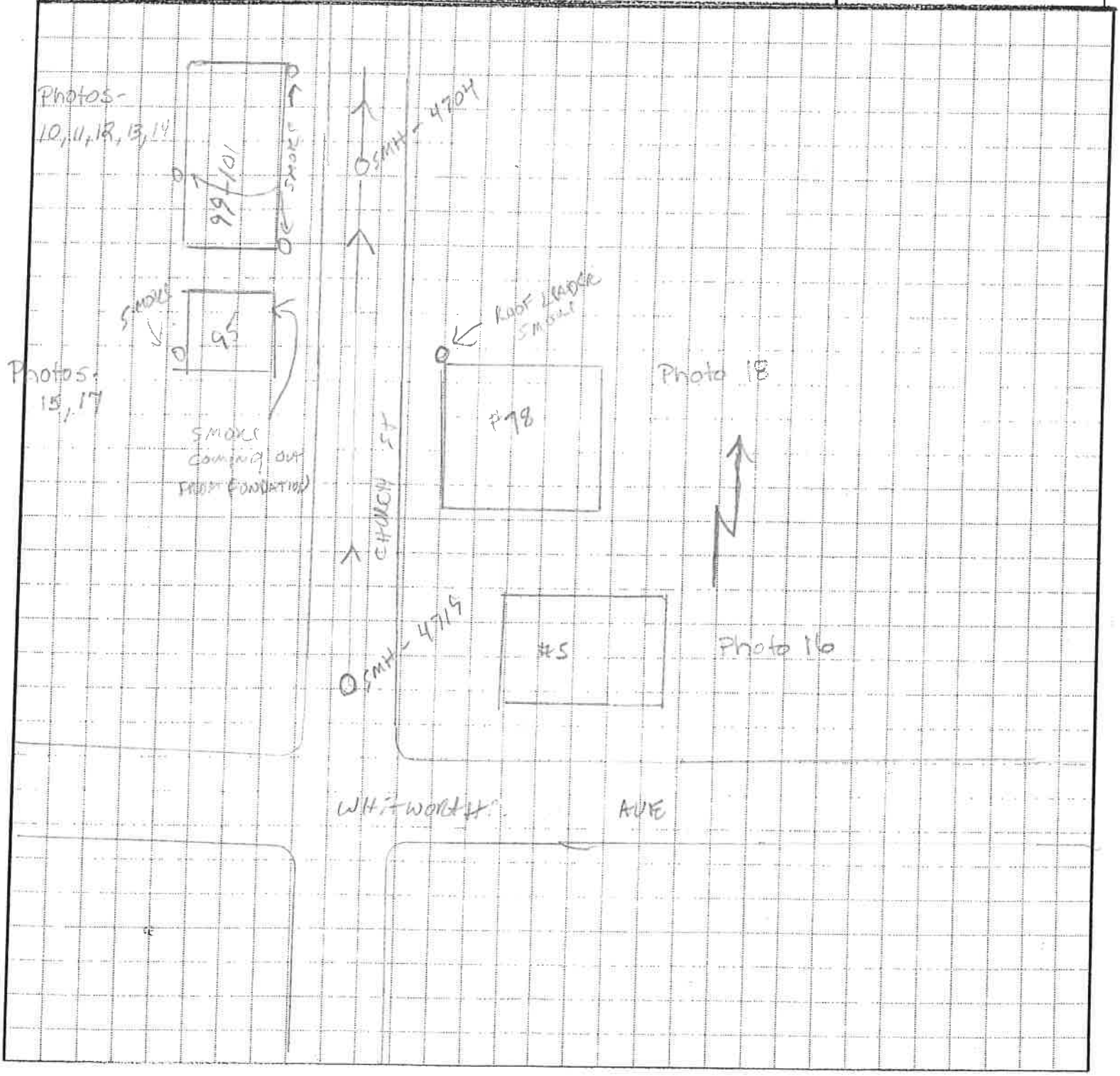
Sketch# 5 Sub _____

Calculated by: P. GRIFFIN Date: 7/22/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
⟶ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

99-101 CHURCH STREET

ROOF LEADER PIPES SMOKING

ROOF LEADER SMOKING

ROOF LEADER PIPES SMOKING

ROOF LEADER PIPES SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

99-101 CHURCH STREET

ROOF LEADER SMOKING

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

95 CHURCH STREET

ROOF LEADER PIPE SMOKING

SMOKING UNDER FOUNDATION - RIGHT FRONT

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

78 CHURCH STREET

ROOF LEADER INTO FOUNDATION - SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

5 WHITWORTH AVENUE

ROOF LEADER SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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Project: Enfield, CT Project #: _____

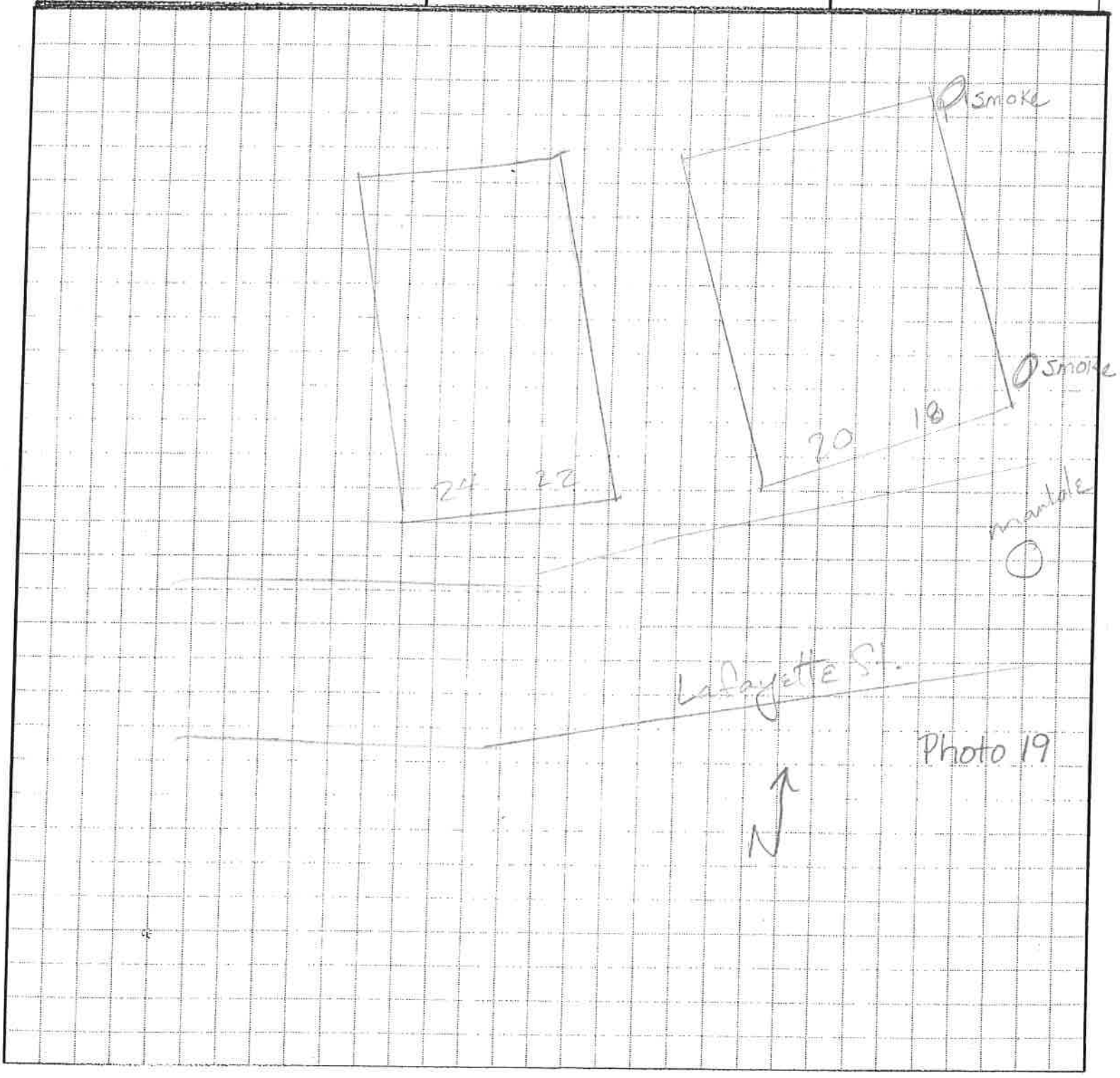
Sketch# 6 Sub _____

Calculated by: K. Foote Date: 7-22-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	☒ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

18 LAFAYETTE STREET

ROOF LEADER INTO FOUNDATION FRONT RIGHT

ROOF LEADER INTO FOUNDATION RIGHT REAR

ADS ENVIRONMENTAL SERVICES

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Project: Enfield, CT Project #: _____

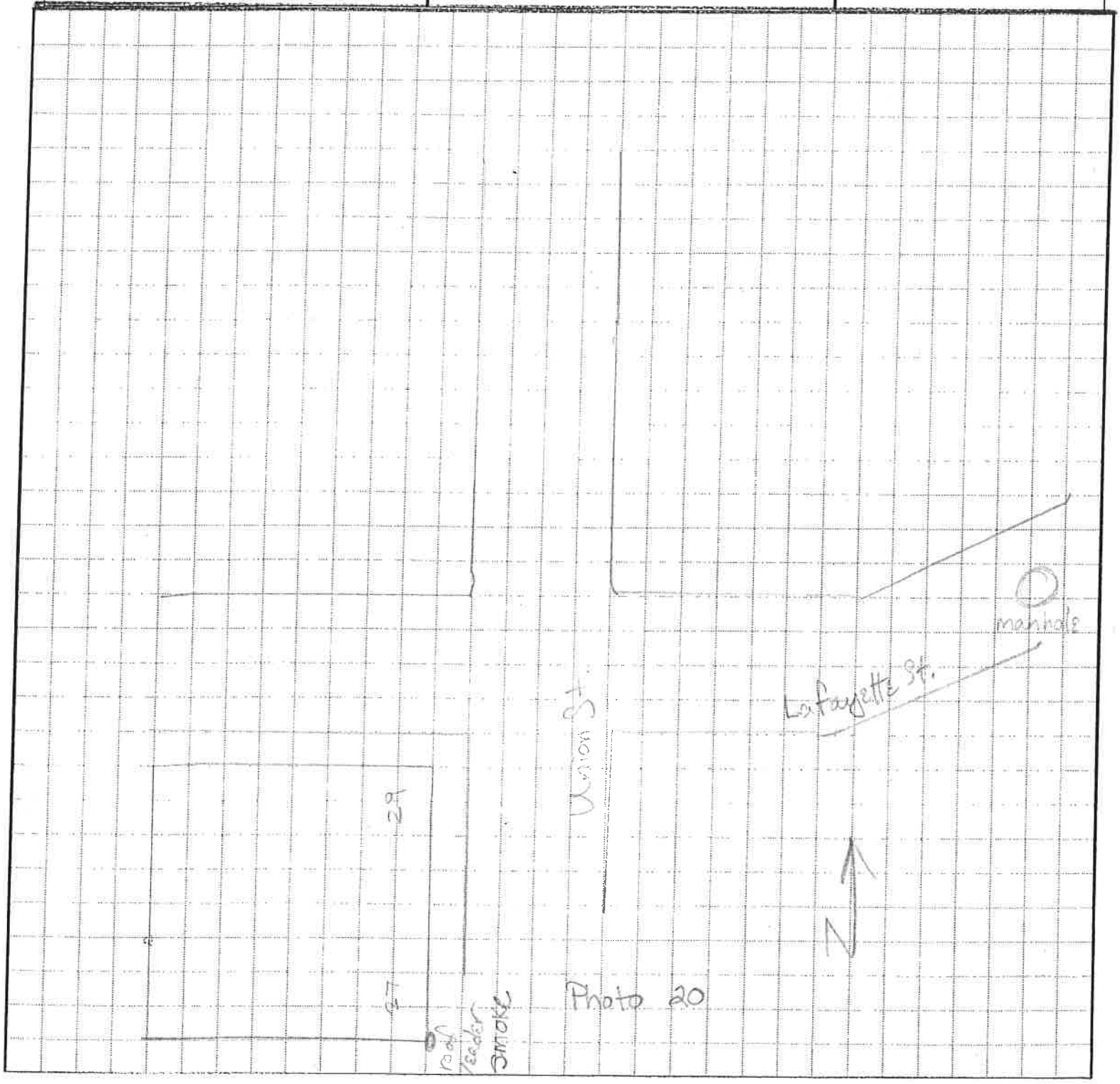
Sketch# 7 Sub _____

Calculated by: K Foote Date: 7-22-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
→ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

27-29 UNION STREET

LEFT FRONT ROOF LEADER SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

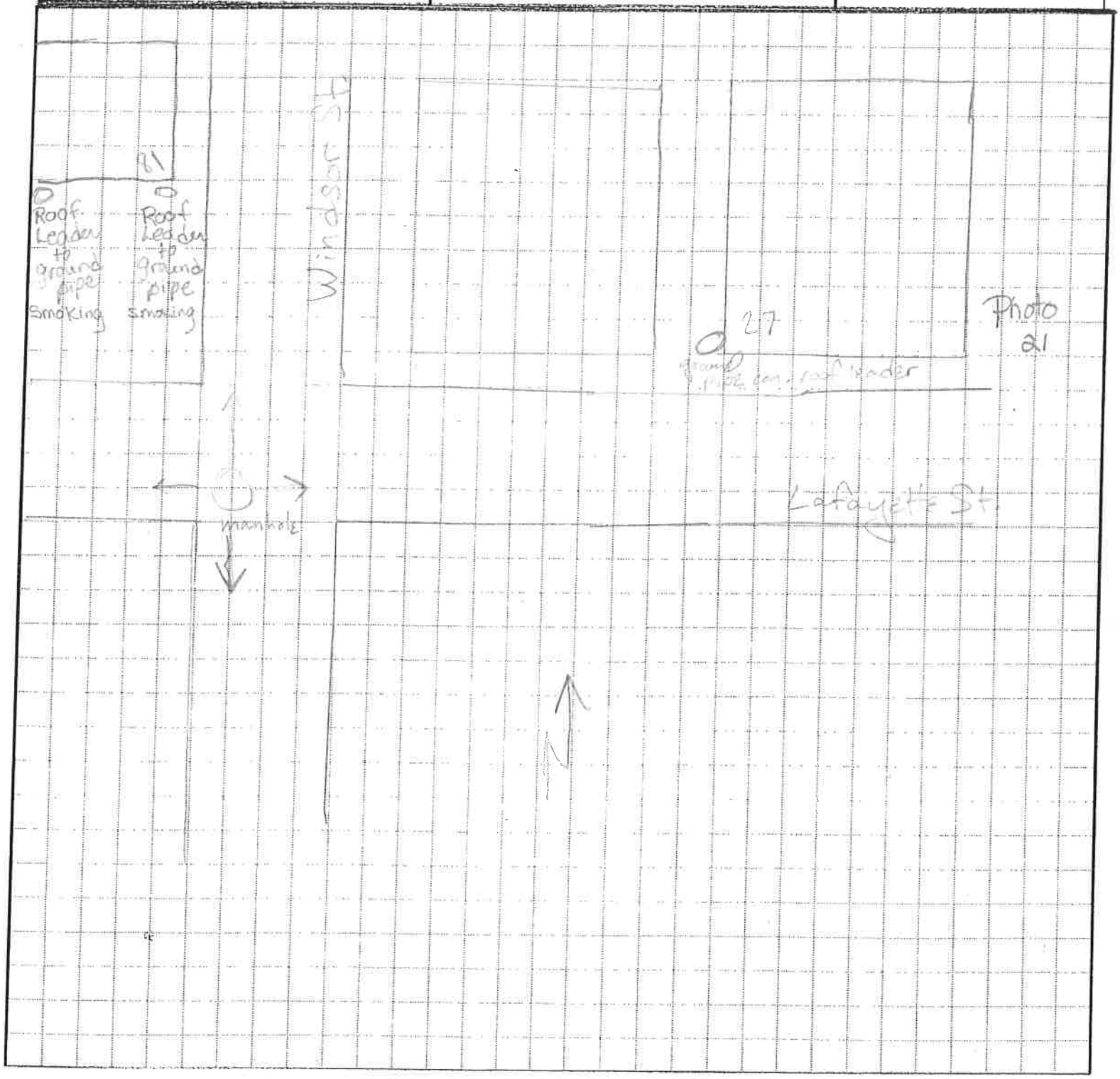
Sketch# 8 Sub _____

Calculated by: K Foote Date: 7-22-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	☒ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

27 LAFAYETTE STREET

LEFT FRONT ROOF LEADER INTO GROUND PIPE - SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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Project: Enfield, CT Project #: _____

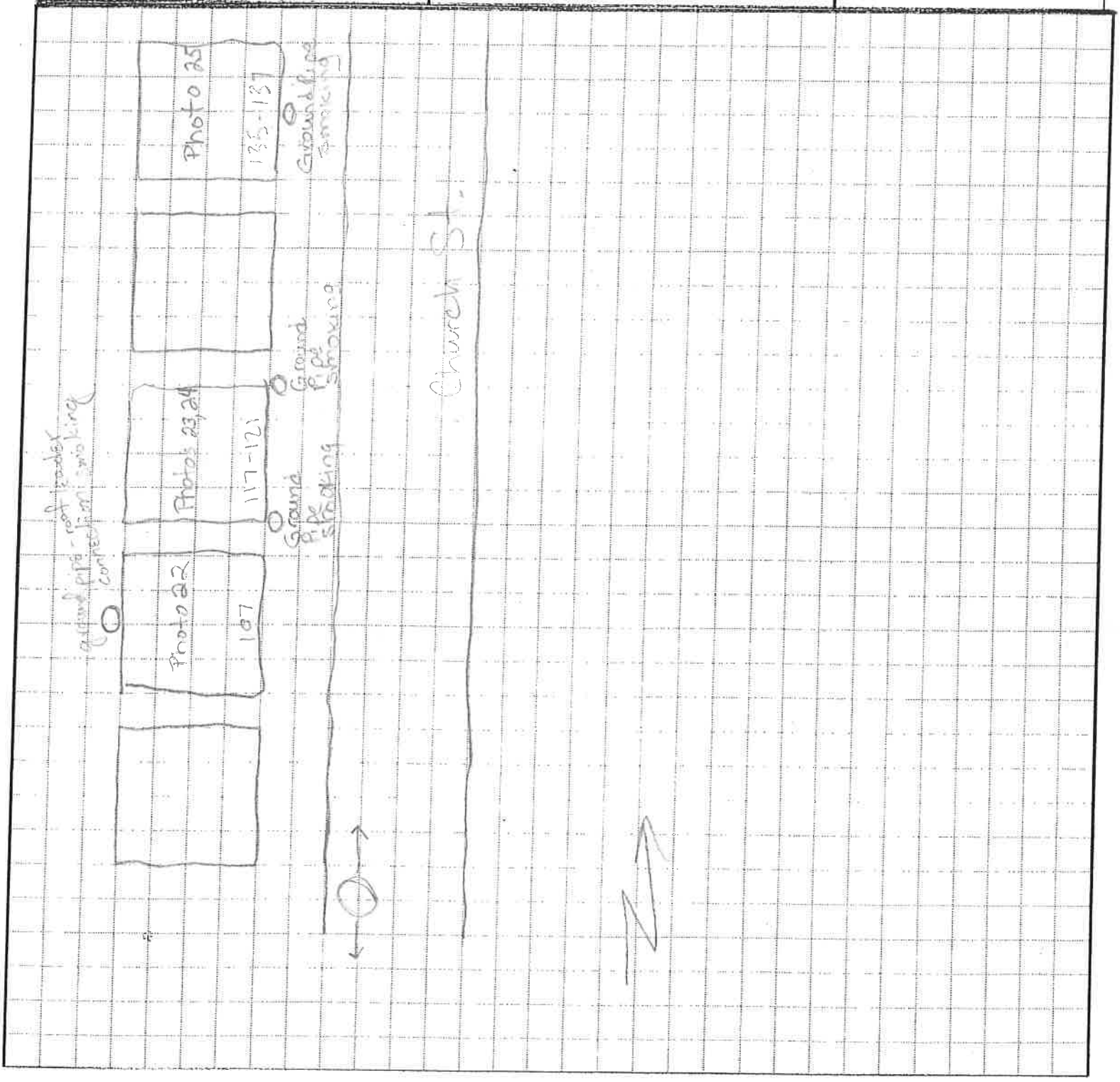
Sketch# 9 Sub _____

Calculated by: K Foote Date: 7-20-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

107 CHURCH STREET

RIGHT REAR ROOF LEADER GROUND PIPE SMOKING

135-137 CHURCH STREET

FRONT ROOF LEADER - GROUND PIPE SMOKING

117-121 CHURCH STREET

LEFT FRONT ROOF LEADER GROUND PIPE SMOKING

117-121 CHURCH STREET

RIGHT FRONT ROOF LEADER GROUND PIPE SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
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Project: Enfield, CT Project #: _____

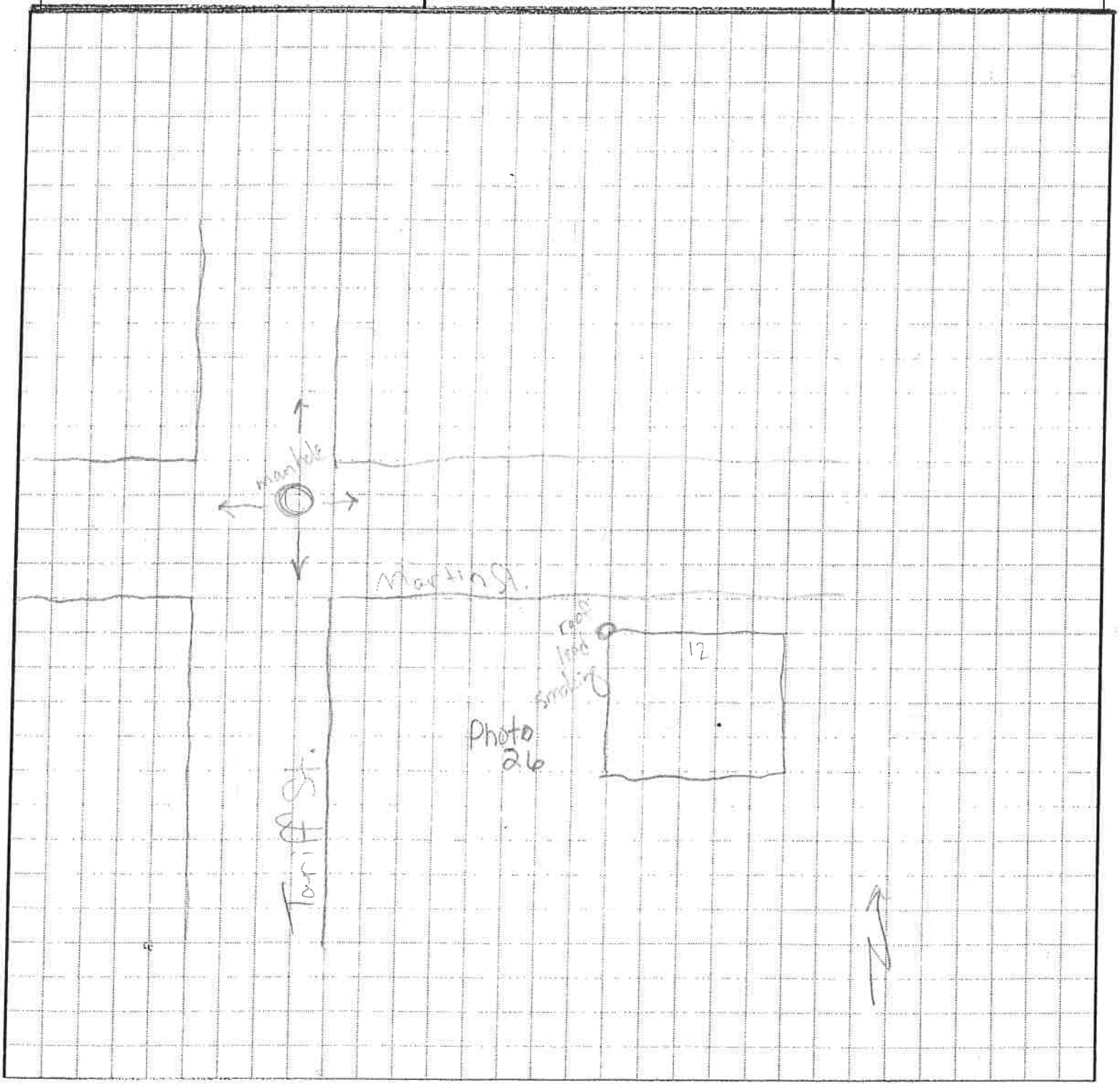
Sketch# 10 Sub _____

Calculated by: K Foote Date: 7-22-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

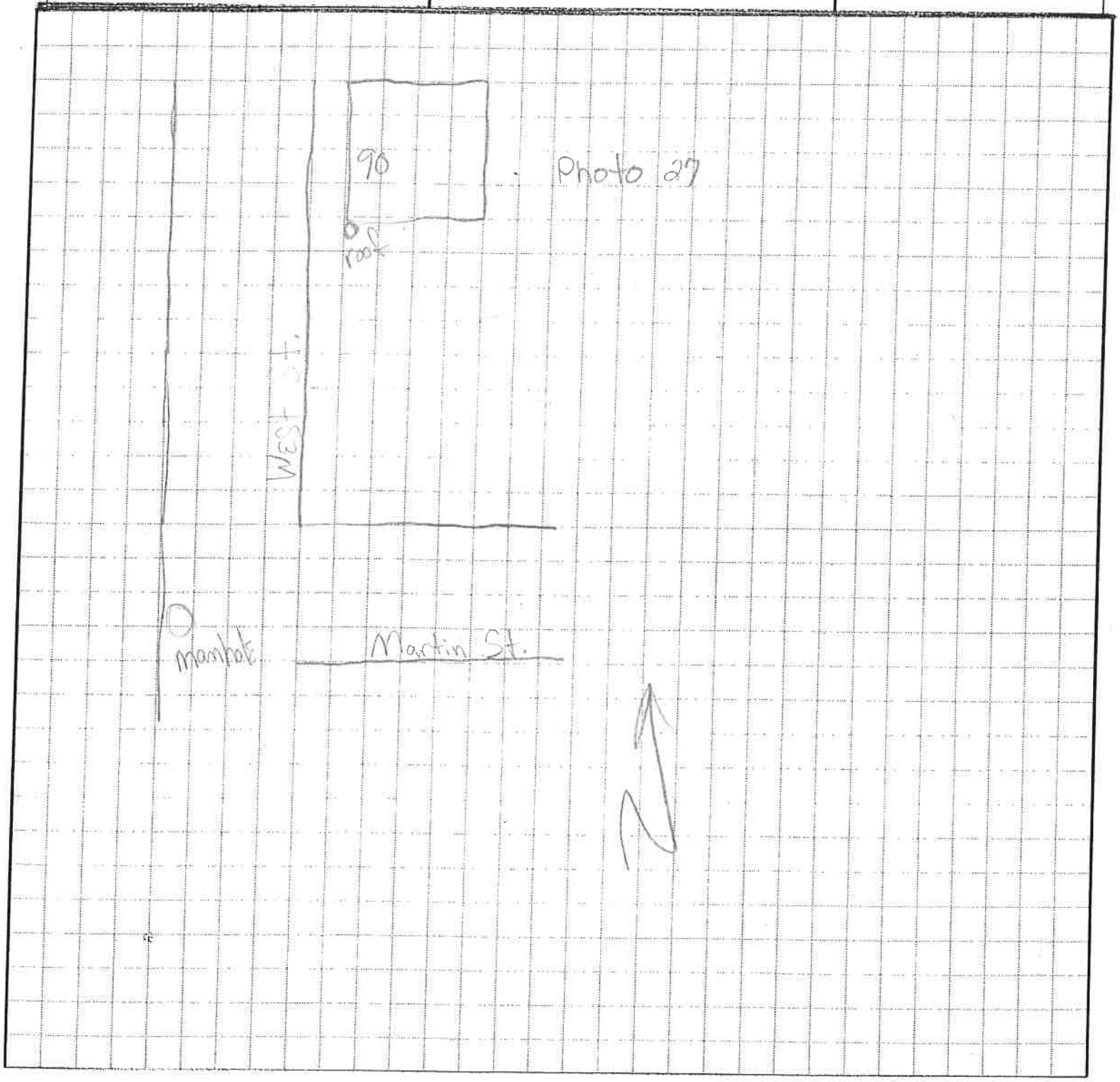
Sketch# 11 Sub _____

Calculated by: K Foote Date: 7-22-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

12 MARTIN STREET

RIGHT FRONT ROOF LEADER
SMOKING

90 WEST STREET

RIGHT FRONT ROOF LEADER
INTO GROUND PIPE SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

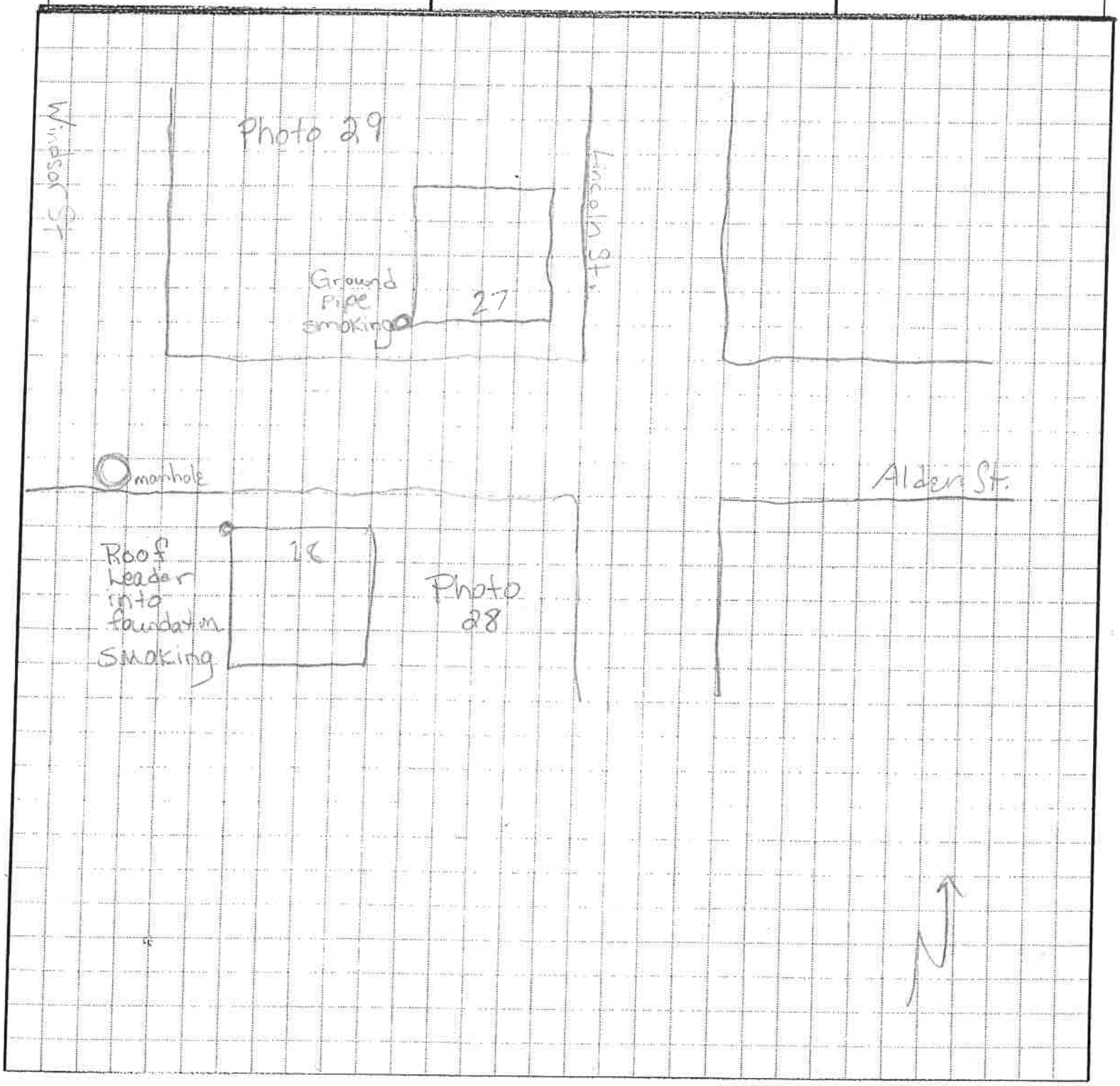
Sketch# 12 Sub _____

Calculated by: K Foote Date: 7-22-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	☒ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

27 ALDEN STREET

LEFT FRONT GROUND PIPE SMOKING

28 ALDEN STREET

RIGHT FRONT ROOF LEADER INTO FOUNDATION SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: EMERALD CT Project #: _____

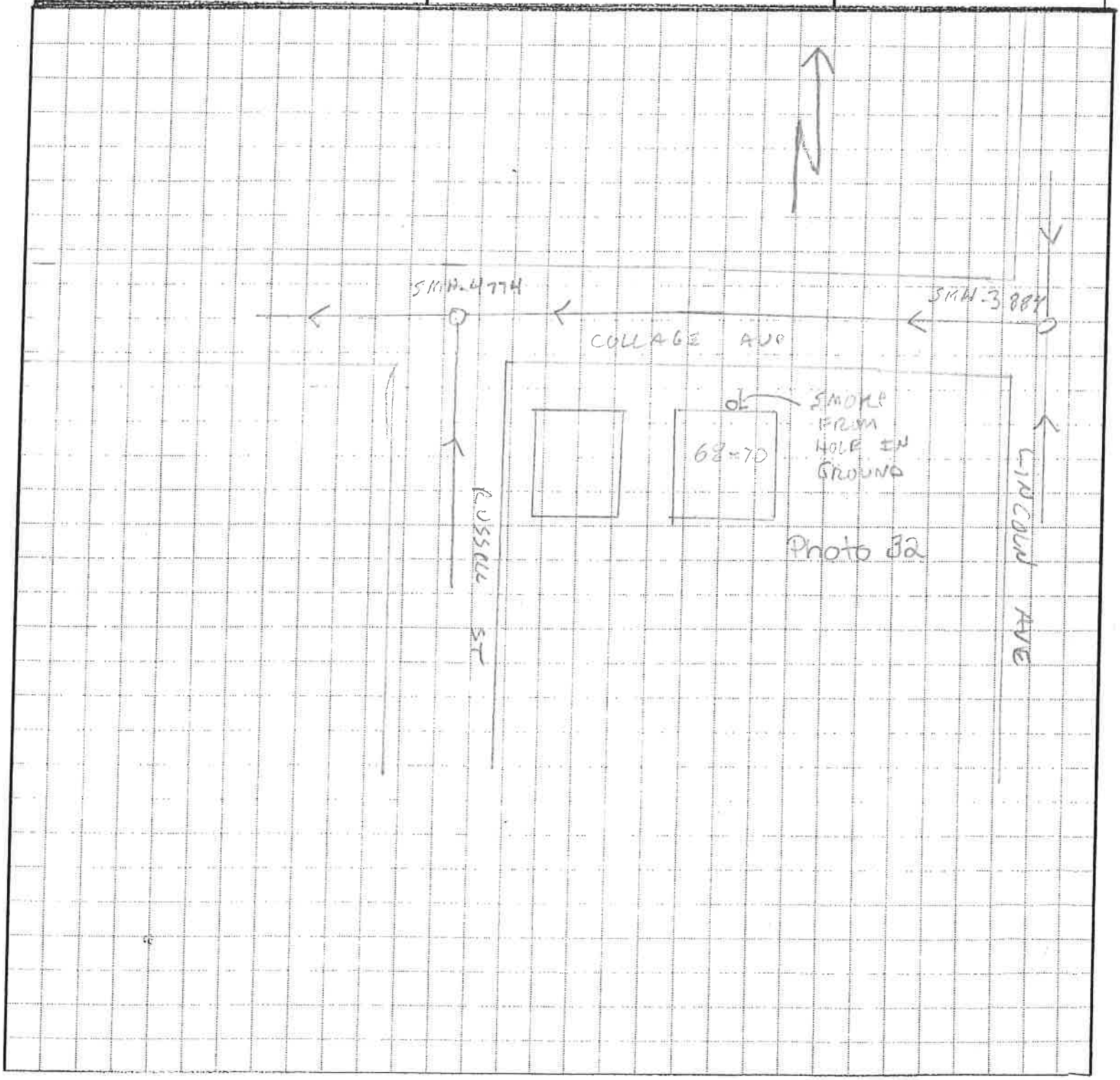
Sketch# 13 Sub _____

Calculated by: R. GUFFEY Date: 7/23/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

68-70 COLLEGE STREET

HOLE IN GROUND -FRONT OF HOUSE
NEAR GAS METER - SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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603.625.1212 * Fax 603.965.7896

Project: EJFIELD ST Project #: _____

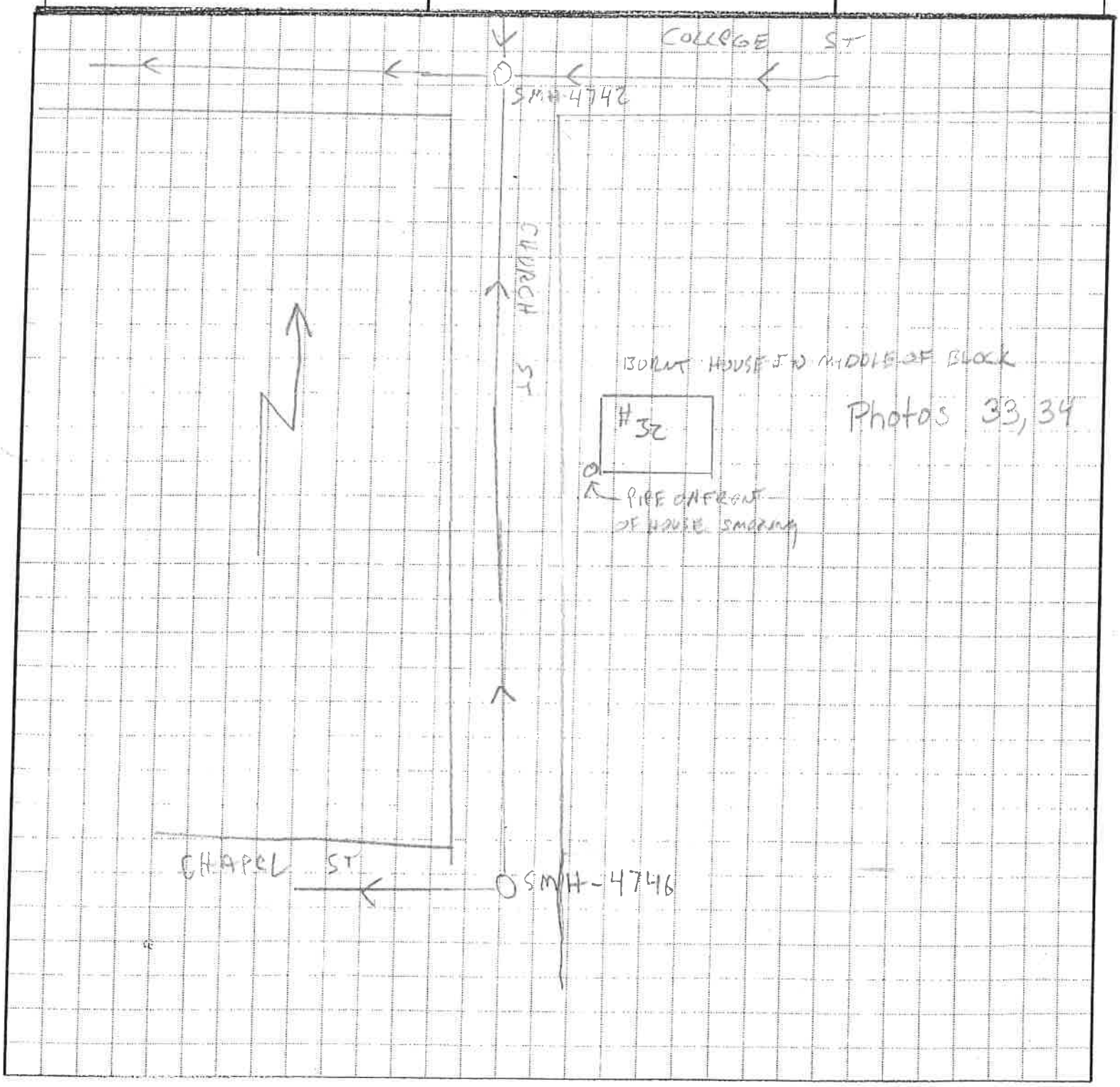
Sketch# 14 Sub _____

Calculated by: P GRIFFIN Date: 7/23/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

32 CHURCH STREET

PIPE ON RIGHT SIDE OF HOUSE - SMOKING

PIPE ON RIGHT SIDE OF HOUSE - SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: FAIRFIELD CT Project #: _____

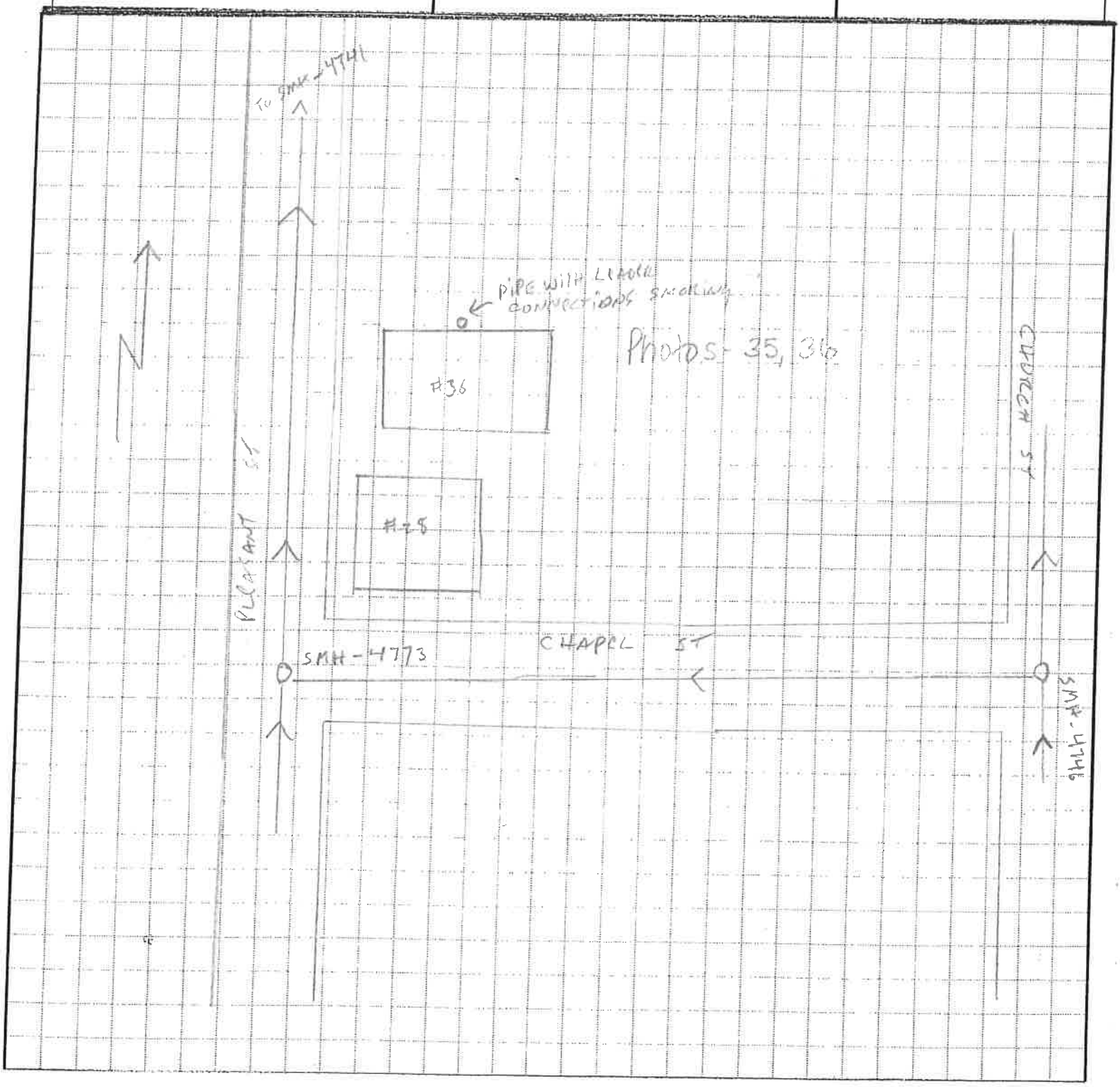
Sketch# 15 Sub _____

Calculated by: P. GRIFFIN Date: 7/23/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

36 PLEASANT STREET

GUTTERS ON LEFT SIDE OF HOUSE
HOOKED INTO PIPE - SMOKING

GUTTERS ON LEFT SIDE OF HOUSE
HOOKED INTO PIPE - SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

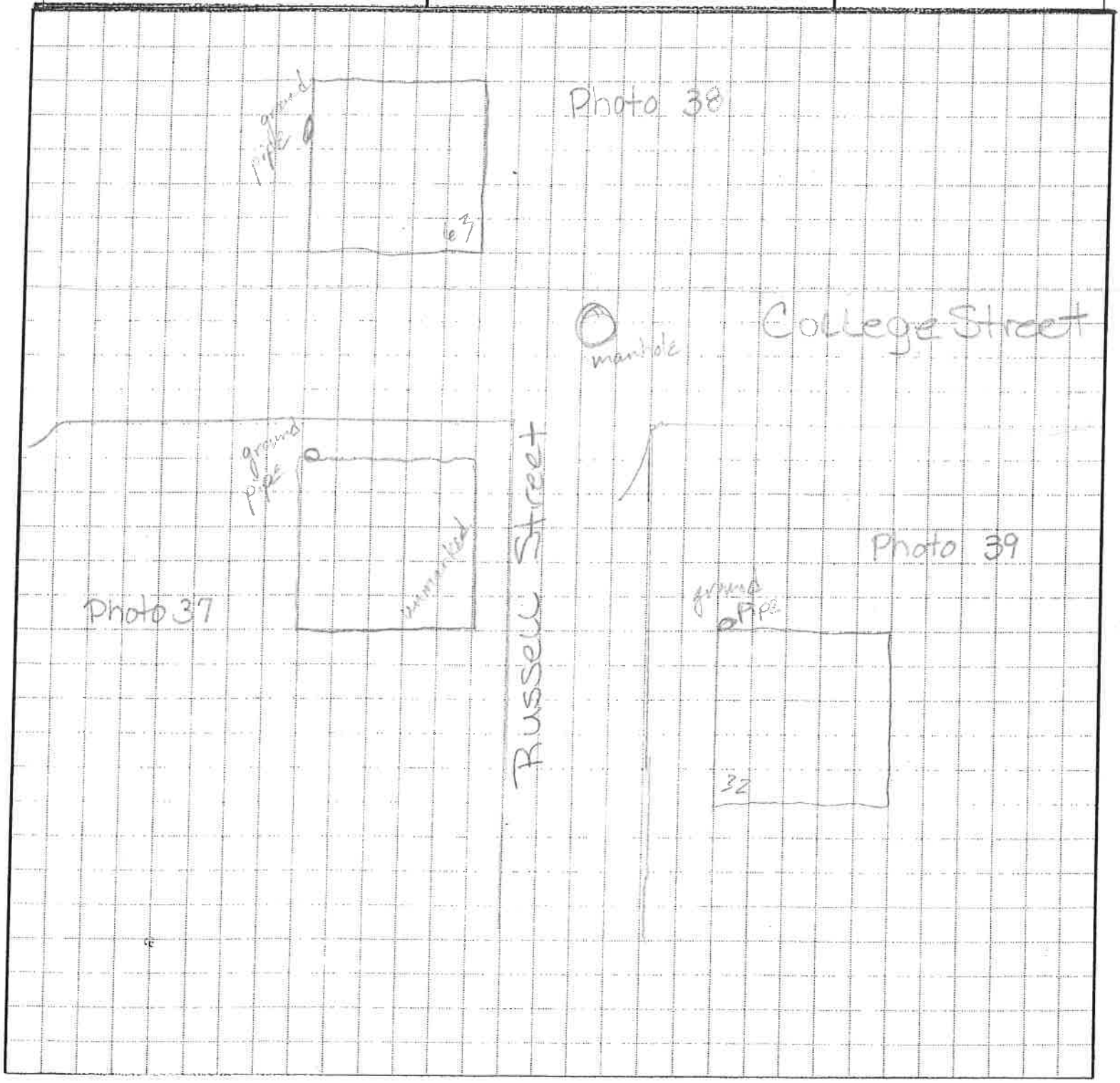
Sketch# 16 Sub _____

Calculated by: K Foote Date: 7-23-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

COLLEGE ST. AT RUSSELL ST.

RIGHT SIDE ROOF LEADER CONNECTED TO GROUND PIPE - SMOKING

32 RUSSELL STREET

LEFT FRONT ROOF LEADER CONNECTED TO GROUND PIPE - SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

63 COLLEGE STREET

MIDDLE REAR ROOF LEADER CONNECTED TO GROUND PIPE - SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

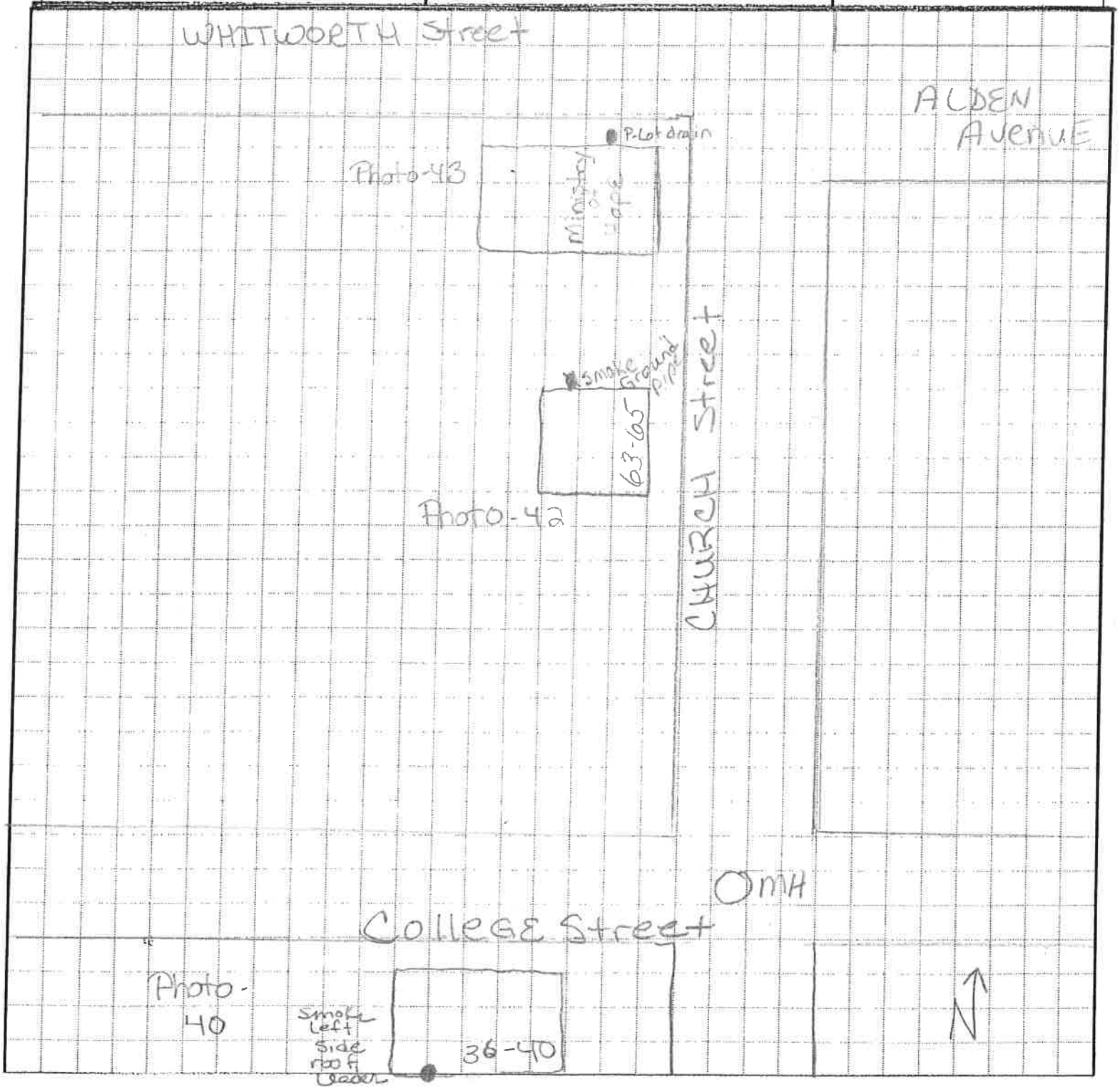
Sketch# 17 Sub _____

Calculated by: K Foote Date: 7-23-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
→ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

63-65 CHURCH STREET

RIGHT SIDE GROUND PIPE SMOKING

CHURCH STREET AT WHITWORTH STREET

PARKING LOT DRAIN SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

36-40 COLLEGE STREET

LEFT SIDE REAR ROOF LEADER CONNECTED TO GROUND PIPE - SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

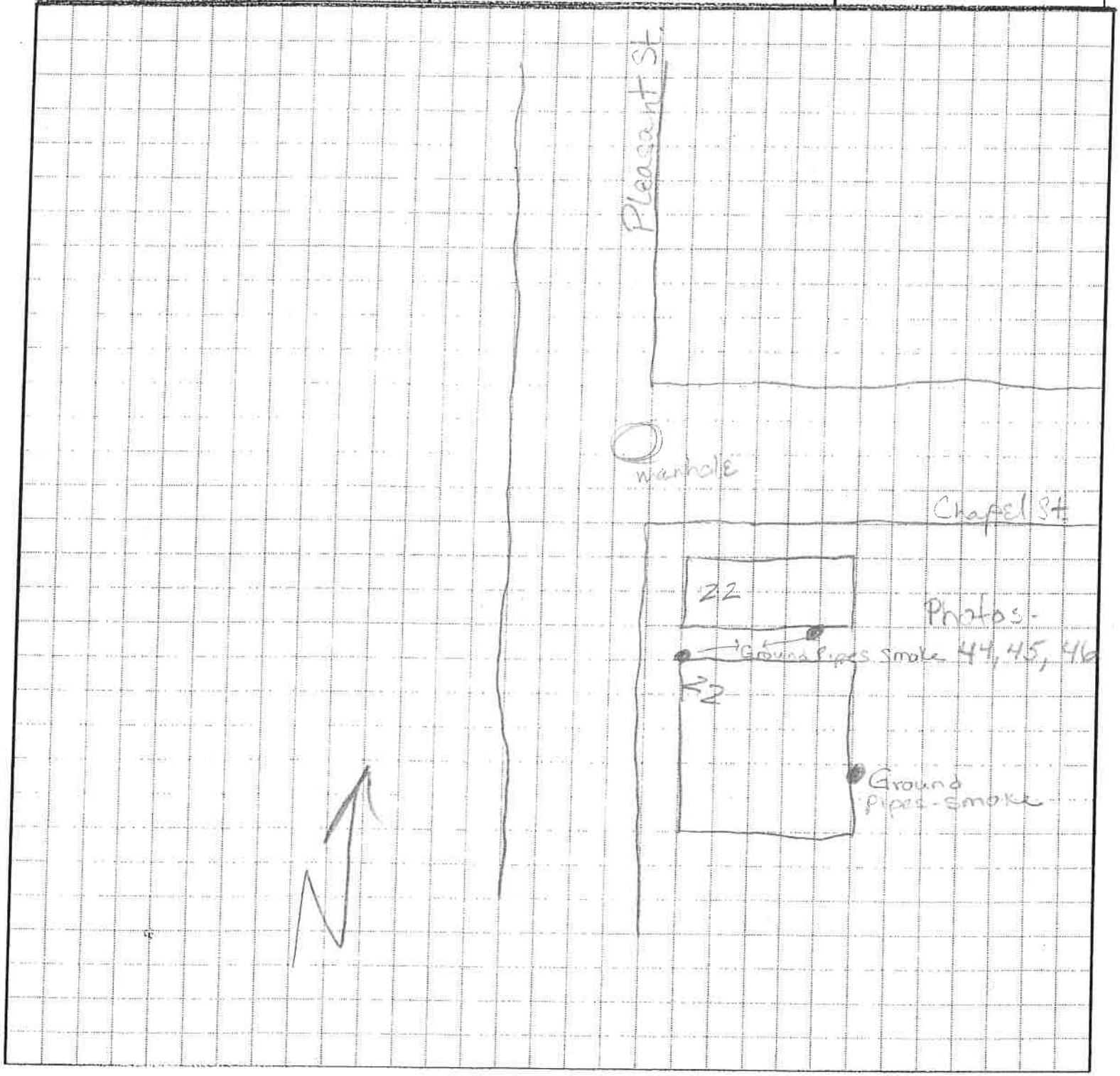
Sketch# 18 Sub _____

Calculated by: K Foote Date: 7-23-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	☒ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
→ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

22 PLEASANT STREET

LEFT FRONT ROOF LEADER - GROUND PIPE SMOKING

MIDDLE REAR ROOF LEADER SMOKING

ROOF LEADER INTO FOUNDATION SMOKING

GROUND PIPE SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

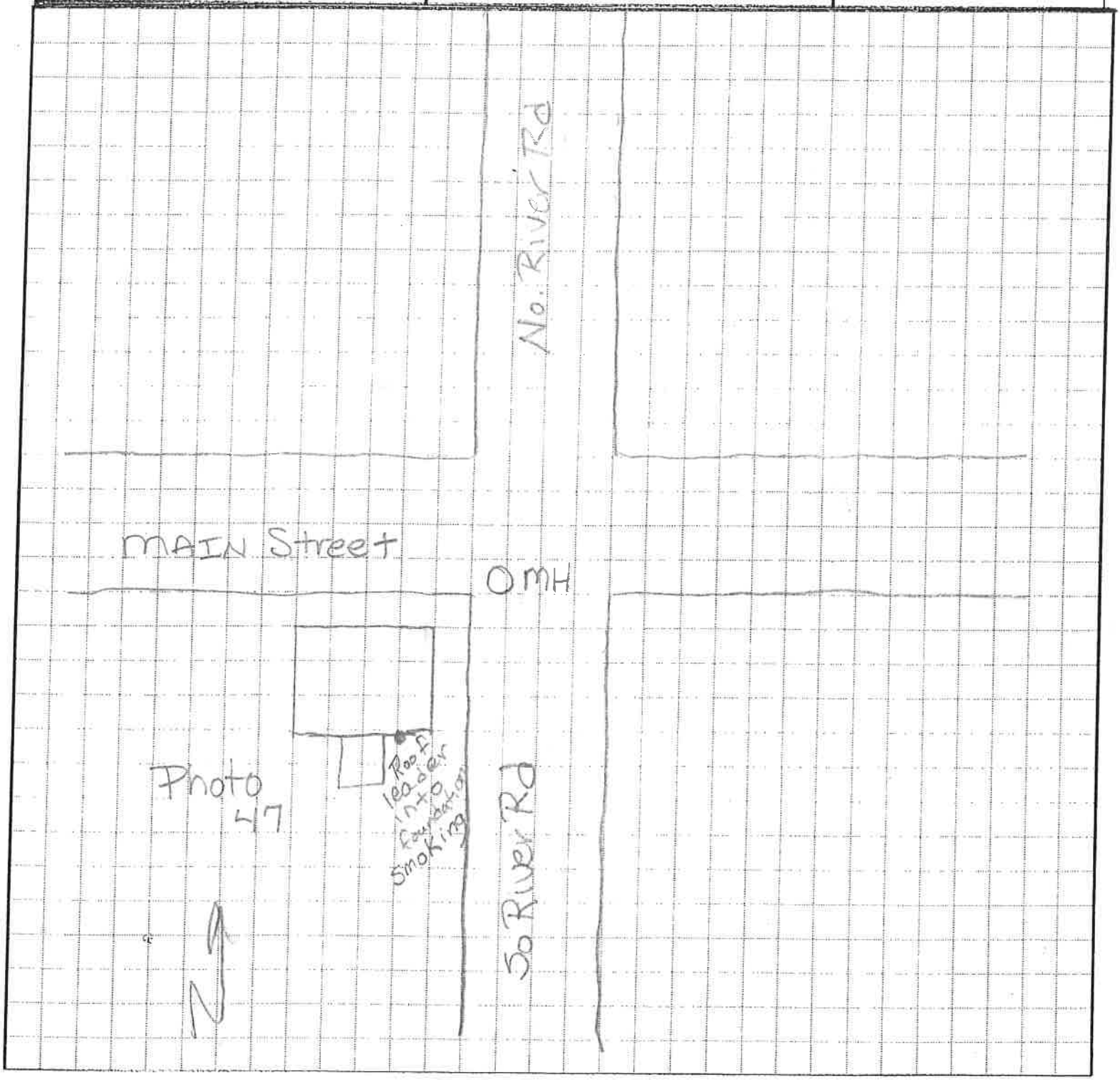
Sketch# 19 Sub _____

Calculated by: K Foote Date: 7-23-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

RIVER STREET AT MAIN STREET

REAR LEFT ROOF LEADER IN PIPE INTO FOUNDATION - SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: [illegible] Project #: _____

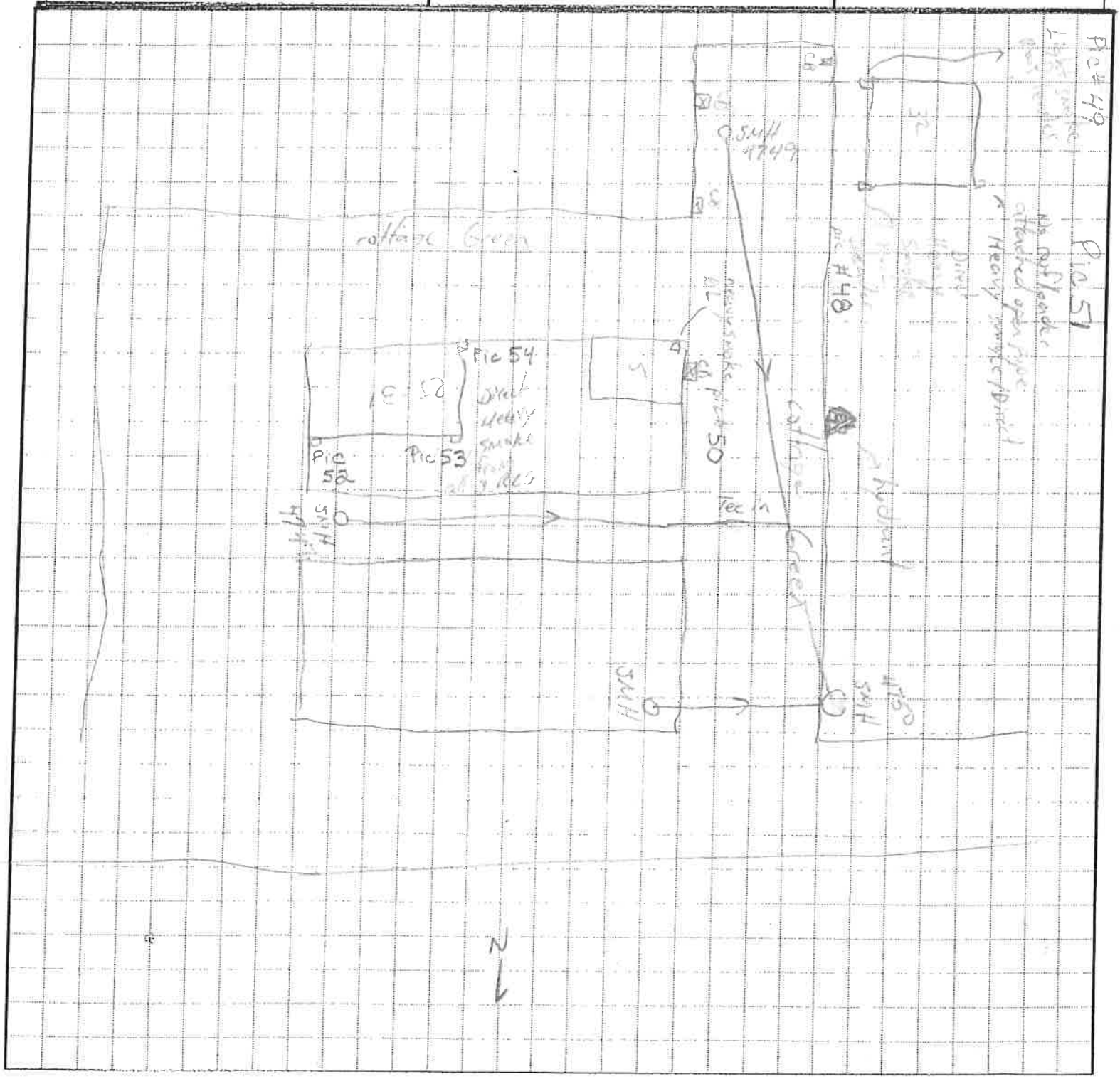
Sketch# 20 Sub _____

Calculated by: CL Date: 7/29/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

32 COTTAGE GREEN

LIGHT SMOKE FROM LEFT FRONT ROOF LEADER

HEAVY SMOKE FROM RIGHT FRONT ROOF LEADER

HEAVY SMOKE FROM RIGHT REAR GROUND PIPE

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

25-31 COTTAGE GREEN

REAR RIGHT ROOF LEADER SMOKING

LEFT REAR ROOF LEADER SMOKING

LEFT FRONT ROOF LEADER SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

5 COTTAGE GREEN

LIGHT SMOKE FROM LEFT FRONT ROOF LEADER

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

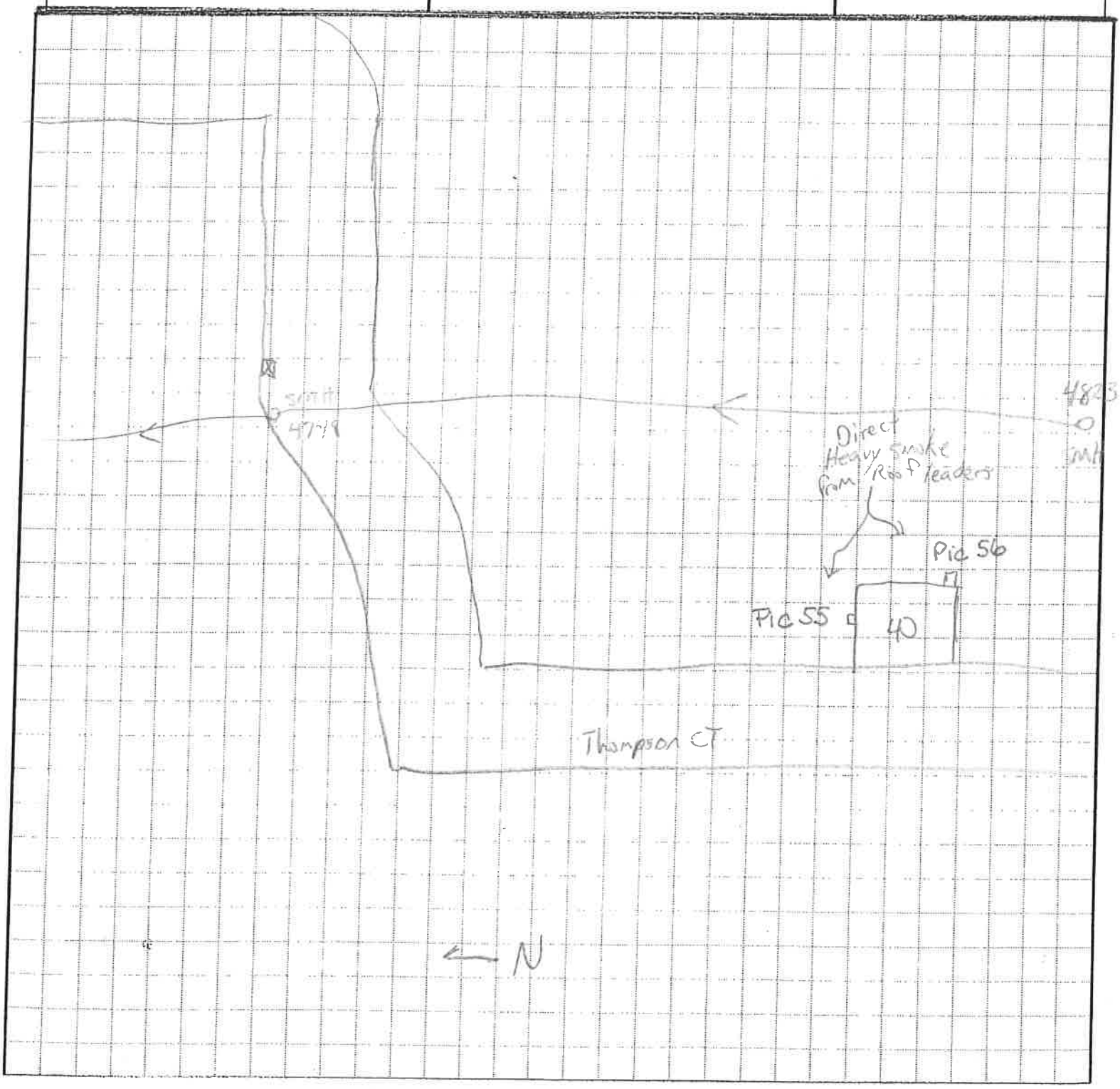
Sketch# 21 Sub _____

Calculated by: CJ Date: 7/29/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

40 THOMPSON COURT

HEAVY SMOKE LEFT CENTER ROOF LEADER

HEAVY SMOKE RIGHT REAR ROOF LEADER

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

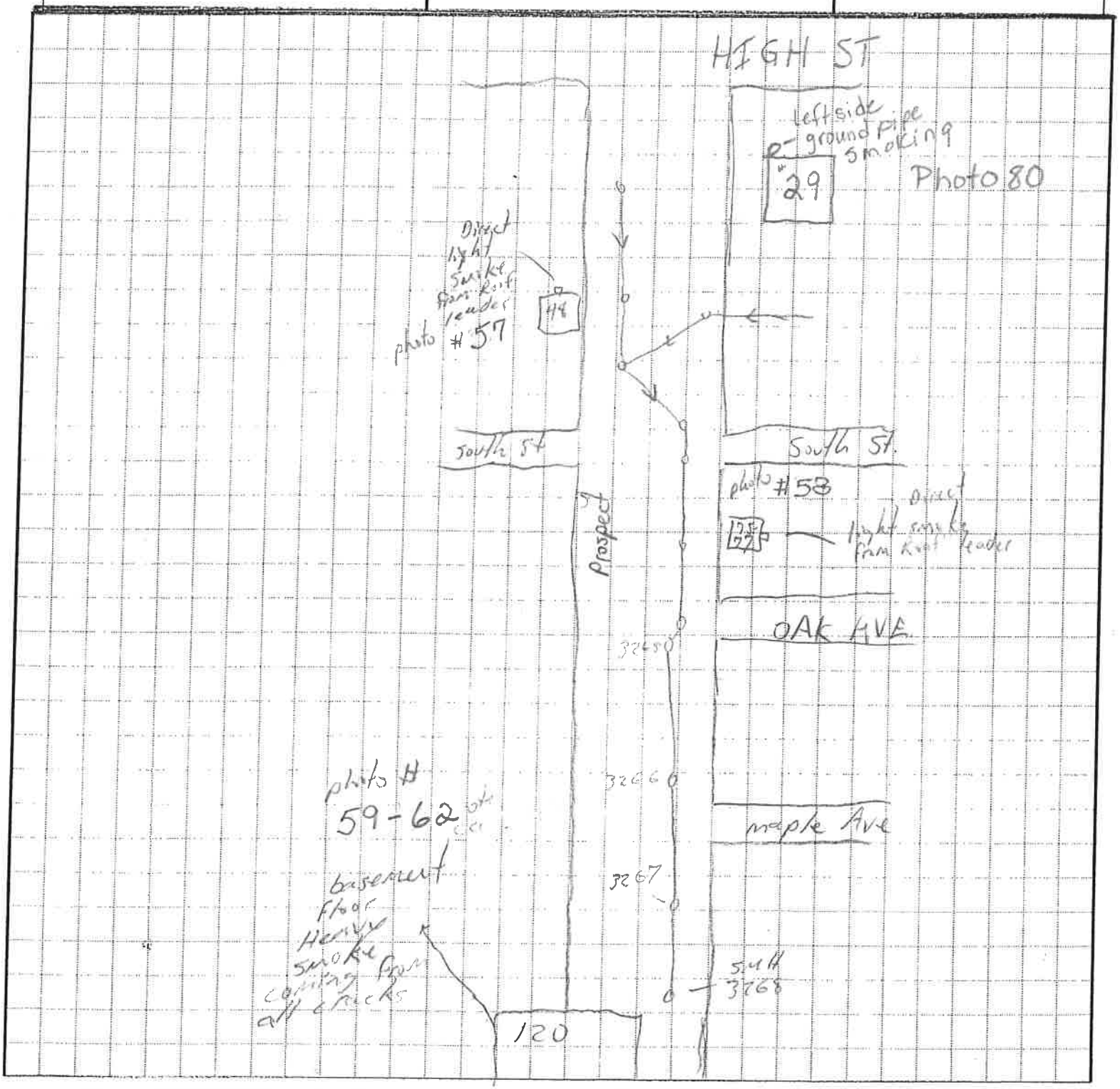
Sketch# 22 Sub _____

Calculated by: CL Date: 7/29/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

29 PROSPECT STREET

LEFT SIDE GROUND PIPE SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

48 PROSPECT STREET

SMOKE FROM RIGHT FRONT ROOF LEADER

75-77 PROSPECT STREET

SMOKE LEFT REAR ROOF LEADER

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

120 PROSPECT STREET BASEMENT FLOOR

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

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603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

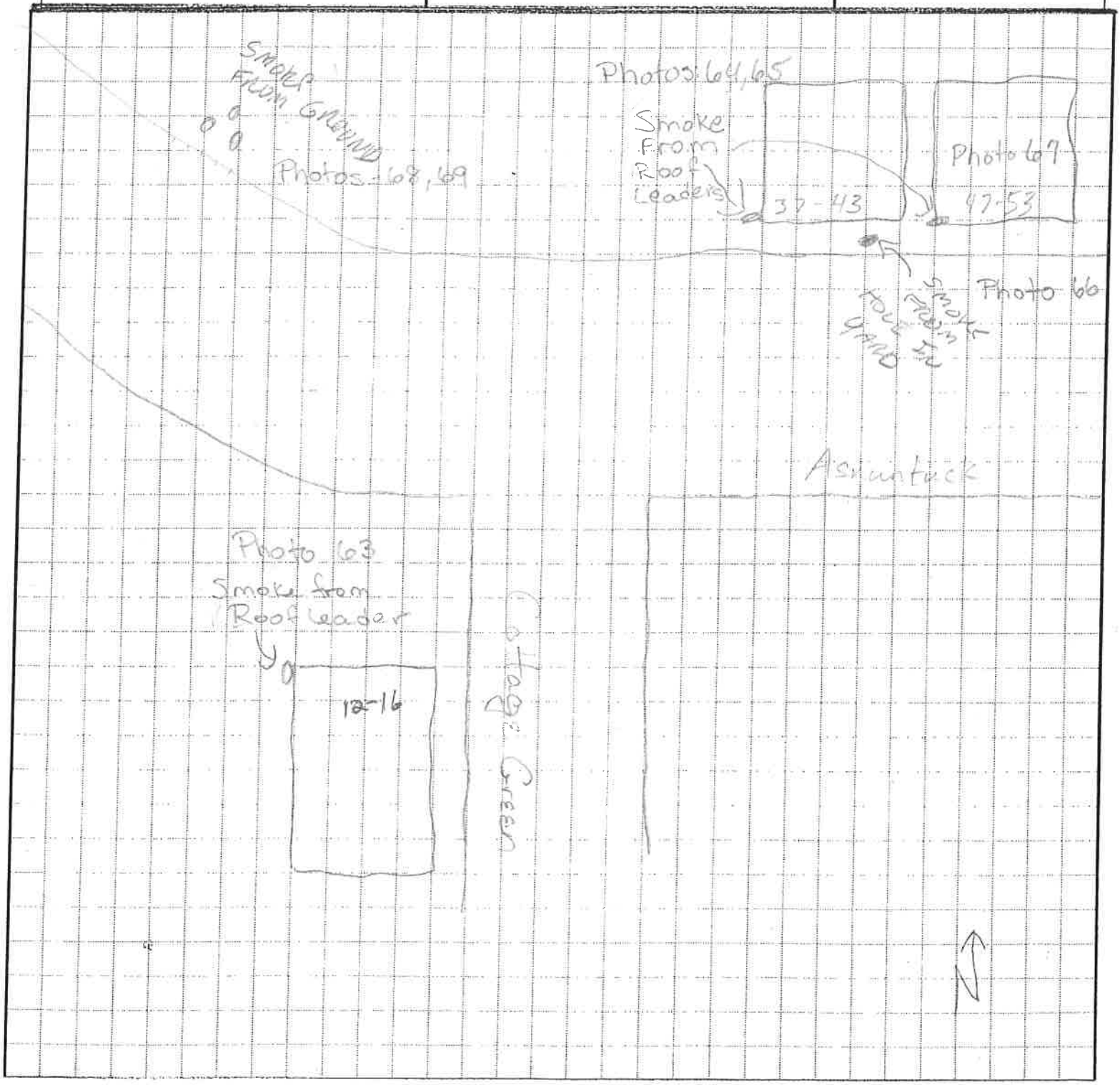
Sketch# 23 Sub _____

Calculated by: K Foote Date: 07/29/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

37-43 ASNUNTUCK STREET

LEFT FRONT GROUND PIPE - SMOKE

LEFT FRONT ROOF LEADER

LEFT FRONT ROOF LEADER

HOLE IN GROUND- FRONT LAWN - SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

47-53 ASNUNTUCK STREET

LEFT FRONT ROOF LEADER GROUND PIPE SMOKING

3 HOLES IN GROUND SMOKING - LOCATED AT BEND IN ROAD BEFORE STOP AND OVERPASS

3 HOLES SMOKING (2ND PHOTO)

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

12-16 COTTAGE GREEN

LEFT REAR ROOF LEADER
GROUND PIPE SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: ENFIELD Project #: _____

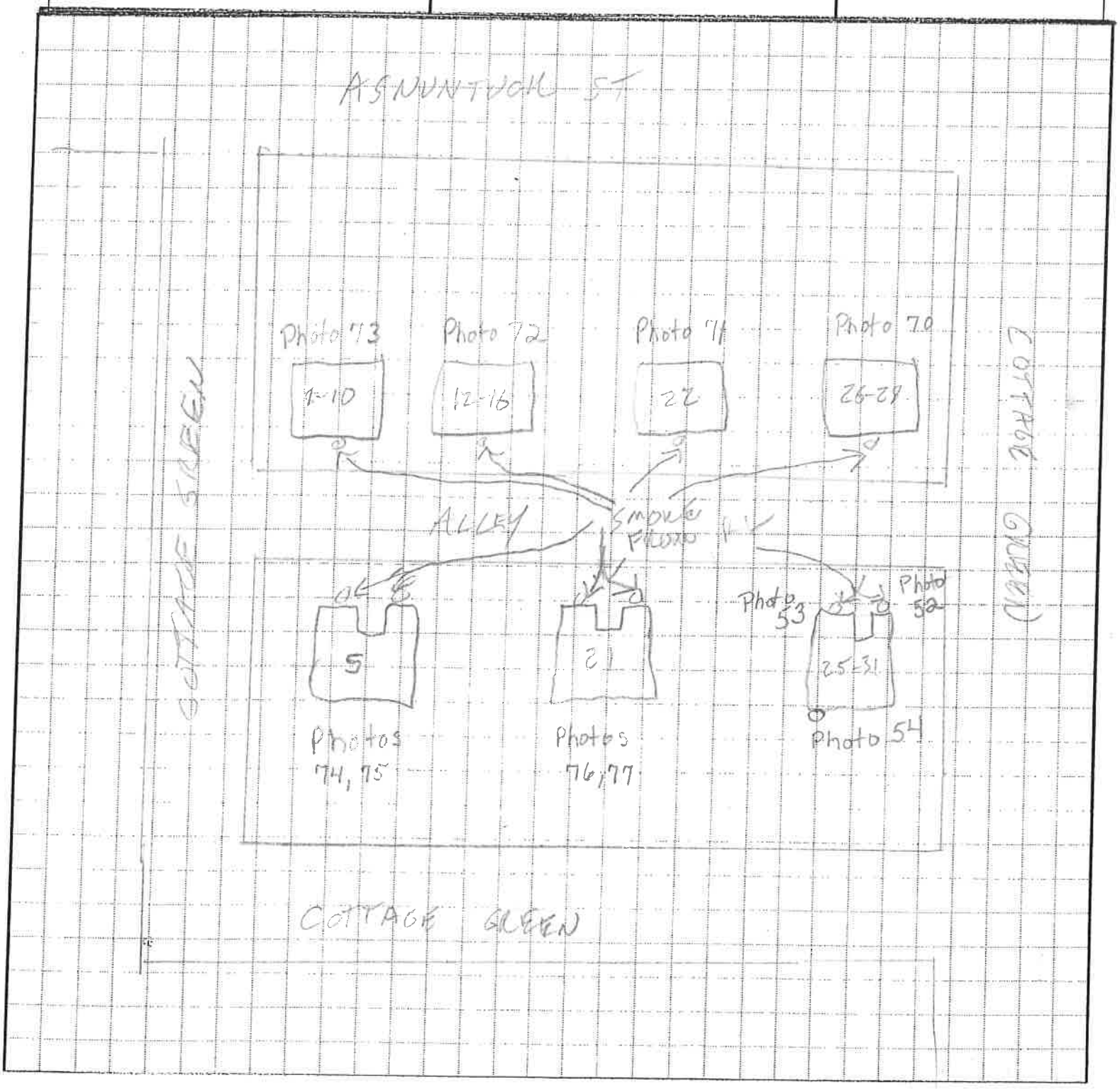
Sketch# 24 Sub _____

Calculated by: P GOLLEY Date: 7/29/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	☒ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

5 COTTAGE GREEN ALLEY

MIDDLE REAR ROOF LEADER SMOKING

MIDDLE REAR ROOF LEADER SMOKING

21 COTTAGE GREEN ALLEY

MIDDLE REAR ROOF LEADER SMOKING

MIDDLE REAR ROOF LEADER GROUND PIPE SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

12-16 COTTAGE GREEN ALLEY

MIDDLE REAR ROOF LEADER GROUND PIPE SMOKING

8-10 COTTAGE GREEN ALLEY

MIDDLE REAR ROOF LEADER SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

26-28 COTTAGE GREEN ALLEY

MIDDLE REAR ROOF LEADER SMOKING

22 COTTAGE GREEN ALLEY

MIDDLE REAR ROOF LEADER SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: [illegible] Project #: _____

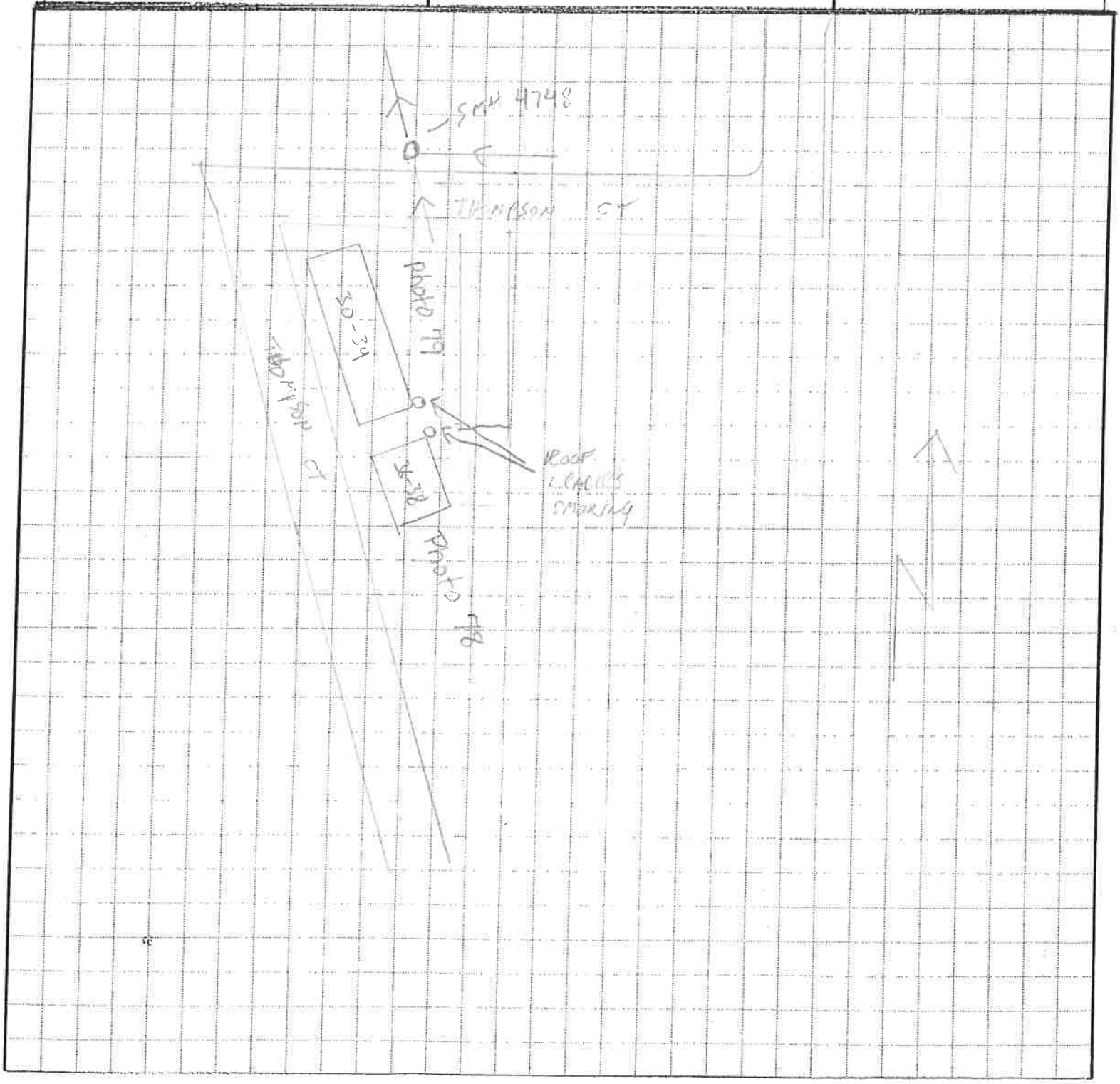
Sketch# 25 Sub _____

Calculated by: [illegible] Date: 7/29/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
➡ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

36-38 THOMPSON COURT

RIGHT FRONT ROOF LEADER

30-34 THOMPSON COURT

LEFT FRONT ROOF LEADER

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: EDFIELD CT Project #: _____

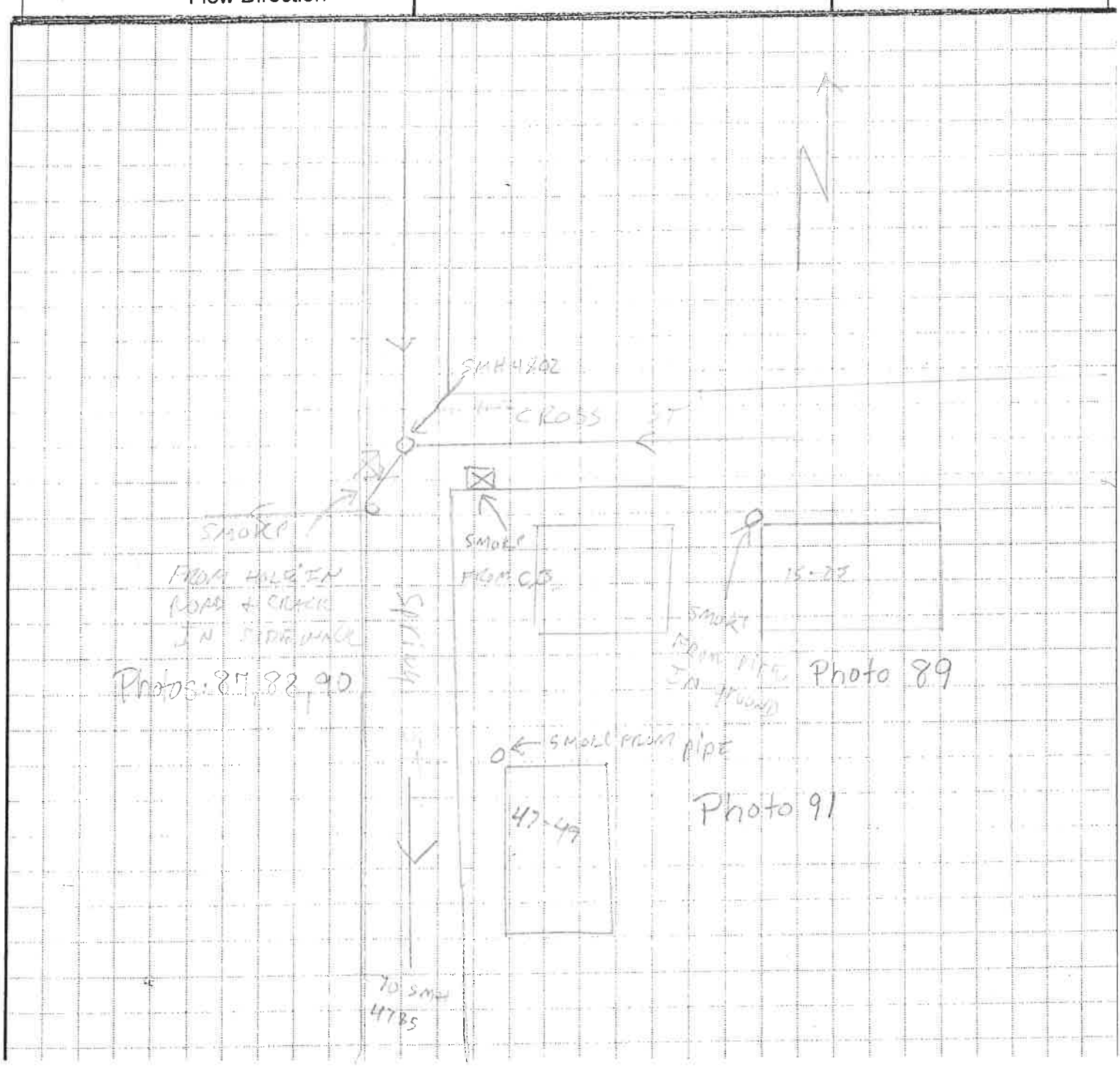
Sketch# 26 Sub _____

Calculated by: P. GRIFFIN Date: 7/30/15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
⟶ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

CROSS STREET AT SPRING STREET

SMOKE FROM CATCH BASIN

SMOKE FROM HOLE- SIDEWALK AND CATCH BASIN

SMOKE FROM CATCH BASIN ON CORNER

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

15-23 CROSS STREET

RIGHT FRONT - SMOKE FROM PIPE

47-49 SPRING STREET

LEFT FRONT - SMOKE FROM GROUND PIPE

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

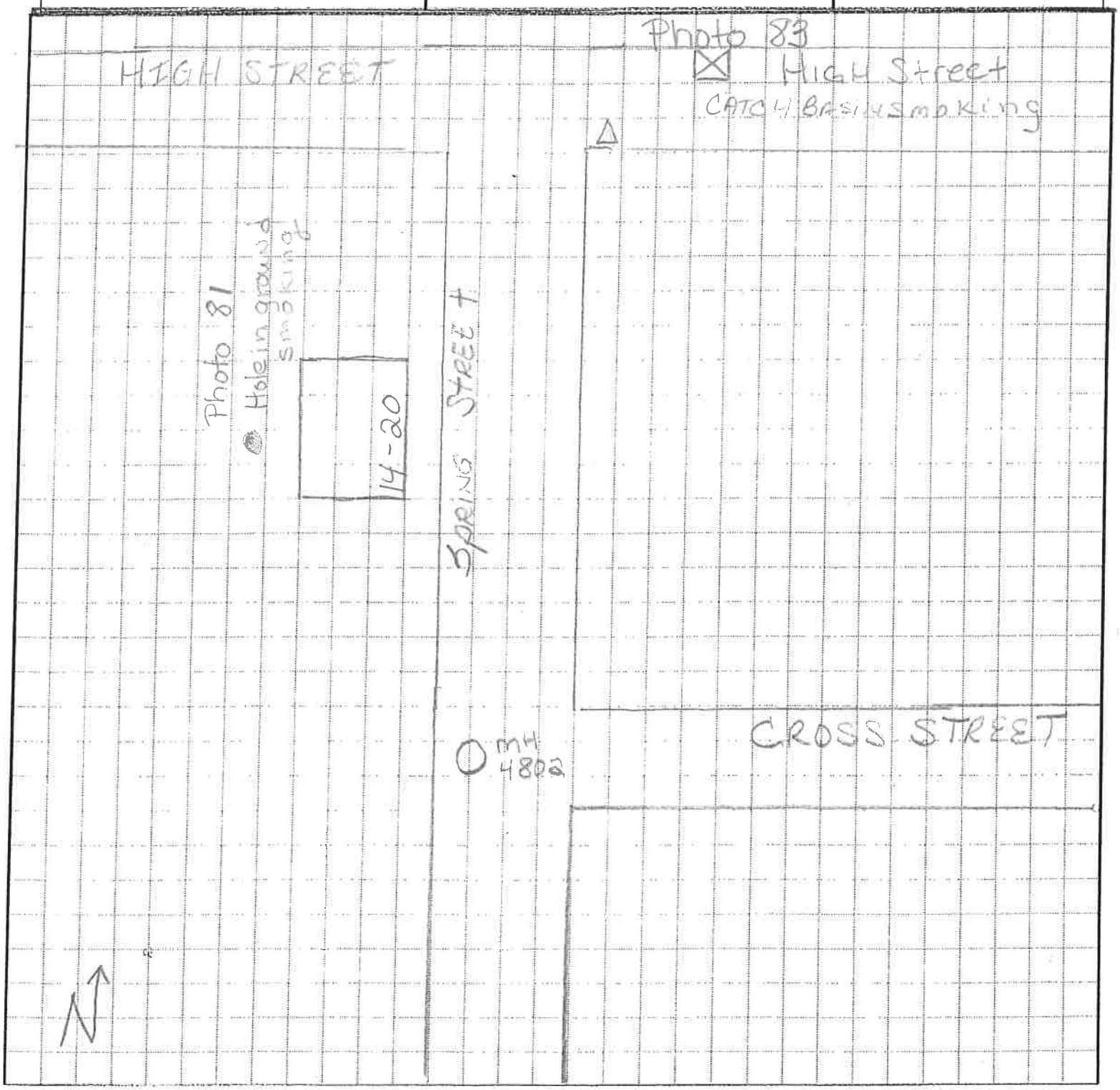
Sketch# 27 Sub _____

Calculated by: K Foote Date: 7-30-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
_ _ _ _ Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
_ _ _ _ Combined Sewer Line		△ Hydrant
⟶ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

14-20 SPRING STREET

HOLE SMOKING REAR OF HOUSE

HIGH STREET & SPRING STREET

CATCH BASIN SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: Enfield, CT Project #: _____

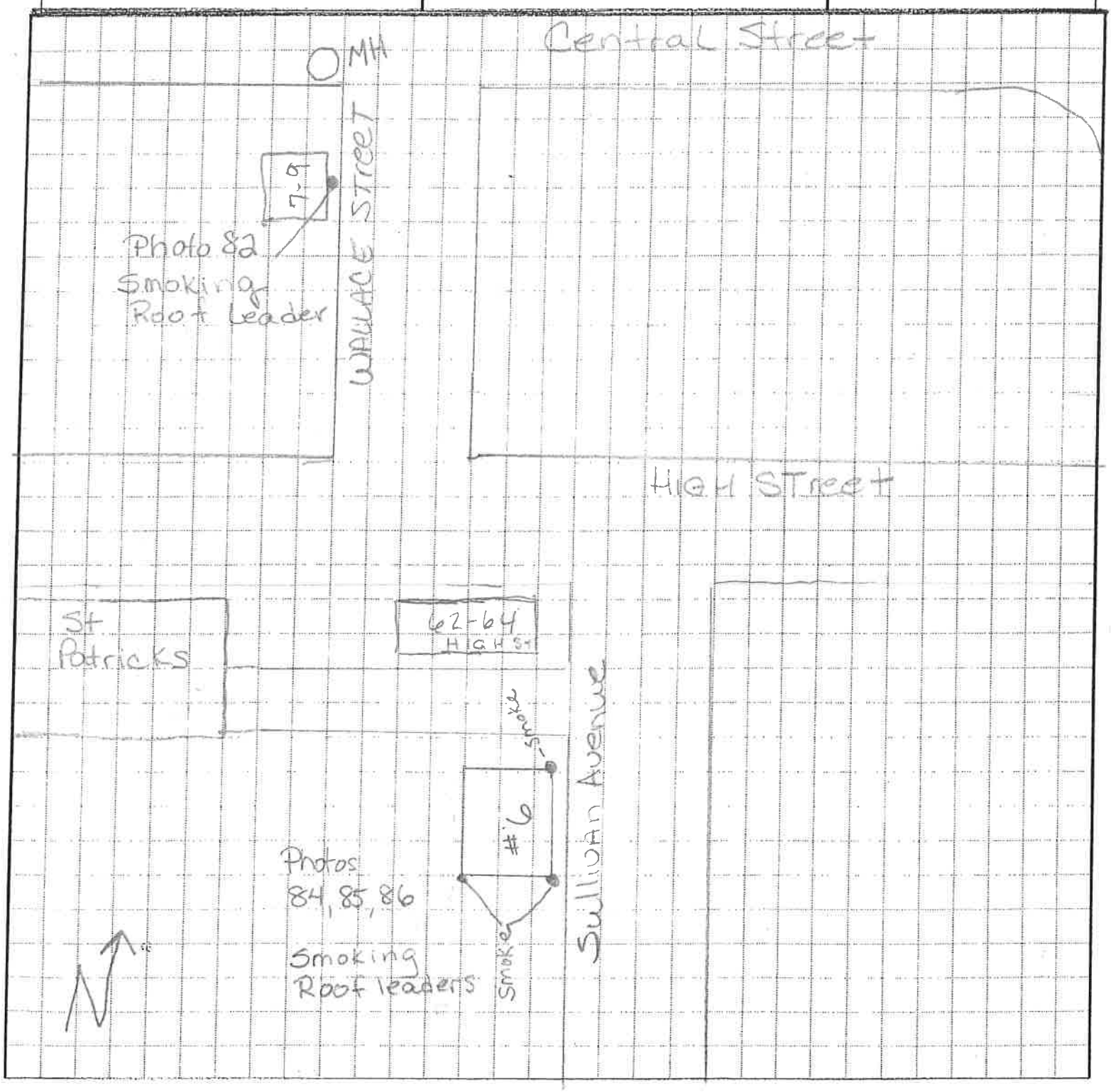
Sketch# 28 Sub _____

Calculated by: K Foote Date: 7-30-15

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — — Combined Sewer Line		△ Hydrant
⟶ Flow Direction		



ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

6 SULLIVAN AVENUE

LEFT SIDE ROOF LEADER SMOKING

LEFT SIDE REAR ROOF LEADER SMOKING

RIGHT SIDE ROOF LEADER SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

7-9 WALLACE STREET

FRONT CENTER ROOF LEADER

SMOKING

ADS ENVIRONMENTAL SERVICES

ADS ENVIRONMENTAL SERVICES

51 Wentworth Ave, Unit 11, Londonderry, NH 03053
603.625.1212 * Fax 603.965.7896

Project: [illegible] Project #: _____

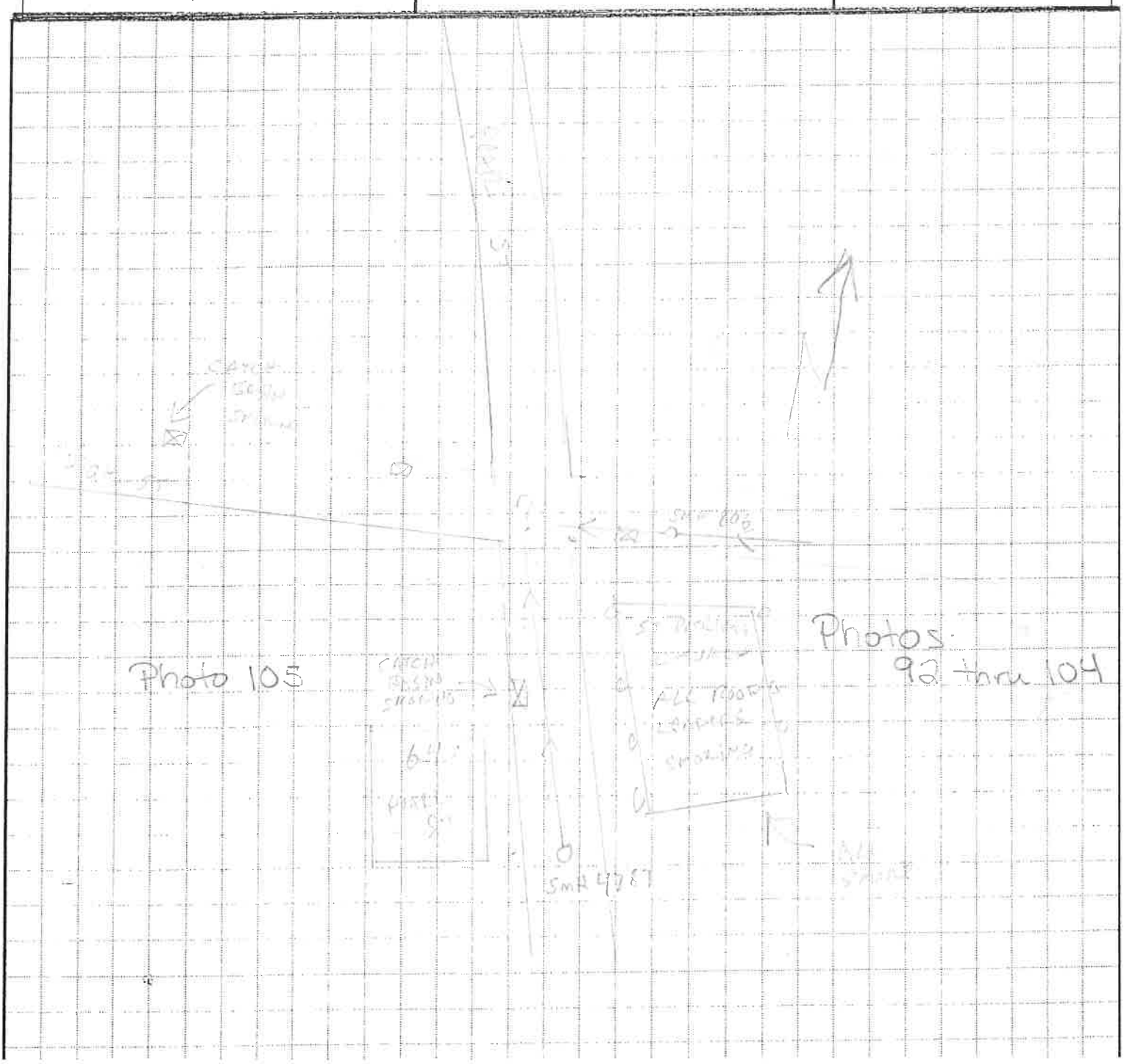
Sketch# 29 Sub _____

Calculated by: [illegible] Date: [illegible]

Checked BY: _____ Date: _____

FIELD SKETCH LOG (Not to Scale)

Legend:		
_____ Sanitary Sewer Line	⊠ Catch Basin	○ Sanitary Manhole
— — — Storm Drain Line	⊗ Area Drain, Yard Drain, Driveway Drain, Foundation Drain Window Well Drain (etc.)	● Storm Manhole
— — — Combined Sewer Line		△ Hydrant
⟶ Flow Direction		



ENFIELD, CT
SMOKE TESTING PHOTOS
JULY 2015

SAINT PATRICKS CHURCH

ALL ROOF LEADERS SMOKING

ADS ENVIRONMENTAL SERVICES

ENFIELD, CT

SMOKE TESTING PHOTOS

JULY 2015

64 PEARL STREET

CATCH BASIN SMOKING

ADS ENVIRONMENTAL SERVICES

TABLE 2
ENFIELD, CT
SMOKE TESTING
SUSPECT SOURCES
JULY 2015

DATE	STREET ADDRESS	SUSPECT SOURCES
7/22/2015	8 HARTFORD AVENUE	ROOF LEADER TO GROUND: RIGHT FRONT
7/22/2015	11 HARTFORD AVENUE	ROOF LEADER TO GROUND: RIGHT FRONT
7/22/2015	19 HARTFORD AVENUE	RIGHT FRONT: GROUND PIPE
7/22/2015	31 HARTFORD AVENUE	RIGHT FRONT: GROUND PIPE
7/22/2015	54-58 HARTFORD AVENUE	ROOF LEADERS TO GROUND: RIGHT FRONT, LEFT FRONT, LEFT REAR
7/22/2015	64-68 HARTFORD AVENUE	ROOF LEADER TO GROUND: LEFT FRONT
7/22/2015	41-43 HARTFORD AVENUE	ROOF LEADERS TO GROUND: RIGHT FRONT
7/22/2015	72 HARTFORD AVENUE	ROOF LEADER TO GROUND: RIGHT FRONT
7/22/2015	57 PLEASANT STREET	ROOF LEADERS TO GROUND: LEFT FRONT, MIDDLE FRONT
7/22/2015	33-39 PLEASANT STREET	ROOF LEADERS TO GROUND: LEFT FRONT, MIDDLE FRONT, MIDDLE REAR
7/22/2015	71-73 WEST STREET	ROOF LEADERS TO GROUND: LEFT REAR, LEFT FRONT
7/22/2015	90 WEST STREET	ROOF LEADER TO GROUND: MIDDLE FRONT
7/22/2015	84 WEST STREET	ROOF LEADERS TO GROUND: LEFT FRONT, LEFT REAR
7/22/2015	11 ALDEN STREET	ROOF LEADERS TO GROUND: MIDDLE FRONT
7/22/2015	17 ALDEN STREET	ROOF LEADERS TO GROUND: LEFT FRONT
7/22/2015	40 ALDEN STREET	ROOF LEADERS TO GROUND: RIGHT SIDE
7/22/2015	82 ALDEN STREET	ROOF LEADERS TO GROUND: RIGHT FRONT, LEFT FRONT
7/22/2015	10-16 NEW STREET	ROOF LEADERS TO GROUND: RIGHT FRONT, LEFT FRONT
7/22/2015	85 CHURCH STREET	ROOF LEADERS TO GROUND: MIDDLE FRONT, LEFT REAR
7/22/2015	91 CHURCH STREET	ROOF LEADERS TO GROUND: RIGHT FRONT, LEFT SIDE MIDDLE
7/23/2015	12-18 LINCOLN AVENUE	ROOF LEADER TO GROUND: LEFT FRONT
7/23/2015	22 LINCOLN AVENUE	ROOF LEADER TO GROUND: LEFT FRONT IS COVERED BUT NOT SECURE
7/23/2015	38-40 LINCOLN AVENUE	ROOF LEADER TO GROUND: RIGHT REAR
7/23/2015	33-35 CHURCH STREET	ROOF LEADER TO GROUND: RIGHT FRONT
7/23/2015	36 PLEASANT STREET	ROOF LEADERS TO GROUND: RIGHT FRONT, RIGHT SIDE
7/23/2015	56-58 PLEASANT STREET	DRIVEWAY DRAIN BETWEEN BUILDINGS
7/23/2015	48-50 PLEASANT STREET	YARD DRAIN BETWEEN BUILDINGS
7/23/2015	38-42 PLEASANT STREET	YARD DRAIN BETWEEN BUILDINGS
7/23/2015	37 RIVER STREET	DRIVEWAY DRAIN
7/23/2015	19-21 RUSSELL STREET	ROOF LEADERS TO GROUND: ALL SIDES
7/23/2015	31 RUSSELL STREET	LEFT SIDE, OPEN GROUND PIPE
7/23/2015	62-64 CHURCH STREET	ROOF LEADERS TO GROUND: LEFT FRONT, LEFT REAR
7/23/2015	56-58 CHURCH STREET	ROOF LEADERS TO GROUND: LEFT FRONT, LEFT REAR
7/23/2015	51 COLLEGE STREET	ROOF LEADERS TO GROUND: ALL SIDES
7/29/2015	14 COTTAGE GREEN	ROOF LEADERS TO GROUND: LEFT FRONT
7/29/2015	50 COTTAGE GREEN	ROOF LEADERS TO GROUND: RIGHT FRONT
7/29/2015	29 PROSPECT STREET	ROOF LEADERS TO GROUND: RIGHT REAR, LEFT FRONT
7/29/2015	81-83 PROSPECT STREET	ROOF LEADERS TO GROUND: RIGHT FRONT, LEFT FRONT, LEFT REAR, RIGHT REAR
7/29/2015	84-86 PROSPECT STREET	ROOF LEADER TO GROUND: RIGHT FRONT
7/29/2015	85-87 PROSPECT STREET	ROOF LEADER TO GROUND: LEFT FRONT, LEFT REAR, MIDDLE REAR
7/29/2015	28 PROSPECT STREET	ROOF LEADERS TO GROUND: RIGHT FRONT, LEFT FRONT
7/29/2015	29 PROSPECT STREET	ROOF LEADERS TO GROUND: RIGHT SIDE, RIGHT REAR, MIDDLE REAR
7/29/2015	51 PROSPECT STREET	ROOF LEADER TO GROUND: LEFT FRONT
7/29/2015	3 ASNUNTUCK STREET	ROOF LEADERS TO GROUND: ALL FRONT
7/29/2015	37-43 ASNUNTUCK STREET	ROOF LEADERS TO GROUND: RIGHT FRONT, LEFT REAR
7/30/2015	15-23 CROSS STREET	ROOF LEADER TO GROUND: LEFT SIDE
7/30/2015	40-38 SPRING STREET	ROOF LEADER TO GROUND: LEFT FRONT
7/30/2015	9-11 SPRING STREET	ROOF LEADERS TO GROUND: LEFT FRONT, RIGHT FRONT
7/30/2015	5-7 SPRING STREET	ROOF LEADER TO GROUND: RIGHT FRONT
7/30/2015	100 HIGH STREET - CHURCH & DEPARTMENT OF SOCIAL SERVICES	ROOF LEADERS TO GROUND: ALL SIDES
7/30/2015	1B HIGH STREET	ROOF LEADERS TO GROUND: LEFT FRONT, RIGHT FRONT

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APPENDIX H: EXISTING PLANT DESIGN CRITERIA

APPENDIX H

Enfield Wastewater Facilities Plan

Existing Plant Design Criteria

(Based on January 2010 to December 2013 Plant Data)

PROCESS / DESCRIPTION	AVERAGE FLOW	DESIGN FLOW	PEAK FLOW
RAW WASTEWATER DATA			
TOTAL FLOW IN MGD (ACTUAL) ("Q")	5.25	10.0	16.2
BOD CONCENTRATION, MG/L	215	216	
BOD LOADING, LBS/D	9,414	18,014	
TSS CONC IN MG/L	196	197	
TSS LOADING IN LBS/D	8,582	16,430	
TN MG/L	32	32	
TN LBS/D	1,401	2,669	
AERATED GRIT CHAMBER			
NUMBER OF UNITS	2	2	2
UNIT WIDTH, FT	12.5	12.5	12.5
UNIT LENGTH, FT	40	40	40
UNIT DEPTH ABOVE HOPPER, FT	8.9	8.9	8.9
UNIT VOLUME, GAL	33,300	33,300	33,300
TOTAL VOLUME, GAL	66,600	66,600	66,600
DETENTION TIME IN MIN AT Q	18.3	9.6	5.9
PRIMARY SETTLING			
NUMBER OF UNITS	2	2	2
UNIT DIAMETER, FT	85	85	85
SWD, FT	12.0	12.0	12.0
UNIT SURFACE AREA, SF	5,700	5,700	5,700
TOTAL SURFACE AREA, SF	11,400	11,400	11,400
OVERFLOW RATE, GPD/SF	460	880	1,420
TOTAL WEIR LENGTH, FT	534	534	534
WEIR OVERFLOW RATE, GPD/LF	9,800	18,700	30,300
UNIT VOLUME, GAL	509,300	509,300	509,300
TOTAL VOLUME, GAL	1,018,600	1,018,600	1,018,600
DETENTION TIME, AT Q, HRS	4.66	2.44	1.51
BOD PRIMARY EFFLUENT, MG/L	129		
TSS PRIMARY EFFLUENT, MG/L	60		
BOD REMOVAL EFFICIENCY, %	40		
TSS REMOVAL EFFICIENCY, %	69		

APPENDIX H

Enfield Wastewater Facilities Plan

Existing Plant Design Criteria

(Based on January 2010 to December 2013 Plant Data)

PROCESS / DESCRIPTION	AVERAGE FLOW	DESIGN FLOW	PEAK FLOW
AERATION TANKS			
NUMBER OF UNITS	4	4	4
UNIT WIDTH, FT	24	24	24
UNIT LENGTH, FT	248	248	248
UNIT SIDE WATER DEPTH, FT	16.1	16.1	16.1
UNIT VOLUME, GAL	717,000	717,000	717,000
TOTAL VOLUME, GAL	2,868,000	2,868,000	2,868,000
TOTAL VOLUME, CF	384,000	384,000	384,000
BOD LOADING, LBS/D/1000 CF AVG	17.2	32.8	
AVG. MLSS CONCENTRATION, mg/l	2,000	2,000	
PRIMARY ANOXIC ZONES			
NUMBER OF UNITS	4	4	4
UNIT WIDTH, FT	24	24	24
UNIT LENGTH, FT	61.2	61.2	61.2
UNIT SIDE WATER DEPTH, FT	16.1	16.1	16.1
UNIT VOLUME, GAL	177,000	177,000	177,000
TOTAL VOLUME, GAL	708,000	708,000	708,000
TOTAL VOLUME, CF	95,000	95,000	95,000
DETENTION TIME IN HRS AT Q	3.24	1.70	1.05
AEROBIC ZONES NO.1			
NUMBER OF UNITS	4	4	4
UNIT WIDTH, FT	24	24	24
UNIT LENGTH, FT	61.2	61.2	61.2
UNIT SIDE WATER DEPTH, FT	16.1	16.1	16.1
UNIT VOLUME, GAL	177,000	177,000	177,000
TOTAL VOLUME, GAL	708,000	708,000	708,000
TOTAL VOLUME, CF	95,000	95,000	95,000
DETENTION TIME IN HRS AT Q	3.24	1.70	1.05
AEROBIC ZONES NO.2			
NUMBER OF UNITS	4	4	4
UNIT WIDTH, FT	24	24	24
UNIT LENGTH, FT	61.2	61.2	61.2
UNIT SIDE WATER DEPTH, FT	16.1	16.1	16.1
UNIT VOLUME, GAL	177,000	177,000	177,000
TOTAL VOLUME, GAL	708,000	708,000	708,000
TOTAL VOLUME, CF	95,000	95,000	95,000
DETENTION TIME IN HRS AT Q	3.24	1.70	1.05

APPENDIX H

Enfield Wastewater Facilities Plan
Existing Plant Design Criteria
(Based on January 2010 to December 2013 Plant Data)

PROCESS / DESCRIPTION	AVERAGE FLOW	DESIGN FLOW	PEAK FLOW
AEROBIC ZONES NO.3			
NUMBER OF UNITS	4	4	4
UNIT WIDTH, FT	24	24	24
UNIT LENGTH, FT	30.2	30.2	30.2
UNIT SIDE WATER DEPTH, FT	16.1	16.1	16.1
UNIT VOLUME, GAL	88,000	88,000	88,000
TOTAL VOLUME, GAL	352,000	352,000	352,000
TOTAL VOLUME, CF	47,000	47,000	47,000
DETENTION TIME IN HRS AT Q	1.61	0.84	0.52
SECONDARY ANOXIC ZONES			
NUMBER OF UNITS	4	4	4
UNIT WIDTH, FT	24	24	24
UNIT LENGTH, FT	31	31	31
UNIT SIDE WATER DEPTH, FT	16.1	16.1	16.1
UNIT VOLUME, GAL	90,000	90,000	90,000
TOTAL VOLUME, GAL	360,000	360,000	360,000
TOTAL VOLUME, CF	48,000	48,000	48,000
DETENTION TIME IN HRS AT Q	1.65	0.86	0.53
REAERATION ZONE (EFFLUENT CHANNEL)			
NUMBER OF UNITS	1	1	1
UNIT WIDTH, FT	3	3	3
UNIT LENGTH, FT	96	96	96
UNIT SIDE WATER DEPTH, FT	5.50	5.50	5.50
UNIT VOLUME, GAL	12,000	12,000	12,000
TOTAL VOLUME, GAL	12,000	12,000	12,000
TOTAL VOLUME, CF	2,000	2,000	2,000
DETENTION TIME IN MIN AT Q	3.29	1.73	1.07
SECONDARY CLARIFICATION			
NUMBER OF TANKS	4	4	4
DIAMETER, FT	85	85	85
TANK SWD, FT	12	12	12
UNIT SURFACE AREA, SF	5,700	5,700	5,700
TOTAL SURFACE AREA, SF	22,800	22,800	22,800
UNIT VOLUME, GAL	509,000	509,000	509,000
TOTAL VOLUME, GAL	2,036,000	2,036,000	2,036,000
TOTAL VOLUME, CF	68,000	68,000	68,000
DETENTION TIME IN HRS AT Q	9.3	4.9	3.0
SOLIDS LOADING RATE, LB/SF/D	8	15	24
SURFACE OVERFLOW RATE, GPD/SF	240	440	720

APPENDIX H

Enfield Wastewater Facilities Plan
Existing Plant Design Criteria
(Based on January 2010 to December 2013 Plant Data)

PROCESS / DESCRIPTION	AVERAGE FLOW	DESIGN FLOW	PEAK FLOW
DISINFECTION			
NUMBER OF REACTOR CHANNELS	2	2	2
CHANNEL DEPTH, FT	12.4	12.4	12.4
CHANNEL WIDTH, FT	30.0	30.0	30.0
CHANNEL LENGTH, FT	58.0	58.0	58.0
UNIT CAPACITY, CF	21,576	21,576	21,576
TOTAL REACTOR CAPACITY, CF	43,152	43,152	43,152
TOTAL REACTOR CAPACITY, GAL	323,000	323,000	323,000
DETENTION TIME, MIN	89	46	29
SLUDGE DEWATERING			
NUMBER OF BELT PRESSES	2	2	
BELT PRESS SIZE, M	2	2	
OPERATION, DAYS/WEEK	5	5	
No. OF PRESSES UTILIZED	2	2	
SLUDGE PRODUCTION, GAL/WEEK	355,200	355,200	
DESIGN SLUDGE FEED RATE, GPM	100	100	
DESIGN LOADING RATE, LB/HR	1,500	1,500	
FILTER PRESS CAPTURE RATE, %	90%	90%	
CAKE PRODUCTION RATE, WET TON/D	26	26	
CAKE PRODUCTION RATE, WET TON/WK	131	131	
CAKE PRODUCTION RATE, WET TON/YR	6,812	6,812	

APPENDIX I: UNIT PROCESS CAPACITY ANALYSIS

Enfield WPCF Facilities Plan
Date revised: 07/16/2015

Appendix I: Unit Process Capacity Analysis

Process	Existing Design Data	Units on Service	Capacity? ADF[1,2] (MGD)	Capacity? Design Flow[1] (MGD)	Capacity? Peak Hour Flow[1] (MGD)	Limiting Capacity	Design Criteria	Capacity adequate?	Comments
			5.4	10.0	16.8				
Influent Screening	Max flow rate: 20 MGD - Head loss @ 30% blocked: 2.82 in - Channel dimensions: 3'-0" W x 3'-0" D - 3/4" bar rack spacing	1	Acceptable	Acceptable	Needs Upgrade	Approach Velocity: 4.3 FPS @ PHF Velocity Thru Clean Bar Rack: 2.58 FPS	2-4 FPS velocity through openings per TR-16 (page 5-3) 1.5 FPS Min. Approach Velocity & 5.0 FPS Max. Velocity thru Bar Rack (MFR Guidelines)	Yes	But should be enclosed. Screenings grinder/washer required
Grit Chamber	40'L x 12.5'W x 8.9DAP[3]	2	Acceptable	Acceptable	Acceptable	9.6 MGD @ 10 min HRT[4] 16.8 MGD @ 6 min HRT	3-10 min minimum HRT @ PHF[5] per TR-16 (page 5-8)	Yes	But in need of rehabilitation. Consider new headworks building
Primary Clarifiers	85' Diameter, 12' SWD[6]	2	Acceptable	Acceptable	Acceptable	13.7 MGD @ SOR[7] 1,200 gpd/sf 34.2 MGD @ SOR 3,000 gpd/sf	1,200 gpd/sf max. @ ADF per TR16 (page 5-13) 3,000 gpd/sf max. @ PHF per TR16 (page 5-13) 10-16 ft SWD per TR16 (page 5-14)	Yes	But in need of rehabilitation. By pass required. Eliminate co-settling to increase solids removal efficiency. If activated sludge wasted to primary tanks, average SOR limited to 600-800 gpd/sf, and peak hourly SOR limited to 1,200 gpd/sf per
Aeration Basins	248'L x 24'W x 16.1'SWD	4	Needs Upgrade	Needs Upgrade	Needs Upgrade	4.3 MGD to 8.5 MGD @ 8-16 hrs HRT Primary Anoxic: 1.7 hr HRT @ 10 MGD Primary Aerobic: 4.2 hr HRT @ 10 MGD Secondary Anoxic: 0.9 hr @ 10 MGD Secondary Aerobic: 1.73 hr HRT @ 10 MGD	8 to 16 hrs HRT in a 4 stage Bardenpho per TR16 Primary Anoxic : 1 -3hr HRT per TR16 (page 6-42) Primary Aerobic: 4 -8hr HRT per TR16 Secondary Anoxic: 2-4hr HRT per TR16 (page 6-42) Secondary Aerobic: 0.5-1 hr HRT per TR16	No	Requires modifications for nitrogen removal
Blowers	2000-4500 SCFM @ 7.1 PSI Motor size: 200 hp	3	Needs Upgrade	Needs Upgrade	Needs Upgrade	Air requirements @ Max Month Flow and Min T : Air mixing requirements for aerobic zones: 1793 scfm Air mixing requirements for grit chamber: 400 scfm Total mixing air requirements: 2193 scfm Total process air requirements: 7182 scfm	Aeration requirements for summer airflow rates and coldest expected winter temperature Air mixing requirements for Grit Chamber: 3-8 cfm/ft of tank length per TR-16 (page 5-8) and M&E (page 389) Air mixing requirements for A.T: 0.12 scfm/sf of tank area per TR-16 (page 6-21) Oxygen supply: 0.8-1.2 lb O2/lb BOD removed per TR-16 (page 6-21) Oxygen supply: 4.2-4.6 lbO2/lb Ammonia oxidized	No	Blowers oversized and pressure seems low
Mixers	4 HP submersible mixer Primary Anoxic: 61.2'L x 24'W x 16.1'SWD Secondary Anoxic: 31'L x 24'W x 16.1'SWD	2	Needs Upgrade	Needs Upgrade	Needs Upgrade	Primary Anoxic: 7 to 12 hp required for mixing Secondary Anoxic: 4 to 6 hp required for mixing	0.3 to 0.5 hp/10^3 ft^3 per M&E 4th Edition (page 753)	No	Investigate energy efficient mixing alternatives
Internal Recirculation Pumps	6338 gpm at 2 ft	4	Needs Upgrade	Needs Upgrade	Needs Upgrade	Max. capacity: 5.4 MGD (3750 gpm for each unit) Min. Capacity: 1.35 MGD (940 gpm for each unit)	IRQ[8] = 100 to 400% ADF for 4-stage Berdenpho per TR16 (page 6-43)	No	IR pumps oversized
Secondary Clarifiers	85' Diameter, 12' SWD	4	Acceptable	Acceptable	Acceptable	16.0 MGD @ SOR 700 gpd/sf 36.5 MGD @ SOR 1,600 gpd/sf	700 gpd/sf max. @ ADF per M&E (page 687) 1,600 gpd/sf max. @ PHF per M&E (page 687) 16 ft SWD per TR16 (page 6-29) 12-20 ft SWD per M&E (page687)	Yes	But in need of equipment rehabilitation
Contact Chlorine Tanks	58'L x 30'W x 12.4'SWD	2	Acceptable	Acceptable	Marginal	30 min HRT @ 15.5 MGD 28 min HRT @ 16.8 MGD	30 min contact time @ PHF per TR-16 (page 8-5)	Yes	
Return Activated Sludge (RAS) Pumps	1,800 gpm at 20 ft	2	Needs Upgrade	Needs Upgrade	Needs Upgrade	Max capacity: 2700 gpm @ 33 ft	At least one pump for each clarifier (page 6-23) Maximum required capacity should be available with largest pump out of service per TR16 (page 6-23) RAS rate = 50 to 100% ADF for 4-stage Bardenpho per TR16 (page 6-43)	No	Two pumps in service and one stand by
Waste Activated Sludge (WAS) Pump	231 gpm at 34 ft	1	Needs Upgrade	Needs Upgrade	Needs Upgrade	0.12 MGD (80 gpm) to 1.35 MGD (940 gpm)	Provide required capacity w/ largest unit out of service Max. capacity: 25% ADF per TR16 (page 6-24) Min. capacity: 80 gpm (2 ft/s in 4-in pipe) per TR16 (page 6-24)	No	Need 2-3 units (1-2 duty, 1 standby)
Belt Filter Press (Sludge Dewatering)	Size 2 M - 1,500 lbs/hr design loading 90% Min. sludge capture rate Operation: 5 days/week, 10-12 hrs on Mondays and Tuesdays, 5-6hrs/day rest of week = 355,000 Gal/Week Type of sludge: 40/60 (Primary/WAS) Design flowrate: 100 GPM	2	Acceptable	Acceptable	Acceptable	1500 lbs/hr	400 -700 lb/m.hr Solid loading rate per meter of belt width per M&E (page 1566) 20-50 gal/m.min hydraulic loading rate per meter of belt width per M&E (page 1566)	Yes	Existing BFPs require high maintenance, high water consumption, & generate odors

1. Flows based on MOR data
2. Average Design Flow
3. Depth Above Hopper
4. Hydraulic Retention Time
5. Peak Hour Flow
6. Side Water Depth
7. Surface Overflow Rate
8. Internal Recycle Flowrate with 4 units on service

APPENDIX J: PRE-RENOVATION HAZARDOUS MATERIALS INSPECTION

PRE-RENOVATION HAZARDOUS MATERIALS INSPECTION

Garage Building, Sludge Pumping Building and Operations Building

PERFORMED AT:

Enfield Water Pollution Control Facility
90 Parson Road
Enfield, CT

PREPARED FOR:

Mr. Michael Burns
Woodard & Curran
1699 King Street, Suite 406
Enfield, CT

ENVIRONMENTAL, LLC

PREPARED BY:

AMC ENVIRONMENTAL, LLC
P. O. BOX 423
STRATFORD, CONNECTICUT 06615
(203) 378-5020

Inspection Date: July & August 2014
Report Date: March 9, 2015

1.0 INTRODUCTION

In July & August 2014, AMC Environmental, LLC conducted a pre-renovation hazardous materials inspection at Enfield WPCF buildings located at 90 Parsons Road in Enfield, CT. The purpose of the Inspection was to identify potential hazardous building materials that may be associated with the scheduled renovation project. The scope of this inspection is limited to the materials described below.

Asbestos Containing Materials (ACM)

The asbestos inspection was conducted in accordance with the USEPA National Emission Standard for Hazardous Air Pollutants Act (NESHAP) as amended November 20, 1990. The NESHAP final rule requires the identification and removal of all regulated asbestos containing material (ACM) in a building prior to demolition or disturbance.

Asbestos inspection performed by: Jason Pringle
State of Connecticut licensed Asbestos Inspector
License # 000269

Lead Based Paint

The lead-based paint screen was performed to satisfy the requirements set by the State of Connecticut Department of Environmental Protection (DEP). Bureau of Waste Management "Guidance for the Management and Disposal of Lead-Contaminated Materials Generated in the Lead Abatement, Renovation, and Demolition Industries".

Additionally, OSHA regulates lead dust exposure to workers in the construction industry under 29 CFR 1926.62 Lead in Construction.

The lead based paint screen was performed by Jason Pringle; a State of Connecticut Licensed Lead inspector (License # 000880).

Polychlorinated Biphenyls (PCBs)

The PCB inspection was performed to satisfy the Toxic Substances Control Act (TSCA) of 1976. This authorized U.S. EPA to control substances that were determined to cause unreasonable risk to public health or the environment. In 1979 the U.S. EPA banned the manufacture of new products containing PCBs and developed regulatory requirements for the storage, labeling, use, and disposal of materials containing PCBs at levels above the regulatory thresholds. As a result, caulking materials with concentrations above 50-ppm must be managed as PCB wastes and removed following special procedures. PCB concentrations below this threshold of 50 ppm are overseen on the state level and regulated by the State of Connecticut Department of Environmental Protection (DEP). IF PCB's are present over 1ppm in the caulking and glazing, additional samples will be required.

Universal Waste Products:

Universal Waste products include a variety of materials that can be found in building materials or as a component of a building fixture and are subject to Universal Waste regulations. Fluorescent lamps, thermostats, mercury switches, manometers, natural gas meters, batteries and used electronics all constitute as being a universal waste. Other universal wastes such as pesticides are not included in the scope of this inspection. Universal waste products are subject to USEPA and State Regulations, which require collection and recycling of these materials. Each material must be disposed into the appropriate treatment or recycling facilities.

Mercury

Fluorescent lamps, thermostats, mercury switches, manometers, natural gas meters, and other items can contain mercury levels high enough for them to be classified as a special waste, therefore restricting their disposal as ordinary construction debris. The mercury and mercury vapors associated with these products must be reclaimed prior to disposal of these products.

2.0 BUILDING DESCRIPTION

The inspection included three buildings located at 90 Parson Road in Enfield, CT. The buildings were the Operations Building, the Sludge Pumping Building and the Garage Building. These buildings are all part of the Enfield Water Pollution Control Facility. The buildings consist of various masonry facades with metal trim, vinyl and metal windows and doors.

3.0 ASBESTOS CONTAINING MATERIALS

Inspection

This asbestos-containing materials inspection included materials that might be disturbed during the anticipated renovations at the three buildings located at 90 Parsons Road in Enfield, CT. Semi-destructive testing techniques are utilized during the inspection process. Suspect building materials that are inaccessible for inspection and sampling are assumed to be ACM for the purpose of this report. Suspect materials for a project of this nature are generally located under windowsills, behind window panels or covers, behind window jambs, or in otherwise concealed areas of the window system.

During the inspection, the Inspector documents the location, quantity, class, and friability of each suspect material. Friability is an industry term that measures a materials resilience. Material that can be easily crumbled, pulverized, or reduced to powder (by hand) when dried is defined as being friable. Estimated quantities of identified ACM's are provided for positive material only. Each material is either quantified in square or linear footage, depending on the type of material. For a full list of ACM and Materials needing to be re-tested or assumed ***see Table 1.*** For a full list of all non-asbestos containing materials tested ***see Table 2.***

Bulk Sampling

The United States Environmental Protection Agency (USEPA) has separated ACM into three categories. These categories are: Thermal System Insulation (TSI), Surfacing Materials, and Miscellaneous materials. TSI includes all materials that are used to prevent heat loss or gain, or water condensation on mechanical systems. Examples of TSI are pipe covering, boiler insulation, duct wrap, and mudded fitting cement. Surfacing includes any material that sprayed, toweled, or otherwise to an existing surface. Surfacing applications are commonly used in fireproofing and acoustical applications. All other material fall into the miscellaneous category such as vinyl floor tiles, ceiling tiles and drywall. All sampling methods and sampling quantities are collected at AMC's discretion and meet or exceed requirements set by the USEPA.

Bulk Sample Analysis

Samples of suspect materials are transmitted directly to an independent, State of Connecticut Department of Public Health (DPH), laboratory for analysis by Polarized Light Microscopy (PLM). PLM is the acceptable method of analysis in accordance with the Environmental Protection Agency (EPA) "Interim Method for the Determination of Asbestos in Bulk Insulation", 40 CFR 763, Subpart F, Appendix A EPA 600/M4-82-020. The Inspector collected "sets" of samples for each homogenous material sampled. Each sample is analyzed in the set until one sample is determined to contain asbestos (more than 1%). Sample analyses are reported in percentage of asbestos. The USEPA defines ACM as any material that contains more than 1 % asbestos, by way of PLM. "NAD", refers to "No asbestos Detected", and "DNA" refers to "Did Not Analyze" due to stop at first positive. The State of Connecticut Department of Public Health, the USEPA, as well as the United States Department of Labor regulate any material determined to contain greater than 1% of asbestos.

Friable ACM

Other analytical methods are recommended for certain friable material samples. The Point Count Method can further analyze friable materials shown to contain less than 10% asbestos by PLM analysis. Recommended, by the United States Environmental Protection Agency, the Point Count Method is accepted as providing accurate analytical results when determining the percent content of bulk samples with very low asbestos concentrations. Friable material containing less than 1 % asbestos must be analyzed by the (PLM) Point Count Method.

Non-Friable ACM

Non-friable asbestos samples showing percentages containing less than 1%, NAD, or "TRACE", should be confirmed by the "NOB TEM ELAP 198.4 Method". This procedure is recommended by the USEPA. If the results from this analysis determine asbestos content to still be less than 1 %, the sample is considered not to be asbestos containing.

4.0 Results

Garage Building

During the course of the building inspection of the Garage Building, a total of nineteen (19) samples of suspect ACM were collected, all of which were analyzed by PLM "stop on first positive".

From the nineteen (19) samples, two (2) types of ACM were identified. The materials identified were the flashing on the parapet on the roof and the black sealant on the exterior brick. A complete inventory of identified ACM is provided in the Asbestos Containing Materials Summary Table (***Table 1***). A complete inventory of materials sampled is provided in the ***Table 2*** non-asbestos containing materials (see **Appendix A** for analytical results). **Please note that all materials homogeneous to documented ACM shall be assumed to also be asbestos containing.**

Sludge Pumping Building

During the course of the building inspection of the Sludge Pumping Building, a total of twenty-eight (28) samples of suspect ACM were collected, all of which were analyzed by PLM "stop on first positive".

From the twenty-eight (28) samples, six (6) types of ACM were identified. The materials identified were the roof tar and flashing cement on the Roof, large pipe insulation and pipe insulation from the basement pump room and the interior door and window caulk on the first Floor. A complete inventory of identified ACM is provided in the Asbestos Containing Materials Summary Table (***Table 1***). A complete inventory of materials sampled is provided in the ***Table 2*** non-asbestos containing materials (see **Appendix A** for analytical results). **Please note that all materials homogeneous to documented ACM shall be assumed to also be asbestos containing.**

Operations Building

During the course of the building inspection of the Operations Building, a total of ninety-nine (99) samples of suspect ACM were collected, all of which were analyzed by PLM "stop on first positive".

From the ninety-nine (99) samples, eight (8) types of ACM were identified. The materials identified were the tan speckled sheet flooring in Rooms 01, and 02; interior window glazing in Room 26 (also assumed to be found on other windows), interior window caulk in Room 10; door caulk in Rooms 2, 6, 7 and 18; round duct insulation in Rooms 16, 27 and 36 (assume all hard insulation); sprayed-on insulation in Room 34; top sealant in Room 36 and the penetration flashing (2nd layer) on the Roof. A complete inventory of identified ACM is provided in the Asbestos Containing Materials Summary Table (***Table 1***). A complete inventory of materials sampled is provided in the ***Table 2*** non-asbestos containing materials (see **Appendix A** for

analytical results). **Please note that all materials homogeneous to documented ACM shall be assumed to also be asbestos containing.**

Discussion of Results

This report reflects sampling that took place in the Operations Building, Sludge Pumping Building and the Garage Building. This pre-renovation inspection is limited to materials that were reported that may be impacted during the renovations scheduled at the facility.

5.0 RECOMMENDATIONS CONCERNING ASBESTOS

Laws govern all asbestos activities undertaken in the State of Connecticut. AMC Environmental, LLC suggests the following to ensure compliance with state, federal, or local asbestos regulations and to reduce possible liabilities.

- State of Connecticut, Department of Public Health; Standards for Asbestos Abatement (19a-332-1a through 19a-332a-16).
- State of Connecticut Licensure and Training Requirements for Persons Engaged in Asbestos Abatement and Consultation Services Section 20-440-1 through 20-440-9.
- The Federal Regulation governing asbestos is Title 40 of the Code of Federal Regulations (40 CFR), Part 61, Subpart M, Demolition and/or Renovation of Facilities with Asbestos-Containing Materials.

The following recommendations pertain to asbestos removal projects.

- A Licensed Asbestos Project Designer should develop a plan or specification to ensure asbestos is removed in a safe and proper manner. At a minimum, these specifications should include an effective asbestos removal plan, a thorough health and safety plan, reference to applicable legal standards, necessary regulatory notification, adequate insurance requirements and proper bidding procedures.
- A Licensed Contractor must perform the asbestos removal.

Inaccessible Areas

This was a limited asbestos inspection pertinent to the scope of work provided. Please note wall cavities were not accessed; however, these areas are subject to pipe insulation and other suspect asbestos containing materials. This is especially common in bathrooms, locker rooms or rooms that there is piping. **Some equipment, gaskets and other materials within the machinery may have been inaccessible and therefore may not have been sampled.**

Therefore, if any suspect materials are identified not listed in this report during the renovation of the building or the scope of work changes, work should stop and the materials should be tested.

Disclaimer

Any work performed by AMC Environmental, LLC was done using the degree of care and skill ordinarily exercised under similar circumstances by members of the profession practicing in the same or similar capacity. The standard of care shall exclusively be judged as of the date of services rendered and not according to later standards. The conclusions and recommendations contained in this report are based on limited environmental sampling and visual observations, and were arrived at in accordance with generally accepted standards of industrial hygiene practice. No other warranty, expressed or implied, is made.

TABLE 1

ASBESTOS CONTAINING MATERIALS SUMMARY

AMC Environmental, LLC

P.O. Box 423, Stratford, CT 06615

TABLE 1

ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Garage Building
Enfield, CT

AMC Tracking # ASB0215		Laboratory: EMSL Analytical, Inc.				Laboratory Order # 031504426			
LOCATION(S)	MATERIAL TYPE	SAMPLE #	CLASS	BULK SAMPLE ANALYSIS RESULTS				QUANTITY*	F/NF
				PLM	PLM PC	TEM NOB	ACM		
Roof	Flashing on Parapet	B071406 B071407	MISC	12% chrys			YES	300 lin. ft.	NF
Exterior – side B	Black sealant on brick	B071414 B071415	MISC	7% chrys			YES	10 lin. ft.	NF
					Estimated Quantity:				

KEY:		ANALYTICAL METHODS:
NA - Not Analyzed	SF - Square Feet	PLM PC – EPA 600/R-93/116 Quantitation 400 Point Count
NAD - No Asbestos Detected	LF - Linear Feet	TEM NOB – New York ELAP 198.4 Method
F - Friable	Chrys - Chrysotile	PLM – EPA 600-R-93/116 Method
NF - Non-Friable	Amos - Amosite	PS – Previously Samples
TSI - Thermal Systems Insulation	Anth - Anthophylite	ACM - Asbestos Containing Material
SURF - Type of Surfacing Material	Trem - Tremolite	ASSD – Assumed Asbestos Containing Material
MISC - Miscellaneous Material	Croc - Crocidolite	

*** Please Note: Quantities are estimates. Determination of exact quantities for bidding purposes is the sole responsibility of the contractor**

Samples Analyzed By EPA Method 600/R-93/116 (PLM)
IN ACCORDANCE WITH STATE OF CONNECTICUT REGULATIONS Section 19a333-5

NOTE Polarized Light Microscopy may not consistently detect asbestos in samples of roofing, flashing, floor tile, mastic and similar non-organically bound materials. Transmission Electron Microscopy is currently the only method that can definitely determine if this material contains asbestos > 0.1% by weight. However, the State of Connecticut Regulations state that bulk samples shall not be composited for analysis and shall be analyzed for asbestos content by polarized light microscopy (PLM), using the "Interim Method for the Determination of Asbestos in Bulk Insulation Samples" found at Appendix A to subpart F in 40 CFR Part 763 as amended, or the current EPA method for the analysis of asbestos in building materials by polarized light microscopy.

TABLE 1

ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Sludge Pumping Building
Enfield, CT

AMC Tracking # ASB0215		Laboratory: EMSL Analytical, Inc.				Laboratory Order # 031504427			
LOCATION(S)	MATERIAL TYPE	SAMPLE #	CLASS	BULK SAMPLE ANALYSIS RESULTS				QUANTITY*	F/NF
				PLM	PLM PC	TEM NOB	ACM		
Roof	Roof tar	B071401 B071402	MISC	3% chrys			YES	1,400 sq. ft.	NF
Roof	Flashing on cement	B071405 B071406 B071407	MISC	4% chrys			YES	TBD	NF
Basement-Pump Room	Large pipe insulation	B071419 B071420 B071421	TSI	20% chrys			YES	< 10 lin. ft.	F
Basement – Pump Room	Pipe insulation	B071422 B071423 B071424	TSI	25% chrys			YES	< 10 lin.ft.	F
1st floor	Interior door caulk	B071425 B071426 B071427	MISC	4% chrys			YES	120. lin ft.	NF
1st floor	Interior window caulk	B071428	MISC	3% chrys			YES	100 lin. ft.	NF

KEY:		ANALYTICAL METHODS:
NA - Not Analyzed	SF - Square Feet	PLM PC – EPA 600/R-93/116 Quantitation 400 Point Count
NAD - No Asbestos Detected	LF - Linear Feet	TEM NOB – New York ELAP 198.4 Method
F - Friable	Chrys - Chrysotile	PLM – EPA 600-R-93/116 Method
NF - Non-Friable	Amos - Amosite	PS – Previously Samples
TSI - Thermal Systems Insulation	Anth - Anthophylite	ACM - Asbestos Containing Material
SURF - Type of Surfacing Material	Trem - Tremolite	ASSD – Assumed Asbestos Containing Material
MISC - Miscellaneous Material	Croc - Crocidolite	

*** Please Note: Quantities are estimates. Determination of exact quantities for bidding purposes is the sole responsibility of the contractor**

Samples Analyzed By EPA Method 600/R-93/116 (PLM)
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AMC Environmental, LLC

P.O. Box 423, Stratford, CT 06615

TABLE 1

ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Operations Building
Enfield, CT

AMC Tracking # ASB0215	Laboratory: EMSL Analytical, Inc.	Laboratory Order # 031504434

LOCATION(S)	MATERIAL TYPE	SAMPLE #	CLASS	BULK SAMPLE ANALYSIS RESULTS				QUANTITY*	F/NF
				PLM	PLM PC	TEM NOB	ACM		
Room 01, 02,	Tan speckled sheet flooring	B071401 B071402	MISC	2% chrys			YES	400 sq. ft.	NF
Room 26	Interior window glazing	B071441 B071442	MISC	2% chrys			YES	All openings	NF
Room 10	Interior window caulk – Type 1 and Type 2	B071443 B071444 B071445 B071446	MISC	3% chrys			YES	All openings	NF
Room 2, 6, 7, 18	Door caulk	B071447 B071448	MISC	12% chrys			YES	150 lin. Ft.	NF
Room 16, 27, 36	Round duct insulation (hard) (assume all hard insulation)	B071457 B071458 B071459	TSI	55% chrys			YES	1,200 sq. ft.	F
Room 34	Sprayed-on insulation	B071460 B071461 B071462	TSI	15% amos			YES	4,000 sq. ft	F
Room 36	Top sealant(white) on Incinerator	B071463 B071464 B071465	MISC	20% chrys			YES	8 lin. Ft.	NF
Roof	Flashing at penetration – 2nd layer	B071493 B071494	MISC	11% chrys			YES	TBD	NF
					Estimated Quantity:				

KEY:		ANALYTICAL METHODS:
NA - Not Analyzed	SF - Square Feet	PLM PC – EPA 600/R-93/116 Quantitation 400 Point Count
NAD - No Asbestos Detected	LF - Linear Feet	TEM NOB – New York ELAP 198.4 Method
F - Friable	Chrys - Chrysotile	PLM – EPA 600-R-93/116 Method
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*** Please Note: Quantities are estimates. Determination of exact quantities for bidding purposes is the sole responsibility of the contractor**

Samples Analyzed By EPA Method 600/R-93/116 (PLM)
IN ACCORDANCE WITH STATE OF CONNECTICUT REGULATIONS Section 19a333-5

NOTE Polarized Light Microscopy may not consistently detect asbestos in samples of roofing, flashing, floor tile, mastic and similar non-organically bound materials. Transmission Electron Microscopy is currently the only method that can definitely determine if this material contains asbestos > 0.1% by weight. However, the State of Connecticut Regulations state that bulk samples shall not be composited for analysis and shall be analyzed for asbestos content by polarized light microscopy (PLM), using the "Interim Method for the Determination of Asbestos in Bulk Insulation Samples" found at Appendix A to subpart F in 40 CFR Part 763 as amended, or the current EPA method for the analysis of asbestos in building materials by polarized light microscopy.

TABLE 2

NON-ASBESTOS CONTAINING MATERIALS

TABLE 2

NON-ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Garage Building
Enfield, CT

AMC Tracking # ASB0215	Lab: EMSL Analytical, Inc.	Lab # 031504426
Sample #	**Sample Location**	**Sample Description**
B071401	Lower roof	Rubber roofing
B071402	Lower roof	Rubber roofing
B071403	Upper roof	Rubber roofing
B071404	Roof	Sealant on parapet
B071405	Roof	Sealant on parapet
B071408	Roof	Insulation (ISO) below rubber roof
B071409	Roof	Insulation (ISO) below rubber roof
B071410	Roof	Paper barrier on deck
B071411	Roof	Paper barrier on deck
B071412	Roof	Caulk at parapet
B071413	Roof	Caulk at parapet
B071416	Main Room	Flue cement
B071417	Main Room	Flue cement
B071418	Main Room	Window glazing
B071419	Main Room	Window glazing

TABLE 2

NON-ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Sludge Pumping Building
Enfield, CT

AMC Tracking # ASB0215	Lab: EMSL Analytical, Inc.	Lab # 031504427
Sample #	**Sample Location**	**Sample Description**
B071403	Roof	Tar on deck
B071404	Roof	Tar on deck
B071408	Roof	Insulation below built-up roofing
B071409	Roof	Insulation below built-up roofing
B071410	Roof	Insulation below rubber roofing
B071411	Roof	Insulation below rubber roofing
B071412	Roof	Built-up roofing
B071413	Roof	Built-up roofing
B071414	Roof	Built-up roofing
B071415	Roof	Built-up roofing
B071416	Basement Pump Room	Pipe fitting/elbow
B071417	Basement Pump Room	Pipe fitting/elbow
B071418	Basement Pump Room	Pipe fitting/elbow
B071419	Basement Pump Room	Large pipe insulation

TABLE 2

NON-ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Operations Building
Enfield, CT

AMC Tracking # ASB0215	Lab: EMSL Analytical, Inc.	Lab #
Sample #	**Sample Location**	**Sample Description**
B071405	Room 01	Cove base
B071406	Room 02	Cove base
B071407	Room 01	Adhesive associated w/ cove base
B071408	Room 02	Adhesive associated w/ cove base
B071409	Room 01	CMU block
B071410	Room 02	CMU block
B071411	Room 02	CMU block
B071412	Room 02	CMU block mortar
B071413	Room 01	CMU block mortar
B071414	Room 02	CMU block mortar
B071415	Room 02	2x4 ceiling tile – type 1
B071416	Room 02	2x4 ceiling tile – type 1
B071418	Room 01	Brick
B071419	Room 02	Brick
B071421	Room 01	Brick mortar
B071422	Room 02	Brick mortar
B071424	Room 03	Green speckled sheet flooring
B071425	Room 03	Green speckled sheet flooring
B071427	Room 12	12” ceiling tile
B071428	Room 10	12” ceiling tile
B071429A	Room 10	12” ceiling tile
B071429B	Room 10	12” ceiling tile
B071430A	Room 13	Duct cloth cover
B071430B	Room 13	Duct cloth cover
B071431A	Room 13	Duct cloth cover
B071431B	Room 13	Duct cloth cover
B071432A	Room 13	Duct cloth cover
B071432B	Room 13	Duct cloth cover
B071433	Room 10	Green ceramic floor tile
B071434	Room 10	Green ceramic floor tile
B071435	Room 26	Grout associated w/ tile
B071436	Room 26	Grout associated w/ tile
B071437	Room 10	Yellow thinset associated w/ wall tile
B071438	Room 26	Yellow thinset associated w/ wall tile
B071439	Room 10	Green 4” ceramic wall tile
B071440A	Room 26	Green 4” ceramic wall tile
B071440AT	Room 26	Green 4” ceramic wall tile thinset

TABLE 2

NON-ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Operations Building
Enfield, CT

AMC Tracking # ASB0215	Lab: EMSL Analytical, Inc.	Lab #
Sample #	**Sample Location**	**Sample Description**
B071440B	Room 26	Green 4" ceramic wall tile
B071440BT	Room 26	Green 4" ceramic wall tile thinset
B071449	Room 11	Paper on fiberglass pipe insulation
B071450	Room 11	Paper on fiberglass pipe insulation
B071451	Room 34	Duct wrap – Type 1
B071452	Room 34	Duct wrap – Type 1
B071453	Room 34	Duct wrap – Type 1
B071454	Room 34	Duct wrap – Type 2
B071455	Room 34	Duct wrap – Type 2
B071456	Room 34	Duct wrap – Type 2
B071466	Boiler room	Flue cement
B071467	Boiler room	Flue cement
B071468	Room 23	Carpet glue
B071469	Room 23	Carpet glue
B071470	Room 23	Cove base
B071471	Room 23	Cove base
B071472	Room 23	Cove base adhesive
B071473	Room 23	Cove base adhesive
B071474	Room 26	2x4 ceiling tile
B071475	Room 26	2x4 ceiling tile
B071476	Boiler room	Burner gasket
B071477	Boiler room	Burner gasket
B071478	Boiler room	Burner gasket
B071479	Exterior	Window glazing compound – soft
B071480	Exterior	Window glazing compound – soft
B071481	Exterior	Window caulk – soft
B071482	Exterior	Window caulk – soft
B071483	Roof	Built-up roofing
B071484	Roof	Built-up roofing
B071485	Roof	Built-up roofing
B071486	Roof	Built-up roofing
B071487	Roof	Black material below built-up roofing
B071488	Roof	Black material below built-up roofing
B071489	Roof	Insulation (roofing)
B071490	Roof	Insulation (roofing)
B071491	Roof	Rubber roofing
B071492	Roof	Rubber roofing

TABLE 2

NON-ASBESTOS CONTAINING MATERIALS
SUMMARY TABLE

90 Parsons Road
Enfield WPCF – Operations Building
Enfield, CT

AMC Tracking # ASB0215	Lab: EMSL Analytical, Inc.	Lab #
Sample #	**Sample Location**	**Sample Description**
B071495	Roof	Flashing at penetration – 1st layer
B071496	Roof	Flashing at penetration – 1st layer
B071497	Roof	Tar at penetration
B071498	Roof	Tar at penetration

6.0 LEAD-BASED PAINT

X-Ray Fluorescence Screen

The lead-based paint screening was performed using an X-Ray Fluorescence (XRF) Radiation Monitoring Device (RMD) Lead Paint Analyzer (LPA 1), serial number 1326. The screen includes accessible surfaces and building materials on the painted exterior of the surfaces. The lead screen tests representative components and surfaces throughout the exterior of the building. It is not intended to test all painted surfaces, but to achieve a representation of painted components for the purpose of characterizing the waste stream.

The X-ray Fluorescence Analyzer (XRF) is the most common and accepted means of field-testing for lead in paint. The XRF detects lead through gamma ray technology. It is designed to measure the total weight of lead in a measured area. The results are reported in milligrams per centimeter squared (mg/cm^2). Most states have set a legal limit for lead in paint; Connecticut uses the $1.0 mg/cm^2$ threshold. The lead screen provides the data necessary to accurately identify the waste streams that will be generated as a result of the renovation activities. These waste streams can then be evaluated by the Toxicity Characteristic Leachate Procedure (TCLP) test to determine if the waste will need to be discarded as hazardous lead waste or non-hazardous solid waste.

Worker Protection

Toxic level lead-based paint as defined by the State of Connecticut Regulations means a level of lead which when present in a dried paint, plaster or other accessible surface in a residential dwelling contains more than 0.50 percent lead by dry weight as measured by atomic absorption spectrophotometry (AAS), or 1.0 milligrams lead per square centimeter of surface as measured on site by an X-ray fluorescence analyzer or other equipment deemed sufficiently accurate and reliable by the commissioner. OSHA regulates lead dust exposure to workers under 29 CFR 1926.62 and considers any detectable level of lead in paint (above or below Connecticut's level) to be a concern. Therefore OSHA requires exposure assessments be conducted for each task where painted surfaces or components are disturbed.

Lead Waste Characterization

The State of Connecticut Department of Environmental Protection regulates the disposal of hazardous waste. Lead containing waste is analyzed by a procedure known as a TCLP or Toxicity Leachate Procedure (Regulation of State DEP 22a-449©-101). This analytical test determines a buildings material waste classification.

The TCLP test requires a 100-gram sample of waste material, which is then analyzed and assessed for its ability to leach out lead into the environment. The waste is classified as hazardous waste if the sample results are greater than 5.0 mg/l of lead. The wastes are classified as non-hazardous if the TCLP sample result is less than this threshold. All materials

and components containing equal to or greater than 1.0mg/cm2 of lead by XRF requires waste classification analysis.

Results

XRF Testing Results

Garage Building

No painted surfaces were found in the Garage Building.

Sludge Pumping Building

Toxic Levels of lead-based paint were identified on five (5) surfaces. Seventeen (17) painted surfaces and components were tested with five (5) actionable (positive or inconclusive) level of lead from the Sludge Pumping Building. Poor and intact surfaces were identified. All like components within a given designation are assumed to have the same testing result as the actual component tested. The components that tested positive were the sewer pipe, effluent pipe and dewatering pipe in the pump room and the I-beam in the chlorination room.

A complete inventory of tested building materials is illustrated in Detailed Reports and can be found in **Appendix B**.

Operations Building

Toxic Levels of lead-based paint were identified on nine (9) surfaces. Twenty-nine (29) painted surfaces and components were tested with nine (9) actionable (positive or inconclusive) level of lead from the Operations Building. Poor and intact surfaces were identified. All like components within a given designation are assumed to have the same testing result as the actual component tested. The components that tested positive were the door in Room 1; glazed block walls in Rooms 1, 2, 6, 9, 21 and 24, the SC-PS2 pipe in Room 33 and the air duct in Room 36.

A complete inventory of tested building materials is illustrated in Detailed Reports and can be found in **Appendix B**.

Conclusion

Toxic levels of lead were found on a variety of surfaces that may be impacted by anticipated renovations. If any of the surfaces that were identified as lead-based paint will be disturbed during the renovation, lead-safe work practices must be used. Initial exposure assessments

must be performed on employees who engage in activities that disturb building materials with any detectable levels of lead in paint. Personal protective equipment must be provided to employees during such activities. Lead safe work practices and protocols should be followed. If the scope of work changes and includes surfaces not included in this report, additional sampling must be performed prior to the commencement of work. Any identified lead-based paint that is not intact should be rendered intact and stabilized.

7.0 POLYCHLORINATED BIPHENYLS (PCB's)

BACKGROUND

The PCB inspection was performed to satisfy the Toxic Substances Control Act (TSCA) of 1976. This authorized U.S. EPA to control substances that were determined to cause unreasonable risk to public health or the environment. In 1979 the U.S. EPA banned the manufacture of new products containing PCBs and developed regulatory requirements for the storage, labeling, use, and disposal of materials containing PCBs at levels above the regulatory thresholds. As a result, caulking materials with concentrations above 50-ppm must be managed as PCB wastes and removed following special procedures. PCB concentrations below this threshold of 50 ppm are overseen on the state level and regulated by the State of Connecticut Department of Environmental Protection (DEP).

INSPECTION

PCB's can be found in a variety of items including transformers, capacitors, fluorescent light ballast, and other oil-containing equipment. Certain building materials such as flooring, caulking, roofing and insulation can also contain these materials. This PCB inspection focused on the caulking and window glazing associated with the various window systems found within the WPCF buildings. PCB's were extensively used between 1950 through 1977 in caulking material.

Potential PCB-containing caulking can exist in buildings constructed or renovated between 1950 and 1980. PCB caulking and glazing compounds can be found around windows frames and sills, door frames, masonry columns and other masonry building materials on interior and exterior surfaces, as well as in expansion joints. PCB containing items must be managed and disposed of properly in accordance with special requirements. Representative samples of caulking and window glazing material from the building's window systems were tested prior to the start of the renovation project. Samples were obtained from both interior and exterior window components. If the results of the samples prove to be contaminated with PCB's, the surrounding soils and substrates also need to be surveyed to assess the potential for residual PCB contamination. PCB-containing caulking may leach PCBs into adjacent surfaces such as brick or block, soils, and impacted dust inside of buildings with PCB-containing caulking.

PCB concentrations in original caulking can vary from less than 50 parts per million (ppm) up to and exceeding 200,000 ppm. In locations where the original caulking has been replaced, PCBs may have leached into the surrounding substrate. In those locations where new caulking has replaced the original PCB caulking, PCBs may have also leached back into the new caulking at concentrations above the 50-ppm regulatory threshold.

Currently, the USEPA regulates the disposal of this material under the Toxic Substance Control Act (40 CFR761.62. The Toxic Substances Control Act (TSCA) of 1976 authorized U.S. EPA to control substances that were determined to cause unreasonable risk to public health or the environment. In 1979 the U.S. EPA banned the manufacture of new products containing PCBs and developed regulatory requirements for the storage, labeling, use, and disposal of materials containing PCBs at levels above the regulatory thresholds. In addition, the regulations under TSCA specify allowed or authorized uses of PCBs in certain situations. If a material or item is not specifically listed it is considered unauthorized. The U.S. EPA considers building materials containing PCBs, including caulking with PCB concentrations exceeding 50-ppm to be an unauthorized use. As a result, caulking materials with concentrations above 50-ppm must be managed as PCB wastes and removed following special procedures. PCB concentrations below this threshold of 50 ppm are overseen on the state level and regulated by the State of Connecticut Department of Environmental Protection (DEP). Safe work practices are still necessary when workers are exposed or renovations disturb concentrations below this limit, and the waste generated is required to be properly disposed of.

Results

A total of fourteen (14) bulk samples of window and door frame caulking and glazing were tested from the Operations Building, the Sludge Pumping Building and the Garage Building at the Enfield WPCF. Of the fourteen (14) samples, four (4) samples identified the presence of PCB's greater than the threshold level of 50 parts per million (ppm). The four (4) samples were all located in the Sludge Pumping Building. However, EPA states that PCB concentrations that are slightly under the 50 ppm may still need to be categorized under TSCA. The reasoning is that the caulk may have been at one time above the 50 ppm threshold or that new caulk was applied over the original PCB containing caulk and the PCB's leached into the new caulk. Therefore, based on the data, PCB's are present within the window caulk and glazing. This warrants additional testing of both the source material and surrounding substrates. Soil sampling should also be included in the next phase of testing (see **Appendix C** for analytical results).

1 PPM (parts per million) = 1 mg/Kg

Sample Number	Component	Location	Result in mg/Kg
PCB-01	**Door caulk**	**Room 6 – Operations Bldg.**	**46**
PCB-02	**Door caulk**	**Room 6 – Operations Bldg.**	**49**
PCB-03	Interior window glazing	Locker room – Operations Bldg.	19
PCB-04	Interior window glazing	Room 26 – Operations Bldg.	12
PCB-05	Interior window caulk	Locker room – Operations Bldg.	27
PCB-06	Interior window caulk	Locker room – Operations Bldg.	30
PCB-07	Exterior window caulk	Exterior Side D – Operations Bldg.	ND
PCB-08	Caulk on stone	Exterior Side D – Operations Bldg.	2.16
PCB-09	**Interior door caulk**	**Sludge Pumping Bldg.**	**450**
PCB-10	**Interior door caulk**	**Sludge Pumping Bldg.**	**280**
PCB-11	**Interior window caulk**	**Sludge Pumping Bldg.**	**910**
PCB-12	**Interior window caulk**	**Sludge Pumping Bldg.**	**790**
PCB-13	Window glazing	Old Plant/Garage Building	ND
PCB-14	Window glazing	Old Plant/Garage Building	ND

Samples listed in bold exceed the 50 ppm threshold.

Conclusion

Initial samples of caulking and glazing compound were obtained from the interior and exterior of the Operations Building, Sludge Pumping Building and the Garage Building. Both the interior and exterior samples identified several elevated levels of PCB's in the window frame caulk and door frame caulk. Both TSCA and non-TSCA concentrations were found. This phase of testing is preliminary and additional testing is needed to properly characterize and isolate PCB and non-PCB containing materials. Due to the high levels of some of the sample results, notification to the EPA is required and removal of the contaminated caulk is mandatory. Additionally, soil and substrate testing at and around the windows where PCB's were identified is needed in order to accurately identify the extent of the PCB contamination and migration path. Once all additional assessment is complete, a PCB Remediation plan must be developed and submitted for approval to the United States Environmental Protection Agency Region 1 office.

8.0 UNIVERSAL WASTE PRODUCTS (limited)

Inspection

Mercury

Fluorescent lamps, thermostats, mercury switches, manometers, natural gas meters, and other items can contain mercury levels high enough for them to be classified as a special waste, therefore restricting their disposal as ordinary construction debris. The mercury and mercury vapors associated with these products must be reclaimed prior to disposal of these products.

Polychlorinated Biphenyls (PCBs) and Di-ethylhexlpthlalate (DEHP) Lighting Ballasts and Capacitors

PCBs and DEHP can be found in a variety of items including transformers, capacitors, fluorescent light ballast, and other oil-containing equipment. Certain building materials such as flooring, caulking and insulation can also contain these materials. DEHP and PCB containing items must be managed and disposed of properly in accordance with special requirements.

Results

There were several White Rodgers thermostatic controls in the Operations Building and the Sludge Pump Building that appear to be suspect for containing Mercury. These controls could not be positively identified as mercury containing. Therefore, unless positively identified, these controls should be handled in such a manner as it does contain mercury. Other controls in the Operations Building, Sludge Pumping Building and the Garage Building did not appear to contain mercury.

There were NOT any known fluorescent lamps that contained mercury tubes or any PCB containing ballast documented in the Operations Building, Sludge Pumping Building or the Garage Building. However, it is typically assumed that all florescent light ballast contain over 50 PPM PCBs and should to be removed and placed in 55 gallon drums and recycled per 40 CFR 761.60-61. Table 3 lists all suspect PCB ballasts throughout the Operations Building, Sludge Pumping Building and the Garage Building. Table 3 also lists potential mercury containing thermostats located within the Operations Building, Sludge Pumping Building and the Garage Building. It was not reported that there are any known batteries located within the Operations Building, Sludge Pumping Building and the Garage Building if batteries are found to be within these buildings, then they should be considered Universal Waste.

Discussion

All universal waste products must be removed and recycled prior to renovation if they are included in the renovation project. Proper disposal of all chemicals is required. Waste

manifests should be kept when applicable, and all local, state and Federal guidelines must be followed for transport and disposal of these materials.

Report Reviewed by:

Jason Pringle
Principal

TABLE 3

UNIVERSAL WASTE PRODUCTS

AMC Environmental, LLC
P.O. Box 423, Stratford, CT 06615

TABLE 3

SUMMARY OF UNIVERSAL WASTE PRODUCTS

Enfield WPCF – Garage Building
90 Parson Road
Enfield, CT

Fixture Type or Components	Ballast	Electronics		Fluorescent Lamps	Potential Hazard
		Description	Quantity		
Light Ballast	4				PCB

AMC Environmental, LLC
P.O. Box 423, Stratford, CT 06615

TABLE 3

SUMMARY OF UNIVERSAL WASTE PRODUCTS

Enfield WPCF – Sludge Pumping Building
90 Parson Road
Enfield, CT

Fixture Type or Components	Ballast	Electronics		Fluorescent Lamps	Potential Hazard
		Description	Quantity		
Thermostat		Honeywell	1		Mercury
Thermostat		White-Rodgers	4		Mercury
Thermostat		Penn	2		Mercury
Light Ballast	10				PCB

AMC Environmental, LLC
P.O. Box 423, Stratford, CT 06615

TABLE 3

SUMMARY OF UNIVERSAL WASTE PRODUCTS

Enfield WPCF – Operations Building
90 Parson Road
Enfield, CT

Fixture Type or Components	Ballast	Electronics		Fluorescent Lamps	Potential Hazard
		Description	Quantity		
Thermostat		Johnson Controls	5		Mercury
Light Ballasts	203				PCB

APPENDIX A

LABORATORY RESULTS – ASBESTOS

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EMSL Order: 031504426
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Phone: (203) 378-5020
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Received:
Analysis Date:
Collected:

Project: **EXFIELD/ WPCF/ OLD PLANT**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
B071401 *031504426-0001*	LOWER ROOF/ RUBBER ROOFING	Black Non-Fibrous Homogeneous		8% Ca Carbonate 70% Matrix 22% Non-fibrous (other)	**None Detected**
B071402 *031504426-0002*	LOWER ROOF/ RUBBER ROOFING	Black Non-Fibrous Homogeneous		75% Matrix 25% Non-fibrous (other)	**None Detected**
B071403 *031504426-0003*	UPPER ROOF/ RUBBER ROOFING	Black Non-Fibrous Homogeneous		63% Matrix 37% Non-fibrous (other)	**None Detected**
B071404 *031504426-0004*	ROOF/ SEALANT ON PARAPIT	Black Non-Fibrous Homogeneous	3% Cellulose	2% Mica 95% Non-fibrous (other)	**None Detected**
B071405 *031504426-0005*	ROOF/ SEALANT ON PARAPIT	Black Non-Fibrous Homogeneous	4% Cellulose	53% Matrix 43% Non-fibrous (other)	**None Detected**
B071406 *031504426-0006*	ROOF/ FLASHING ON PARAPIT	Black Non-Fibrous Homogeneous		20% Ca Carbonate 68% Non-fibrous (other)	**12% Chrysotile**
B071407 *031504426-0007*	ROOF/ FLASHING ON PARAPIT				**Stop Positive (Not Analyzed)**
B071408 *031504426-0008*	ROOF/ INSULATION (ISO)/ BELOW RUBBER ROOFING	Brown/Tan Non-Fibrous Homogeneous	15% Cellulose	85% Non-fibrous (other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos %	Type
B071409 *031504426-0009*	ROOF/ INSULATION (ISO)/ BELOW RUBBER ROOFING	Brown Fibrous Homogeneous	12%	Cellulose	88%	Non-fibrous (other)		**None Detected**
B071410 *031504426-0010*	ROOF/ PAPER/BARRIER ON DECK	Gray Fibrous Homogeneous	75%	Cellulose	25%	Non-fibrous (other)		**None Detected**
B071411 *031504426-0011*	ROOF/ PAPER/BARRIER ON DECK	Gray Fibrous Homogeneous	78%	Cellulose	22%	Non-fibrous (other)		**None Detected**
B071412 *031504426-0012*	ROOF/ CAULK AT PARAPIT	Gray/White Non-Fibrous Homogeneous			20% 80%	Ca Carbonate Non-fibrous (other)		**None Detected**
B071413 *031504426-0013*	ROOF/ CAULK AT PARAPIT	Gray Non-Fibrous Homogeneous			32% 48% 20%	Ca Carbonate Matrix Non-fibrous (other)		**None Detected**
B071414 *031504426-0014*	EXTERIOR/ BLACK SEALANT ON BRICK	Black Non-Fibrous Homogeneous			15% 78%	Ca Carbonate Non-fibrous (other)	**7%**	**Chrysotile**
B071415 *031504426-0015*	EXTERIOR/ BLACK SEALANT ON BRICK							**Stop Positive (Not Analyzed)**
B071416 *031504426-0016*	MAIN RM/ FLUE CEMENT	Brown/Gray Non-Fibrous Homogeneous	5%	Cellulose	58% 37%	Quartz Non-fibrous (other)		**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos				Asbestos
Sample	**Description**	**Appearance**	**%**	**Fibrous**	**%**	**Non-Fibrous**	**% Type**
B071417 *031504426-0017*	MAIN RM/ FLUE CEMENT	Gray Non-Fibrous Homogeneous	12%	Wollastonite	34% 54%	Quartz Non-fibrous (other)	**None Detected**
B071418 *031504426-0018*	MAIN RM/ WINDOW GLAZING	Gray Non-Fibrous Homogeneous			55% 45%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071419 *031504426-0019*	MAIN RM/ WINDOW GLAZING	White Non-Fibrous Homogeneous			48% 52%	Ca Carbonate Non-fibrous (other)	**None Detected**

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Project: **EXFIELD/ WPCF/ OLD PLANT**

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Report Comments:

Analyst(s):

Emmanuel Alberto PLM (7)

Noel Anderson PLM (10)

Samples reviewed and approved by:

James Hall, Laboratory Manager
or other approved signatory

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Project: **ENFIELD/ WPCF/ SLUDGE PUMP BLDG.**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos %	Type
B071401 *031504427-0001*	ROOF/ ROOF TAR	Black Non-Fibrous Homogeneous			85% 12%	Matrix Non-fibrous (other)	**3%**	**Chrysotile**
B071402 *031504427-0002*	ROOF/ ROOF TAR						**Stop Positive (Not Analyzed)**	
B071403 *031504427-0003*	ROOF/ TAR ON DECK	Black Non-Fibrous Homogeneous	2%	Glass	5% 90% 3%	Quartz Matrix Non-fibrous (other)	**None Detected**	
B071404 *031504427-0004*	ROOF/ TAR ON DECK	Black Non-Fibrous Heterogeneous			70% 30%	Matrix Non-fibrous (other)	**None Detected**	
B071405 *031504427-0005*	ROOF/ FLASHING ON CEMENT	Black Non-Fibrous Homogeneous			95% 1%	Matrix Non-fibrous (other)	**4%**	**Chrysotile**
B071406 *031504427-0006*	ROOF/ FLASHING ON CEMENT						**Stop Positive (Not Analyzed)**	
B071407 *031504427-0007*	ROOF/ FLASHING ON CEMENT						**Stop Positive (Not Analyzed)**	
B071408 *031504427-0008*	ROOF/ INSULATION/ BELOW BUILT-UP ROOFING	Yellow Fibrous Homogeneous	95%	Glass	5%	Non-fibrous (other)	**None Detected**	
B071409 *031504427-0009*	ROOF/ INSULATION/ BELOW BUILT-UP ROOFING	Yellow Fibrous Homogeneous	80%	Glass	20%	Non-fibrous (other)	**None Detected**	

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos % Type
B071410 *031504427-0010*	ROOF/ INSULATION/ BELOW RUBBER ROOFING	Brown Fibrous Heterogeneous	96%	Cellulose	4%	Non-fibrous (other)	**None Detected**
B071411 *031504427-0011*	ROOF/ INSULATION/ BELOW RUBBER ROOFING	Brown Fibrous Heterogeneous	90%	Cellulose	10%	Non-fibrous (other)	**None Detected**
B071412 *031504427-0012*	ROOF/ BUILT-UP ROOFING	Black Non-Fibrous Homogeneous	5%	Cellulose	85% 10%	Matrix Non-fibrous (other)	**None Detected**
B071413 *031504427-0013*	ROOF/ BUILT-UP ROOFING	Black Non-Fibrous Homogeneous			12% 80% 8%	Quartz Matrix Non-fibrous (other)	**None Detected**
B071414 *031504427-0014*	ROOF/ BUILT-UP ROOFING	Black Non-Fibrous Homogeneous			85% 15%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071415 *031504427-0015*	ROOF/ BUILT-UP ROOFING	Black Non-Fibrous Heterogeneous			55% 45%	Matrix Non-fibrous (other)	**None Detected**
B071416 *031504427-0016*	BASEMENT/ PUMP ROOM/ PIPE FITTING/ELBOW	Gray Fibrous Homogeneous	25%	Min. Wool	45% 30%	Gypsum Non-fibrous (other)	**None Detected**
B071417 *031504427-0017*	BASEMENT/ PUMP ROOM/ PIPE FITTING/ELBOW	Gray Fibrous Homogeneous	35%	Min. Wool	45% 20%	Gypsum Non-fibrous (other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos %	Type
B071418 *031504427-0018*	BASEMENT/ PUMP ROOM/ PIPE FITTING/ELBOW	Gray Non-Fibrous Heterogeneous	40%	Min. Wool	50% 10%	Gypsum Non-fibrous (other)		**None Detected**
B071419 *031504427-0019*	BASEMENT/ PUMP ROOM/ LARGE PIPE INSULATION	Gray Fibrous Homogeneous	30%	Min. Wool	45% 25%	Gypsum Non-fibrous (other)		**None Detected**
B071420 *031504427-0020*	BASEMENT/ PUMP ROOM/ LARGE PIPE INSULATION	Gray Fibrous Homogeneous			45% 35%	Gypsum Non-fibrous (other)	**20%**	**Chrysotile**
B071421 *031504427-0021*	BASEMENT/ PUMP ROOM/ LARGE PIPE INSULATION							**Stop Positive (Not Analyzed)**
B071422 *031504427-0022*	BASEMENT/ PUMP ROOM/ PIPE INSULATION	Tan Fibrous Homogeneous			40% 35%	Gypsum Non-fibrous (other)	**25%**	**Chrysotile**
B071423 *031504427-0023*	BASEMENT/ PUMP ROOM/ PIPE INSULATION							**Stop Positive (Not Analyzed)**
B071424 *031504427-0024*	BASEMENT/ PUMP ROOM/ PIPE INSULATION							**Stop Positive (Not Analyzed)**
B071425 *031504427-0025*	1ST FLR/ INTERIOR/ DOOR CAULK	Gray Non-Fibrous Homogeneous			20% 75% 1%	Ca Carbonate Matrix Non-fibrous (other)	**4%**	**Chrysotile**

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			Non-Asbestos		Asbestos	
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**%**	**Type**
B071426 *031504427-0026*	1ST FLR/ INTERIOR/ DOOR CAULK				**Stop Positive (Not Analyzed)**	
B071427 *031504427-0027*	1ST FLR/ INTERIOR/ DOOR CAULK				**Stop Positive (Not Analyzed)**	
B071428 *031504427-0028*	1ST FLR/ INTERIOR/ WINDOW CAULK	Gray Non-Fibrous Homogeneous		97% Non-fibrous (other)	**3%**	**Chrysotile**

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Report Comments:

Analyst(s):

Emily Myint PLM (15)

Jessica Fearon-Brown PLM (5)

Samples reviewed and approved by:

James Hall, Laboratory Manager
or other approved signatory

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Project: **ENFIELD WPCF - ADMIN. BLDG./ CT**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
B071401 *031504434-0001*	RM 01 - TAN SPECKEL SHEET FLOORING	Gray Fibrous Homogeneous		55% Ca Carbonate 43% Non-fibrous (other)	**2% Chrysotile**
B071402 *031504434-0002*	RM 02 - TAN SPECIAL SHEET FLOORING				**Stop Positive (Not Analyzed)**
B071405 *031504434-0003*	RM 01 - BLACK/ COVEBASE	Black Non-Fibrous Homogeneous		15% Ca Carbonate 85% Non-fibrous (other)	**None Detected**
B071406 *031504434-0004*	RM 02 - BLACK/ COVEBASE	Black Non-Fibrous Homogeneous		20% Ca Carbonate 80% Non-fibrous (other)	**None Detected**
B071407 *031504434-0005*	RM 01 - ADHESIVE ASS. W/ COVEBASE	Brown Non-Fibrous Homogeneous	<1% Cellulose	100% Non-fibrous (other)	**None Detected**
B071408 *031504434-0006*	RM 02 - ADHESIVE ASS. W/ COVEBASE	Brown Non-Fibrous Homogeneous		95% Matrix 5% Non-fibrous (other)	**None Detected**
B071409 *031504434-0007*	RM 01 - CMU BLOCK	Tan Non-Fibrous Homogeneous		25% Quartz 75% Non-fibrous (other)	**None Detected**
B071410 *031504434-0008*	RM 01 - CMU BLOCK	Tan Non-Fibrous Homogeneous		35% Quartz 65% Non-fibrous (other)	**None Detected**
B071411 *031504434-0009*	RM 02 - CMU BLOCK	Tan Non-Fibrous Homogeneous		35% Quartz 35% Gypsum 30% Non-fibrous (other)	**None Detected**

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Project: **ENFIELD WPCF - ADMIN. BLDG./ CT**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos				Asbestos
Sample	**Description**	**Appearance**	**%**	**Fibrous**	**%**	**Non-Fibrous**	**% Type**
B071412 *031504434-0010*	RM 02 - CMU MORTAR	Green Non-Fibrous Homogeneous			55% 15% 30%	Quartz Ca Carbonate Non-fibrous (other)	**None Detected**
B071413 *031504434-0011*	RM 01 - CMU MORTAR	Green Non-Fibrous Homogeneous	2%	Cellulose	55% 15% 28%	Quartz Ca Carbonate Non-fibrous (other)	**None Detected**
B071414 *031504434-0012*	RM 02 - CMU MORTAR	Green Non-Fibrous Heterogeneous			45% 35% 20%	Quartz Gypsum Non-fibrous (other)	**None Detected**
B071415 *031504434-0013*	RM 02 - 2X4 CEILING TILE TYPE 1	Gray Fibrous Homogeneous	45% 35%	Min. Wool Cellulose	20%	Non-fibrous (other)	**None Detected**
B071416 *031504434-0014*	RM 02 - 2X4 CEILING TILE TYPE 1	Gray Fibrous Homogeneous	25% 45%	Min. Wool Cellulose	30%	Non-fibrous (other)	**None Detected**
B071418 *031504434-0015*	RM 01 - BRICK	Tan Non-Fibrous Homogeneous			50% 50%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071419 *031504434-0016*	RM 02 - BRICK	Tan Non-Fibrous Homogeneous			15% 85%	Quartz Non-fibrous (other)	**None Detected**
B071421 *031504434-0017*	RM 01 - BRICK MORTAR	Gray Non-Fibrous Homogeneous			55% 15% 30%	Quartz Ca Carbonate Non-fibrous (other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos % Type
B071422 *031504434-0018*	RM 02 - BRICK MORTAR	Gray Non-Fibrous Homogeneous			45% 35% 20%	Quartz Gypsum Non-fibrous (other)	**None Detected**
B071424 *031504434-0019*	RM 03 - GREEN SPECKELED SHEET FLOORING	Green Non-Fibrous Homogeneous	2%	Cellulose	5% 45% 48%	Mica Ca Carbonate Non-fibrous (other)	**None Detected**
B071425 *031504434-0020*	RM 03 - GREEN SPECKELED SHEET FLOORING	Green Non-Fibrous Homogeneous			45% 30% 25%	Quartz Ca Carbonate Non-fibrous (other)	**None Detected**
B071427 *031504434-0021*	RM 12 - 12 INCH CT	Tan Non-Fibrous Homogeneous	65%	Min. Wool	35%	Non-fibrous (other)	**None Detected**
B071428 *031504434-0022*	RM 10 - 12 INCH CT	Gray Fibrous Heterogeneous	85%	Min. Wool	15%	Non-fibrous (other)	**None Detected**
B071429A *031504434-0023*	RM 10 - 12 INCH CT	Tan Fibrous Homogeneous	65%	Min. Wool	35%	Non-fibrous (other)	**None Detected**
B071429B *031504434-0024*	RM 10 - 12 INCH CT	Gray Fibrous Homogeneous	86%	Min. Wool	14%	Non-fibrous (other)	**None Detected**
B071430A *031504434-0025*	RM 13 - DUCT CLOTH COVER	Yellow Fibrous Homogeneous	70%	Glass	30%	Non-fibrous (other)	**None Detected**
B071430B *031504434-0026*	RM 13 - DUCT CLOTH COVER	Tan/Silver Fibrous Homogeneous	80%	Glass	20%	Non-fibrous (other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos % Type
B071431A *031504434-0027*	RM 13 - DUCT CLOTH COVER	Yellow Fibrous Homogeneous	55%	Glass	45%	Non-fibrous (other)	**None Detected**
B071431B *031504434-0028*	RM 13 - DUCT CLOTH COVER	Tan/Silver Fibrous Homogeneous	15% 65%	Cellulose Glass	20%	Non-fibrous (other)	**None Detected**
B071432A *031504434-0029*	RM 13 - DUCT CLOTH COVER	Yellow Fibrous Homogeneous	70%	Glass	30%	Non-fibrous (other)	**None Detected**
B071432B *031504434-0030*	RM 13 - DUCT CLOTH COVER	Tan Fibrous Homogeneous	60% 10%	Glass Cellulose	15% 15%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071433 *031504434-0031*	RM 10 - GREEN CERAMIC FLOOR TILE	Green Non-Fibrous Homogeneous			55% 45%	Quartz Non-fibrous (other)	**None Detected**
B071434 *031504434-0032*	RM 10 - GREEN CERAMIC FLOOR TILE	Gray Non-Fibrous Heterogeneous			40% 60%	Quartz Non-fibrous (other)	**None Detected**
B071435 *031504434-0033*	RM 26 - GROUT ASS. W/ TILE	White Non-Fibrous Homogeneous			65% 35%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071436 *031504434-0034*	RM 26 - GROUT ASS. W/ TILE	White Non-Fibrous Homogeneous			45% 55%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071437 *031504434-0035*	RM 10 - YELLOW THINSET ASS. W/ WALL TILE	Yellow Non-Fibrous Homogeneous			15% 85%	Ca Carbonate Non-fibrous (other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
B071438 *031504434-0036*	RM 26 - YELLOW THINSET ASS. W/ WALL TILE	Brown Non-Fibrous Homogeneous		95% Matrix 5% Non-fibrous (other)	**None Detected**
B071439 *031504434-0037*	RM 10 - GREEN 4 INCH WALL TILE	Tan Non-Fibrous Homogeneous		35% Quartz 65% Non-fibrous (other)	**None Detected**
B071440A-Ceramic Tile *031504434-0038*	RM 26 - GREEN 4 INCH WALL TILE	White Non-Fibrous Homogeneous		15% Quartz 85% Non-fibrous (other)	**None Detected**
B071440A-Thin Set *031504434-0038A*	RM 26 - GREEN 4 INCH WALL TILE	Brown Non-Fibrous Homogeneous		65% Matrix 35% Non-fibrous (other)	**None Detected**
B071440B-Ceramic Tile *031504434-0039*	RM 26 - GREEN 4 INCH WALL TILE	Tan/White Non-Fibrous Homogeneous		15% Quartz 85% Non-fibrous (other)	**None Detected**
B071440B-Thin Set *031504434-0039A*	RM 26 - GREEN 4 INCH WALL TILE	Yellow Non-Fibrous Homogeneous		80% Matrix 20% Non-fibrous (other)	**None Detected**
B071441 *031504434-0040*	RM 26 - IMT. WINDOW GLAZING	Gray Non-Fibrous Homogeneous		55% Ca Carbonate 43% Non-fibrous (other)	**2% Chrysotile**
B071442 *031504434-0041*	RM 26 - IMT. WINDOW GLAZING				**Stop Positive (Not Analyzed)**
B071443 *031504434-0042*	RM 10 - IMT. WINDOW CAULK TYPE 1 - HARD	Gray Non-Fibrous Homogeneous		55% Ca Carbonate 42% Non-fibrous (other)	**3% Chrysotile**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos %	Type
B071444 *031504434-0043*	RM 10 - IMT. WINDOW CAULK TYPE 1 - HARD						**Stop Positive (Not Analyzed)**	
B071445 *031504434-0044*	RM 10 - IMT. WINDOW CAULK TYPE 2 SOFT						**Stop Positive (Not Analyzed)**	
B071446 *031504434-0045*	RM 10 - IMT. WINDOW CAULK TYPE 2 SOFT						**Stop Positive (Not Analyzed)**	
B071447 *031504434-0046*	RM 6 - DOOR CAULKING	Gray Non-Fibrous Homogeneous			45%	Ca Carbonate	**12%**	**Chrysotile**
					43%	Non-fibrous (other)		
B071448 *031504434-0047*	RM 6 - DOOR CAULKING						**Stop Positive (Not Analyzed)**	
B071449 *031504434-0048*	RM 11 - PAPER ON FG PIPE INS	Tan Fibrous Homogeneous	85%	Glass	15%	Non-fibrous (other)	**None Detected**	
B071450 *031504434-0049*	RM 11 - PAPER ON FG PIPE INS	Tan/Green Fibrous Homogeneous	75%	Glass	25%	Non-fibrous (other)	**None Detected**	
B071451 *031504434-0050*	RM 34 - DUCT WRAP - TYPE 1/ TAN	Yellow Fibrous Homogeneous	85%	Glass	15%	Non-fibrous (other)	**None Detected**	
B071452 *031504434-0051*	RM 34 - DUCT WRAP - TYPE 1/ TAN	Yellow Fibrous Homogeneous	85%	Glass	15%	Non-fibrous (other)	**None Detected**	
B071453 *031504434-0052*	RM 34 - DUCT WRAP - TYPE 1/ TAN	Tan/White Fibrous Homogeneous	92%	Glass	8%	Non-fibrous (other)	**None Detected**	

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos				Asbestos	
Sample	**Description**	**Appearance**	**%**	**Fibrous**	**%**	**Non-Fibrous**	**%**	**Type**
B071454 *031504434-0053*	RM 34 - DUCT WRAP - TYPE 2/ PAPER	Brown Fibrous Homogeneous	85%	Cellulose	15%	Non-fibrous (other)		**None Detected**
B071455 *031504434-0054*	RM 34 - DUCT WRAP - TYPE 2/ PAPER	Yellow Fibrous Homogeneous	55% 20%	Cellulose Glass	25%	Non-fibrous (other)		**None Detected**
B071456 *031504434-0055*	RM 34 - DUCT WRAP - TYPE 2/ PAPER	Brown/Yellow Fibrous Homogeneous	15% 85%	Cellulose Glass	0%	Non-fibrous (other)		**None Detected**
B071457 *031504434-0056*	RM 36 - ROUND DUCT/ HARD	Gray Non-Fibrous Homogeneous	25%	Min. Wool	50% 25%	Gypsum Non-fibrous (other)		**None Detected**
B071458 *031504434-0057*	RM 36 - ROUND DUCT/ HARD	Gray Fibrous Homogeneous	5%	Cellulose	40%	Non-fibrous (other)	**55%**	**Chrysotile**
B071459 *031504434-0058*	RM 36 - ROUND DUCT/ HARD							**Stop Positive (Not Analyzed)**
B071460 *031504434-0059*	RM 34 - SPRAYED ON INSULATION	Tan/White Fibrous Homogeneous	40%	Min. Wool	45%	Non-fibrous (other)	**15%**	**Amosite**
B071461 *031504434-0060*	RM 34 - SPRAYED ON INSULATION							**Stop Positive (Not Analyzed)**
B071462 *031504434-0061*	RM 34 - SPRAYED ON INSULATION							**Stop Positive (Not Analyzed)**
B071463 *031504434-0062*	RM 36 - TOP SEALANT	Gray Fibrous Homogeneous			15% 65%	Mica Non-fibrous (other)	**20%**	**Chrysotile**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos % Type
B071464 *031504434-0063*	RM 36 - TOP SEALANT						**Stop Positive (Not Analyzed)**
B071465 *031504434-0064*	RM 36 - TOP SEALANT						**Stop Positive (Not Analyzed)**
B071466 *031504434-0065*	BOILER RM - FLUE CEMENT	Gray Non-Fibrous Homogeneous	10%	Wollastonite	90%	Non-fibrous (other)	**None Detected**
B071467 *031504434-0066*	BOILER RM - FLUE CEMENT	Gray Non-Fibrous Homogeneous	30%	Wollastonite	70%	Non-fibrous (other)	**None Detected**
B071468 *031504434-0067*	RM 23 - CARPET GLUE	Yellow Non-Fibrous Homogeneous			100%	Non-fibrous (other)	**None Detected**
B071469 *031504434-0068*	RM 23 - CARPET GLUE	Yellow Non-Fibrous Homogeneous			85% 15%	Matrix Non-fibrous (other)	**None Detected**
B071470 *031504434-0069*	RM 23 - COVE BASE	Black Non-Fibrous Homogeneous	<1%	Cellulose	15% 85%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071471 *031504434-0070*	RM 23 - COVE BASE	Black Non-Fibrous Homogeneous			20% 80%	Ca Carbonate Non-fibrous (other)	**None Detected**
B071472 *031504434-0071*	RM 23 - COVE BASE ADHESIVE	Yellow Non-Fibrous Homogeneous			35% 65%	Ca Carbonate Non-fibrous (other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos				Asbestos
Sample	**Description**	**Appearance**	**%**	**Fibrous**	**%**	**Non-Fibrous**	**% Type**
B071473 *031504434-0072*	RM 23 - COVE BASE ADHESIVE	Brown Non-Fibrous Homogeneous			90% 10%	Matrix Non-fibrous (other)	**None Detected**
B071474 *031504434-0073*	RM 26 - 2X4 CEILING TILE	Gray Fibrous Homogeneous	35% 25%	Min. Wool Cellulose	40%	Non-fibrous (other)	**None Detected**
B071475 *031504434-0074*	RM 26 - 2X4 CEILING TILE	Tan/Yellow Non-Fibrous Homogeneous	45% 35%	Cellulose Min. Wool	20%	Non-fibrous (other)	**None Detected**
B071476 *031504434-0075*	BOILER RM - BURNER GASKET	Brown Fibrous Homogeneous	55%	Glass	45%	Non-fibrous (other)	**None Detected**
B071477 *031504434-0076*	BOILER RM - BURNER GASKET	Brown Non-Fibrous Homogeneous	55%	Glass	45%	Non-fibrous (other)	**None Detected**
B071478 *031504434-0077*	BOILER RM - BURNER GASKET	Brown Non-Fibrous Homogeneous	95%	Cellulose	5%	Non-fibrous (other)	**None Detected**
B071479 *031504434-0078*	EXTERIOR - WINDOW GLAZING - SOFT BLACK	Gray Non-Fibrous Homogeneous			100%	Non-fibrous (other)	**None Detected**
B071480 *031504434-0079*	EXTERIOR - WINDOW GLAZING - SOFT BLACK	Gray Non-Fibrous Homogeneous			100%	Non-fibrous (other)	**None Detected**
B071481 *031504434-0080*	EXT. - WINDOW CAULK SOFT GRAY	Gray Non-Fibrous Homogeneous			25% 75%	Ca Carbonate Non-fibrous (other)	**None Detected**

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Samples analyzed by EMSL Analytical, Inc. New York, NY AIHA-LAP, LLC--IHLAP Accredited #102581, NVLAP Lab Code 101048-9, NYS ELAP 11506, NJ NY022, CT PH-0170, MA AA000170

EMSL Analytical, Inc.
307 West 38th Street, New York, NY 10018
Phone/Fax: (212) 290 0051 / (212) 290 0059
http://www.EMSL.com manhattanlab@emsl.com

EMSL Order: 031504434
CustomerID: AMCT50
CustomerPO:
ProjectID:

Attn: **Jason Pringle**
AMC Environmental, LLC
PO Box 423

Stratford, CT 06615

Phone: (203) 378-5020
Fax: (203) 375-7344
Received:
Analysis Date:
Collected:

Project: **ENFIELD WPCF - ADMIN. BLDG./ CT**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

Sample	Description	Appearance	Non-Asbestos %	Fibrous	Non-Asbestos %	Non-Fibrous	Asbestos %	Type
B071482 *031504434-0081*	EXT. - WINDOW CAULK SOFT GRAY	Gray Non-Fibrous Homogeneous			25% 75%	Ca Carbonate Non-fibrous (other)	**None Detected**	
B071483 *031504434-0082*	ROOF - BUILT-UP ROOFING	Black Fibrous Homogeneous	5%	Cellulose	95%	Non-fibrous (other)	**None Detected**	
B071484 *031504434-0083*	ROOF - BUILT-UP ROOFING	Black Non-Fibrous Homogeneous	4%	Cellulose	96%	Non-fibrous (other)	**None Detected**	
B071485 *031504434-0084*	ROOF - BUILT-UP ROOFING	Black Non-Fibrous Homogeneous	4%	Cellulose	96%	Non-fibrous (other)	**None Detected**	
B071486 *031504434-0085*	ROOF - BUILT-UP ROOFING	Black Non-Fibrous Homogeneous			85% 15%	Matrix Non-fibrous (other)	**None Detected**	
B071487 *031504434-0086*	ROOF - BLACK MATERIAL BOILER BUILT-UP	Black Non-Fibrous Homogeneous			100%	Non-fibrous (other)	**None Detected**	
B071488 *031504434-0087*	ROOF - BLACK MATERIAL BOILER BUILT-UP	Gray Non-Fibrous Homogeneous			15% 85%	Quartz Non-fibrous (other)	**None Detected**	
B071489 *031504434-0088*	ROOF - INSULATION (ROOFING)	Yellow Fibrous Homogeneous	85%	Glass	15%	Non-fibrous (other)	**None Detected**	
B071490 *031504434-0089*	ROOF - INSULATION (ROOFING)	Yellow Fibrous Homogeneous	95%	Glass	5%	Non-fibrous (other)	**None Detected**	

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Samples analyzed by EMSL Analytical, Inc. New York, NY AIHA-LAP, LLC--IHLAP Accredited #102581, NVLAP Lab Code 101048-9, NYS ELAP 11506, NJ NY022, CT PH-0170, MA AA000170

EMSL Analytical, Inc.
307 West 38th Street, New York, NY 10018
Phone/Fax: (212) 290 0051 / (212) 290 0058
http://www.EMSL.com manhattanlab@emsl.com

EMSL Order: 031504434
CustomerID: AMCT50
CustomerPO:
ProjectID:

Attn: **Jason Pringle**
AMC Environmental, LLC
PO Box 423

Stratford, CT 06615

Phone: (203) 378-5020
Fax: (203) 375-7344
Received:
Analysis Date:
Collected:

Project: **ENFIELD WPCF - ADMIN. BLDG./ CT**

Test Report: Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy

			Non-Asbestos				Asbestos	
Sample	**Description**	**Appearance**	**%**	**Fibrous**	**%**	**Non-Fibrous**	**%**	**Type**
B071491 *031504434-0090*	ROOF - RUBBER ROOFING	Black Non-Fibrous Homogeneous			100%	Non-fibrous (other)		**None Detected**
B071492 *031504434-0091*	ROOF - RUBBER ROOFING	Black Non-Fibrous Homogeneous	5%	Cellulose	85% 10%	Matrix Non-fibrous (other)		**None Detected**
B071493 *031504434-0092*	ROOF - FLASHING @ PENETRATION - 2ND LAYER	Black Fibrous Homogeneous			89%	Non-fibrous (other)	**11%**	**Chrysotile**
B071494 *031504434-0093*	ROOF - FLASHING @ PENETRATION - 2ND LAYER							**Stop Positive (Not Analyzed)**
B071495 *031504434-0094*	ROOF - FLASHING @ PENETRATION - 1ST LAYER	Black Fibrous Homogeneous	5%	Synthetic	85% 10%	Matrix Non-fibrous (other)		**None Detected**
B071496 *031504434-0095*	ROOF - FLASHING @ PENETRATION - 1ST LAYER	Black Non-Fibrous Homogeneous			15% 80% 5%	Ca Carbonate Matrix Non-fibrous (other)		**None Detected**
B071497 *031504434-0096*	ROOF - TAR @ PENETRATION	Black Fibrous Homogeneous			100%	Non-fibrous (other)		**None Detected**
B071498 *031504434-0097*	ROOF - TAR @ PENETRATION	Black Non-Fibrous Homogeneous	10%	Cellulose	90% 0%	Matrix Non-fibrous (other)		**None Detected**

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Samples analyzed by EMSL Analytical, Inc. New York, NY AIHA-LAP, LLC--IHLAP Accredited #102581, NVLAP Lab Code 101048-9, NYS ELAP 11506, NJ NY022, CT PH-0170, MA AA000170

EMSL Analytical, Inc.
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http://www.EMSL.com manhattanlab@emsl.com

EMSL Order:	031504434
CustomerID:	AMCT50
CustomerPO:	
ProjectID:	

Attn: **Jason Pringle**
AMC Environmental, LLC
PO Box 423

Stratford, CT 06615

Phone:	(203) 378-5020
Fax:	(203) 375-7344
Received:	
Analysis Date:	
Collected:	

Project: **ENFIELD WPCF - ADMIN. BLDG./ CT**

The samples in this report were submitted to EMSL for analysis by Asbestos Analysis of Bulk Materials via EPA 600/R-93/116 Method using Polarized Light Microscopy. The reference number for these samples is the EMSL Order ID above. Please use this reference number when calling about these samples.

Report Comments:

Analyst(s):

Emily Myint PLM (38)

Keri-Dean Scarlett PLM (49)

Samples reviewed and approved by:

James Hall, Laboratory Manager
or other approved signatory

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Samples analyzed by EMSL Analytical, Inc. New York, NY AIHA-LAP, LLC--IHLAP Accredited #102581, NVLAP Lab Code 101048-9, NYS ELAP 11506, NJ NY022, CT PH-0170, MA AA000170

THIS IS THE LAST PAGE OF THE REPORT.

APPENDIX B

XRF REPORT

LEAD INSPECTION DATA PAGE

ADDRESS Pump Room

DATE June 24, 2014

NOTES: **E** = Ceiling **F** = Floor **+** = positive for lead **I** =Intact **P** = Poor

Sample Number	Location	Side	Color	Surface Type	Substrate	Paint Condition	Results Mg/cm^2	Comments
01	Calibration	-	-	-	-	-	1.0	
02	Calibration	-	-	-	-	-	1.0	
03	Calibration	-	-	-	-	-	1.0	
04	Pump Room	B	Yellow	Wall	Concrete	I	0.0	
05	Pump Room	B	Tan	Sewer pipe	Metal	P	1.0	+
06	Pump Room	C	Red	Floor	Concrete	P	0.2	
07	Pump Room	C	Light Green	Effluent Pipe	Metal	P	3.2	+
08	Pump Room	C	Dark Green	Effluent Pipe	Metal	P	1.2	+
09	Pump Room	D	Brown	Dewatering Pipe	Metal	P	2.1	+
10	Electrical Room	B	Tan	Wall	Block	P	0.0	
11	Electrical Room	B	Red	Floor	Concrete	P	0.0	
12	Electrical Room	A	Red	Platform	Concrete	P	0.0	
13	Electrical Room	A	Gray	Wall	Block	P	0.0	
14	Chlorination Room	A	Gray	Wall	Concrete	P	0.1	
15	Chlorination Room	D	Blue	I-Beam	Metal	I	1.0	+
16	Chlorination Room	D	Tan	Wall	Block	I	0.0	
17	Chlorination Room	A	Red	Floor	Concrete	I	0.0	
18	Chlorination Room	B	Yellow	Pipe	PVC	I	0.0	
19	Chlorination Room	B	White	Ceiling	Concrete	I	0.0	
20	Chlorination Room	A	Dark Blue	Metal support	Metal	P	0.0	

LEAD INSPECTION DATA PAGE

ADDRESS Pump Room

DATE June 24, 2014

NOTES: **E** = Ceiling **F** = Floor **+** = positive for lead **I** =Intact **P** = Poor

Sample Number	Location	Side	Color	Surface Type	Substrate	Paint Condition	Results Mg/cm^2	Comments
21	Calibration	-	-	-	-	-	1.0	
22	Calibration	-	-	-	-	-	1.0	
23	Calibration	-	-	-	-	-	1.0	

LEAD INSPECTION DATA PAGE

ADDRESS Operations Building

DATE July 3, 2014

NOTES: **E** = Ceiling **F** = Floor **+** = positive for lead **I** =Intact **P** = Poor

Sample Number	Location	Side	Color	Surface Type	Substrate	Paint Condition	Results Mg/cm^2	Comments
01	Calibration	-	-	-	-	-	1.0	
02	Calibration	-	-	-	-	-	1.0	
03	Calibration	-	-	-	-	-	1.0	
04	Room 1	B	Tan	Door casing	Metal	I	0.3	
05	Room 1	B	Tan	Door	Metal	I	1.0	+
06	Room 1	A	Green	Wall	Glazed block	I	1.0	+
07	Room 2	C	Off white	Wall	Brick	I	3.5	+
08	Room 2	A	Tan	Door	Metal	I	0.0	
09	Room 2	A	Tan	Door jamb	Metal	I	0.0	
10	Room 6	A	Green	Wall	Glazed block	I	2.9	+
11	Room 7	A	Yellow	Wall	CMU Block	I	0.0	
12	Room 9	C	Green	Wall	Glazed block	I	3.9	+
13	Room 10	B	White	Wall	Metal	I	0.0	
14	Room 10	B	Green	Locker	Metal	I	0.0	
15	Room 21	C	Blue	Wall	Glazed block	I	3.8	+
16	Room 25	C	Gray	Floor	Concrete	P	0.0	
17	Room 25	D	White	Wall	CMU Block	I	0.0	
18	Room 24	A	Red	Floor	Concrete	P	0.0	
19	Room 24	A	White	Wall	Glazed CMU	I	4.0	+
20	Room 31		Yellow	Wall	CMU		0.0	

LEAD INSPECTION DATA PAGE

ADDRESS Operations Building

DATE July 3, 2014

NOTES: **E** = Ceiling **F** = Floor **+** = positive for lead **I** =Intact **P** = Poor

Sample Number	Location	Side	Color	Surface Type	Substrate	Paint Condition	Results Mg/cm^2	Comments
21	Room 31	A	Gray	Floor	Concrete	P	0.0	
22	Room 32	B	Tan	Wall	CMU block	P	0.0	
23	Room 33	B	Blue	Column	Concrete	P	0.2	
24	Room 33	D	Red	Pipe	Metal	P	0.0	
25	Room 33	B	Brown	SC-PS2 Pipe	Metal	I	2.0	+
26	Room 33	C	Yellow	Wall	Concrete	P	0.0	
27	Room 35	A	Gray	Wall	Concrete	P	0.0	
28	Room 35	B	Yellow	Wall	Concrete	P	0.0	
29	Room 35	C	Gray	Ceiling	Concrete	P	0.0	
30	Room 36	D	Tan	Wall	Concrete	P	0.0	
31	Room 36	C	Gray	I-Beam	Metal	I	0.0	
32	Room 36	D	Blue	Air Duct	Metal	I	1.0	+
33	Calibration	-	-	-	-	-	0.9	
34	Calibration	-	-	-	-	-	1.0	
35	Calibration	-	-	-	-	-	0.9	

APPENDIX C

PCB ANALYTICAL RESULTS

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

February 18, 2015

Jason Pringle
AMC Environmental, LLC
PO Box 423
Stratford, CT 06615

Project Location: Enfield - WPCF - Admin Bldg.
Client Job Number:
Project Number: [none]
Laboratory Work Order Number: 15B0498

Enclosed are results of analyses for samples received by the laboratory on February 16, 2015. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Lisa A. Worthington
Project Manager

Table of Contents

Sample Summary 3

Case Narrative 4

Sample Results 5

15B0498-01 5

15B0498-02 6

15B0498-03 7

15B0498-04 8

15B0498-05 9

15B0498-06 10

15B0498-07 11

15B0498-08 12

15B0498-09 13

15B0498-10 14

15B0498-11 15

15B0498-12 16

15B0498-13 17

15B0498-14 18

Sample Preparation Information 19

QC Data 20

Polychlorinated Biphenyls with 3540 Soxhlet Extraction 20

B115387 20

Dual Column RPD Report 21

Flag/Qualifier Summary 34

Certifications 35

Chain of Custody/Sample Receipt 36

con-test® ANALYTICAL LABORATORY

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

AMC Environmental, LLC
PO Box 423
Stratford, CT 06615
ATTN: Jason Pringle

REPORT DATE: 2/18/2015

PURCHASE ORDER NUMBER:

PROJECT NUMBER: [none]

ANALYTICAL SUMMARY

WORK ORDER NUMBER: 15B0498

The results of analyses performed on the following samples submitted to the CON-TEST Analytical Laboratory are found in this report.

PROJECT LOCATION: Enfield - WPCF - Admin Bldg.

FIELD SAMPLE #	LAB ID:	MATRIX	SAMPLE DESCRIPTION	TEST	SUB LAB
PCB-01 Rm6 - Door Caulk	15B0498-01	Caulk		SW-846 8082A	
PCB-02 Rm6 - Door Caulk	15B0498-02	Caulk		SW-846 8082A	
PCB-03 Locker Rm. Int. Window Glazing	15B0498-03	Caulk		SW-846 8082A	
PCB-04 Rm6 - Int. Window Glazing	15B0498-04	Caulk		SW-846 8082A	
PCB-05 Locker Rm Int. Window Caulk	15B0498-05	Caulk		SW-846 8082A	
PCB-06 Locker Rm Int. Window Caulk	15B0498-06	Caulk		SW-846 8082A	
PCB-07 Ext Side D Caulk on Metal Window	15B0498-07	Caulk		SW-846 8082A	
PCB-08 Ext Side D Caulk on Stone	15B0498-08	Caulk		SW-846 8082A	
PCB-09 Sludge Pump Bldg. Int. Door Caulk	15B0498-09	Caulk		SW-846 8082A	
PCB-10 Sludge Pump Bldg. Int. Door Caulk	15B0498-10	Caulk		SW-846 8082A	
PCB-11 Sludge Pump Bldg. Int. Window Caulk	15B0498-11	Caulk		SW-846 8082A	
PCB-12 Sludge Pump Bldg. Int. Window Caulk	15B0498-12	Caulk		SW-846 8082A	
PCB-13 Old Plant Window Glazing	15B0498-13	Caulk		SW-846 8082A	
PCB-14 Old Plant Window Glazing	15B0498-14	Caulk		SW-846 8082A	

con-test® ANALYTICAL LABORATORY

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

CASE NARRATIVE SUMMARY

All reported results are within defined laboratory quality control objectives unless listed below or otherwise qualified in this report.

SW-846 8082A

Qualifications:

S-01

The surrogate recovery for this sample is not available due to sample dilution below the surrogate reporting limit required from high analyte concentration and/or matrix interferences.

Analyte & Samples(s) Qualified:

Decachlorobiphenyl

15B0498-01[PCB-01 Rm6 - Door Caulk], 15B0498-02[PCB-02 Rm6 - Door Caulk], 15B0498-05[PCB-05 Locker Rm Int. Window Caulk], 15B0498-09[PCB-09 Sludge Pump Bldg. Int. Door Caulk], 15B0498-10[PCB-10 Sludge Pump Bldg. Int. Door Caulk], 15B0498-11[PCB-11 Sludge Pump Bldg. Int. Window Caulk], 15B0498-12[PCB-12 Sludge Pump Bldg. Int. Window Caulk]

Decachlorobiphenyl [2C]

15B0498-01[PCB-01 Rm6 - Door Caulk], 15B0498-02[PCB-02 Rm6 - Door Caulk], 15B0498-05[PCB-05 Locker Rm Int. Window Caulk], 15B0498-09[PCB-09 Sludge Pump Bldg. Int. Door Caulk], 15B0498-10[PCB-10 Sludge Pump Bldg. Int. Door Caulk], 15B0498-11[PCB-11 Sludge Pump Bldg. Int. Window Caulk], 15B0498-12[PCB-12 Sludge Pump Bldg. Int. Window Caulk]

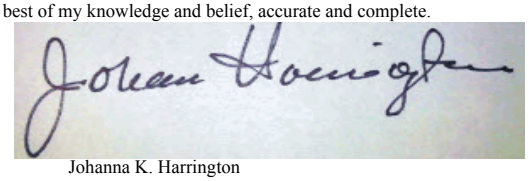
Tetrachloro-m-xylene

15B0498-01[PCB-01 Rm6 - Door Caulk], 15B0498-02[PCB-02 Rm6 - Door Caulk], 15B0498-05[PCB-05 Locker Rm Int. Window Caulk], 15B0498-09[PCB-09 Sludge Pump Bldg. Int. Door Caulk], 15B0498-10[PCB-10 Sludge Pump Bldg. Int. Door Caulk], 15B0498-11[PCB-11 Sludge Pump Bldg. Int. Window Caulk], 15B0498-12[PCB-12 Sludge Pump Bldg. Int. Window Caulk]

Tetrachloro-m-xylene [2C]

15B0498-01[PCB-01 Rm6 - Door Caulk], 15B0498-02[PCB-02 Rm6 - Door Caulk], 15B0498-05[PCB-05 Locker Rm Int. Window Caulk], 15B0498-09[PCB-09 Sludge Pump Bldg. Int. Door Caulk], 15B0498-10[PCB-10 Sludge Pump Bldg. Int. Door Caulk], 15B0498-11[PCB-11 Sludge Pump Bldg. Int. Window Caulk], 15B0498-12[PCB-12 Sludge Pump Bldg. Int. Window Caulk]

The results of analyses reported only relate to samples submitted to the Con-Test Analytical Laboratory for testing.
I certify that the analyses listed above, unless specifically listed as subcontracted, if any, were performed under my direction according to the approved methodologies listed in this document, and that based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.



Johanna K. Harrington
Manager, Laboratory Reporting

con-test® ANALYTICAL LABORATORY
39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: PCB-01 Rm6 - Door Caulk Sampled: 2/15/2015 00:00

Sample ID: 15B0498-01

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1221 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1232 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1242 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1248 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1254 [1]	46	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1260 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1262 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL
Aroclor-1268 [1]	ND	7.8	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:15	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	*	30-150	S-01	2/17/15 22:15
Decachlorobiphenyl [2]	*	30-150	S-01	2/17/15 22:15
Tetrachloro-m-xylene [1]	*	30-150	S-01	2/17/15 22:15
Tetrachloro-m-xylene [2]	*	30-150	S-01	2/17/15 22:15

con-test® ANALYTICAL LABORATORY

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: PCB-02 Rm6 - Door Caulk Sampled: 2/15/2015 00:00

Sample ID: 15B0498-02

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1221 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1232 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1242 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1248 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1254 [1]	49	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1260 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1262 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL
Aroclor-1268 [1]	ND	7.2	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 22:33	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	*	30-150	S-01	2/17/15 22:33
Decachlorobiphenyl [2]	*	30-150	S-01	2/17/15 22:33
Tetrachloro-m-xylene [1]	*	30-150	S-01	2/17/15 22:33
Tetrachloro-m-xylene [2]	*	30-150	S-01	2/17/15 22:33

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-03 Locker Rm. Int. Window Glazing** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-03

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1221 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1232 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1242 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1248 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1254 [1]	19	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1260 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1262 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL
Aroclor-1268 [1]	ND	1.2	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 8:52	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	98.7	30-150		2/18/15 8:52
Decachlorobiphenyl [2]	88.7	30-150		2/18/15 8:52
Tetrachloro-m-xylene [1]	97.7	30-150		2/18/15 8:52
Tetrachloro-m-xylene [2]	87.2	30-150		2/18/15 8:52

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: PCB-04 Rm6 - Int. Window Glazing Sampled: 2/15/2015 00:00

Sample ID: 15B0498-04

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1221 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1232 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1242 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1248 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1254 [1]	12	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1260 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1262 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL
Aroclor-1268 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/17/15 23:09	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	97.5	30-150		2/17/15 23:09
Decachlorobiphenyl [2]	87.4	30-150		2/17/15 23:09
Tetrachloro-m-xylene [1]	67.4	30-150		2/17/15 23:09
Tetrachloro-m-xylene [2]	61.1	30-150		2/17/15 23:09

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-05 Locker Rm Int. Window Caulk** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-05

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1221 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1232 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1242 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1248 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1254 [1]	27	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1260 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1262 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL
Aroclor-1268 [1]	ND	7.7	mg/Kg	40		SW-846 8082A	2/16/15	2/17/15 23:27	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	*	30-150	S-01	2/17/15 23:27
Decachlorobiphenyl [2]	*	30-150	S-01	2/17/15 23:27
Tetrachloro-m-xylene [1]	*	30-150	S-01	2/17/15 23:27
Tetrachloro-m-xylene [2]	*	30-150	S-01	2/17/15 23:27

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-06 Locker Rm Int. Window Caulk** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-06

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1221 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1232 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1242 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1248 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1254 [1]	30	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1260 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1262 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL
Aroclor-1268 [1]	ND	1.5	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 9:05	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	81.0	30-150		2/18/15 9:05
Decachlorobiphenyl [2]	79.9	30-150		2/18/15 9:05
Tetrachloro-m-xylene [1]	78.2	30-150		2/18/15 9:05
Tetrachloro-m-xylene [2]	73.1	30-150		2/18/15 9:05

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-07 Ext Side D Caulk on Metal Window** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-07

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1221 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1232 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1242 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1248 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1254 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1260 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1262 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL
Aroclor-1268 [1]	ND	0.51	mg/Kg	2		SW-846 8082A	2/16/15	2/18/15 0:02	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	103	30-150		2/18/15 0:02
Decachlorobiphenyl [2]	91.2	30-150		2/18/15 0:02
Tetrachloro-m-xylene [1]	93.9	30-150		2/18/15 0:02
Tetrachloro-m-xylene [2]	82.8	30-150		2/18/15 0:02

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-08 Ext Side D Caulk on Stone** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-08

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1221 [1]	ND	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1232 [1]	ND	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1242 [1]	ND	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1248 [1]	ND	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1254 [1]	0.96	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1260 [1]	1.2	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1262 [1]	ND	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL
Aroclor-1268 [1]	ND	0.78	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 0:20	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	91.2	30-150		2/18/15 0:20
Decachlorobiphenyl [2]	79.9	30-150		2/18/15 0:20
Tetrachloro-m-xylene [1]	54.4	30-150		2/18/15 0:20
Tetrachloro-m-xylene [2]	49.2	30-150		2/18/15 0:20

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-09 Sludge Pump Bldg. Int. Door Caulk** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-09

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1221 [1]	ND	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1232 [1]	ND	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1242 [1]	ND	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1248 [2]	220	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1254 [1]	230	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1260 [1]	ND	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1262 [1]	ND	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL
Aroclor-1268 [1]	ND	31	mg/Kg	160		SW-846 8082A	2/16/15	2/18/15 0:38	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	*	30-150	S-01	2/18/15 0:38
Decachlorobiphenyl [2]	*	30-150	S-01	2/18/15 0:38
Tetrachloro-m-xylene [1]	*	30-150	S-01	2/18/15 0:38
Tetrachloro-m-xylene [2]	*	30-150	S-01	2/18/15 0:38

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-10 Sludge Pump Bldg. Int. Door Caulk** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-10

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1221 [1]	ND	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1232 [1]	ND	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1242 [1]	ND	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1248 [2]	140	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1254 [1]	140	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1260 [1]	ND	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1262 [1]	ND	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL
Aroclor-1268 [1]	ND	19	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 0:56	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	*	30-150	S-01	2/18/15 0:56
Decachlorobiphenyl [2]	*	30-150	S-01	2/18/15 0:56
Tetrachloro-m-xylene [1]	*	30-150	S-01	2/18/15 0:56
Tetrachloro-m-xylene [2]	*	30-150	S-01	2/18/15 0:56

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Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-11 Sludge Pump Bldg. Int. Window C** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-11

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1221 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1232 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1242 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1248 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1254 [1]	910	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1260 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1262 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL
Aroclor-1268 [1]	ND	54	mg/Kg	100		SW-846 8082A	2/16/15	2/18/15 1:14	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	*	30-150	S-01	2/18/15 1:14
Decachlorobiphenyl [2]	*	30-150	S-01	2/18/15 1:14
Tetrachloro-m-xylene [1]	*	30-150	S-01	2/18/15 1:14
Tetrachloro-m-xylene [2]	*	30-150	S-01	2/18/15 1:14

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Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: **PCB-12 Sludge Pump Bldg. Int. Window C** Sampled: 2/15/2015 00:00

Sample ID: 15B0498-12

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1221 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1232 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1242 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1248 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1254 [1]	790	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1260 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1262 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL
Aroclor-1268 [1]	ND	49	mg/Kg	200		SW-846 8082A	2/16/15	2/18/15 1:32	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	*	30-150	S-01	2/18/15 1:32
Decachlorobiphenyl [2]	*	30-150	S-01	2/18/15 1:32
Tetrachloro-m-xylene [1]	*	30-150	S-01	2/18/15 1:32
Tetrachloro-m-xylene [2]	*	30-150	S-01	2/18/15 1:32

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Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: PCB-13 Old Plant Window Glazing Sampled: 2/15/2015 00:00

Sample ID: 15B0498-13

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1221 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1232 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1242 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1248 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1254 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1260 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1262 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL
Aroclor-1268 [1]	ND	0.77	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 1:49	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	58.0	30-150		2/18/15 1:49
Decachlorobiphenyl [2]	52.2	30-150		2/18/15 1:49
Tetrachloro-m-xylene [1]	58.7	30-150		2/18/15 1:49
Tetrachloro-m-xylene [2]	53.1	30-150		2/18/15 1:49

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

Project Location: Enfield - WPCF - Admin Bldg. Sample Description: Work Order: 15B0498

Date Received: 2/16/2015

Field Sample #: PCB-14 Old Plant Window Glazing Sampled: 2/15/2015 00:00

Sample ID: 15B0498-14

Sample Matrix: Caulk

Polychlorinated Biphenyls with 3540 Soxhlet Extraction

Analyte	Results	RL	Units	Dilution	Flag/Qual	Method	Date Prepared	Date/Time Analyzed	Analyst
Aroclor-1016 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1221 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1232 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1242 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1248 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1254 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1260 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1262 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL
Aroclor-1268 [1]	ND	0.74	mg/Kg	4		SW-846 8082A	2/16/15	2/18/15 2:07	KAL

Surrogates	% Recovery	Recovery Limits	Flag/Qual	
Decachlorobiphenyl [1]	66.9	30-150		2/18/15 2:07
Decachlorobiphenyl [2]	60.0	30-150		2/18/15 2:07
Tetrachloro-m-xylene [1]	67.1	30-150		2/18/15 2:07
Tetrachloro-m-xylene [2]	60.1	30-150		2/18/15 2:07

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Sample Extraction Data

Prep Method: SW-846 3540C-SW-846 8082A

Lab Number [Field ID]	Batch	Initial [g]	Final [mL]	Date
15B0498-01 [PCB-01 Rm6 - Door Caulk]	B115387	0.516	10.0	02/16/15
15B0498-02 [PCB-02 Rm6 - Door Caulk]	B115387	0.555	10.0	02/16/15
15B0498-03 [PCB-03 Locker Rm. Int. Window Glazing]	B115387	0.327	10.0	02/16/15
15B0498-04 [PCB-04 Rm6 - Int. Window Glazing]	B115387	0.517	10.0	02/16/15
15B0498-05 [PCB-05 Locker Rm Int. Window Caulk]	B115387	0.522	10.0	02/16/15
15B0498-06 [PCB-06 Locker Rm Int. Window Caulk]	B115387	0.262	10.0	02/16/15
15B0498-07 [PCB-07 Ext Side D Caulk on Metal Window]	B115387	0.390	10.0	02/16/15
15B0498-08 [PCB-08 Ext Side D Caulk on Stone]	B115387	0.513	10.0	02/16/15
15B0498-09 [PCB-09 Sludge Pump Bldg. Int. Door Caulk]	B115387	0.515	10.0	02/16/15
15B0498-10 [PCB-10 Sludge Pump Bldg. Int. Door Caulk]	B115387	0.539	10.0	02/16/15
15B0498-11 [PCB-11 Sludge Pump Bldg. Int. Window Caulk]	B115387	0.184	10.0	02/16/15
15B0498-12 [PCB-12 Sludge Pump Bldg. Int. Window Caulk]	B115387	0.411	10.0	02/16/15
15B0498-13 [PCB-13 Old Plant Window Glazing]	B115387	0.521	10.0	02/16/15
15B0498-14 [PCB-14 Old Plant Window Glazing]	B115387	0.538	10.0	02/16/15

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QUALITY CONTROL

Polychlorinated Biphenyls with 3540 Soxhlet Extraction - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch B115387 - SW-846 3540C										
Blank (B115387-BLK1)				Prepared: 02/16/15 Analyzed: 02/17/15						
Aroclor-1016	ND	0.20	mg/Kg							
Aroclor-1016 [2C]	ND	0.20	mg/Kg							
Aroclor-1221	ND	0.20	mg/Kg							
Aroclor-1221 [2C]	ND	0.20	mg/Kg							
Aroclor-1232	ND	0.20	mg/Kg							
Aroclor-1232 [2C]	ND	0.20	mg/Kg							
Aroclor-1242	ND	0.20	mg/Kg							
Aroclor-1242 [2C]	ND	0.20	mg/Kg							
Aroclor-1248	ND	0.20	mg/Kg							
Aroclor-1248 [2C]	ND	0.20	mg/Kg							
Aroclor-1254	ND	0.20	mg/Kg							
Aroclor-1254 [2C]	ND	0.20	mg/Kg							
Aroclor-1260	ND	0.20	mg/Kg							
Aroclor-1260 [2C]	ND	0.20	mg/Kg							
Aroclor-1262	ND	0.20	mg/Kg							
Aroclor-1262 [2C]	ND	0.20	mg/Kg							
Aroclor-1268	ND	0.20	mg/Kg							
Aroclor-1268 [2C]	ND	0.20	mg/Kg							
Surrogate: Decachlorobiphenyl	*4.32*		mg/Kg	4.00		108	30-150			
Surrogate: Decachlorobiphenyl [2C]	*4.00*		mg/Kg	4.00		100	30-150			
Surrogate: Tetrachloro-m-xylene	*4.19*		mg/Kg	4.00		105	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*3.71*		mg/Kg	4.00		92.7	30-150			
LCS (B115387-BS1)				Prepared: 02/16/15 Analyzed: 02/17/15						
Aroclor-1016	3.6	0.20	mg/Kg	4.00		90.4	40-140			
Aroclor-1016 [2C]	3.3	0.20	mg/Kg	4.00		81.6	40-140			
Aroclor-1260	4.1	0.20	mg/Kg	4.00		104	40-140			
Aroclor-1260 [2C]	3.5	0.20	mg/Kg	4.00		88.2	40-140			
Surrogate: Decachlorobiphenyl	*4.29*		mg/Kg	4.00		107	30-150			
Surrogate: Decachlorobiphenyl [2C]	*3.88*		mg/Kg	4.00		96.9	30-150			
Surrogate: Tetrachloro-m-xylene	*4.07*		mg/Kg	4.00		102	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*3.54*		mg/Kg	4.00		88.4	30-150			
LCS Dup (B115387-BSD1)				Prepared: 02/16/15 Analyzed: 02/17/15						
Aroclor-1016	3.4	0.20	mg/Kg	4.00		85.9	40-140	5.10	30	
Aroclor-1016 [2C]	3.1	0.20	mg/Kg	4.00		78.7	40-140	3.66	30	
Aroclor-1260	4.0	0.20	mg/Kg	4.00		100	40-140	3.41	30	
Aroclor-1260 [2C]	3.4	0.20	mg/Kg	4.00		85.9	40-140	2.65	30	
Surrogate: Decachlorobiphenyl	*4.27*		mg/Kg	4.00		107	30-150			
Surrogate: Decachlorobiphenyl [2C]	*3.87*		mg/Kg	4.00		96.8	30-150			
Surrogate: Tetrachloro-m-xylene	*3.89*		mg/Kg	4.00		97.3	30-150			
Surrogate: Tetrachloro-m-xylene [2C]	*3.44*		mg/Kg	4.00		86.0	30-150			

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

PCB-01 Rm6 - Door Caulk

Lab Sample ID: 15B0498-01 Date(s) Analyzed: 02/17/2015 02/17/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	46	
	2	0.00	0.00	0.00	44	5.3

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

PCB-02 Rm6 - Door Caulk

Lab Sample ID: 15B0498-02 Date(s) Analyzed: 02/17/2015 02/17/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	49	
	2	0.00	0.00	0.00	46	5.5

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

CB-03 Locker Rm. Int. Window Glazi

Lab Sample ID: 15B0498-03 Date(s) Analyzed: 02/18/2015 02/18/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	19	
	2	0.00	0.00	0.00	16	16.6

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

PCB-04 Rm6 - Int. Window Glazing

Lab Sample ID: 15B0498-04 Date(s) Analyzed: 02/17/2015 02/17/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	12	
	2	0.00	0.00	0.00	11	10.3

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39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

CB-05 Locker Rm Int. Window Caul

Lab Sample ID: 15B0498-05

Date(s) Analyzed: 02/17/2015 02/17/2015

Instrument ID (1):

Instrument ID (2):

GC Column (1): ID: (mm)

GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	27	
	2	0.00	0.00	0.00	26	5.2

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

CB-06 Locker Rm Int. Window Caul

Lab Sample ID: 15B0498-06 Date(s) Analyzed: 02/18/2015 02/18/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	30	
	2	0.00	0.00	0.00	26	14.3

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

PCB-08 Ext Side D Caulk on Stone

Lab Sample ID: 15B0498-08

Date(s) Analyzed: 02/18/2015 02/18/2015

Instrument ID (1):

Instrument ID (2):

GC Column (1): ID: (mm)

GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	0.96	
	2	0.00	0.00	0.00	0.89	7.3
Aroclor-1260	1	0.00	0.00	0.00	1.2	
	2	0.00	0.00	0.00	1.2	3.3

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

-09 Sludge Pump Bldg. Int. Door C

Lab Sample ID: 15B0498-09 Date(s) Analyzed: 02/18/2015 02/18/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1248	1	0.00	0.00	0.00	190	
	2	0.00	0.00	0.00	220	17.3
Aroclor-1254	1	0.00	0.00	0.00	230	
	2	0.00	0.00	0.00	210	10.0

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

-10 Sludge Pump Bldg. Int. Door C

Lab Sample ID: 15B0498-10 Date(s) Analyzed: 02/18/2015 02/18/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1248	1	0.00	0.00	0.00	110	
	2	0.00	0.00	0.00	140	19.6
Aroclor-1254	1	0.00	0.00	0.00	140	
	2	0.00	0.00	0.00	130	5.2

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

11 Sludge Pump Bldg. Int. Window (

Lab Sample ID: 15B0498-11

Date(s) Analyzed: 02/18/2015 02/18/2015

Instrument ID (1):

Instrument ID (2):

GC Column (1): ID: (mm)

GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	910	
	2	0.00	0.00	0.00	760	17.4

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

12 Sludge Pump Bldg. Int. Window (

Lab Sample ID: 15B0498-12

Date(s) Analyzed: 02/18/2015 02/18/2015

Instrument ID (1):

Instrument ID (2):

GC Column (1): ID: (mm)

GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1254	1	0.00	0.00	0.00	790	
	2	0.00	0.00	0.00	660	17.6

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS

Lab Sample ID: B115387-BS1

Date(s) Analyzed: 02/17/2015 02/17/2015

Instrument ID (1):

Instrument ID (2):

GC Column (1): ID: (mm)

GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1016	1	0.00	0.00	0.00	3.6	
	2	0.00	0.00	0.00	3.3	9
Aroclor-1260	1	0.00	0.00	0.00	4.1	
	2	0.00	0.00	0.00	3.5	17

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IDENTIFICATION SUMMARY FOR SINGLE COMPONENT ANALYTES

SW-846 8082A

LCS Dup

Lab Sample ID: B115387-BSD1 Date(s) Analyzed: 02/17/2015 02/17/2015

Instrument ID (1): Instrument ID (2):

GC Column (1): ID: (mm) GC Column (2): ID: (mm)

ANALYTE	COL	RT	RT WINDOW		CONCENTRATION	%D
			FROM	TO		
Aroclor-1016	1	0.00	0.00	0.00	3.4	
	2	0.00	0.00	0.00	3.1	10
Aroclor-1260	1	0.00	0.00	0.00	4.0	
	2	0.00	0.00	0.00	3.4	16

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FLAG/QUALIFIER SUMMARY

*	QC result is outside of established limits.
†	Wide recovery limits established for difficult compound.
‡	Wide RPD limits established for difficult compound.
#	Data exceeded client recommended or regulatory level
	Percent recoveries and relative percent differences (RPDs) are determined by the software using values in the calculation which have not been rounded.
	No results have been blank subtracted unless specified in the case narrative section.
S-01	The surrogate recovery for this sample is not available due to sample dilution below the surrogate reporting limit required from high analyte concentration and/or matrix interferences.

39 Spruce Street * East Longmeadow, MA 01028 * FAX 413/525-6405 * TEL. 413/525-2332

CERTIFICATIONS

Certified Analyses included in this Report

Analyte	Certifications

No certified Analyses included in this Report

The CON-TEST Environmental Laboratory operates under the following certifications and accreditations:

Code	Description	Number	Expires
AIHA	AIHA-LAP, LLC	100033	02/1/2016
MA	Massachusetts DEP	M-MA100	06/30/2015
CT	Connecticut Department of Publilc Health	PH-0567	09/30/2015
NY	New York State Department of Health	10899 NELAP	04/1/2015
NH-S	New Hampshire Environmental Lab	2516 NELAP	02/5/2016
RI	Rhode Island Department of Health	LAO00112	12/30/2015
NC	North Carolina Div. of Water Quality	652	12/31/2015
NJ	New Jersey DEP	MA007 NELAP	06/30/2015
FL	Florida Department of Health	E871027 NELAP	06/30/2015
VT	Vermont Department of Health Lead Laboratory	LL015036	07/30/2015
WA	State of Washington Department of Ecology	C2065	02/23/2016
ME	State of Maine	2011028	06/9/2015
VA	Commonwealth of Virginia	460217	12/14/2015
NH-P	New Hampshire Environmental Lab	2557 NELAP	09/6/2015

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AIR SAMPLE CHAIN OF CUSTODY RECORD

15B0498

39 SPRUCE ST
EAST LONGMEADOW, MA 01028

DOC#284
Rev.July2010

Company Name: AMC Environmental
Address: P.O. Box 423
Stratford, CT
Attention: Jason Pringle
Project Location: Enfield - WPCF - Admin Bldg
Sampled By: J. Pringle

Telephone:
Project #
Client PO #

DATA DELIVERY (check one):
☐FAX ☐EMAIL ☐WEBSITE CLIENT
Fax # :
Email:
Format: ☐EXCEL ☐PDF ☐GIS KEY ☐OTHER___

Proposal Provided? (For Billing purposes)
☐yes _____ proposal date

Please fill out completely, sign, date and retain the yellow copy for your record.

Summa canisters and flow controllers must be returned within 14 days of receipt or rental fees will apply.

Summa canisters will be retained for a minimum of 14 days after sampling date prior to cleaning.

Field ID	Sample Description	Media	Lab #	Date Sampled Start Date Time	Date Sampled Stop Date Time	Total Minutes Sampled	Flow Rate M^3/Min. or L / Min.	Volume Liters or M^3	Matrix Code*	ANALYSIS REQUESTED: PCB - Soxhlet Bulk				"Hg Initial pressure	"Hg Final Pressure	Lab Receipt Pressure	Summa Canister ID	Flow Controller ID
PCB-01	Rm 6 - Door caulk									✓								
02	" Door caulk									✓								
03	Locker Rm Int. window glazing									✓								
04	Rm 26 "	"								✓								
05	Locker Rm "	caulk								✓								
06	"	"								✓								
07	Ext. side D caulk on metal window									✓								
08	" " caulk on stone									✓								

Laboratory Comments:

CLIENT COMMENTS:

Relinquished by: (signature)	Date/Time: 2/13/15
Received by: (signature)	Date/Time: 2/16/15 10:24
Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:

Turnaround **
☐ 7-Day
☐ 10-Day
☐ Other ___
RUSH *
☐ *24-Hr ☒ *48-Hr
☐ *72-Hr ☐ *4-Day
*Approval Required

Special Requirements
Regulations:
Data Enhancement/RCP? ☐Y ☐N
Enhanced Data Package ☐Y ☐N
(Surchage Applies)
Required Detection Limits:
Other:

***Matrix Code:**
SG= SOIL GAS
IA= INDOOR AIR
AMB=AMBIENT
SS = SUB SLAB
D = DUP
BL = BLANK
O = other_____

****Media Codes:**
S=summa can
T=tedlar bag
P=PUF
T=tube
F= filter
C=cassette
O = Other_____

* TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR IS INCORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

AIHA, NELAC & WBE/DBE Certified

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Phone: 413-525-2332
Fax: 413-525-6405
Email: info@contestlabs.com
www.contestlabs.com

AIR SAMPLE CHAIN OF CUSTODY RECORD

15B0498

39 SPRUCE ST
EAST LONGMEADOW, MA 01028

Page 2 of 2
DOC#284
Rev.July2010

Company Name: AMC Environmental
Address:
Attention:
Project Location: Enfield - WPCF
Sampled By:

Telephone:
Project #
Client PO #

DATA DELIVERY (check one):
☐FAX ☐EMAIL ☐WEBSITE CLIENT
Fax # :
Email:
Format: ☐EXCEL ☐PDF ☐GIS KEY ☐OTHER

Proposal Provided? (For Billing purposes)
☐yes proposal date

Please fill out completely, sign, date and retain the yellow copy for your record.

Summa canisters and flow controllers must be returned within 14 days of receipt or rental fees will apply.

Summa canisters will be retained for a minimum of 14 days after sampling date prior to cleaning.

Field ID	Sample Description	Media	Lab #	Date Sampled Start Date Time	Date Sampled Stop Date Time	Total Minutes Sampled	Flow Rate M^3/Min. or L / Min.	Volume Liters or M^3	Matrix Code*	ANALYSIS REQUESTED: PCB Sorbent Bulk				" Hg Initial pressure	" Hg Final Pressure	" Hg Lab Receipt Pressure	Summa Canister ID	Flow Controller ID
09	Sludge Pump Bldg. Int. Door Caulk									✓								
10	" "		" " "							✓								
11	" "		Int. window Caulk							✓								
12	" "		Int. " "							✓								
13	Old Plant		window glazing							✓								
14	" "		" "							✓								
15																		
16																		

Laboratory Comments:

CLIENT COMMENTS:

Relinquished by: (signature)	Date/Time: 2/15/15
Received by: (signature) Paula Ono	Date/Time: 2/16/15 10:24
Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:

Turnaround **
☐ 7-Day
☐ 10-Day
☐ Other ___

RUSH *
☐ *24-Hr ☐ *48-Hr
☐ *72-Hr ☐ *4-Day
*Approval Required

Special Requirements
Regulations:
Data Enhancement/RCP? ☐Y ☐N
Enhanced Data Package ☐Y ☐N
(Surchage Applies)
Required Detection Limits:
Other:

***Matrix Code:**
SG= SOIL GAS
IA= INDOOR AIR
AMB=AMBIENT
SS = SUB SLAB
D = DUP
BL = BLANK
O = other

****Media Codes:**
S=summa can
T=tedlar bag
P=PUF
T=tube
F= filter
C=cassette
O = Other

** TURNAROUND TIME STARTS AT 9:00 A.M. THE DAY AFTER SAMPLE RECEIPT UNLESS THERE ARE QUESTIONS ON YOUR CHAIN. IF THIS FORM IS NOT FILLED OUT COMPLETELY OR IS INCORRECT, TURNAROUND TIME WILL NOT START UNTIL ALL QUESTIONS ARE ANSWERED BY OUR CLIENT.

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FedEx Tracking

772436078876

Ship (P/U) date :
Sat 2/14/2015 4:54 pm

Actual delivery :
Mon 2/16/2015 10:24 am

Delivered

Signed for by: P.BROWN

Travel History

Date/Time	Activity	Location
2/16/2015 - Monday		
10:24 am	Delivered	
7:25 am	On FedEx vehicle for delivery	WINDSOR LOCKS, CT
7:16 am	At local FedEx facility	WINDSOR LOCKS, CT
2/14/2015 - Saturday		
7:49 pm	At destination sort facility	EAST GRANBY, CT
5:08 pm	Left FedEx origin facility	WATERTOWN, CT
4:54 pm	Picked up	STRATFORD, CT

Shipment Facts

Tracking number	772436078876	**Service**	FedEx Priority Overnight
Delivered To	Shipping/Receiving	**Total pieces**	1
Packaging	FedEx Pak	**Special handling section**	Deliver Weekday

FedEx

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East Longmeadow, MA. 01028
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www.contestlabs.com

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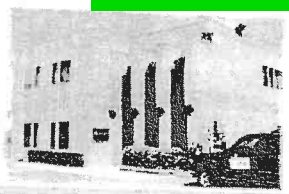


Sample Receipt Checklist

CLIENT NAME: AMC RECEIVED BY: PB DATE: 2-16-15

1) Was the chain(s) of custody relinquished and signed? Yes No No CoC Included
2) Does the chain agree with the samples? Yes No
   If not, explain:
3) Are all the samples in good condition? Yes No
   If not, explain:
4) How were the samples received:
   On Ice ☒ Direct from Sampling ☐ Ambient ☒ In Cooler(s) ☐
   Were the samples received in Temperature Compliance of (2-6°C)? Yes No N/A
   Temperature °C by Temp blank _____ Temperature °C by Temp gun _____
5) Are there Dissolved samples for the lab to filter? Yes No
   Who was notified _____ Date _____ Time _____
6) Are there any RUSH or SHORT HOLDING TIME samples? Yes No
   Who was notified _____ Date _____ Time _____
7) Location where samples are stored: Logan

Permission to subcontract samples? Yes No
(Walk-in clients only) if not already approved
Client Signature: _____

8) Do all samples have the proper Acid pH: Yes No N/A _____
9) Do all samples have the proper Base pH: Yes No N/A _____
10) Was the PC notified of any discrepancies with the CoC vs the samples: Yes No N/A

Containers received at Con-Test

	# of containers		# of containers
1 Liter Amber		8 oz amber/clear jar	
500 mL Amber		4 oz amber/clear jar	
250 mL Amber (8oz amber)		2 oz amber/clear jar	
1 Liter Plastic		Plastic Bag (Ziploc)	13
500 mL Plastic		SOC Kit	
250 mL plastic		Non-ConTest Container	
40 mL Vial - type listed below		Perchlorate Kit	
Colisure / bacteria bottle		Flashpoint bottle	
Dissolved Oxygen bottle		Other glass jar	
Encore		Other	

Laboratory Comments:

40 mL vials: # HCl _____ # Methanol _____
Bisulfate _____ # DI Water _____
Thiosulfate _____ Unpreserved _____

Time and Date Frozen:

Doc# 277
Rev. 4 August 2013

Login Sample Receipt Checklist

(Rejection Criteria Listing - Using Sample Acceptance Policy)

Any False statement will be brought to the attention of Client

Question	Answer (True/False) T/F/NA	Comment
1) The cooler's custody seal, if present, is intact.	NA	
2) The cooler or samples do not appear to have been compromised or tampered with.	T	
3) Samples were received on ice.	NA	
4) Cooler Temperature is acceptable.	NA	
5) Cooler Temperature is recorded.	NA	
6) COC is filled out in ink and legible.	T	
7) COC is filled out with all pertinent information.	T	
8) Field Sampler's name present on COC.	T	
9) There are no discrepancies between the sample IDs on the container and the COC.	T	
10) Samples are received within Holding Time.	T	
11) Sample containers have legible labels.	T	
12) Containers are not broken or leaking.	T	
13) Air Cassettes are not broken/open.	NA	
14) Sample collection date/times are provided.	T	
15) Appropriate sample containers are used.	T	
16) Proper collection media used.	T	
17) No headspace sample bottles are completely filled.	NA	
18) There is sufficient volume for all requsted analyses, including any requested MS/MSDs.	T	
19) Trip blanks provided if applicable.	NA	
20) VOA sample vials do not have head space or bubble is <6mm (1/4") in diameter.	NA	
21) Samples do not require splitting or compositing.	T	

Who notified of False statements? **Date/Time:**

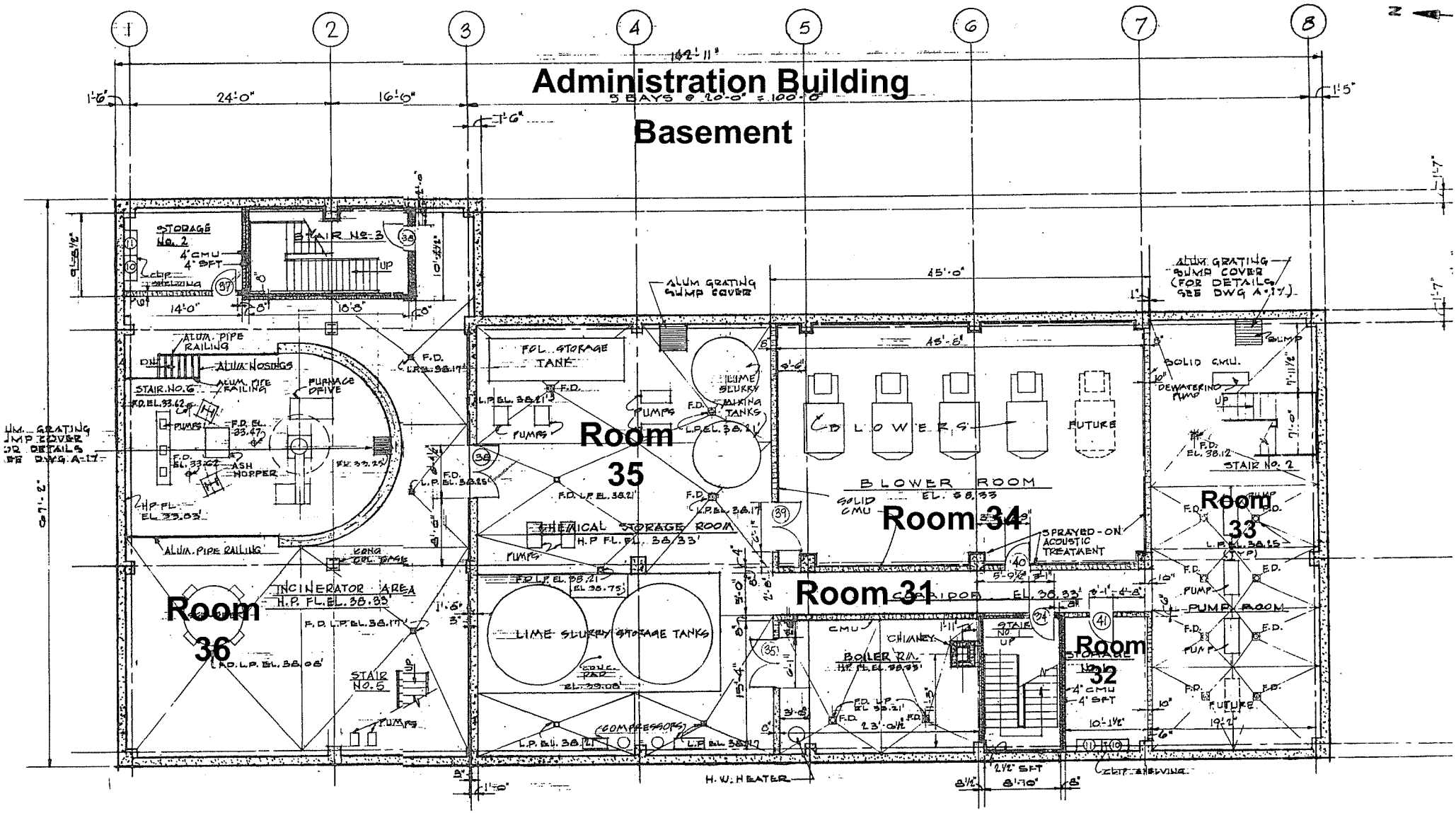
Doc #277 Rev. 4 August 2013 **Log-In Technician Initials:** PB **Date/Time:** 2.16.15 10:24

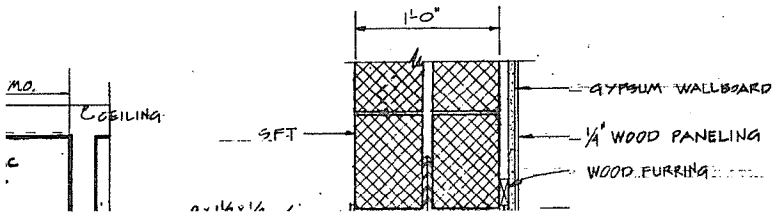
APPENDIX D

DIAGRAM

Administration Building

Basement





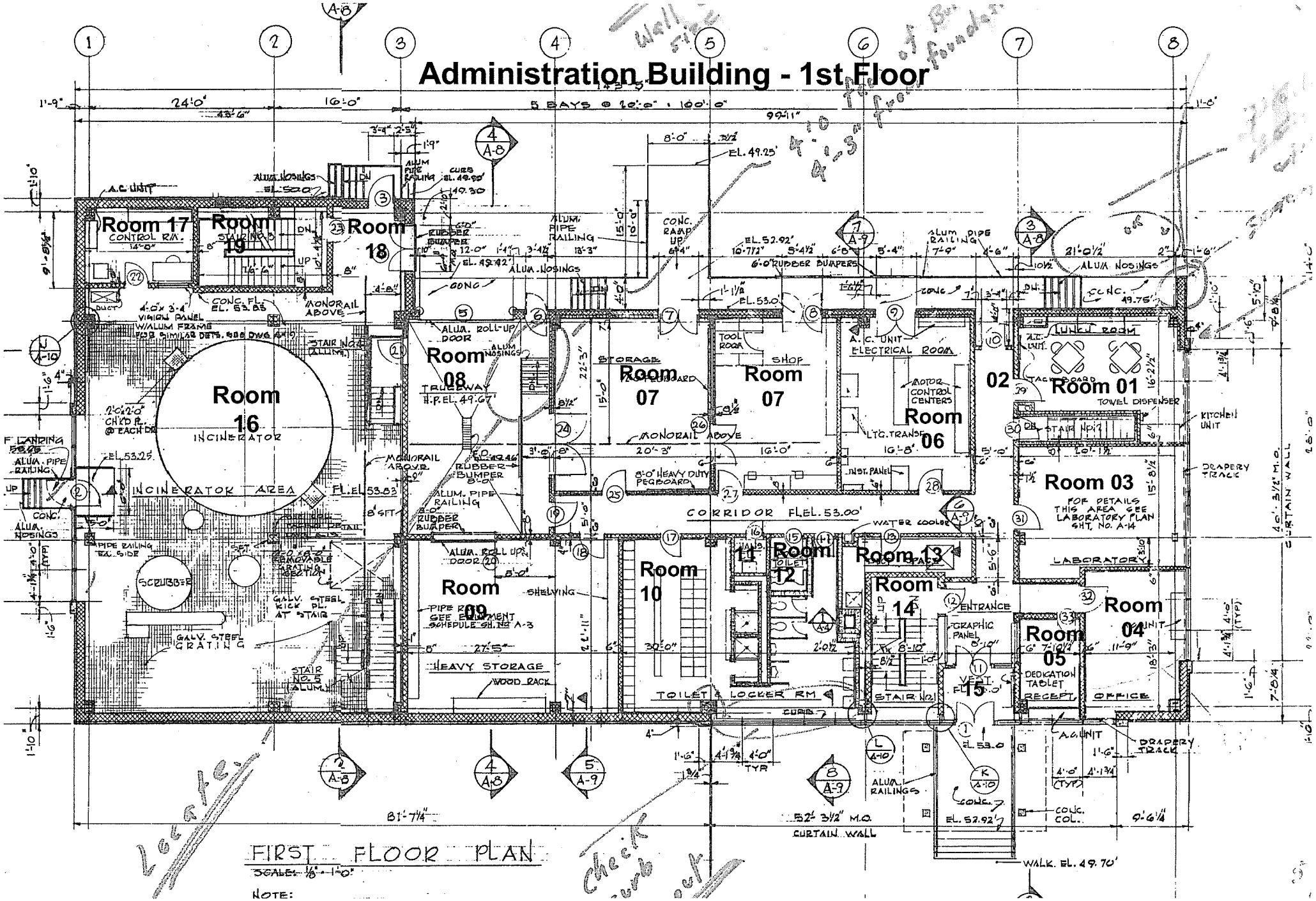
BASEMENT PLAN

SCALE: 1/8" = 1'-0"

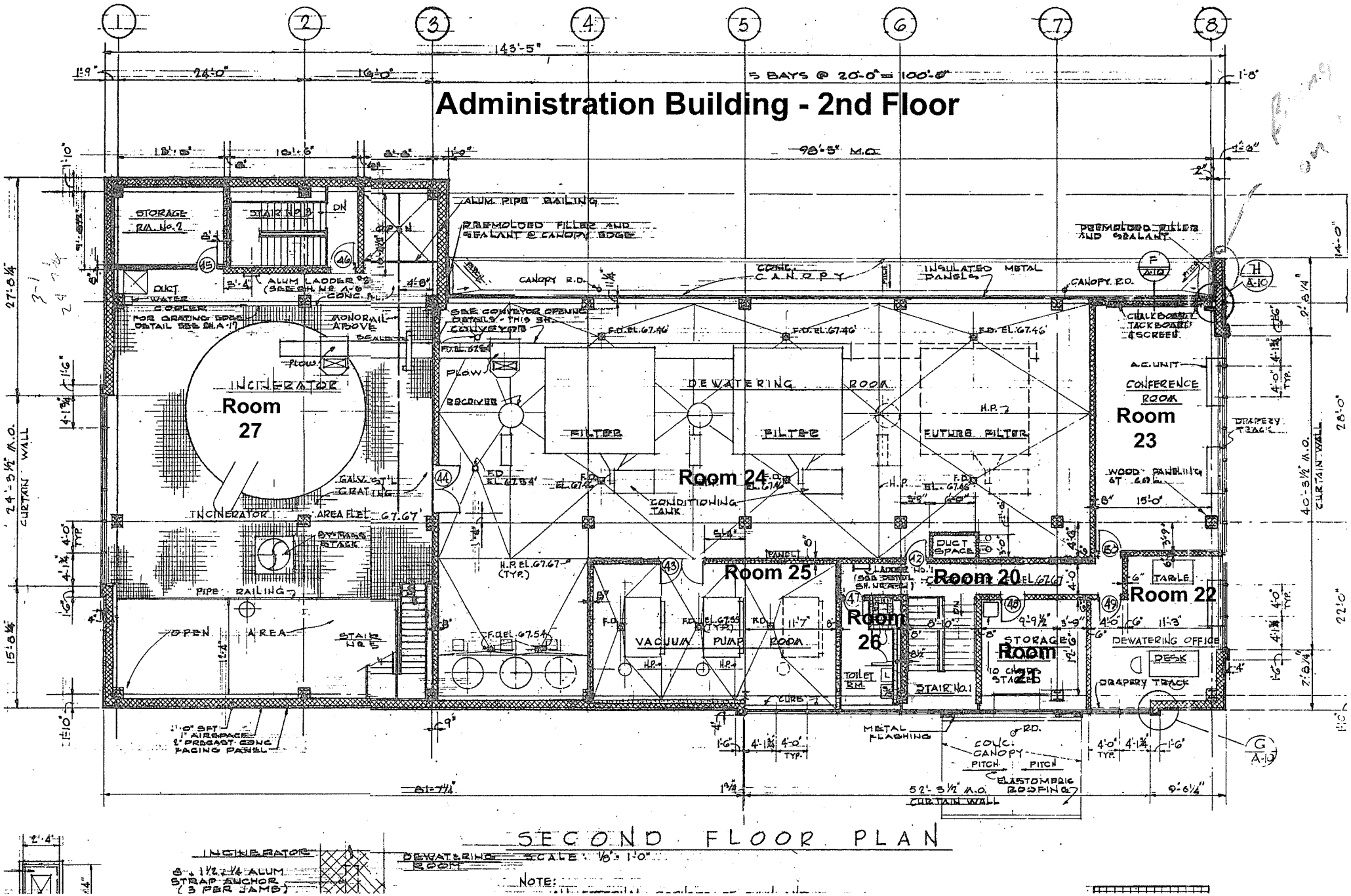
NOTE:

ALL EXTERNAL CORNERS OF C.M.U. WALLS SHALL BE BULLNOSED

Administration Building - 1st Floor



Administration Building - 2nd Floor



APPENDIX E

LAB AND INSPECTOR ACCREDITATIONS

State of Connecticut

Lookup Detail View

Name

Name
JASON P PRINGLE

License Information
lookup

License Type	License Number	Expiration Date	Granted Date	License Name	License Status	Licensure Actions or Pending Charges
Asbestos Consultant-Insp/Mgmt Planner	269	09/30/2015	09/14/2007	Jason P. Pringle	ACTIVE	None

Generated on: 2/17/2015 4:18:10 PM

State of Connecticut

Lookup Detail View

Name

Name
JASON P PRINGLE

License Information
lookup

License Type	License Number	Expiration Date	Granted Date	License Name	License Status	Licensure Actions or Pending Charges
Lead Inspector	880	09/30/2015	04/16/1996	JASON P. PRINGLE	ACTIVE	None

Generated on: 2/17/2015 4:23:45 PM

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 101048-9

EMSL Analytical, Inc.

New York, NY

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

BULK ASBESTOS FIBER ANALYSIS

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2014-07-01 through 2015-06-30

Effective dates

For the National Institute of Standards and Technology

National Voluntary
Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

EMSL Analytical, Inc.
307 W. 38th Street
New York, NY 10018
Jim Hall
Phone: 212-290-0051 Fax: 212-290-0058
E-Mail: ssiegel@emsl.com
URL: http://www.emsl.com

BULK ASBESTOS FIBER ANALYSIS (PLM) **NVLAP LAB CODE 101048-9**

NVLAP Code	*Designation / Description*
18/A01	EPA 600/M4-82-020: Interim Method for the Determination of Asbestos in Bulk Insulation Samples
18/A03	EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials

2014-07-01 through 2015-06-30

Effective dates

For the National Institute of Standards and Technology

NVLAP-01S (REV. 2005-05-19)

APPENDIX K: MANUFACTURERS PROPOSALS FOR BIOLOGICAL TREATMENT SYSTEM

-

- **Appendix K-1: Evoqua Conceptual Proposal – BioMag Process Alternative**

- **Appendix K-2: Kruger Conceptual Proposal – IFAS Process Alternative**

ENFIELD, CT WPCF

BIOMAG™ CONCEPTUAL PROPOSAL

February 2015

2607 N. Grandview Blvd., Suite 130 Waukesha, WI 53188

+1 (262) 547-0141 (toll) +1 (800) 524-6324 (toll-free) www.evoqua.com

CONTENTS

1 DESIGN SUMMARY....3
2 BIOMAG OPERATING COSTS....5
3 ADDITIONAL DESIGN EVALUATION....5
4 SCOPE OF SUPPLY....6
5 PROCESS DESIGN SUPPORT/RECOMMENDATIONS....7
6 BUDGETARY PRICING....8
ATTACHMENT 1 – PRELIMINARY BIOMAG BUILDING LAYOUT
ATTACHMENT 2 – PRELIMINARY BIOMAG PROCESS FLOW DIAGRAM

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Waukesha, WI 53188

Phone: 262-547-0141
Fax: 262-547-4120
www.evoqua.com/

Evoqua Water Technologies is pleased to present a preliminary BioMag system proposal for the Enfield WPCF. The BioMag system is a proven, reliable, treatment process using magnetite to ballast the biological floc in an activated sludge process. This high density ballast (specific gravity of 5.2) allows the plant to operate at elevated mixed liquor concentrations while achieving enhanced settling rates.

1 DESIGN SUMMARY

Table 1 summarizes the design flows used as the basis for the proposed BioMag system.

Table 1: Design flows.

Parameter	Units	Value
Design Average Daily Flow	MGD	5.5
Design Min Month Flow	MGD	4.0
Design Max Month Flow	MGD	7.6
Design Peak Week Flow	MGD	10.3
Design Peak Daily Flow	MGD	14.8
Design Peak Hourly Flow	MGD	17

Table 2 summarizes the design water quality (primary effluent) used as the basis for the proposed BioMag system.

Table 2: Design influent water quality.

Parameter	Units	Value
Biochemical Oxygen Demand (BOD_5)	mg/L	136
Total Suspended Solids (TSS)	mg/L	65
Ammonia Nitrogen (NH_3-N)	mg/L	20
Total Kjeldahl Nitrogen (TKN)	mg/L	28
Total Phosphorus (TP)	mg/L	5.1
Alkalinity	mg/L as $CaCO_3$	350
Max Influent Temperature	°C	20.5
Min Influent Temperature	°C	11.7

Table 3 summarizes the expected effluent performance used as the basis for the proposed BioMag system.

Table 3: Expected effluent performance.

Parameter	Units	Value
Biochemical Oxygen Demand (BOD_5)	mg/L	10[1]
Total Suspended Solids (TSS)	mg/L	10
Total Nitrogen (TN)	mg/L	5[1]

Table 4 summarizes the preliminary process parameters used for the proposed BioMag system.

Table 4: Design and process parameters.

Parameter	Units	Value
Number of biological treatment trains		4 (existing)
Biological treatment volume	MG	~2.84 (existing[2])
Aerobic SRT	d	11.5
MLSS (excluding magnetite)	mg/l	3,000 - 4,500
Aeration/Mixing system		TBD during detailed design process
Max month WAS rate	lb/d	6,089
WAS concentration to recovery process (excluding magnetite, assumes thickening step)	mg/L	12,000
RAS rate	MGD	1.0x at ADF 0.7x at MMF
Number of existing clarifiers		4
Existing clarifier diameter	ft	85

[1] Contingent upon biological system design and configuration.

[2] Volume includes aerobic, anoxic and re-aeration zones.

2 BIOMAG OPERATING COSTS

As a guidance and reference, table 5 lists the main consumables associated with the BioMag system recommended for this project. Chemicals required for the main biological treatment process, such as carbon, are not included below as these chemicals would be required regardless of the BioMag process.

Table 5: Estimated BioMag consumables.

Item	Guidance
Magnetite usage	400 - 450 lb/day at avg. day flow (~$0.30/lb.)
Power usage of magnetite feed / recovery equipment	Approx. 1,500 kWh/d
Polymer	0.5 to 1.5 mg/l – active

3 ADDITIONAL DESIGN EVALUATION

The following design features will need to be evaluated and discussed in more detail as the BioMag design progresses:

- Biological system design
- Existing secondary clarifier sludge removal and center well design
- Supplemental mixing requirements
- Existing return sludge and waste sludge pumping capacity
- Biosolids wasting strategy (ie surface wasting, sludge thickening)
- Chemical feed systems and dosing locations
- BioMag building layout

4 SCOPE OF SUPPLY

Evoqua will supply the following equipment and services with the BioMag system. All equipment or services not specified in table 6 are to be supplied by others.

Table 6: Evoqua Scope of Supply

Item	Quantity	Description
Ballast Storage and Feed System		
Ballast mix tank mixer	1	3 HP – vertical shaft
Magnetite storage	1	25 ton outdoor storage silo
Magnetite dry feeder system	1	10 foot stinger and drop pipe
Compressed Air System	1	Lead/Lag 10 HP air compressors, air receiver and heatless desiccant dryer
Ballast Recovery System		
Magnetic drum separator	2	7.5 HP each
Shear mill	2	40 HP each
Pump – ballast return	1 + 1	Dry Pit Submersible (~200 gpm)
Pump – WAS discharge (after recovery)	1 + 1	Dry Pit Submersible (~150 gpm)
Flow control valves	Multiple	Motor operated modulating plug valve (ballast mix tank feed, mag drum feed)
Flow meters	Multiple	ballast mix tank feed, mag drum
Level sensors/switches	Multiple	mag drum, ballast mix tank
Misc		
Sludge Blanket Sensors	4	one per clarifier
Control System Hardware		
Control panel	1	NEMA 12 control panel with PLC and door mounted HMI
Services		
Engineering support		Site visits/design kickoff; basis of design engineer support
Installation oversight,		Up to 8 days

Item	Quantity	Description
commissioning and training		
Start-up and performance testing	Up to 15 days	

5 PROCESS DESIGN SUPPORT/RECOMMENDATIONS

In the event the aeration system for the existing plant will require upgrading due to the equipment age or replacement due to a significant plant capacity increase, Evoqua will make recommendations for the new aeration system that will be compatible with the BioMag system. Consideration is given to the basin configuration, new aeration equipment energy efficiency, treatment goals, power turndown requirements, capital costs, supplemental mixing requirements and ease of installation. For many plants, Evoqua has recommended the use of simultaneous nitrification denitrification for the upgraded aeration basin, due to the energy savings potential with this process, even when strict denitrification is not required. Simultaneous nitrification denitrification can save 20 – 30% in energy over a conventional MLE process.

Evoqua recommends the use of jet aeration when the aeration system requires upgrading with the addition of BioMag. Jet aeration offers several advantages for any activated sludge process, but has additional benefits when a BioMag system is used. The benefits of jet aeration are:

- Supplemental mixing in the aeration basins, that may be required with a BioMag system, can be eliminated;
- a high oxygen transfer efficiency which does not diminish over time;
- there are no moving parts, which minimizes maintenance;
- there are no parts to be replaced;
- exceptional power turndown with independent mixing and aeration;
- fits any basin configuration; and
- low installation costs.

As this project progresses with the BioMag system, Evoqua will make a more specific recommendation for the equipment and the process configuration for the existing aeration basin and any other basins, anoxic or anaerobic, that may be included in the flowsheet.

6 BUDGETARY PRICING

The budgetary price for the Evoqua BioMag system, as defined herein, including process and design engineering, field services, and equipment supply is **$1,629,000.**

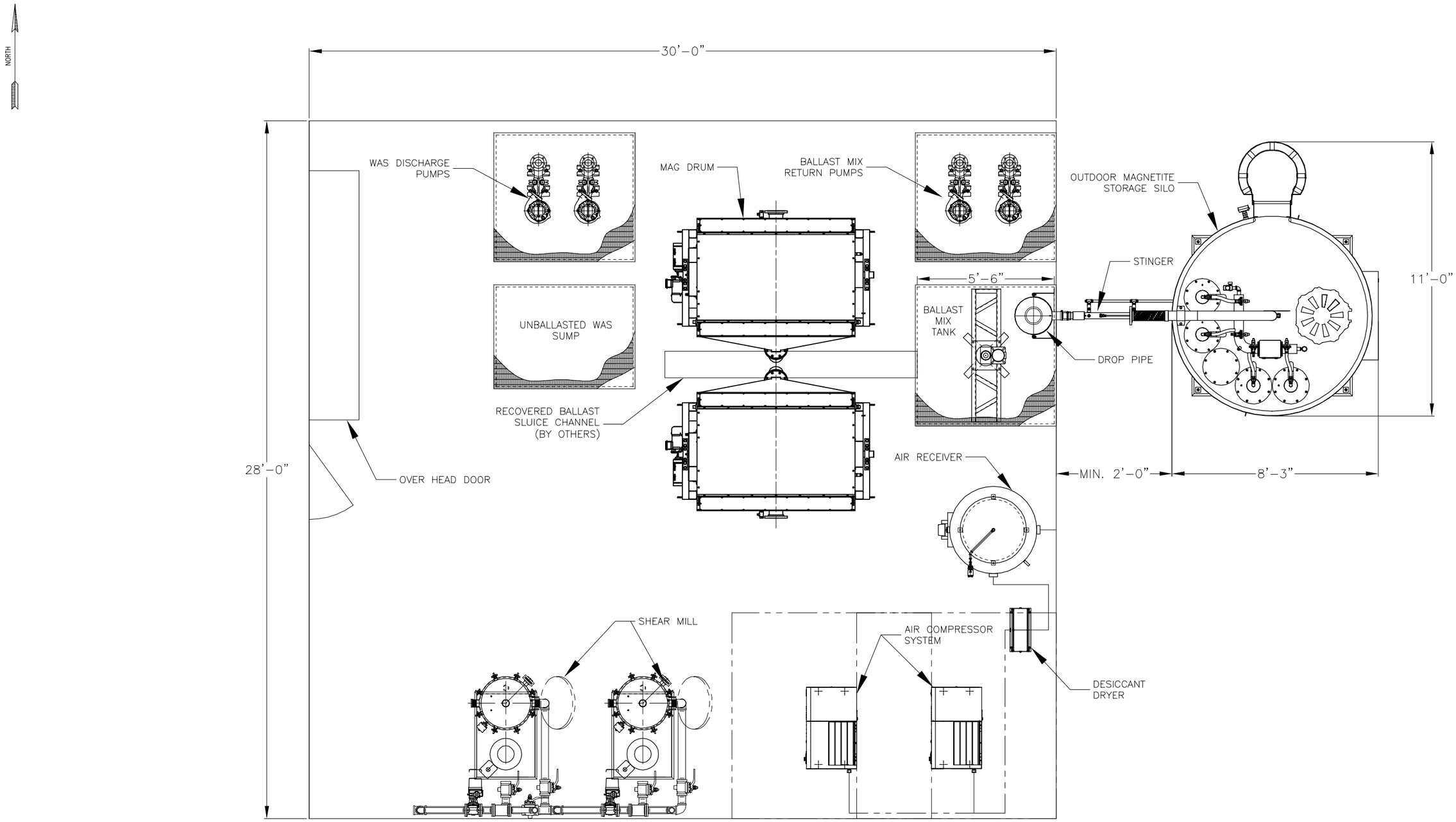
The initial magnetite charge for the proposed system will require approximately **75** tons of virgin magnetite at design conditions. Evoqua can provide magnetite at a cost of **$525** per ton plus freight.

The scope of supply and pricing are based on Evoqua standard equipment selection, standard terms of sale and warranty terms as described herein. Any variations from these standards may affect this budgetary quotation. Additionally, please note this budgetary quotation is for review and informational purposes only and does not constitute an offer for acceptance.

This price makes no provision for bonds, taxes, tariffs, duties, permitting fees and other fees and charges that are not made explicit above.

All pricing is quoted at FOB, Factory (full freight allowed). No taxes, regulatory fees or other costs related to the procurement and installation of the system are included.

ATTACHMENT 1 – PRELIMINARY BIOMAG BUILDING LAYOUT



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DESIGNER	DATE
CHECKER	DATE
ENGINEER	DATE
MANAGER	DATE
FILE:	
SCALE: NTS	

TITLE PLOT PLAN
BIOMAG RECOVERY BUILDING
2 DRUM SYSTEM

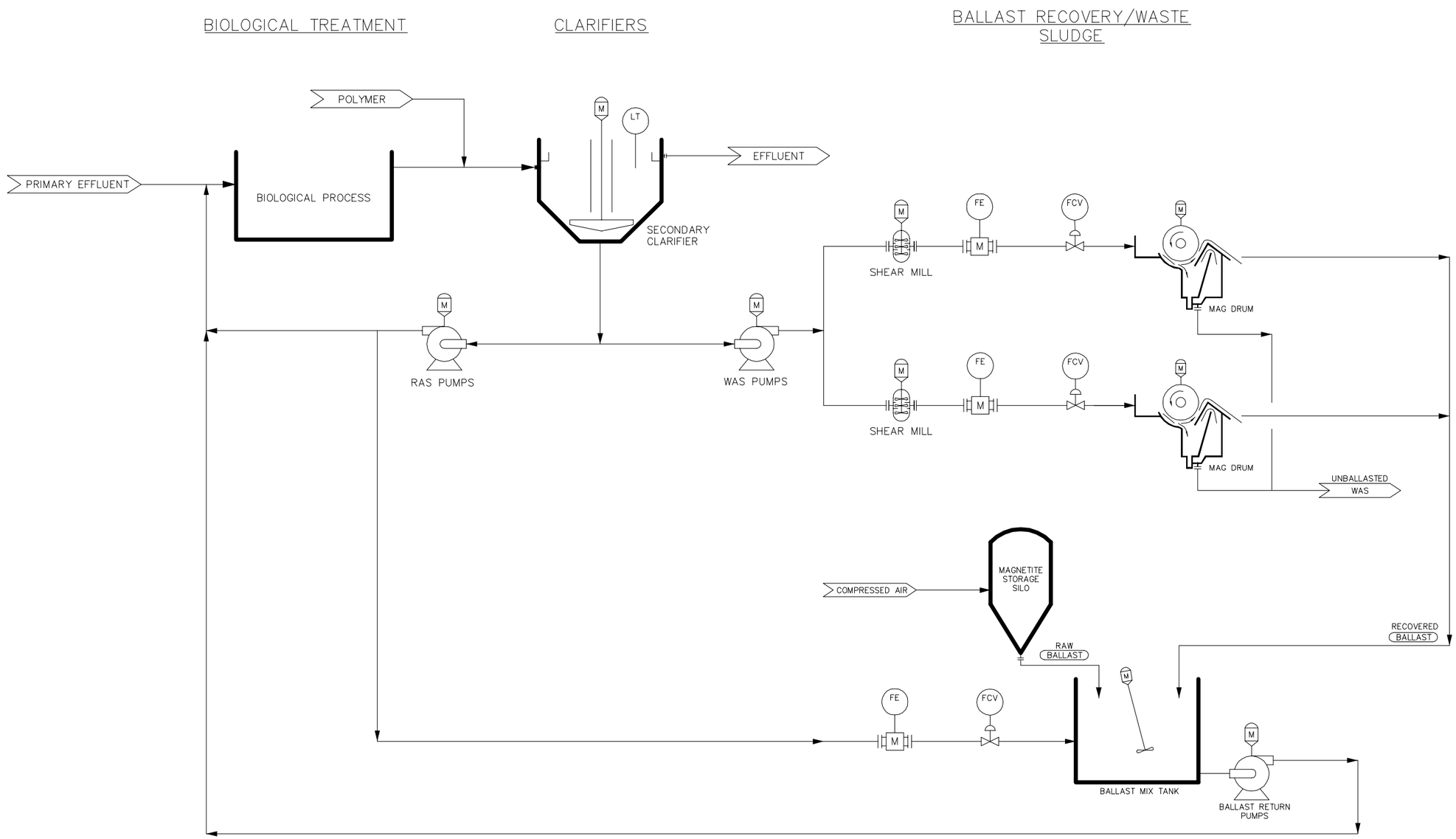
CLIENT

EVOQUA WATER TECHNOLOGIES
WATER TECHNOLOGIES
BUSINESS CENTER – CITY, STATE
BUSINESS CENTER – TEL

PROJECT	CODE	DRAWING	SHEET	REV
		–	1 OF 1	

STD: BORDER-0106-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE

ATTACHMENT 2 – PRELIMINARY BIOMAG PROCESS FLOW DIAGRAM



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REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN

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DESIGNER	DATE	
CHECKER	DATE	
ENGINEER	DATE	
MANAGER	DATE	
FILE:		
SCALE: NTS		

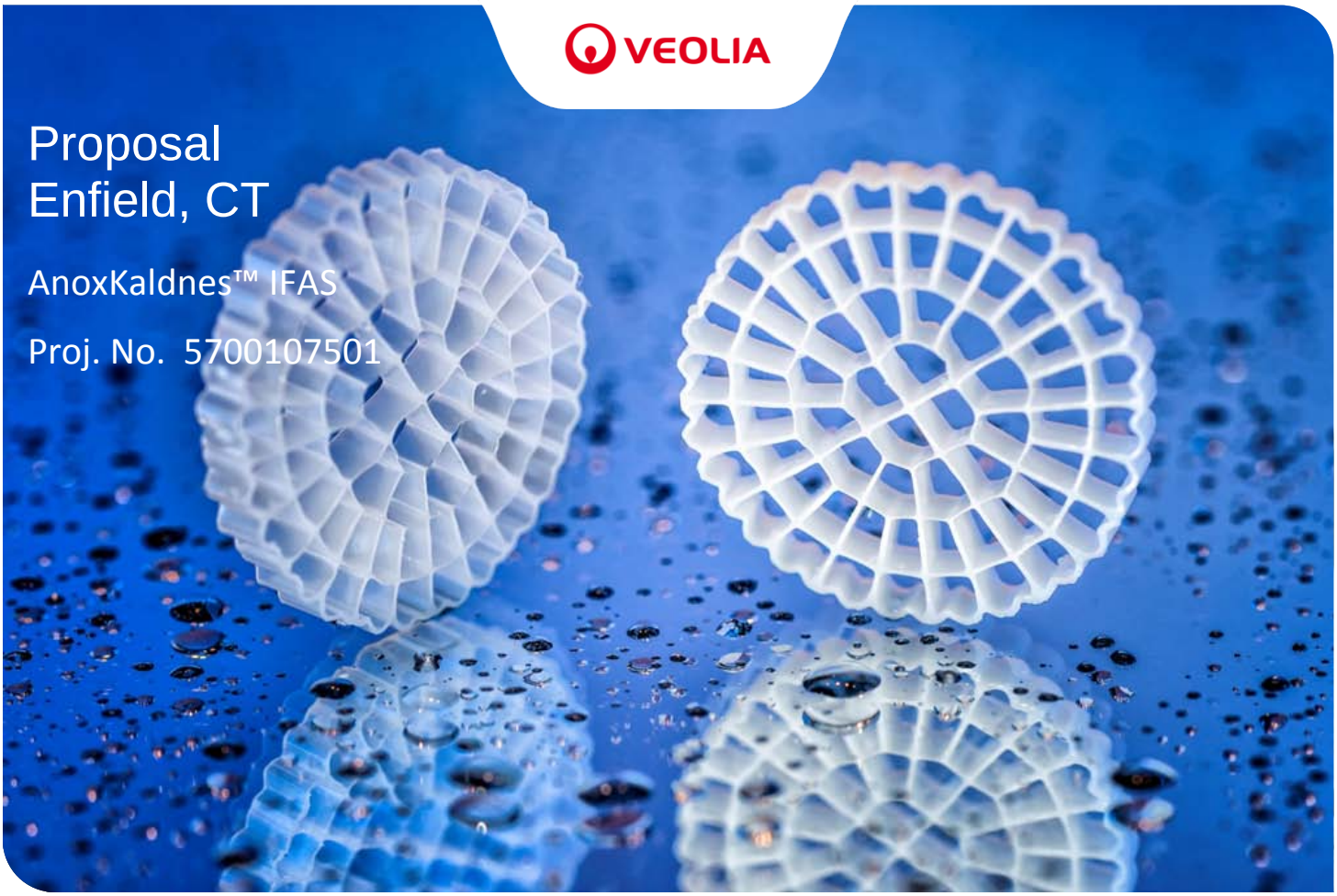
TITLE PRELIMINARY BIOMAG PROCESS FLOW DIAGRAM

CLIENT

evoqua WATER TECHNOLOGIES
WATER TECHNOLOGIES
BUSINESS CENTER – CITY, STATE
BUSINESS CENTER – TEL

PROJECT	CODE	DRAWING	SHEET	REV
		–	1 OF 1	

STD: BORDER-0106-24X36D1 | INTL REF: | BAR = 1" AT PLOT SCALE



Proposal
Enfield, CT

AnoxKaldnes™ IFAS

Proj. No. 5700107501

Submitted to: Amine Hanafi
Woodard & Curran

Submitted by: Daniel Hurt
Application Engineer

Date: 3/3/2015

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Water Technologies

Introduction

I. Kruger Inc is pleased to present this revised proposal for our AnoxKaldnes IFAS System for Enfield, CT.

Kruger proposes to retrofit three of the four existing aeration trains into three (3) new process trains, each train comprised of one (1) 2-stage pre-anoxic reactor for denitrification followed by one (1) aerobic IFAS reactor with media for BOD removal and nitrification, one (1) aerobic non-media reactor for polishing and deoxygenation, one (1) 2-stage post-anoxic reactor for additional denitrification and one (1) re-aeration reactor. Attached is a sketch of the overall layout for the proposed system, as well as equipment cut sheets and an example IFAS reactor drawing from previous job (Bend, OR).

The proposed IFAS system is capable of achieving a soluble $CBOD_5$ < 5 mg/L and a TN < 7.5 mg/L at maximum month conditions. The system can additionally achieve a TN < 5 mg/L (assuming refractory organic nitrogen is less than 1.5 mg/L) at average annual conditions as required in your proposal request. Although Kruger does not anticipate the need for carbon addition at the post-anoxic zone to achieve a TN < 5 mg/L at average annual conditions, it is recommended that the overall plant design allow for the future addition of Micro-C chemical feed equipment if necessary.

The head loss for the IFAS reactor is less than 3 inches at peak hour flow. The head loss for the entire system will depend on the wall opening types and sizes, but the system can be designed such that total head loss from the pre-anoxic zone thru the reaeration zone is 4 – 6 inches depending on the plant's hydraulic requirements.

The annual power consumption for the proposed system is estimated to be 2.63×10^6 KWh. This value is based on the assumption that all three trains are in operation 24 hours per day, 365 days per year.

We appreciate the opportunity to provide this proposal to you. If you have any questions or need further information, please contact our local Representative, Dennis Geran of FR Mahony, or our Regional Sales Manager, Ken Krupa, at (919)-345-0685 (ken.krupa@veolia.com).

cc: CT, KK, GAT, WNM, project file (Kruger)
Dennis Geran (FR Mahony)

Revision	Date	Process Eng.	Comments
0	03/03/2015	WNM	Initial, budgetary proposal.

We Know Water

I. Kruger Inc. (Kruger) is a water and wastewater solutions provider specializing in advanced and differentiating technologies. Kruger provides complete processes and systems ranging from biological nutrient removal to mobile surface water treatment. The ACTIFLO® Microsand Ballasted Clarifier, BioCon® Dryer, BIOSTYR® Biological Aerated Filter (BAF) and NEOSEP™ MBR are just a few of the innovative technologies offered by Kruger.

Kruger Inc. is a Veolia Water Solutions & Technologies' (VWS) company providing innovative water and wastewater treatment solutions for the U.S. municipal market. As a global company with 135 Business Units in 57 countries, **Veolia Water** with nearly 10,000 employees worldwide and with over 250 proprietary technologies is the world leader in water and wastewater treatment.

Kruger delivers unequalled **S**ervice to our customers delivering and creating **V**alue while being environmentally **R**esponsible with a focus on safety. Since 1986, Kruger has been providing leading edge technologies for biological wastewater treatment, High Rate Clarification for phosphorus removal and water treatment, filtration for TSS removal, water reuse and drinking water and Biosolids processing. Based in Cary, North Carolina, Kruger's 120 plus professionals are dedicated to providing the most technically sound solution to meet our customers' needs while following our principles of **SVR.**

Energy Focus

Kruger, along with Veolia Water Solutions & Technologies (VWS) is dedicated to delivering sustainable and innovative technologies and solutions.
We offer our customers integrated solutions which include resource-efficient technology to improve operations, reduce costs, achieve sustainability goals, decrease dependency on limited resources, and comply with current and anticipated regulations.
Veolia's investments in R&D outpace that of our competition. Our focus is on delivering

- neutral or positive energy solutions
- migration towards green chemicals or zero chemical consumption
- water-footprint-efficient technologies with high recovery rates

Our carbon footprint reduction program drives innovation, accelerates adoption and development of clean technologies, and offers our customers sustainable solutions.
Kruger is benchmarking its technologies and solutions by working with our customers and performing total carbon cost analysis over the lifetime of the installation.
By committing to the innovative development of clean and sustainable technologies and solutions worldwide, Kruger and VWS will continue to maximize the financial benefits for every customer.

Process Description

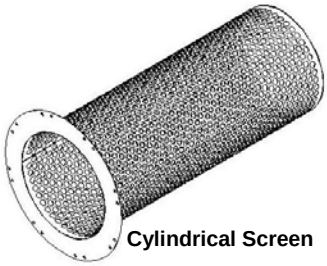
AnoxKaldnes MBBR and IFAS

K5 Media

Kruger's AnoxKaldnes process design is based on more than 20 years of experience with Moving Bed Biological Reactors (MBBR) and Integrated Fixed Film Activated Sludge (IFAS) systems. Our knowledge is supported by lab and pilot scale studies and data from more than 475 AnoxKaldnes operating systems for BOD, nitrification, and TN removal.

The MBBR and IFAS (or Hybas™ – Hybrid Biofilm Activated Sludge) processes are continuous flow through, non-clogging bio-film reactors containing "carrier elements" or media with a high specific surface. The media does not require backwashing or cleaning.

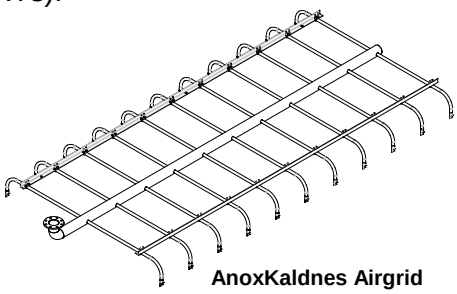
The biomass that treats the wastewater is attached to the surfaces of the media. The media is designed to provide a large protected surface area for the biofilm and optimal conditions for biological activity when suspended in water. Media of different shapes and sizes provide flexibility to use the most suitable type depending on wastewater characteristics, discharge standards and available volumes. AnoxKaldnes media is made from polyethylene and has a density slightly less than water.


Cylindrical Screen

In the MBBR process, all of the biomass is attached to the media and retained in the reactor, with no returned sludge. In the Hybas process, the reactor contains both free-floating biomass (activated sludge) and biomass attached to the media. The free-floating biomass passes through the reactor, is settled and recycled back to the reactor. The media and attached biofilm remain in the reactor as in a MBBR.

The Hybas process is often considered for upgrading existing conventional activated sludge systems within the existing tankage for either maintaining nitrification at new higher flow rates or loads or upgrading a plant to meet new nitrification requirements. It is accomplished by adding the media directly into the activated sludge reactors to enhance the growth of the autotrophic bacteria. The Hybas system is capable of meeting these new effluent requirements at low solids retention times (SRTs) and short hydraulic retention times (HRTs).

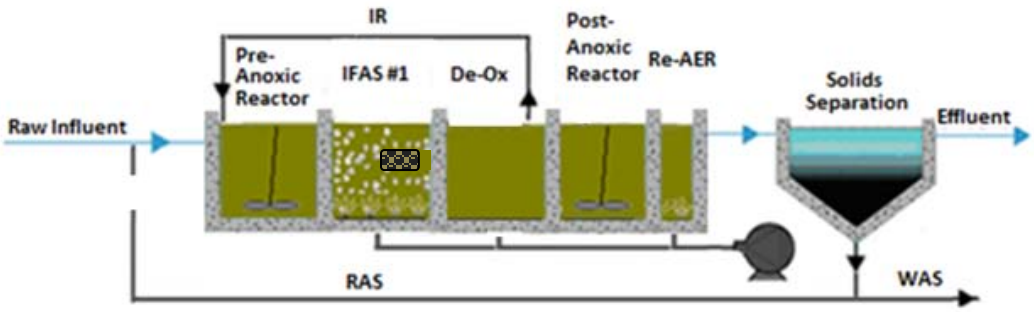
The mixing of the media within MBBR and Hybas reactors is provided by AnoxKaldnes' medium bubble aeration system in aerobic application, whereas specially designed submersible mixers are used in anoxic environments for denitrification.


AnoxKaldnes Airgrid

Kruger's minimum scope of supply for MBBR and Hybas systems includes the AnoxKaldnes media, screen assemblies (to keep media in each reactor), medium bubble aeration grid assemblies and submersible mixers for the anoxic zones. In cases where they are needed, Kruger also provides the blowers, instrumentation and controls, SCADA, and field instruments (dissolved oxygen, nitrate, ammonia, etc.) for single source responsibility.

AnoxKaldnes IFAS System Configuration

Kruger proposes to retrofit three of the four existing aeration trains into three (3) new process trains, each train comprised of one (1) 2-stage pre-anoxic reactor for denitrification followed by one (1) aerobic IFAS reactor with media for BOD removal and nitrification, one (1) aerobic non-media reactor for polishing and deoxygenation, one (1) 2-stage post-anoxic reactor for additional denitrification and one (1) re-aeration reactor.



AnoxKaldnes IFAS Nitrification System in Four-stage Configuration

Design Summary

The proposed design is based on the following influent wastewater characteristics and incorporating peak flow conditions for screen design purposes only. The design assumes that the raw influent wastewater is biodegradable, no toxic compounds are present, sufficient alkalinity is available to avoid pH depressions, that the COD/BOD ratio is between 1.7 and 2.3, and that none of the equipment provided would be used in a classified area (e.g. Class 1, Division 1 or Class 1, Division 2).

Facilities with primary clarification will require screening with a maximum of 6 mm (1/4 inch) openings for removal of particulate matter (rags, debris, etc.) prior to entering the AnoxKaldnes IFAS treatment reactors. Facilities that lack primary clarification will require screening with a maximum of 3 mm (1/8 inch) openings.

Table 1: Influent Design Basis

Parameter	Units	Value
Flow, Annual Average	MGD	5.5
Flow, Max Month Design	MGD	7.6
Flow, Peak Hourly	MGD	17
BOD_5, Design Flow	mg/L	136
TSS, Design Flow	mg/L	65
TKN, Design Flow	mg/L	26
Elevation	ft	50*
Min/Max Temperature	°C	11.7/20.5

* Assumed values.

Table 2: Effluent Objectives

Parameter	Units	Max Month Conditions	Avg. Annual Conditions
$sCBOD_5$ (mg/L)	mg/L	5	5
TN (mg/L)	mg/L	7.5	5

Table 3: Process Design Summary

Parameter	Units	Values
Number of Process Trains	-	3
Number of Pre-Anoxic (2-stage) Reactors per Train	-	1
Number of Hybas Reactors per Train	-	1
Number of Polishing Reactors per Train	-	1
Number of Post-Anoxic (2-stage) Reactors per Train	-	1
Number of Re-Aeration Reactors per Train	-	1
Pre-Anoxic Reactor		
Number of Stages Per Reactor	-	2
Dimensions (Each Stage)	ft	30.6 L x 22 W x 15.3 SWD
Volume (Each Stage)	ft^3	10,317
Total Volume (All Stages, All Trains)	ft^3	61,901
Number of Mixers Per Stage	-	1
Total Number of Mixer (All Stages, All Trains)	-	6
IFAS Reactor		
Dimensions (Each)	ft	22 L x 61.25 W x 15.9 SWD
Volume (Each)	ft^3	21,476
Total Volume (All Reactors, All Trains)	ft^3	64,427
Media Type:	-	K5
Media Protected Surface Area	ft^2/ft^3	243.3
Fill of Biofilm Carriers	%	50
Media Volume (All Reactors, All Trains)	ft^3	32,309
Total Effective Surface Area (All Reactors, All Trains)	ft^2	7,879,182
Aeration System Type	-	Medium Bubble
Residual DO, Max. Month	mg/L	4
Total Process Air Requirement (All Reactors, All Trains)	SCFM	6,500*
Total Mixing Air Requirement (All Reactors, All Trains)	SCFM	2,830
Discharge Pressure (From Top of Drop Pipe)	psi	7.1
Total Screen Sparge Air Requirement (All Reactors, All Trains)	SCFM	324
Discharge Pressure (From Top of Drop Pipe)	psi	3

Parameter	Units	Phase 1 Values
Non-Media Aerobic Reactor		
Dimensions (Each)	ft	61.25 L x 22 W x 16.6 SWD
Volume (Each)	ft^3	22,315
Total Volume (All Reactors, All Trains)	ft^3	66,944
Aeration System Type	-	Fine Bubble
Residual DO, Max. Month	mg/L	2
Total Process Air Requirement (All Reactors, All Trains)	SCFM	814*
Total Mixing Air Requirement (All Reactors, All Trains)	SCFM	606
Discharge Pressure (From Top of Drop Pipe)	psi	8.1
Post-Anoxic Reactor		
Number of Stages Per Reactor	-	2
Dimensions (Each Stage)	ft	23.5 L x 22 W x 17.1 SWD
Volume (Each Stage)	ft^3	8,848
Total Volume (All Stages, All Trains)	ft^3	53,091
Number of Mixers Per Stage	-	1
Total Number of Mixer (All Stages, All Trains)	-	6
Re-Aeration Reactor		
Dimensions (Each)	ft	14.3 L x 22 W x 17.4 SWD
Volume (Each)	ft^3	5,455
Total Volume (All Reactors, All Trains)	ft^3	16,365
Aeration System Type	-	Fine Bubble
Residual DO, Max. Month	mg/L	2
Total Process Air Requirement (All Reactors, All Trains)	SCFM	295*
Total Mixing Air Requirement (All Reactors, All Trains)	SCFM	141
Discharge Pressure (From Top of Drop Pipe)	psi	8.6
MLSS, Max. Month	mg/L	~3,000
IMLR, Max. Month	%	~300
RAS, Max. Month	%	50-100
Recommended Freeboard	ft	2-3
Sludge Production, Max. Month	lb/day	~4,970

* Value includes a 1.2 diurnal peaking factor.

Scope of Supply

Kruger is pleased to present our scope of supply which includes process engineering design, equipment procurement, and field services required for the proposed treatment system, as related to the equipment specified. The work will be performed to Kruger's high standards under the direction of a Project Manager. All matters related to the design, installation, or performance of the system shall be communicated through the Kruger representative giving the Engineer and Owner ready access to Kruger's extensive capabilities.

Process and Design Engineering

Kruger will provide process engineering and design support for the system as follows:

- Process Engineering consisting of aeration system sizing and configuration, sieve and outlet design.
- Review and approval of P&I Diagram for the AnoxKaldnes IFAS portion of the process. Preliminary General Arrangement Drawings and review and approval of final General Arrangement Drawings for the process. Review of reactor drawings with respect to penetrations and dimensions, excluding structural design.
- Equipment installation instructions for all equipment supplied by Kruger.

Field Services

Kruger will furnish a Service Engineer to perform the following tasks:

- Inspect installation of key pieces of equipment during construction.
- Inspect the completed system prior to startup.
- Assist the Contractor with initial startup of the system.
- Train the Owner's staff in the proper operation and maintenance of the AnoxKaldnes IFAS system.
- Test and start any Kruger-supplied control equipment, including PLC programming and SCADA systems.

AnoxKaldnes IFAS System Equipment – Limited to In-Basin Equipment Only

Process and Mechanical Equipment Items	Qty	Description
AnoxKaldnes K5 Media, (ft^3)	32,309	High density polyethylene carrier elements.
Cylindrical Screen Assemblies	54	Eighteen (18) per reactor arranged in two rows of nine (9) screens. 304L SS. 23" ø perforated plate pipes terminated in ANSI flanges for mounting directly to the tank wall.
Air Sparge System	Yes	An air sparging system in 304L SS will be provided to scour the screens.

Process and Mechanical Equipment Items	Qty	Description
V-port Ball Valves	6	One (1) 3” manual air regulating valve for each reaeration reactor and each sieve air sparge header.
Medium Bubble Aeration System	3	One (1) aeration system per IFAS reactor (1 per train). 304L SS including header, lateral piping, and hardware (excluding anchor bolts). Each reactor shall include two air grids.
Fine Bubble Aeration System	6	One (1) fine bubble aeration system for each non-media aerobic reactor and each reaeration reactor. 9” diameter fine bubble diffuser discs with interconnecting piping.
Submersible Mixers	12	One (1) for each pre-DN and post-DN reactor. Submersible Propeller Mixer, 304SS Rails, Hoist, and Receiving Bracket.
IMLR Wall Pumps	3	One (1) per train rated at 7.6 MGD @ 3 feet TDH.
Modulating Airflow Control Valves	6	One (1) 10” motorized BFV for each IFAS reactor and one (1) 4” motorized BFV for each non-media aerobic reactor.
Multistage Centrifugal Blowers	3 + 1	Three (3) duty plus one (1) standby. Each blower will be rated for 2,536 SCFM and will include 150 NPHP motor and standard accessories.
Regenerative Blowers	1 + 1	One (1) duty plus one (1) standby. Each blower will be rated for 324 SCFM and will include 8.5 NPHP motor and standard accessories. Blowers supplied exclusively for air sparging.

Instrumentation and Controls Equipment Items	Qty	Description
PLC Control Panel	1	NEMA 12 Freestanding or Wall Mount Control Panel (For Indoor Use). ControlLogix PLC; Panelview HMI; 120V Feed.
High Level Float Switch	3	One (1) for each media zone.
DO Probe (LDO)	9	One (1) for each IFAS reactor, non-media aerobic reactor and reaeration reactor. Aerobic Zone DO Monitoring.
Thermal Mass Flowmeter	6	One (1) 12-inch flowmeter for IFAS reactor and one (1) 6-inch flowmeter for each non-media aerobic reactor.

Notes Regarding System Design and Installation

- For any MBBR or IFAS system, regardless of manufacturer, the quality and finish of reactor surfaces is important for the long-term longevity of the system. AnoxKaldnes has years of experience in the design and manufacture of MBBR and IFAS systems, with the quality and texture of the finished reactor walls is important. It is particularly important to prevent chipping, holidays, or rough areas that would leave open any annular spaces around media retention screens.

Scope of Supply BY INSTALLER/PURCHASER

The contractor's scope of supply for the AnoxKaldnes IFAS system should include, but is not limited to, the following items:

- All civil/site and electrical work.
- A concrete foundation for the tanks.
- Reactors to house the MBBR treatment equipment.
- All provisions for interconnecting piping.
- Unloading, storage and installation of equipment.
- Centrate equalization tanks
- Cover for reactor tanks

Design Options

In addition to the proposed system as detailed herein, Kruger is able to further incorporate our process and controls expertise into wastewater treatment plants, allowing municipalities to meet stringent effluent requirements and future plant upgrades. Kruger is also able to offer our instrumentation and controls expertise to build upon the proposed system by providing a **customized plant-wide SCADA system** or designing a **Motor Control Center (MCC)**, providing clients a single source responsibility for plant controls. Please contact Kruger if the options above are of interest or to be included in the current proposed system or future upgrades. ***Please note that the design options listed above are not included in the pricing noted herein.*

Schedule

- Shop drawings will be submitted within 6-8 weeks of receipt of an executed contract by all parties.
- All equipment will be delivered within 18-20 weeks after receipt of written approval of the shop drawings.
- Installation manuals will be furnished upon delivery of equipment.
- Operation and Maintenance Manuals will be submitted within 90 days after receipt of approved shop drawings.

Pricing

The price for the AnoxKaldnes IFAS system, as defined herein, including process and design engineering, field services, and equipment supply is: **$2,436,000.**

Pricing is FOB shipping point, with freight allowed to the job site. This pricing does not include any sales or use taxes. In addition, pricing is valid for ninety (90) days from the date of issue and is subject to negotiation of a mutually acceptable contract.

Please note that the above pricing is expressly contingent upon the items in this proposal and are subject to I. Kruger Inc. Standard Terms of Sale detailed herein.

Kruger Standard Terms of Payment

The terms of payment are as follows:

- 10% on receipt of fully executed contract
- 15% on submittal of shop drawings
- 75% on the delivery of equipment to the site

Payment shall not be contingent upon receipt of funds by the Contractor from the Owner. There shall be no retention in payments due to I. Kruger Inc. All other terms per our Standard Terms of Sale are attached.

All payment terms are net 30 days from the date of invoice. Final payment not to exceed 120 days from delivery of equipment.

I. Kruger Inc. Standard Terms of Sale

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.

10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws provisions.

APPENDIX L: MANUFACTURERS PROPOSALS FOR AERATION TANK MIXING SYSTEM

- **Appendix L-1: Aqua-Aerobic Conceptual Proposal for Surface Floating Mixing Alternative**

- **Appendix L-2: Invent Conceptual Proposal for Hyperbolic Mixing Alternative**

- **Appendix L-3: Enviromix Conceptual Proposal for Compressed Gas Mixing Alternative**

AQUA-AEROBIC SYSTEMS, INC.

AquaDDM®

DIRECT-DRIVE MIXER

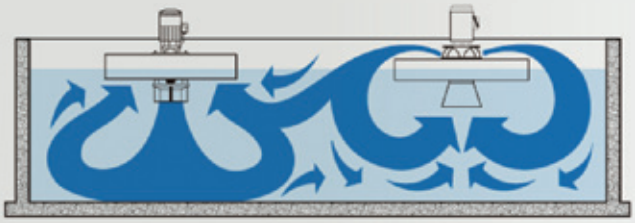
AquaDDM®

DIRECT-DRIVE MIXER

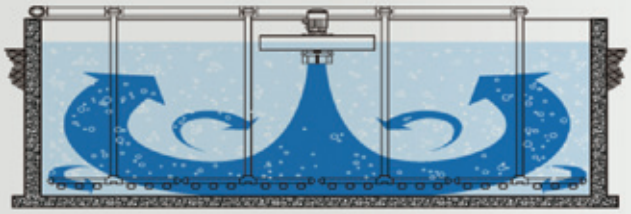
Since 1973, Aqua-Aerobic Systems has installed more than 10,000 AquaDDM® Direct-Drive Mixer units in a variety of municipal and industrial applications. The mixer has also been incorporated into several Aqua-Aerobic processes including the AquaSBR® Sequencing Batch Reactor, Aqua-Aerobic® MBR Membrane Bioreactor, and AquaMB Process® Multiple Barrier Membrane System. The AquaDDM mixer is designed to provide maximum mixing efficiency. When mixing requirements are the controlling factor, the mixer can reduce power costs, while delivering 3-4 times the mixing of any aerator of the same size.

System Features and Advantages

- Available in FSS and SS models ranging from 1-75 HP
- Suitable for most basin configurations
- Floating mixer operates in varying liquid depths
- Anti-fouling impeller
- High volume, downflow mixing pattern and near surface intake eliminates short circuiting
- Eliminates or greatly reduces surface splashing and foaming
- Submerged intake volute eliminates air entrainment
- Lower initial cost, and less expensive to install and maintain than gear reduced (slow speed) units
- More reliable service than submerged directional mixers
- High efficiency mixing reduces power consumption
- One-piece stainless steel shaft; no couplings or submerged bearings
- High Efficiency and Endura® Series motor options are available
- Directional flow assembly, and anti-erosion plate options available



AquaDDM® mixer with mechanical aeration.



AquaDDM® mixer with diffused aeration.

Aqua MixAir® System

The AquaDDM mixer, in combination with mechanical aeration or diffused aeration, composes the Aqua MixAir system. The combined use of downflow AquaDDM mixers and upflow Aqua-Jet® surface aerators creates complementary flow patterns, and results in better suspension of solids and better distribution of oxygen and substrate. This improved process efficiency can result in energy savings of 30-40% in many applications.

When combined with diffused aeration, the AquaDDM mixer provides a full range of aeration control without compromising mixing. This combination enables the operator to operate the diffused air systems only when oxygen is required. Full scale tests and operation in various installations have demonstrated that the addition of AquaDDM mixers to diffused aeration systems improves aeration efficiency by up to 30%.

Anoxic Basins

The AquaDDM mixer is ideal for use in anoxic basins for denitrification and phosphorus reduction. The mixer provides unrivaled mixing and uniform top-to-bottom blending of the basin. Unlike horizontal, side-entering, and submersible mixers, the AquaDDM provides efficient intermixing of the basin contents resulting in increased nutrient reduction.

AquaDDM® Unit Sizes and Dimensions

FSS Series (US units)

FSS Model	HP	RPM	Approx. Ship Wt. (lbs)	Dimensions (inches)					Shaft Dia. (inches)	Mooring Cable Dia. (inches)
				A	B	C	D	E		
5700131	1	1200	462	44.375	14.812	4	11	64	1.5	0.1875
5700231	2	1200	472	44.375	14.812	4	11	64	1.5	
5700331	3	1200	577	51.187	18.563	7	12.25	71	2	
5700531	5	1200	691	51.187	18.563	7	12.25	71	2	
5700731	7.5	1200	722	56.125	18.563	7	12.25	71	2	
5701031	10	900	857	60	19.75	6	12.25	84	2.25	
5701531	15	900	887	60	19.75	6	12.25	84	2.25	
5702031	20	900	1227	65.938	22.563	7	12.75	94.5	2.75	
5702531	25	900	1267	65.938	22.563	7	12.75	94.5	2.75	
5703031	30	900	1676	74.312	27.812	7	13.25	114.5	2.75	0.25
5704031	40	900	1780	74.312	27.812	7	13.25	114.5	2.75	

FSS Series (50 hz Metric Units)

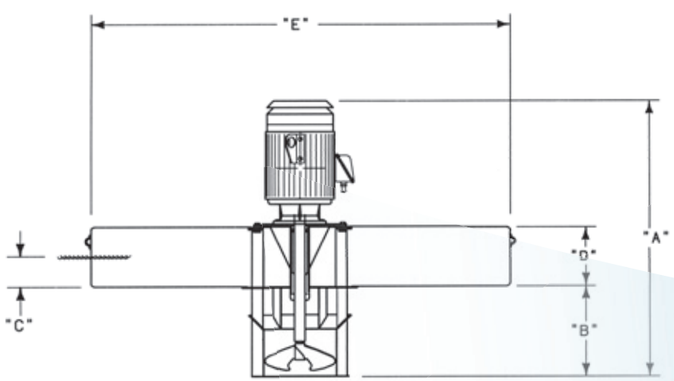
FSS Model	KW	RPM	Approx. Ship Wt. (kg)	Dimensions (mm)					Shaft Dia. (mm)	Mooring Cable Dia. (mm)
				A	B	C	D	E		
5100131	.75	1500	210	1127	376.2	101.6	279.4	1625.6	38.1	4.8
5100231	1.5	1500	214	1127	376.2	101.6	279.4	1625.6	38.1	
5100331	2.2	1500	262	1300.2	471.5	177.8	311.2	1803.4	50.8	
5100531	3.7	1500	313	1300.2	471.5	177.8	311.2	1803.4	50.8	
5100731	5.6	1500	327	1425.6	471.5	177.8	311.2	1803.4	50.8	
5101031	7.5	1000	389	1524	501.7	152.4	311.2	2133.6	57.2	
5101531	11.2	1000	402	1524	501.7	152.4	311.2	2133.6	57.2	
5102031	14.9	1000	557	1674.8	573.1	177.8	323.9	2400.3	69.9	
5102531	18.6	1000	575	1674.8	573.1	177.8	323.9	2400.3	69.9	
5103031	22.4	1000	760	1887.5	706.4	177.8	336.6	2908.3	69.9	6.35
5104031	29.8	1000	807	1887.5	706.4	177.8	336.6	2908.3	69.9	

Stainless Steel Series (US Units)

SS Model	HP	RPM	Approx. Ship Wt. (lbs)	Dimensions (inches)					Shaft Dia. (inches)	Mooring Cable Dia. (inches)
				A	B	C	D	E		
5900131	1	1200	518	44.375	15.062	5	11.188	59.5	1.5	0.1875
5900231	2	1200	528	44.375	15.062	5	11.188	59.5	1.5	
5900331	3	1200	647	51.312	18.938	7	12	70	2	
5900531	5	1200	762	51.312	18.938	7	12	70	2	
5900731	7.5	1200	792	56.125	18.938	7	12	70	2	
5901031	10	900	952	59.625	19.75	6	12	83	2.25	
5901531	15	900	982	59.625	19.75	6	12	83	2.25	
5902031	20	900	1319	65.812	22.563	7	12.625	91	2.75	
5902531	25	900	1359	65.812	22.563	7	12.625	91	2.75	
5903031	30	900	1806	74.063	27.812	7	13	114.625	2.75	
5904031	40	900	1910	74.063	27.812	7	13	114.625	2.75	
5905031	50	900	2641	83	31.25	8	16	114.625	3.5	
5906031	60	900	2711	83	31.25	8	16	114.625	3.5	0.25
5907031	75	900	2801	88.625	31.25	8	16	114.625	3.875	

Stainless Steel Series (50 hz Metric Units)

SS Model	KW	RPM	Approx. Ship Wt. (kg)	Dimensions (mm)					Shaft Dia. (mm)	Mooring Cable Dia. (mm)
				A	B	C	D	E		
5000131	.75	1500	236	1127	382.6	127	284.2	1511.3	38.1	4.8
5000231	1.5	1500	240	1127	382.6	127	284.2	1511.3	38.1	
5000331	2.2	1500	293	1303.3	481.0	177.8	304.8	1778.0	50.8	
5000531	3.7	1500	346	1303.3	481.0	177.8	304.8	1778.0	50.8	
5000731	5.6	1500	359	1425.6	481.0	177.8	304.8	1778.0	50.8	
5001031	7.5	1000	432	1514.5	501.7	152.4	304.8	2108.2	57.2	
5001531	11.2	1000	445	1514.5	501.7	152.4	304.8	2108.2	57.2	
5002031	14.9	1000	598	1671.6	573.1	177.8	320.7	2311.4	69.9	
5002531	18.6	1000	616	1671.6	573.1	177.8	320.7	2311.4	69.9	
5003031	22.4	1000	819	1881.2	706.4	177.8	330.2	2911.5	69.9	
5004031	29.8	1000	866	1881.2	706.4	177.8	330.2	2911.5	69.9	
5005031	37.3	1000	1198	2108.2	790.6	203.2	406.4	2911.5	88.9	
5006031	44.7	1000	1230	2108.2	790.6	203.2	406.4	2911.5	88.9	6.35
5007031	55.9	1000	1271	2251.1	790.6	203.2	406.4	2911.5	98.4	



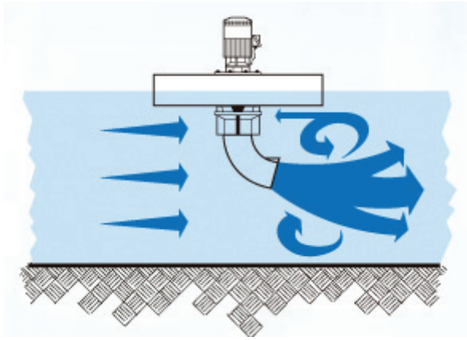
AquaDDM® Component Parts

Component	SS*	FSS*	Component	SS*	FSS*
Impeller	316 S.S.	316 S.S.	Flotation Assembly	304 S.S.	Fiberglass
Impeller Shaft	17-4 PH S.S.	17-4 PH S.S.	All Chassis Fasteners	18-8 S.S.	18-8 S.S.
Motor Base Assembly	304 S.S.	304 S.S.	Float Center Structure	304 S.S.	304 S.S.
Intake Volute Assembly	304 S.S.	304 S.S.	Float Filler	Closed Cell Polyurethane	

AquaDDM® Accessory Options

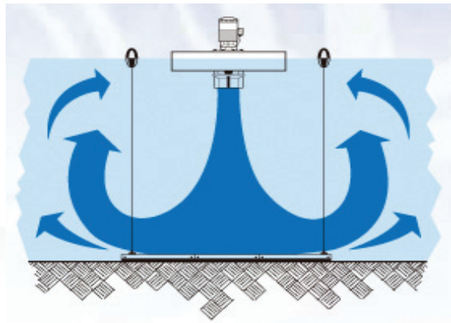
Directional Flow Assembly

The AquaDDM is available with an optional directional discharge assembly which converts the downward vertical flow to a horizontal flow. The AquaDDM with a directional flow assembly is ideally suited for use in long narrow tanks and oxidation ditches where directional flow may be necessary or desirable. In such applications, the AquaDDM with a directional flow assembly greatly reduces or eliminates short circuiting of the basin, eliminates deadspots and provides exceptional mixing of the basin contents.



Anti-Erosion Plate

Aqua-Aerobic Systems has designed an anti-erosion plate for use in those applications where the AquaDDM is installed in earthen basins.



AquaDDM®
Typical Applications

The AquaDDM mixer can be utilized in a number of applications: anoxic systems, back mixing, equalization, disinfection, neutralization, denitrification, directional mixing, blending combined streams, and sequencing batch reactors (SBRs).

Anoxic Mixing

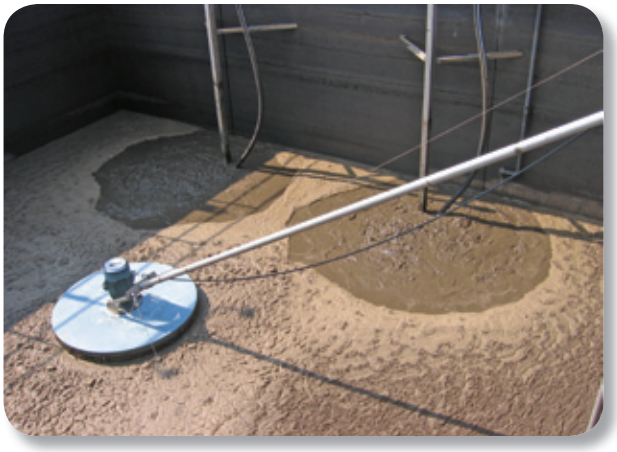
- This plant installed (54) 7.5 HP AquaDDM mixers in its (18) anoxic mixing basins to meet new permit requirements for denitrification and phosphorus prior to tertiary filtration in order to provide 25 MGD of reclaimed water

Denitrification

- (20) 7.5 HP AquaDDM mixers are divided among five anoxic basins to provide a completely mixed environment for successful denitrification, without aeration, in this 65 MGD wastewater treatment facility

Sequencing Batch Reactors

- AquaDDM mixers are utilized in this dual-basin AquaSBR system to meet the plant's strict permit effluent levels (mg/l) of 8.0 BOD, 30 TSS, 1.5 Total Kjeldahl Nitrogen, 1.0 Ammonia Nitrogen, and 0.75 Total Phosphorus



Aerobic Digesters

- This plant replaced (16) submersible mixers with four (4) AquaDDM mixers in its two anoxic basins and one (1) Aqua MixAir system in its two aerobic digesters (consisting of an AquaDDM mixer combined with diffused aeration)

Providing TOTAL Water Management Solutions

Visit our website at www.aqua-aerobic.com to learn more about the AquaDDM® Direct-Drive Mixer and our complete line of products and services:

Aeration & Mixing

Biological Processes

Filtration

Membrane Systems

Controls & Monitoring Systems

Aftermarket Products and Services

AQUA-AEROBIC SYSTEMS, INC.

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p 815.654.2501 f 815.654.2508
www.aqua-aerobic.com
solutions@aqua-aerobic.com

The information contained herein relative to data, dimensions and recommendations as to size, power and assembly are for purpose of estimation only. These values should not be assumed to be universally applicable to specific design problems. Particular designs, installations and plants may call for specific requirements. Consult Aqua-Aerobic Systems, Inc. for exact recommendations or specific needs. Patents Apply.

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Bulletin #702F 9/12

Enfield WFP
Enfield , CT
Woodard & Curran

Objective: Recommend quantity and size of AquaDDM mixers in 4) Primary Anoxic Zones, 4) Aerobic Zones #2 and 4) Secondary Anoxic Zones.

Design Data:

▪ **Primary Anoxic Zones**				
▪ **Aerobic Zones #2**			▪ **Secondary Anoxic Zones**	
TSS	=	2 %		
Length	=	61.2 ft	Length	= 49.2 ft
Width	=	24 ft	Width	= 24 ft
Water Depth	=	16.1 ft	Water Depth	= 16.1 ft
Volume	=	0.18 MG	Volume	= 0.14 MG
Material	=	concrete		

Scope: Recommend quantity and size of AquaDDM mixers

Calculations:

Power Requirement

A mixing level of 20 HP/MG is recommended to provide complete mix conditions.

Power	=	20 HP/MG x 0.18 MG	= 20 HP/MG x 0.14 MG
	=	4 HP	= 3 HP

Recommendation:

The length to width ratio requires the uses of (2) DDM mixers in each mixing zone. The recommendation is to install (2) two - 2 HP DDM mixers in each of the twelve zones to be mixed.

JFF

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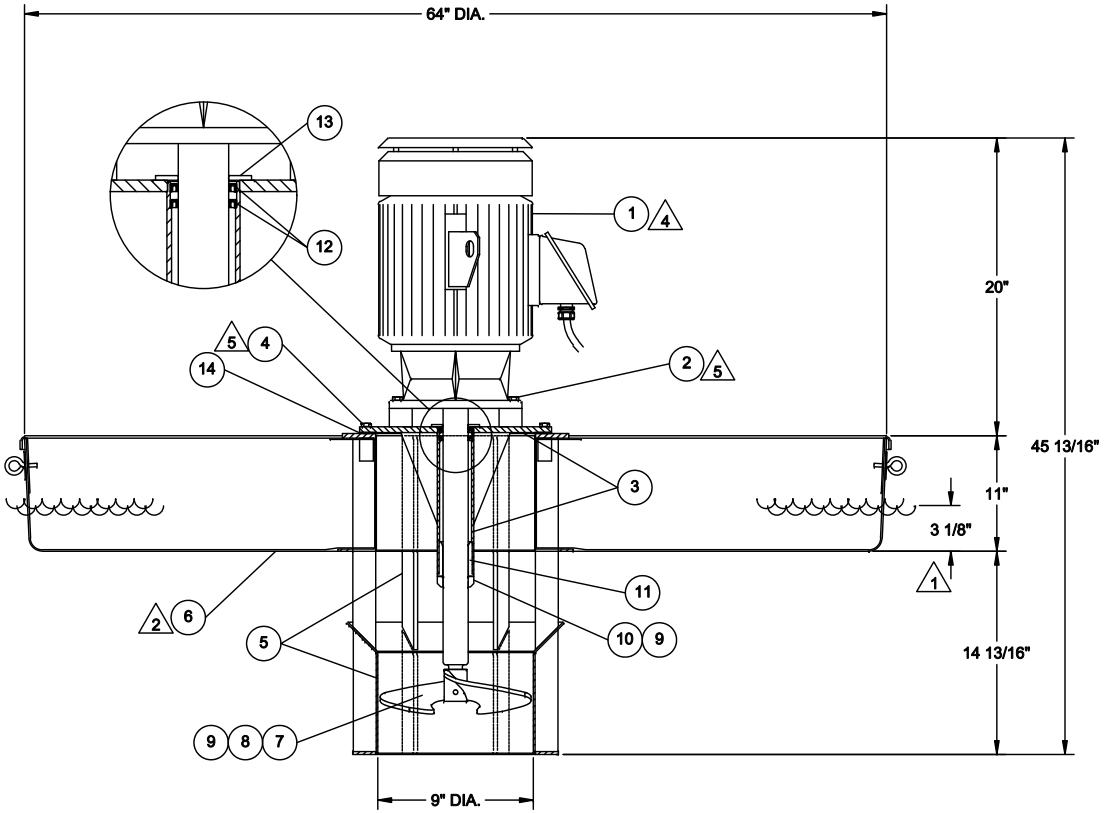

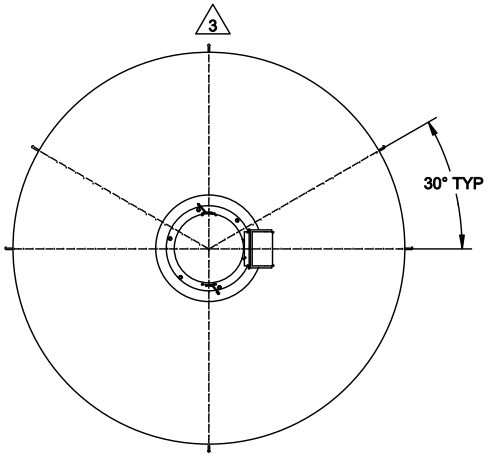

TOP VIEW

NOTES:

1. APPROXIMATE OPERATING WATER LEVEL.
2. THE FLOAT WILL BE FILLED WITH TWO COMPONENT, CLOSED CELL, POLYURETHANE FOAM (APPROX. 2 LBS. PER CUBIC FOOT DENSITY).
3. THE FLOAT MOORING ANCHOR POINTS WILL BE 316 STAINLESS STEEL WITH A QUANTITY OF SIX (6) EYES APPLICABLE FOR A THREE (3) OR FOUR (4) POINT MOORING SYSTEM.
4. MOTOR SPECIFICATIONS: TEFC, 1.15 SERVICE FACTOR, CLASS-F INSULATION, CONTINUOUS DUTY, NEMA DESIGN LETTER-B, NON-HYGROSCOPIC WINDINGS, CORROSION-RESISTANT PAINT, ONE-PIECE 17-4 PH STN. STL. SHAFT.
5. THESE FASTENERS ARE TO BE SAFETY WIRED IN PLACE.
6. POWER SECTION INCLUDES ITEMS: 1,2,3,7,8,9,10,11,12.
7. BALANCING: THE ENTIRE ROTATING ASSEMBLY INCLUDING THE MOTOR ROTOR, SHAFT AND IMPELLER SHALL BE DYNAMICALLY BALANCED TO WITHIN 2.0 MILS PEAK-TO-PEAK HORIZONTAL DISPLACEMENT MEASURED AT THE UPPER AND LOWER MOTOR BEARINGS. MEASUREMENTS SHALL BE TAKEN AT FREQUENCY EQUIVALENT TO THE MOTOR RPM WITH THE MOTOR IN A VERTICAL, SHAFT DOWN POSITION AND WITH THE MOTOR OR ENTIRE POWER SECTION MOUNTED ON RESILIENT PADS.
8. THE NOMINAL UNIT WEIGHT IS 422 POUNDS.
9. THE CALCULATED RESERVE BUOYANCY IS 820 POUNDS BASED ON WEIGHTS OF STANDARD UNIT SPECIFICATIONS.
10. COMPRESSION FITTING WILL BE SUPPLIED IF THE UNIT IS PROVIDED WITH FACTORY-ATTACHED ELECTRICAL CABLE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
10 15	1		COMPRESSION FITTING (OPTIONAL)	ZINC PLATED	
14	1		MOTOR BASE GASKET	NEOPRENE	
13	1		SEAL PLATE	DELRIN	
12	2		LIP SEAL	NITRILE	
11	1		ANTI-DEFLECTION INSERT	DELRIN	
10	1		LOWER SLINGER	DELRIN	
9	4		SET SCREW	316 STN. STL.	
8	1		PROPELLER PIN	17-4 STN. STL.	
7	1		PROPELLER	STN. STL.	
6	1		FLOAT ASSEMBLY	FIBERGLASS	
5	1		INTAKE VOLUTE	304 STN. STL.	
4	6		BOLT, MOTOR BASE	316 STN. STL.	
3	1		MOTOR BASE ASSEMBLY	304 STN. STL.	
2	4		BOLT, MOTOR	316 STN. STL.	
1	1		MOTOR		

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

JOB NAME:
JOB LOCATION:

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: MIXER
DRAWN BY: JAK DATE:
CHECKED BY: DATE:
WEIGHT: LBS SHEET: 1 OF 1

DRAWING NAME: MIXER ASSEMBLY, FSS, 2 HP
DRAWING NUMBER: 2802099
SCALE: N.T.S. SIZE: C

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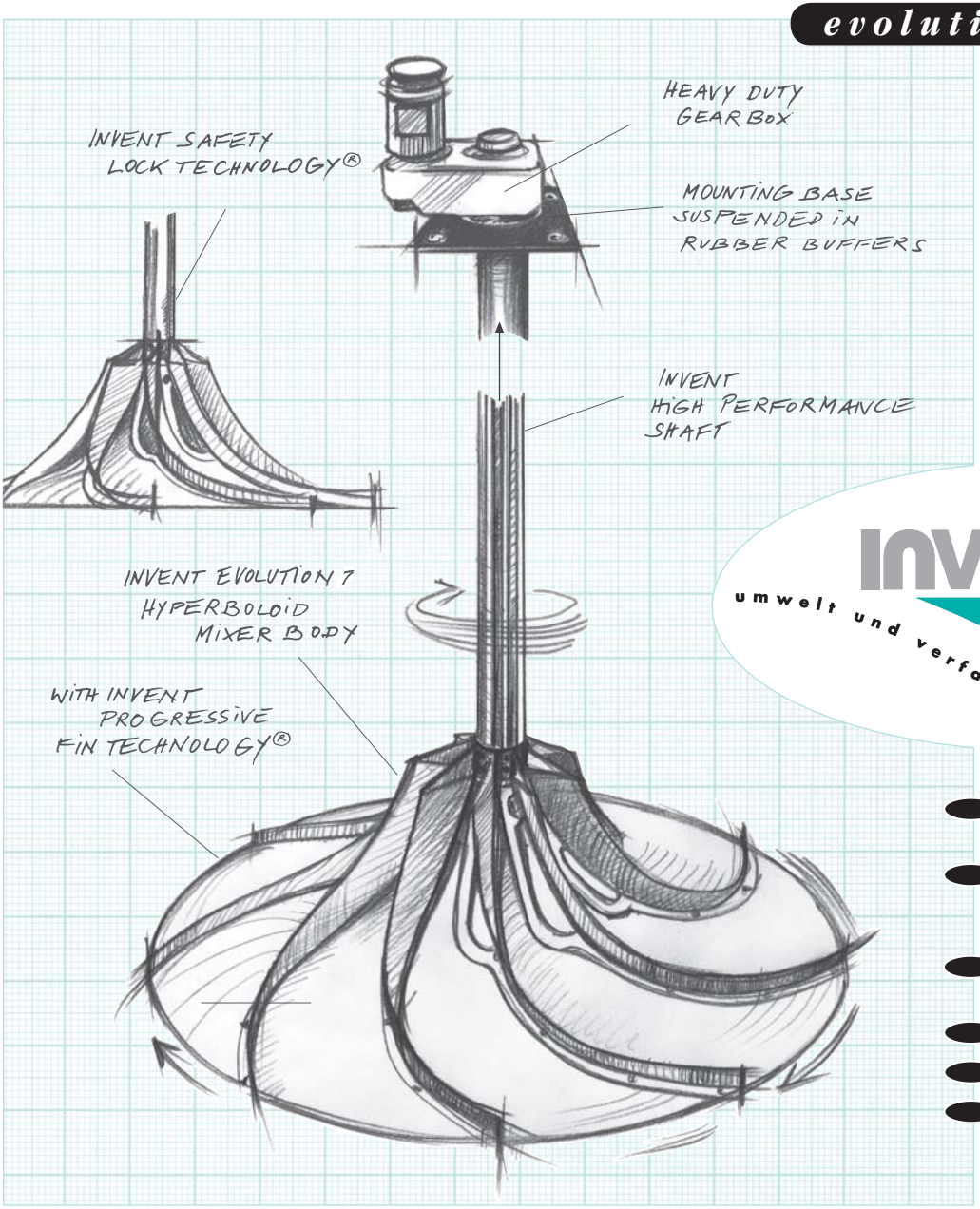
HYPERCLASSIC®- Mixer

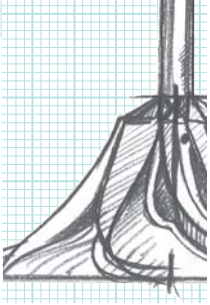
evolution 7

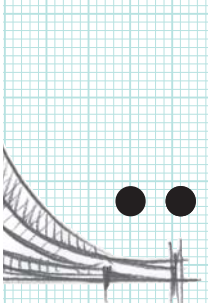
mixing technology



invent®
umwelt und verfahrenstechnik

- Fluid mechanically optimized
- Excellent suspension and homogenizing characteristics
- Low energy consumption
- Robust construction
- Low maintenance
- Low operational costs



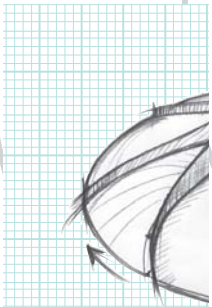


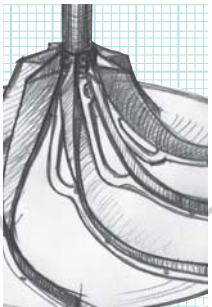
innovation for nature

The growing pollution of our environment is a problem which concerns all of us. For years water pollution, in particular, has continued to grow in threatening proportions. Water is turning into a more and more limited resource. As a consequence, forward-looking technologies are desperately needed for water and wastewater treatment. With great commitment **INVENT** *is dedicated to the development and implementation of such technologies, thus creating powerful products which contribute greatly to the preservation of the water quality of our groundwater, rivers and lakes.*

The protection, the preservation and, where necessary, the restoration of our environment will remain one of the most important tasks of our society in the future.

INVENT *takes on responsibility in this field, with innovative environmental and process engineering.*





HyperClassic®

The Benchmark

The Benchmark-
for more than 20 years

INVENT develops, produces and globally markets innovative machines and plants for the treatment of water and wastewater.

Water and wastewater treatment plants are usually created as a made-to-measure design and lay-out for a particular project.
Depending on the original situation and the intended treatment, various process engineering steps are combined so that the aim of the process engineering is safely within reach. While doing so, the engineer draws from a range of known unit processes. The most important processes from this range are stirring and mixing processes. They play a decisive role in nearly all water and wastewater treatment plants.

Below you will find some examples for important applications of mixing technology in water and wastewater treatment plants.

The table shown to the right is impressive proof of the importance of mixing processes for the water and wastewater treatment.

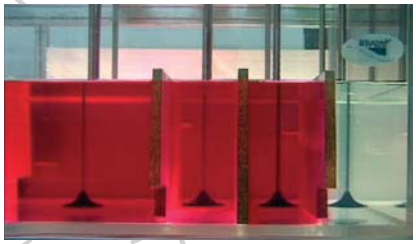
4 **INVENT HYPERCLASSIC®** *-Mixers combined with* **iDISC®** *Membrane Aeration System*

Application	Mixing task
Mixing and equalization tank	Suspension and Homogenization
Neutralization	Flash-Mixing
Pre-Mixing of Precipitants	Flash-Mixing
Precipitation	Suspension and Homogenization
Coagulation	Suspension and Homogenization
Biological phosphate elimination	Suspension and Homogenization
Denitrification	Suspension and Homogenization
BOD or COD removal	Homogenization and Dispersion
Disinfection	Flash-Mixing
Sludge treatment	Suspension and Homogenization
Storage of chemicals/chemical solution	Suspension

An Overview

INVENT made a significant contribution to the efficiency and cost-effectiveness of such plants by introducing the hyperboloid mixing technology to the market for water and wastewater treatment over 20 years ago. Since then, the hyperboloid mixing technology has been continuously developed and improved. Thousands of successful installations in municipal and industrial water and wastewater treatment plants world-wide impressively demonstrate that the hyperboloid mixing technology has already become the industrial standard in this field of application. With the current version **HYPERCLASSIC®** ***evolution 7***, the seventh, completely revised and revolutionary improved version of the classic hyperboloid mixer is now available.

The **INVENT HYPERCLASSIC®**-Mixer is a vertical mixer with a hyperboloid-shaped mixer-body, installed close to the bottom, and a drive mounted in dry position above the water level. Contrary to other products, it was developed and optimized especially for applications in the area of water and wastewater treatment.



Optimal design presents short circuit flows and guarantees optimal reactor behaviour.

The Task

As the above table shows, mixers for applications in water and wastewater treatment are mainly used for suspension and homogenization tasks as well as for intensive mixing and flash-mixing. These tasks should be implemented in a reliable, secure and energy-saving way and with the lowest possible maintenance requirement.

With regard to process engineering the following demands must be met:

- The settling of particles, such as activated sludge flakes, should be reliably avoided (suspension).
- Particles, such as activated sludge flocks, should be distributed evenly throughout the wastewater in order, for example, to efficiently reduce the nitrogen and phosphate percentage (homogenization).
- In the anaerobic and anoxic part of the activated sludge tank, turbulences on the water surface should be reduced to a minimum, in order to prevent the transfer of oxygen from the air into the wastewater.
- The energy input should be executed with as little shear force as possible, in order to avoid the destruction of the activated sludge flakes.
- Short circuit currents should be avoided.
- The reactor behaviour, upon which the process technological lay-out is based e.g. plug flow or completely stirred, together with the mixer design, should be implemented in a realistic way.

As a consequence of the above mentioned considerations it is important, from a fluid mechanics perspective, to take into account the following points when developing a mixer:

- The mixer- body should be positioned close to the bottom, so that the energy input takes place where the sedimentation of particles should be avoided.
- The mixer should be positioned as centrally as possible in the tank, should run slowly and have a large diameter, so that

the energy input takes place in a homogeneous way and the particles can be distributed evenly. A design like this is energy-efficient and low in shear force.

- In order to avoid short circuit currents and the correct implementation of the desired reactor behaviour, it is necessary to manufacture the mixer in various diameters and directions of rotation. These are then chosen according to the tank geometry and the position of the supply and discharge pipes.

Finally, when designing the perfect mixer, all mechanical factors must be considered also:

- The mixer should run smoothly in order to take the strain off the drive and shaft as well as the bridges. This is achieved by a high number of blades. Two-bladed constructions are the most disadvantageous.
- Reaction forces in the vertical direction at the shaft, drive and bridge are to be avoided. They result in a large increase in wear.

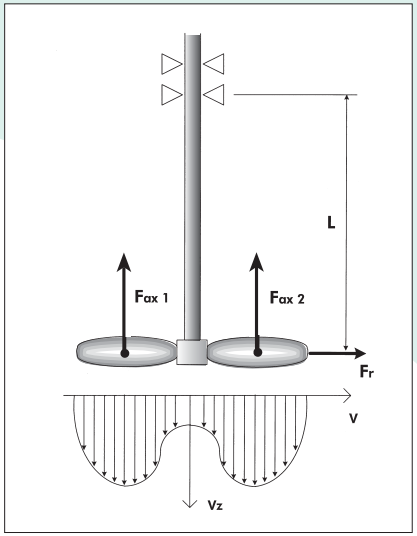


Figure 1: Conventional mixer – high reaction forces on drive and bridge (upwards)

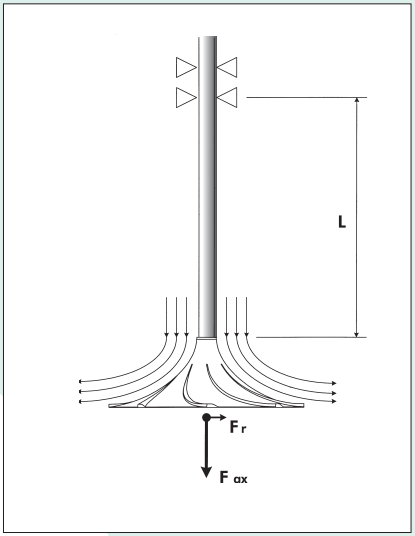


Figure 2: **HYPERCLASSIC®***-Mixer – low forces on drive and bridge (downwards)*

- It must be possible to adjust the mixer to a perfect position on the bridge. The mixer should be galvanically separated from the bridge.
- The drive design should be robust and rather on the large side. It should possess a high efficiency factor and its bearings should have a calculated minimum life expectancy of 100.000 hours. Depending on the installation location, further specific demands must be taken into consideration.

- All parts submerged in water should be non-corrosive and maintenance-free during their life.
- The mixer body should be completely free of tenon joints.
- The gear unit should possess the highest-possible energy efficiency factor.

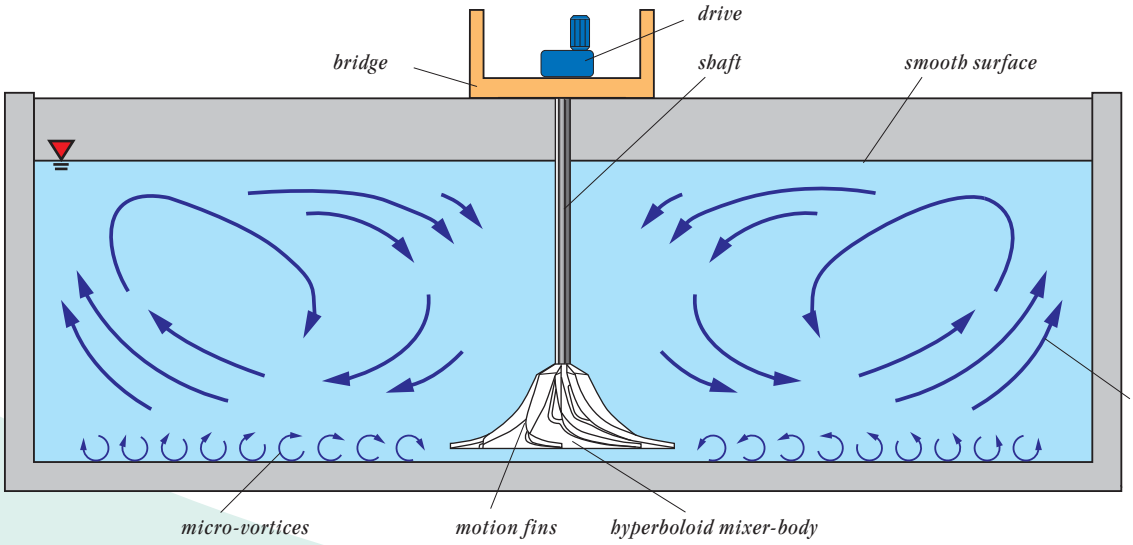
The Solution

The **INVENT HYPERCLASSIC**®-Mixer is a vertical shaft mixer with a hyperboloid-shaped mixer-body installed close to the bottom and a dry-mounted drive. In contrast to other products, it was developed and optimized especially for applications in the area of water and wastewater treatment.
The way the hyperboloid mixer functions can be seen in the opposite illustration. The mixer is pictured with its three main components, the drive, the shaft and the hyperboloid mixer-body in a typical aeration tank, which, depending on the type of treatment plant, can be rectangular or round.

Naturally, other shapes of tank are also possible.
The hyperboloid mixer rotates close to the bottom and its 8 integrated and specially optimized motion fins thus produce a bottom flow which is directed radially outwards. Particularly at the bottom, this flow is turbulent and thus effectively which whirls up depositions. Along the walls the flow rises upwards and transports all particles until they are just below the water surface. On the water surface the speed has been reduced to such an extent that no further surface turbulences can be produced and therefore oxygen input via the water surface can be effectively avoided.

Due to the flow on the water surface which is directed towards the shaft, all particles are distributed evenly throughout the tank. Finally, in the centre of the tank the water is again transported downwards along the shaft. A vortex-shaped main flow is thus created throughout the whole tank, which ensures excellent homogenization and mixing.
This way also short circuit currents can be efficiently prevented.

Optimal design guarantees high efficiency



Schematical representation of the hyperboloid mixer with indication of the streamlines

The Solution

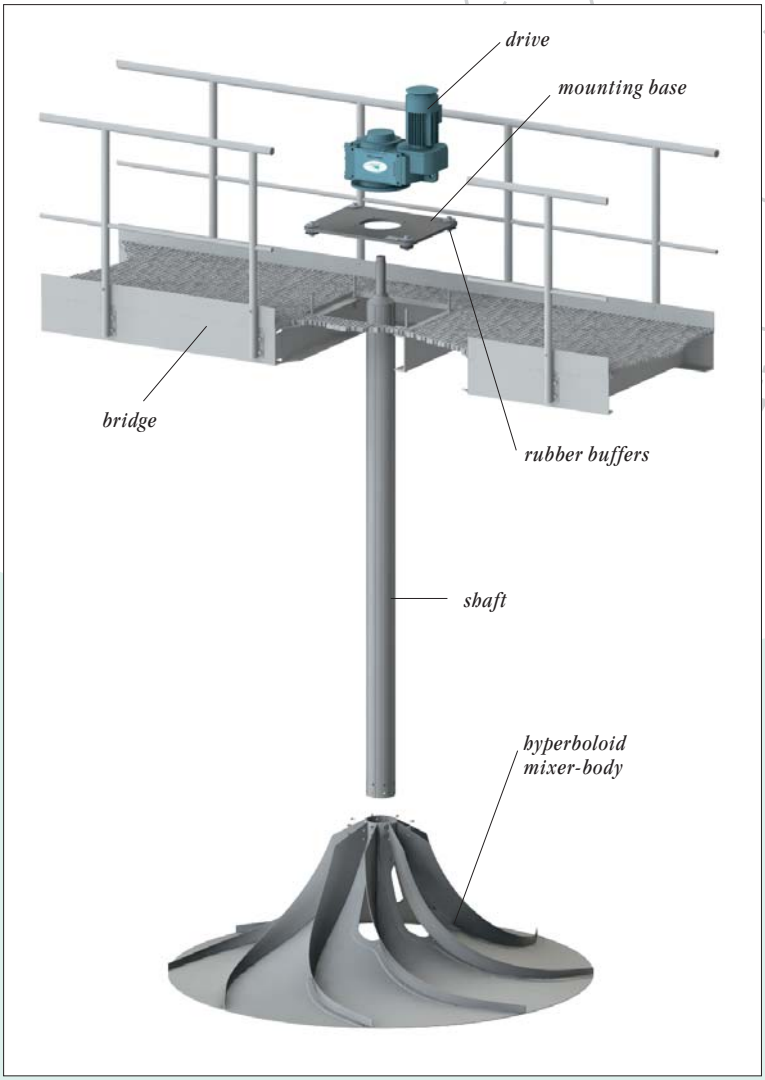
The shape of the hyperboloid mixer is based on complex potential-theoretical calculations and simulations in computational fluid dynamics (CFD[1]). This results in a flow pattern, which, in summary, exhibits the following basic advantages

- With regard to both quality and quantity, the produced macro-scale flow has the most favourable fluid-mechanical pattern. By actively re-directing the flow on the surface of the mixer, fixation losses are minimized and a high efficiency is achieved.
- The highest velocities and turbulent fluctuating velocities are induced at the bottom. This means that the energy input takes place directly at the bottom, so that the input energy is specifically used to whirl up and suspend sludge flocs and is not wasted anywhere else.
- The flow stays attached to the hyperboloid mixer surface. Flow separations, eddy formations and thus energy losses are prevented. This also boosts the efficiency.
- **HYPERCLASSIC**®-Mixers operate completely without pulsation due to the closed shape and the 8 motion fins (high number of blades).

6 out of 120
***HYPERCLASSIC®**-Mixers in a wwtp in Berlin, Germany*

- The uniform, radial flow-off over the complete mixer body facilitates a flow, which is largely free of periodic fluctuations. The effect of this flow is that the hyperboloid mixer centers itself. Therefore the forces on the gear and the bridges is small. In addition, no oscillations are transferred to the shaft and the bridges which allows a simple and economical bridge construction.
- All reaction forces on the gear and bridges are axial and directed downwards. The radial forces which are generated are very small. Therefore mixers with long shafts can also be constructed without problems.
- The finely graduated diameter range along with the selectable rotational direction, especially in long tanks with lengthwise through-flow, has big advantages with regard to the retention time and the flow in tanks of this type. This contributes decisively to a high operational safety level and clarification performance.

[1] CFD: Computational Fluid Dynamics



Design and Material Selection

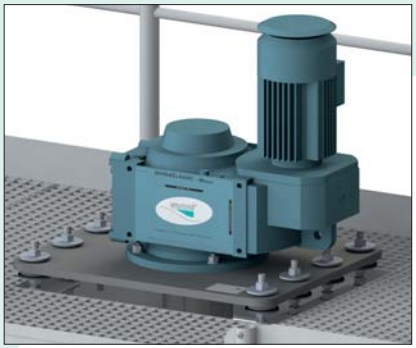
As illustrated in the accompanying blow-up drawing, the hyperboloid mixer is made up of three main components which are precisely fitted to each other: the drive, the shaft and the hyperboloid mixer-body.

Drive

The drive is assembled dry and is arranged on a bridge or mounting bracket where it is easily accessible for rarely needed maintenance work. For wastewater ponds or SBR plants with varying water levels, the hyperboloid mixer can also be mounted on a special float.

Only energy-saving and robust geared motors with reinforced bearings from renowned manufacturers are used. Normally, high service factors are selected and the calculated bearing life expectancy is more than 100.000 h. Special, customer-specific models can be built after clearance.

Well-proven, robust and safe to operate



The geared motor sits on a mounting base in a rubber buffer bearing. The propagation of sound waves is thus avoided and the complete mixer is thereby galvanically separated from the bridge.

Shaft

The shaft provides the connection between the drive and the mixer body. It transfers the required torque, in order to allow the hyperboloid mixer to rotate.
The shaft is manufactured from a specially developed FRP[1] pipe designed for the loads which occur. It is dimensioned with great care and designed for endurance. Through the use of high strength composite materials, the shaft is very light, extremely corrosion-resistant and flexible.

It is particularly easy to mount because of the light weight. All **HYPERCLASSIC**®-Mixers can be designed without a bearing because of their innovative design. The small bearing forces are transferred to the geared motor via the shaft and absorbed there. Consequently, no parts whatsoever which require maintenance are located below the water line.

Hyperboloid Mixer-Body

The hyperboloid mixer-body, developed out of the **INVENT** laboratory in accordance with the most up-to-date knowledge on the mechanics of fluids, is manufactured of special plastic components.
The use of the most modern composites also guarantees a high-strength, corrosion-resistant and light component here.

The hyperboloid mixer body is connected to the lower end of the shaft by means of a shaft/hub connection. The **INVENT**® ***Safety Lock Technology***® is used for this purpose. This enables a simple and rapid assembly as well as a simple removal even after many years of operation. Under operation conditions the connection is safely protected against self-loosening.

The complete hyperboloid mixer is not just producing a favourable flow field but is also absolutely non-clogging because of the optimal shape and the motion fins which are seamlessly integrated in the mixer-body.

The latest development step "***evolution 7***" uses the new by **INVENT** developed ***Progressive Fin Technology***®. In conjunction with an enlarged opening for the secondary current an increase in efficiency of up to 20% compared to the previous models was achieved.

[1]FRP: Fibre-reinforced Plastic

1 out of 32 **HYPERCLASSIC®** *-Mixers in a large wwtp in Vienna, Austria*

7 out of 33 **HYPERCLASSIC®** *-Mixers in the wwtp Berlin-Stahnsdorf, Germany*

The Installation

Due to the simple construction and the light weight of the components, the assembly can be carried out without big efforts. The hyperboloid mixer is normally delivered to the construction site in a disassembled state. There the shaft is first of all connected to the drive unit by pulling the top end of the shaft into the hollow shaft of the drive. Next both drive and shaft are placed on top of the prepared stainless-steel thread bolts or adhesion anchors on the bridge or the bracket. Then the drive is aligned and is ready for operation after the electrical connection and checking of the oil level.

The last step consists of screwing the hyperboloid mixer-body to the lower shaft flange. Just a short dry run and the **HYPERCLASSIC®**-Mixer is ready for operation.

Of course, the hyperboloid mixer can also be mounted and dismantled in a filled tank. In the unlikely but theoretically possible case of a motor or drive defect, these components can be exchanged without having to dismantle the complete mixer.

Simple, problem-free and quick

Low operational costs due to low energy consumption

3 out of 90 **HYPERCLASSIC®** *-Mixers in the wwtp Bowery Bay, New York, USA*

45 **HYPERCLASSIC®** *-Mixers in the wwtp Sulaibiya, Kuwait-City, Kuwait*

The Operation

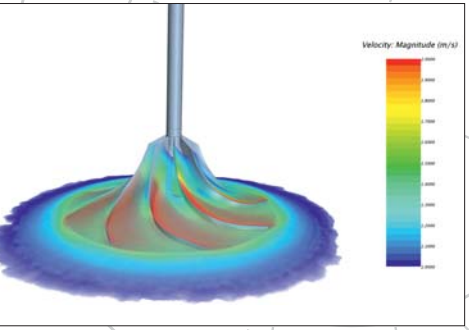
After a short dry run and a check of the direction of rotation the hyperboloid mixer can start operating without any further work. It is designed for permanent operation and does not require any maintenance work, except an occasional inspection of the oil level. Depending on the type of oil, an oil change is carried out once every 1 or 2 years.

Due to the location and the excellent accessibility of the drive this is child's play. There are no work-intensive and unpleasant pulling and cleaning jobs, which for example, is generally the case with submerged drives. Expensive maintenance work, such as the exchange of mechanical seals, are superfluous, because no parts which are subject to wear are installed below water level.

Low maintenance costs

2 out of 48 **HYPERCLASSIC®** *-Mixers in a wwtp in Stockholm, Sweden*

Competent and experienced



CFD Simulation of flow close to mixer body of the **HYPERCLASSIC®** ***evolution 7***

Layout and Design

For the layout and design of an optimum mixer it is also essential to consider the reactor design and any further marginal conditions (such as the shape of the tank, type and location of supply and discharge pipes, physical characteristics of the media, desired reactor behaviour, etc.). The mixer and the reactor must form a unit. After an extensive analysis of requirements and definition of the process engineering aims, this will be successful only if there is a range of innovative tools, measuring data and empirical values to fall back on in order to choose and lay out the perfect mixer.

For both the development and the determination of the basis for the layout of its mixers, **INVENT** always makes use of the latest developments in research and the associated technologies. Modern laser-Doppler-anemometry (LDA) and ultrasound-Doppler-anemometry (UDA) processes are therefore used for the determination of speed profiles in the laboratory and in large-scale models. In addition to conventional fluid mechanical methods for scale-up, the most up-to-date numeric simulations (CFD) are applied.

3D-CAD-programs and finite-element-methods (FEM) are used for the mixer design.

The application of mixers, however, also demands process engineering know-how, so that biological reactors can function optimally, short circuit currents can be avoided and the desired reactor behaviour is achieved.

The accompanying diagram shows a numerical simulation of an activated sludge tank with multiple thoroughly mixed stirring reactors, which are created by individual **HYPERCLASSIC®**-Mixers

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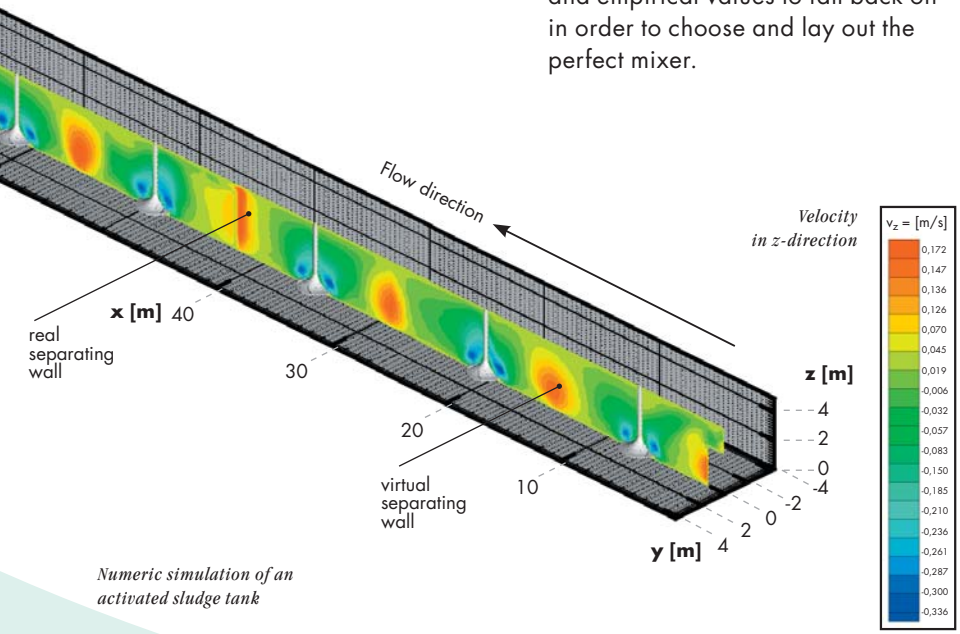


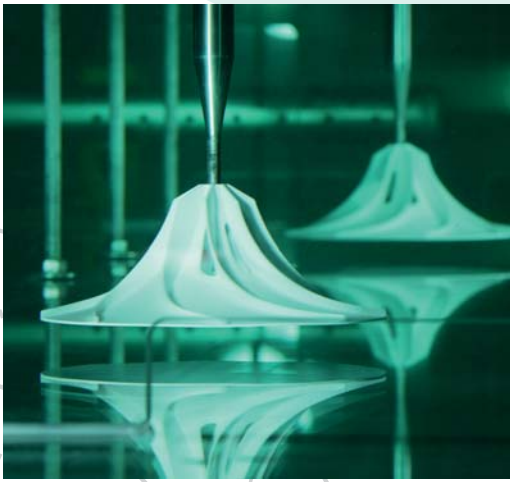
Numeric simulation of an activated sludge tank

[1] CFD: Computational Fluid Dynamics

Mixing test at the **INVENT** *laboratories*

The Laboratory

Apart from standard applications, time and time again very special terms of reference, tank geometries or mixing tasks must be mastered. In this case, **INVENT** can fall back on the instruments described above, but also on a very well-equipped mixing laboratory as well as on spacious testing facilities which are equipped with state-of-the-art testing and measuring technology.
All conceivable configurations can be replicated to scale and examined. This delivers further fundamental data in addition to the existing foundation for the layout and can of course also be used for the optimization of plants.



HYPERCLASSIC® *-Mixers* ***evolution 7***
in pilot scale test tank

Continuous improvement and quality contol

HYPERCLASSIC® *-Mixer* ***evolution 7***
in large scale test rig

HYPERCLASSIC®

INVENT Products worldwide

INVENT *Team meeting*

INVENT®, **HYPERCLASSIC**®, **Safety Lock Technology**® and **Progressive Fin Technology** ® are registered trademarks of **INVENT** Umwelt- and Verfahrenstechnik AG.

Chosen References

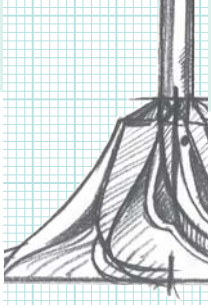
- Berlin Schönerlinde, Germany
  120 **HYPERCLASSIC**®-Mixers
- Berlin Stahnsdorf, Germany
  40 **HYPERCLASSIC**®-Mixers
- Berlin Münchehofe, Germany
  40 **HYPERCLASSIC**®-Mixers
- Berlin Wassmannsdorf, Germany
  30 **HYPERCLASSIC**®-Mixers
- Bremen, Germany
  40 **HYPERCLASSIC**®-Mixers
- Stockholm, Sweden,
  48 **HYPERCLASSIC**®-Mixers
- Barcelona, Spain
  72 **HYPERCLASSIC**®-Mixers
- Wien, Austria
  32 **HYPERCLASSIC**®-Mixers
- Zürich, Switzerland
  8 **HYPERCLASSIC**®-Mixers
- Davos, Switzerland
  10 **HYPERCLASSIC**®-Mixers
- Amsterdam, The Netherlands
  16 **HYPERCLASSIC**®-Mixers
- Maastricht, Niederlande,
  32 **HYPERCLASSIC**®-Mixers
- Kuwait City, Kuwait,
  45 **HYPERCLASSIC**®-Mixers
- Yokohama, Japan,
  12 **HYPERCLASSIC**®-Mixers
- Dubai, UAE
  32 **HYPERCLASSIC**®-Mixers
- Shanghai, China
  100 **HYPERCLASSIC**®-Mixers
- New York, Bowery Bay, USA
  90 **HYPERCLASSIC**®-Mixers
- New York, Jamaica, USA
  84 **HYPERCLASSIC**®-Mixers
- Washington, Blue Plains, USA
  132 **HYPERCLASSIC**®-Mixers

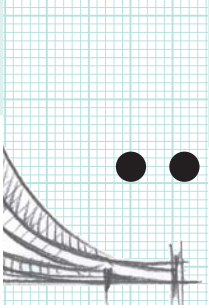
Successful worldwide

The Service

How can we support you with the planning, optimization, modernization of your plant, or just generally with the realization of your ideas? Please ask us about it!

In close co-operation with you, the **INVENT** team will draw up a first draft and will, if necessary, develop it further together with you via numerous iteration steps, until all requirements are met. After the order has been placed an experienced team of engineers will see to it that your project is carried out on schedule.
In accordance with the agreement we will deliver and install the plant for you and will also carry out the commissioning. Our service team will reliably take care of all necessary maintenance work.





Professional and innovative

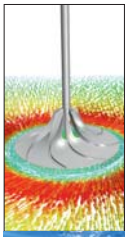
Beyond the delivery of components and plants we also offer you general advisory and engineering services in the field of stirring technology. This can be, for example, the layout or optimisation of a stirrer, or the experimental examination of a stirring tank on a laboratory-scale or through numeric simulation.

Furthermore, we carry out large-scale acceptance tests, whereby usually the velocity field, the solid matter concentration distribution and the detention distribution are examined.

Other Products and Services

INVENT is the market leader for mixers, mixing and aeration systems and membrane aeration systems for the water and wastewater treatment. Please do not hesitate to ask for information about our additional product lines. We would also be happy to offer you complete system solutions for your plant, such as a carefully laid-out and adapted equipment package. We simulate and optimize your plant with the help of appropriate software packages, or else we optimize your plant or building with regard to fluid mechanics.

We are your competent partner for all questions on water and wastewater treatment.



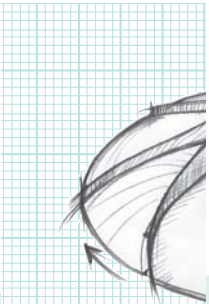
engineering & consulting

aeration technology

software-products

system solutions

research & development



locations

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HYPERCLASSIC® *evolution 7* Mixer design

May 05, 2015

Offer number	QT-1505003-HCM-Rev00
Project	Enfield, CT Primary Anoxic and Aerobic Zone 2
Sales contact	Patrick O'Donnell

Waste water properties		
Origin	municipal	
MLSS concentration	2,500	ppm
SVI	80	ml/g
Temperature	68	°F

Basin geometry		
Basin type	rectangular	
Width	24.0	ft
Length	61.2	ft
Water depth	16.1	ft
Freeboard	2.0	ft
Basin area	1,469	sqft
Basin volume	0.177	Mgal
Number of basins	1	-
Mixer rows	1	-
Mixers per row	1	-
Total number of mixers	1	-

Mixer		
Type	HCM/2500-24-3.0hp	
Selected diameter	98.4	in
Output speed	23.1	rpm
Rated power	3.0	hp
Power input	2.2	hp
Power consumption	2.7	hp
Power density	0.09	hp/1000 cuft
Mixing intensity	50	1/s
Bottom flow velocity	7.8	in/s
Average bottom flow velocity	19.0	in/s
Mixer pumping capacity	12,112	cuft/min
Effective service factor	4.1	-
Bottom distance	23.0	in
Total mixer weight	728	lb
Outer diameter	6.6	in
Shaft length	163.8	in
Flange diameter	13.8	in
Hollow shaft	2.4	in
Rated torque	8,054	lb.in
Start-up torque	20,135	lb.in
Static axial force	728	lbf
Dynamic axial force	904	lbf
Grid frequency	60	Hz
Rated voltage	460	V
Rated current	3.8	A
Start-up current	32.3	A
Power reserve	25	%

April 30, 2015

Amine Hanafi
Woodard & Curran
1699 King Street, Suite 406
Enfield, CT 06082

RE: Budgetary Proposal— BioMix™ System – Anoxic and Swing Zones
Enfield, CT WPCF
Proposal # OM-14-123972

Amine,

Please find attached our proposal for a BioMix™ Compressed Gas Mixing System for the Anoxic and Swing Zones at the Enfield, CT WPCF.

The Enfield, CT WPCF is the type of facility that, when utilizing BioMix™ system in lieu of a mechanical mixing will attain reduced maintenance expense and reduced energy cost savings while providing improved mixed conditions.

The primary advantages of BioMix™ compressed gas mixing, versus other mixing technologies are:

- Reduced energy consumption – up to 60%+ savings versus traditional mixing.
- Reduced maintenance – BioMix™ maintenance is minimized and localized:
    - No moving parts in the basin.
    - Replace 20+ mixers with a single compressor.
    - Adaptable to any basin geometry with power input specific to the application.
    - No expensive bridges or platforms required.
    - EnviroMix will guarantee homogeneous mixing through a Field Performance Test demonstrating Coefficient of Variation of <10%.

Municipalities today are making decisions reflective of long-term cost of ownership as well as environmental stewardship. This 304SS system provides both: The 20-year ownership costs are significantly lower and address not only the initial capital and installation costs, but also equipment replacement, maintenance and energy consumption. BioMix offers significant advantage for this application and we look forward to the opportunity of discussing further with you.

We hope that you will find this proposal responsive to your needs. Please contact me with any questions.

Best Regards,

Tyler Kunz, P.E.
Vice President of Sales

BUDGETARY PROPOSAL

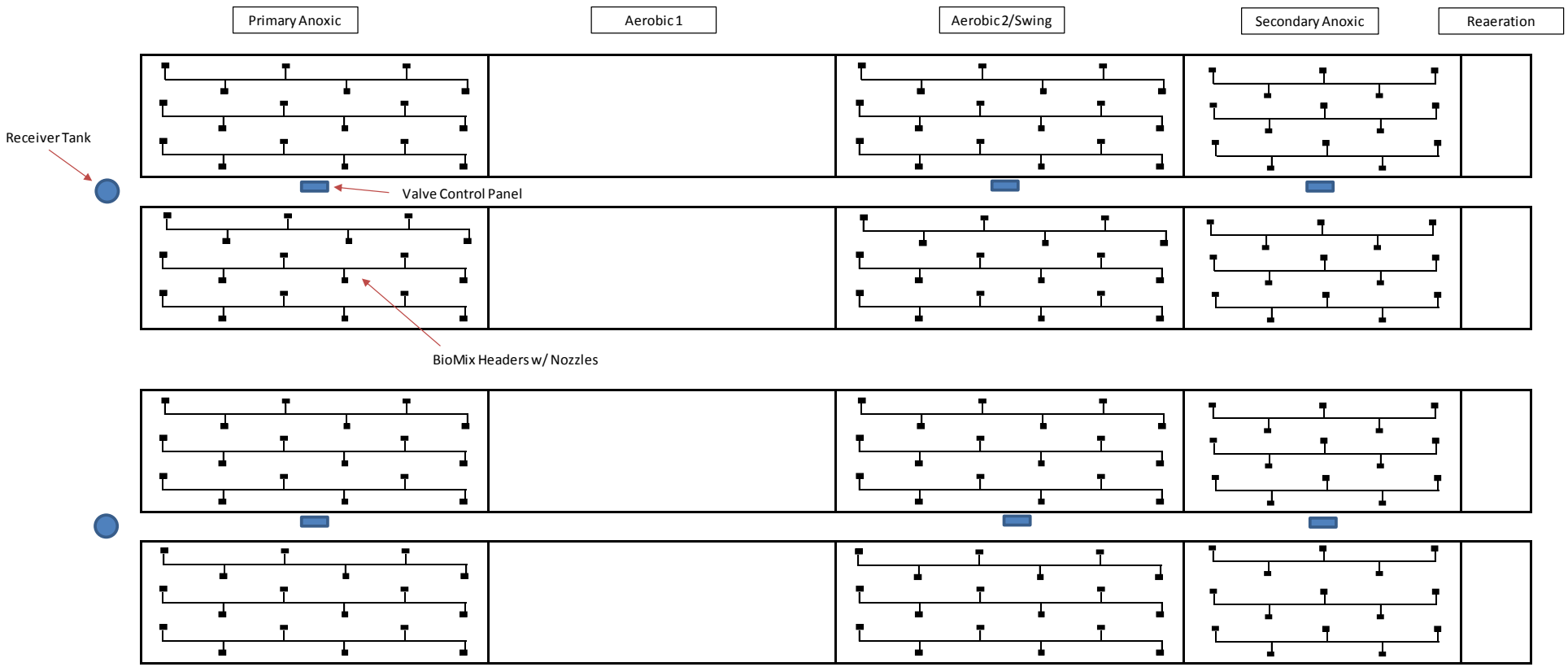
PROJECT DEFINITION

Current Process – Submersible Mixers. Zones to be reconfigured.

Future Process – A BioMix™ Compressed Gas Mixing System is proposed to provide complete mix conditions of the Anoxic and Swing Zones.

Primary Anoxic Zone:	61.2-ft x 24-ft x 16.1-ft SWD
Aerobic Zone2/Swing:	61.2-ft x 24-ft x 16.1-ft SWD
Secondary Anoxic Zone:	49.2-ft x 24-ft x 16.1-ft SWD

See next page for proposed BioMix configuration.



BioMix™ Configuration			
Zone	Primary Anoxic	Aerobic 2	Secondary Anoxic
Size of Pipe (Ø)	2-Inch		
Length of Header	±52'	±52'	±40'
Nozzles / Header	6	6	5
Headers / Basin	3	3	3
Total Number of Nozzles / Basin	18	18	15
Total Nozzles	204		

DESCRIPTION OF SYSTEM PROPOSED

BioMix™ systems provide mixing in liquids by firing short bursts of compressed air through engineered nozzles affixed to the floor of a tank. This compressed air is intermittently fired in fractional second durations to mix the tank. The relatively small surface area of the large gas volumes and their rapid upward velocity enable BioMix™ to transfer an insignificant amount of oxygen to the wastewater, providing efficient anaerobic/anoxic mixing. Valve Panels (VP) with 304SS enclosure, mounted at the tank wall, will control the firing of the compressed air through Sch 5 304SS press-technology tank piping and the 304SS BioMix™ nozzles. An operator interface in the VP allows user input to optimally control the firing pressure, sequence, frequency and duration for each tank. Electrical power requirements are limited to the power to operate the compressed air source and the 120V VP.

All BioMix™ installations share the following key benefits:

- Significantly reduced power consumption compared to mechanical mixing
- Reduced numbers of operating equipment to be maintained
- No mechanical or electrical components in the wastewater
- Non-clogging, self-cleaning in-tank components
- Minimal scheduled maintenance of other components (compressor, air control valves) in controlled environments

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SCOPE OF SUPPLY SUMMARY

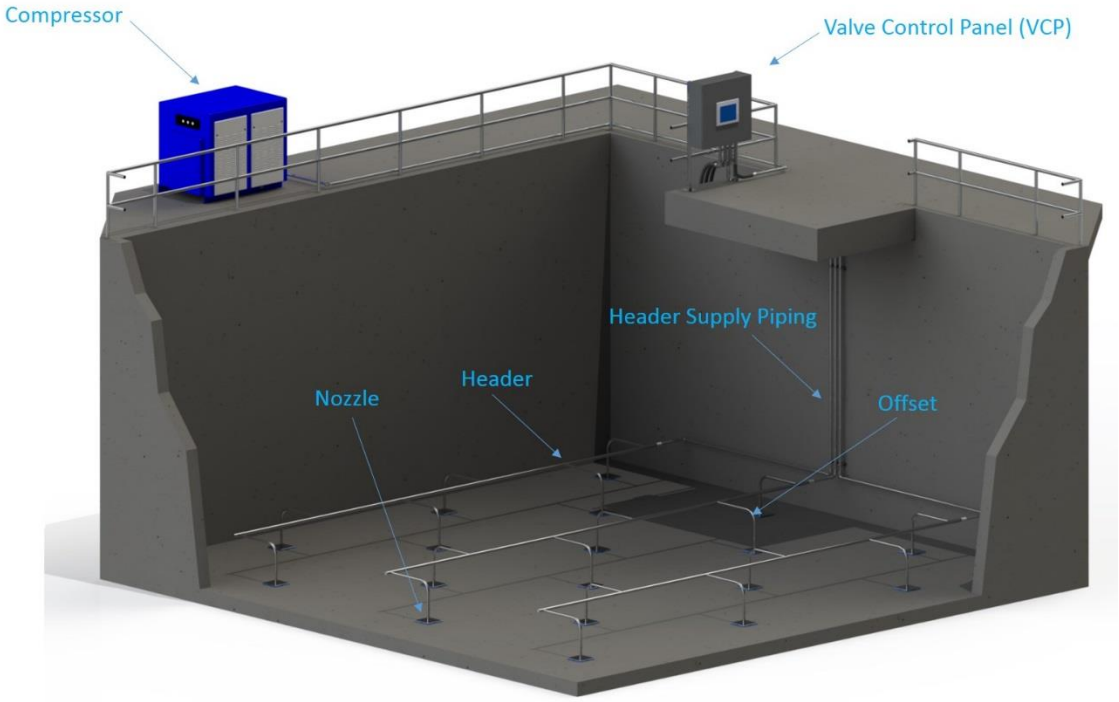
EnviroMix proposes the following BioMix™ System:

- (6) – 304SS Valve Panel with EnviroMix HMI controller, six (6) electrically-actuated poppet valves and corresponding valve manifold.
- (204)— 304SS BioMix™ 90-degree nozzles affixed to straight headers (see above configuration detail)
- 304SS Sch5 press-technology in-tank air piping to tank headers and nozzles, 200 psig industrial hose from VPs to in-tank air piping, respective fittings and 304SS wall/pipe supports and anchors
- (1)—20 HP Quincy QGS rotary-screw air compressor with integrated filter and receiver tank.

  (Expected 21.2-HP total operating requirement—includes motor and fan)
- (2) – days of on-site time for a qualified representative are included for equipment installation, testing, startup, and operations and maintenance training
- Submittals and Operations & Maintenance manuals
- Assumptions:
  - Electrical connection to compressor (460/3/60) and VP/receiver drain valves (120/1/60) by others
  - Interconnecting compressed air piping to VP from compressor receiver by others
  - Control wiring (if required) to VP and compressor by others
  - Excludes installation

PICTURE FROM SIMILAR INSTALLATION

The following illustrations show a typical BioMix™ layout and picture from a similar installation:



PROPOSED PRICING

It is our intent that this budgetary proposal for the Anoxic and Swing Zones mixing system serves as the basis for a more detailed proposal. **Pricing for the above Scope of Supply is $475,000.**

Tyler Kunz, P.E.
Vice President of Sales
180 East Bay Street, Suite 200, Charleston SC 29401
tkunz@enviro-mix.com C 262 720 0316; T 843 573 7510

APPENDIX M: CONCEPTUAL DESIGN CRITERIA FOR RECOMMENDED PLAN

APPENDIX M

Enfield Wastewater Facilities Plan
Conceptual Design Criteria for Recommended Plan

PROCESS / DESCRIPTION	AVERAGE FLOW	MAXIMUM MONTH	PEAK FLOW
RAW WASTEWATER DATA			
TOTAL FLOW IN MGD (ACTUAL) ("Q")	5.5	7.6	17.0
BOD CONCENTRATION, MG/L	215	216	
BOD LOADING, LBS/D	9,862	13,691	
TSS CONC IN MG/L	196	197	
TSS LOADING IN LBS/D	8,991	12,487	
TN MG/L	32	32	
TN LBS/D	1,468	2,028	
AERATED GRIT CHAMBER			
NUMBER OF UNITS	2	2	2
UNIT WIDTH, FT	12.5	12.5	12.5
UNIT LENGTH, FT	40	40	40
UNIT DEPTH ABOVE HOPPER, FT	8.9	8.9	8.9
UNIT VOLUME, GAL	33,300	33,300	33,300
TOTAL VOLUME, GAL	66,600	66,600	66,600
DETENTION TIME IN MIN AT Q	17.4	12.6	5.6
GRIT BLOWERS			
NUMBER OF UNITS	2		
BLOWER TYPE	POSITIVE DISPLACEMENT		
AIR SUPPLY RANGE, SCFM/FT	4 - 5		
TOTAL AIR SUPPLY RANGE, SCFM	320 - 400		
SEPTAGE RECEIVING STATION			
Wetwell			
NUMBER OF UNITS	1		
VOLUME, GAL	10,200		
Septage Transfer Pump			
NUMBER OF UNITS	1		
TYPE	DIAPHRAGM		
INFLUENT SCREEN			
NUMBER OF UNITS	2		
SCREEN TYPE	MECHANICAL MULTI-RAKE BAR		
SCREEN OPENNING SIZE, IN	0.25		
BYPASS BAR SCREEN			
NUMBER OF UNITS	1		
SCREEN TYPE	MANUAL BAR		
WIDTH, FT	3.0		
CLEAR OPENNING, IN	1.5		

APPENDIX M

Enfield Wastewater Facilities Plan
Conceptual Design Criteria for Recommended Plan

PROCESS / DESCRIPTION	AVERAGE FLOW	MAXIMUM MONTH	PEAK FLOW
PRIMARY SETTLING			
NUMBER OF UNITS	2	2	2
UNIT DIAMETER, FT	85	85	85
SWD, FT	12.0	12.0	12.0
UNIT SURFACE AREA, SF	5,700	5,700	5,700
TOTAL SURFACE AREA, SF	11,400	11,400	11,400
OVERFLOW RATE, GPD/SF	480	670	1,490
TOTAL WEIR LENGTH, FT	534	534	534
WEIR OVERFLOW RATE, GPD/LF	10,300	14,200	31,800
UNIT VOLUME, GAL	509,300	509,300	509,300
TOTAL VOLUME, GAL	1,018,600	1,018,600	1,018,600
DETENTION TIME, AT Q, HRS	4.44	3.22	1.44
PRIMARY SLUDGE PUMPS			
NUMBER OF PUMPS	4		
PUMP TYPE	DIAPHRAGM DOUBLE DISC		
DRIVE TYPE	VARIABLE SPEED		
PRIMARY SLUDGE GRINDER			
NUMBER OF UNITS	1		
UNIT TYPE	In-Line		
UNIT SIZE	6"		
REACTOR TANKS			
NUMBER OF UNITS	4	4	4
UNIT WIDTH, FT	24	24	24
UNIT LENGTH, FT	248	248	248
UNIT SIDE WATER DEPTH, FT	16.1	16.1	16.1
UNIT VOLUME, GAL	717,000	717,000	717,000
TOTAL VOLUME, GAL	2,868,000	2,868,000	2,868,000
TOTAL VOLUME, CF	384,000	384,000	384,000
BOD LOADING, LBS/D/1000 CF AVG	18.0	25.0	
AVG. MLSS CONCENTRATION, mg/l	2,500	2,500	

APPENDIX M

Enfield Wastewater Facilities Plan
Conceptual Design Criteria for Recommended Plan

PROCESS / DESCRIPTION	AVERAGE FLOW	MAXIMUM MONTH	PEAK FLOW
AERATION BLOWERS			
NUMBER OF UNITS		4.00	
TOTAL PROCESS AIR REQUIREMENT, CFM (ALL TANKS)		7,200	
TOTAL MIXING AIR REQUIREMENT, CFM (ALL TANKS)		1,800	
DISCHARGE PRESSURE, PSI		8.60	
INTERNAL RECIRCULATION PUMP			
NUMBER OF UNITS		4	
TYPE		SUBMERSIBLE PROPELLER	
CAPACITY (EACH)		3,800 GPM @ 2 FT TDH	
AERATION SYSTEM			
DIFFUSER TYPE		FINE BUBBLE MEMBRANE DISC	
SIZE, INCH		9"	
DIFFUSER SUBMERGENCE, FT		15.3	
MIXING SYSTEM			
TYPE		COMPRESSED GAS MIXING	
TOTAL NUMBER OF NOZZLES		204	
TOTAL NUMBER OF VALVE CONTROL PANELS (VCP)		6	
COMPRESSOR			
NUMBER OF UNITS		2	
TYPE		ROTARY SCREW	
MOTOR SIZE, HP		20	
SECONDARY CLARIFICATION			
NUMBER OF TANKS	4	4	4
DIAMETER, FT	85	85	85
TANK SWD, FT	12	12	12
UNIT SURFACE AREA, SF	5,700	5,700	5,700
TOTAL SURFACE AREA, SF	22,800	22,800	22,800
UNIT VOLUME, GAL	509,000	509,000	509,000
TOTAL VOLUME, GAL	2,036,000	2,036,000	2,036,000
TOTAL VOLUME, CF	68,000	68,000	68,000
DETENTION TIME IN HRS AT Q	8.9	6.4	2.9
SOLIDS LOADING RATE, LB/SF/D	10	14	31
SURFACE OVERFLOW RATE, GPD/SF	250	340	750
RETURN ACTIVATED SLUDGE (RAS) PUMPS			
NUMBER OF UNITS		3	
PUMP TYPE		SCREW CENTRIFUGAL	
DRIVE TYPE		VARIABLE SPEED	
CAPACITY (EACH)		2,700 GPM @ 33 FT TDH	

APPENDIX M

Enfield Wastewater Facilities Plan
Conceptual Design Criteria for Recommended Plan

PROCESS / DESCRIPTION	AVERAGE FLOW	MAXIMUM MONTH	PEAK FLOW
WASTE ACTIVATED SLUDGE (WAS) PUMPS			
NUMBER OF UNITS	2		
PUMP TYPE	ROTARY LOBE		
DRIVE TYPE	VARIABLE SPEED		
CAPACITY (EACH)	320 GPM @ 30 FT TDH		
DISINFECTION			
NUMBER OF REACTOR CHANNELS	2	2	2
CHANNEL DEPTH, FT	12.4	12.4	12.4
CHANNEL WIDTH, FT	30.0	30.0	30.0
CHANNEL LENGTH, FT	58.0	58.0	58.0
UNIT CAPACITY, CF	21,576	21,576	21,576
TOTAL REACTOR CAPACITY, CF	43,152	43,152	43,152
TOTAL REACTOR CAPACITY, GAL	323,000	323,000	323,000
DETENTION TIME, MIN	85	61	27
SODIUM HYPOCHLORITE FEED SYSTEM			
NUMBER OF PUMPS		2	
PUMP TYPE		PERISTALTIC	
NUMBER OF STORAGE TANKS		3	
STORAGE TANK VOLUME, GAL		2,000	
SODIUM HYDROXIDE FEED SYSTEM			
NUMBER OF PUMPS		2	
PUMP TYPE		PERISTALTIC	
NUMBER OF STORAGE TANKS		2	
STORAGE TANK VOLUME, GAL		1,000	
POLYMER FEED SYSTEM			
NUMBER OF PUMPS		2	
PUMP TYPE		PERISTALTIC	
NUMBER OF STORAGE TANKS		2	
STORAGE TANK VOLUME, GAL		1,000	
SODIUM PERMANGANATE FEED SYSTEM			
NUMBER OF PUMPS		2	
PUMP TYPE		PERISTALTIC	
NUMBER OF STORAGE TANKS		2	
STORAGE TANK VOLUME, GAL		800	
CARBON ADDITION FEED SYSTEM			
NUMBER OF PUMPS		2	
PUMP TYPE		PERISTALTIC	
NUMBER OF STORAGE TANKS		2	
STORAGE TANK VOLUME, GAL		1,400	

APPENDIX M

Enfield Wastewater Facilities Plan
Conceptual Design Criteria for Recommended Plan

PROCESS / DESCRIPTION	AVERAGE FLOW	MAXIMUM MONTH	PEAK FLOW
GRAVITY THICKENERS			
NUMBER OF UNITS		2	
UNIT DIAMETER, FT		35	
SIDE WATER DEPTH, FT		14	
UNIT SURFACE AREA, SF		963	
TOTAL SURFACE AREA, SF		1,926	
TOTAL VOLUME, GAL		201,500	
PROJECTED SOLIDS LOADING RATE, LB/SF/DAY		5.3	
SLUDGE DEWATERING PRESS			
NUMBER OF PRESSES		2	
THROUGHPUT PER UNIT, DRY LBS/HR		1,800	
AVERAGE CAPTURE RATE, %		97%	
AVERAGE SLUDGE CAKE SOLIDS, %		26%	
CONNECTED POWER PER UNIT, HP		20	
PLANT WATER SYSTEM			
PUMP TYPE		HORIZONTAL CENTRIFUGAL	
DRIVE TYPE		VARIABLE SPEED	
ODOR CONTROL SYSTEM			
NUMBER OF UNITS		1	
TYPE		ACTIVATED CARBON ADSORBER	
FLOW RATE, CFM		9,100	
VESSEL DIAMETER, FT		9	

APPENDIX N: HUBER SCREW PRESS PILOT TEST REPORT – CONCEPTUAL DRAWING

Huber Technology Inc. ROTAMAT® Screw Press RoS3Q 280 Pilot Test

Enfield WPCF

90 Parsons Road

Enfield, CT 06082

Test Date: 5/4/2015 - 5/8/2015

Job Number: 9821

Attendants:	Position:	Association
Guenter Rackl	Technician	Huber Technology, Inc.

Table of Contents

1. Pilot Unit- Screw Press RoS3Q 280 ……...……..……...……...3
1.1 Screw Press RoS3Q 280 Technical Data ……..……..…..…4

2. Facility Specifications and Requirements……6

3. Bench Test Results of Polymer Reaction ……...……7

4. Pilot Test Results ……....……..……8
4.1 Sludge Test ……...……..……..…...9
4.1.1 Polymer Dosing and Effect on Cake Solids …….…….....11
4.1.2 Hydraulic and Solids Loading Effect on Cake Solids …….……...…….…..12
4.1.3 Capture Rate ……....…….…….…….……..15

5. Conclusion ……..……..……...……...……18

6. Summary of Activities …….……..……..19

Appendices …….……...……..…..…..……..20
Appendix A - Screw Press RoS3Q 280 Pilot Test Photos …….…..……..21

List of Figures:

Figure 1 - General Overview 1
Figure 2 - General Overview 2
Figure 3 - Polymer Dosing Effect on Cake Solids
Figure 4 - Solid Loading on Cake Solids
Figure 5 - Screw Speed Effect on Throughput
Figure 6 - Screw Speed Effect on Cake Solids
Figure 7 - Polymer Consumption and Capture Rate
Figure 8 - Screw Speed Effect on Capture Rate
Figure 9 - Inlet Feed Pressure Effect on Capture Rate

List of Tables:

Table 1 - Pilot Test Power Requirements
Table 2 - Pilot Test Water Requirements
Table 3 - Bench Test Results
Table 4 - Pilot Test Schedule
Table 5 - Pilot Test Final Results
Table 6 - Sludge Test Conclusion

1. Pilot Unit - Screw Press RoS3Q 280

Pilot testing is a useful tool in evaluating sludge and its suitability for dewatering with screw press technology. This allows for a full range of testing with different parameters to find the most optimal method of operation and to determine what ranges of operation are achieved from maximum throughput to minimum polymer consumption.

The tests performed provided the following:

- Most efficient set-points for peak cake solids performance.
- Polymer consumption rates for varying capture rates and cake solids.
- Ranges for good or acceptable performance.
- Absolute maximum throughput

The dewatering machine is a screw press with conical shaft and cylindrical sieves. The machine is subdivided into the entering zone, the three part thickening and dewatering zone, and the pressing zone with a pneumatic backpressure cone. The pilot unit is mounted on a trailer that contains all necessary equipment to operate the dewatering machine.

The pilot unit is comprised of:

- The Screw Press RoS3Q 280
- A thin sludge pump: progressive cavity pump, SEEPEX 2-10 LBN.
- A polymer station: *Velodyne* , incline mixing.
- A flow meter for thin sludge and polymer.
- Injection and mixing devices for the polymer
- Sludge polymer mixing devices: Reactor pipe (17 feet).
- Controller: Allen Bradley programming control (PLC) and operator interface.

The controls are equipped with a PLC and operator interface (HMI). The screw press is designed for and can be operated under complete automation.

The most important and required parameters are:

- Desired volume flow rate of thin sludge and polymer [GPM]
- Dry solids (DS) of sludge In and Out [%]
- Polymer consumption [lbs polymer / ton DS]
- Speed of screw press [%]

1.1 Screw Press RoS3Q 280 Technical Data:

HUBER ROTAMAT® Screw Press RoS3Q 280

- Screw Drive: *BAUER* motor and gearbox
  - Type: BF40Z-34/D06XA4-TF/AMUL-C2-SP
  - Class I, Div 2 with 0.37 kW (0.5 HP), 460 V AC, 60 Hz ; speed motor 1680 rpm, shaft 1.4 (with 60 Hz) VFD controlled (12-120 Hz)
- Pressure Gauge, inlet of press: make *IFM*
- Wash System Solenoid Valves: *Burkert* type 5282 A
  - 120 V AC, 60 Hz, 2 - 10 bar (30 - 145 PSI)

- Polymer Feed System: *Velodyne*
  - Model max. 1 GPH, serial: 21471 (revision: January 2009)
    - Mixing Motor: *BALDOR* , 90 V AC, 60 Hz
    - Polymer Dosing Pump: progressive cavity
      - *SEEPEX* , Model: serial 0505956152-7
      - maximum capacity: 1.5 GPH / 50 PSI

Flocculation_system: polymer injection ring, mixing device (mounted to the feed pipe, size: 1 1/2") and pipe flocculation reactor.

Feed pump: progressive cavity pump, make: *SEEPEX* (VFD controlled: max. capacity 30

Flow meters: *KROHNE* (Thin Sludge and Polymer)

Control_panel: capable of fully automated operations; manufacturer: *Ell*, includes HMI for easy set-point modification.

Table 1 - Pilot Test Power Requirements

	Voltage/ Hertz	Power	FLA (Amps)	Operation Mode	VFD
Feed Pump	460 V / 60 Hz	4 kW/ 5 HP	7.5	CC: 3.25 kWh	Yes
Screw Press	460 V / 60 Hz	0.37 kW/ 0.5 HP	1.1	CC: 0.30 kWh	Yes
Polymer System	120 V / 60 Hz	-	9.2	CC: 0.83 kWh	Yes
Compressor	120 V / 60 Hz	-	10.5	IC: 0.1 kWh	No
Flow Meter, Solenoid Valve	120 V / 60 Hz	-	0.5	0.1 kWh	No

NOTES:

VFD - Variable Frequency Drive
CC - Continuous Consumption
IC - Intermittent Consumption
kW - Kilowatt
HP - Horse Power
AMPS - Amperes
kWh - Kilowatt Hours

Table 2 - Pilot Test Water Requirements

	Type	Pressure	Operation Mode	Demand
Polymer	Potable Water or Filtered Plant Water	60-70 PSI	Continuous	Normal Solid Load (80 - 100 lbs DS) 1 - 1.5 GPM High Solid Load (120 - 200 lbs DS) 2 - 3 GPM
Wash Water	Filtered Plant Water	50 PSI Minimum	Intermittent: Standard is 30 minutes between wash cycles	Water Demand: 15 gallons per wash cycle (at 22.5 GPM)

NOTES:

PSI - Pounds per Square Inch
DS - Dry Solids
GPM - Gallons per Minute
Lbs - Pounds

2. Facility Specifications and Requirements:

Enfield WPCF	
Design Daily Flow	10 MGD
Actual Daily Flow	Unknown
Sludge Type	Blended Primary / Secondary
Sludge Age	Unknown
Waste Sludge Flow	100,000 GPD
Solid Content	2.0% - 3.8%
Volatile Solids	90%
Existing Solids Handling System	BFP - Komline Sanderson GRS-SE-2

3. Bench Test Results of Polymer Reaction:

The first step of the pilot test is conducting bench tests to determine which polymers are suitable for the sludge generated at the Enfield WPCF. The bench tests were performed using polymers from the manufacturers (K) Ashland and (FBS) Fort Bend Services. The products tested were FBS 6750, FBS 6804, FBS 7802. Table 3 below shows the bench test results from multiple trials with different polymers.

The pilot unit was installed and settings 1 through 8 below were tested or observed:

1. Throughput
2. Speed of screw press auger
3. Polymer consumption
4. Concentration of polymer solution
5. Various pressures at discharge of screw press
6. Conditions at mixing valve
7. Flocculation pipe (pressure feeding of screw press only)
8. Different polymers

Table 3 - Bench Test Results

Polymer (Type)	Sludge (mL)	Polymer (mL)	Polymer Solution Strength (%)	Free Water Drainage (mL)	Free Water (%)
FBS 6750	200	25	0.25	115	45%
FBS 6804	200	75	0.25	170	48%
FBS 7802	200	55	0.25	140	43%

FBS 6750: Medium, Stable Flocculent
FBS 6804: Medium, Stable Flocculent
FBS 7802: Medium, Stable Flocculent

The most effective polymer and sludge reaction occurred with the FBS 7802 polymer which released 43% of the liquid from the sludge within 30 seconds, therefore the polymer was used for piloting.

4. Pilot Test Results:

Pilot testing is performed to determine the operating conditions and ranges for the screw press to achieve its best performance. The success of the screw press performance is measured using several parameters such as the following:

- Cake Solids Characteristics
- Polymer Consumption
- Capture Rate
- Solids / Hydraulic Loading
- Screw Speed
- Solid Loading
- Pressure Settings

The testing program is sometimes modified during test runs in case of unusual operating conditions or performance characteristics. Table 4 represents the schedule which was followed throughout the testing period.

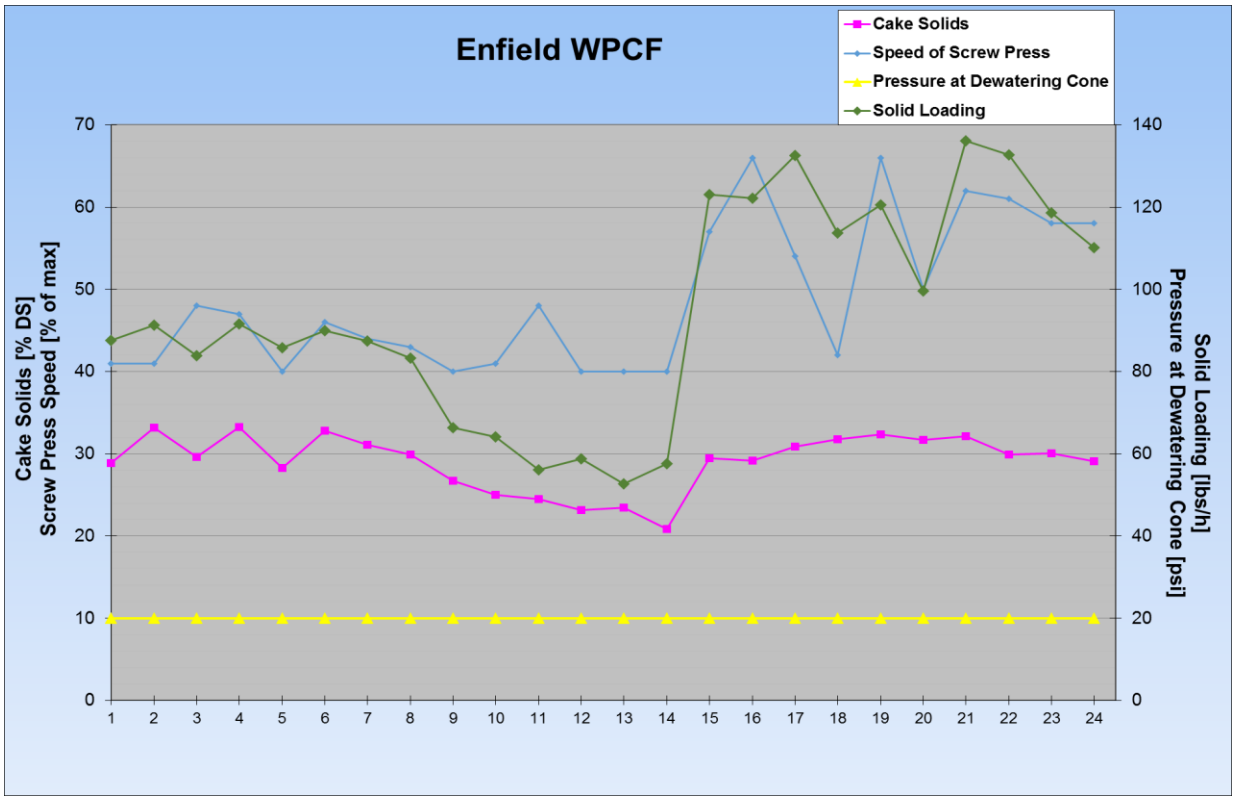
Table 4 - Pilot Test Schedule

Day	Test Runs	Sludge Type	Polymers Used
Monday	Arrival - Setup 1 - 8	Blend	FBS 7802
Tuesday	9 - 20	Blend	FBS 7802
Wednesday	21 - 24	Blend	FBS 7802
Thursday	Cleanup	N/A	N/A
Friday	Cleanup - Departure	N/A	N/A

4.1 Sludge Test

Figure 1 and figure 2 are a graphical overview of the main parameters and conditions of which the screw press was operated within:

Figure 1 - General Overview 1



The cake solids ranged between 20.9% and 33.2% DS. The polymer consumption was maintained within a range of 15 lbs. active / dry ton and 48 lbs. active / dry ton to ensure good dewatering performance.

Figure 2 - General Overview 2

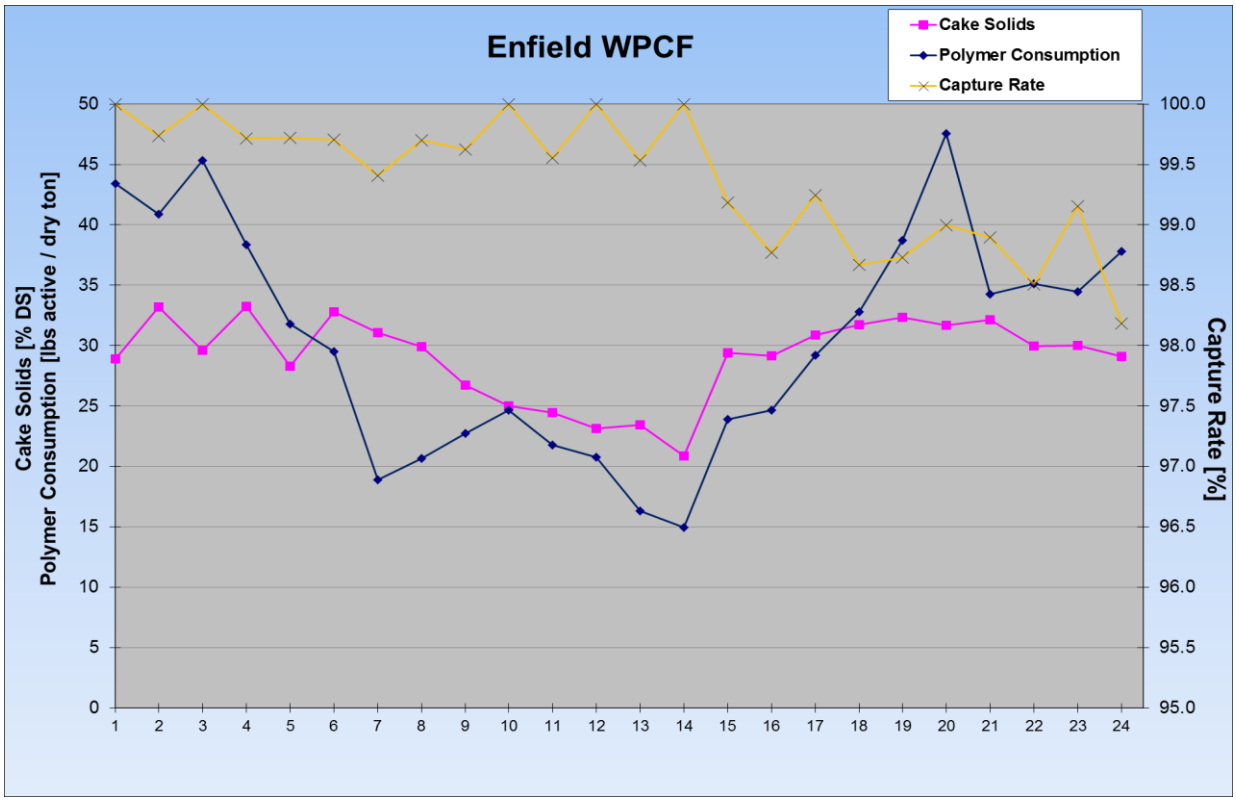


Table 5 - Pilot Test Final Results

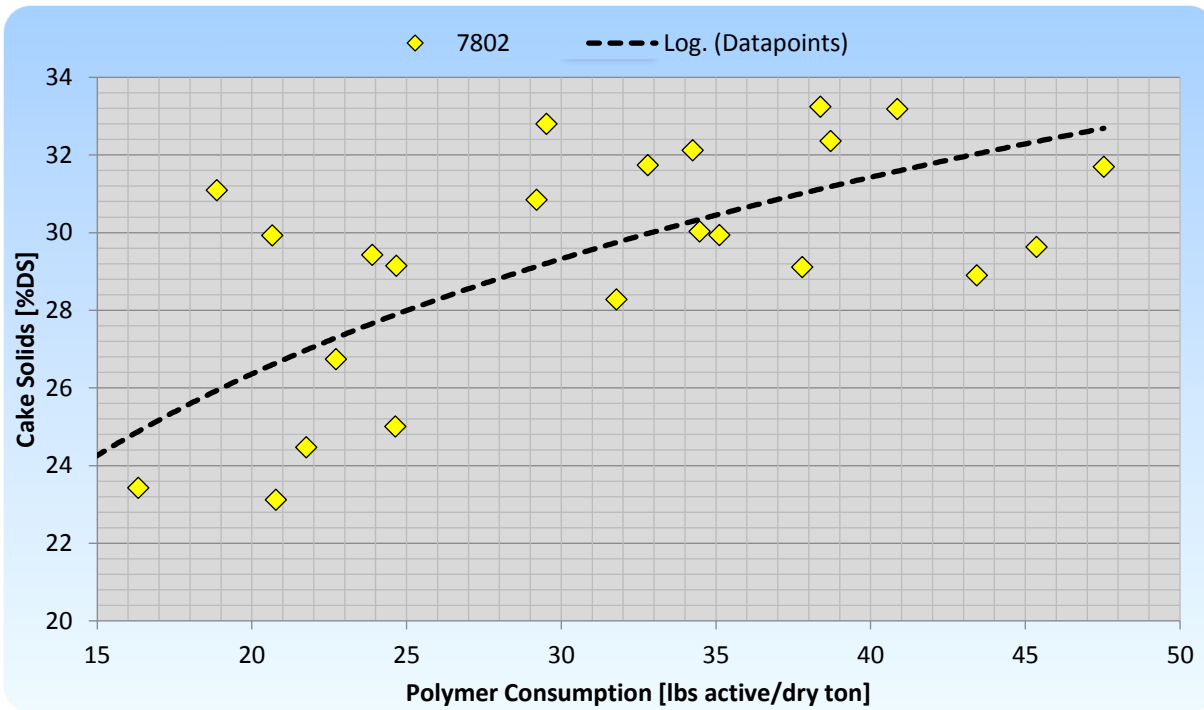
Enfield WPCF			
Sludge Type: Blended Primary / Secondary	**Minimum**	**Maximum**	**Average**
Screw Press Speed (rpm)	0.8	1.4	1
Pressure at Screw Press Inlet (psi)	0	6.3	2
Pressure at Dewatering Cone (psi)	20	20	20
Feed Sludge Solid Content (%DS)	2	3.8	2.7
Cake Solids (%DS)	20.9	33.2	29
Solid Loading Rate (lbs/hr)	53	136	94
Flow Rate (GPM)	4.8	10	7
Polymer Consumption (lbs act/ton DS)	15	48	30
Capture Rate (%)	98.2	100	99.4

These set-points cover a wide range to determine the best performance settings. The above ranges are not intended to be the final design parameters for any construction or upgrades. The optimal and operational set-points and ranges are defined in the conclusion of this report.

4.1.1 Polymer Dosing Effect on Cake Solids

The screw press was operated with one polymer and multiple dosing rates ranging from 14.9 - 47.5 lbs active / dry ton. Figure 3 illustrates the effect that the polymer dosing had on the cake solids.

Figure 3 - Polymer Dosing Effect on Cake Solids



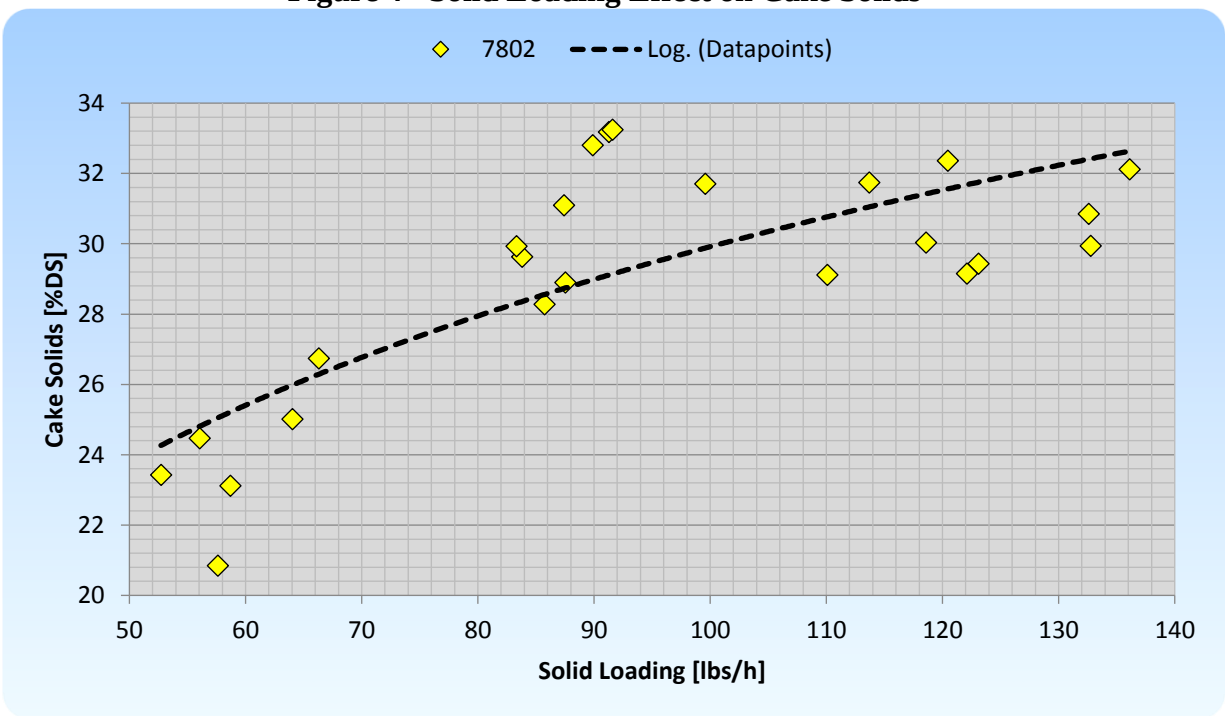
The cake solids were consistent between 20.9% to 33.2% when using 15 - 48 lbs active / dry ton. The dry solid content is increasing with the increase of polymer consumption. The optimal polymer consumption is 30 - 35 lbs. active / dry ton solids.

4.1.2 Solid and Hydraulic Loading Effect on Cake Solids:

The screw press was operated using sludge with an inlet solid content of 2% and 3.8% DS. The sludge flow rate was set between 4.8 and 10.2 GPM resulting in a maximum solid loading of 136 lbs/hr.

The solid loading certainly affects the performance of the screw press and there is always an optimum loading for a certain set of parameters. Figure 4 shows that the maximum cake solids achievable with these parameters was 33.2 % DS.

Figure 4 - Solid Loading Effect on Cake Solids

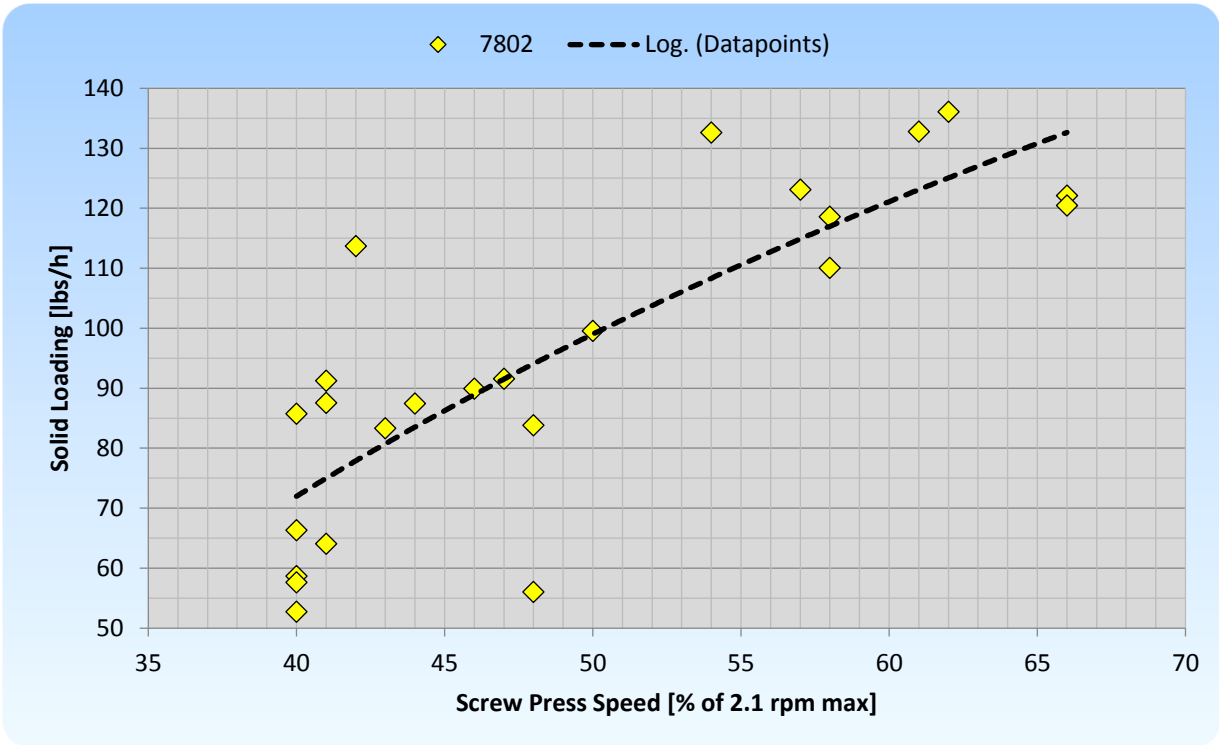


In general the effect of the solids loading on the discharged cake solids is also related to the screw speed. The solids loading determines the speed of the auger with higher loading rates requiring higher screw speeds which can often result in a lower discharging rate of cake solids.

There is always a compromise when setting the operational parameters of the screw press trying to achieve the highest possible high cake solids with the maximum possible throughput. In theory the optimal performance solution is to utilize an oversized machine allowing for an extended retention time. However, that is not the most cost effective solution. The system should be designed with a careful balance in mind allowing for high cake solids with an acceptable throughput and carefully calculated life cycle costs.

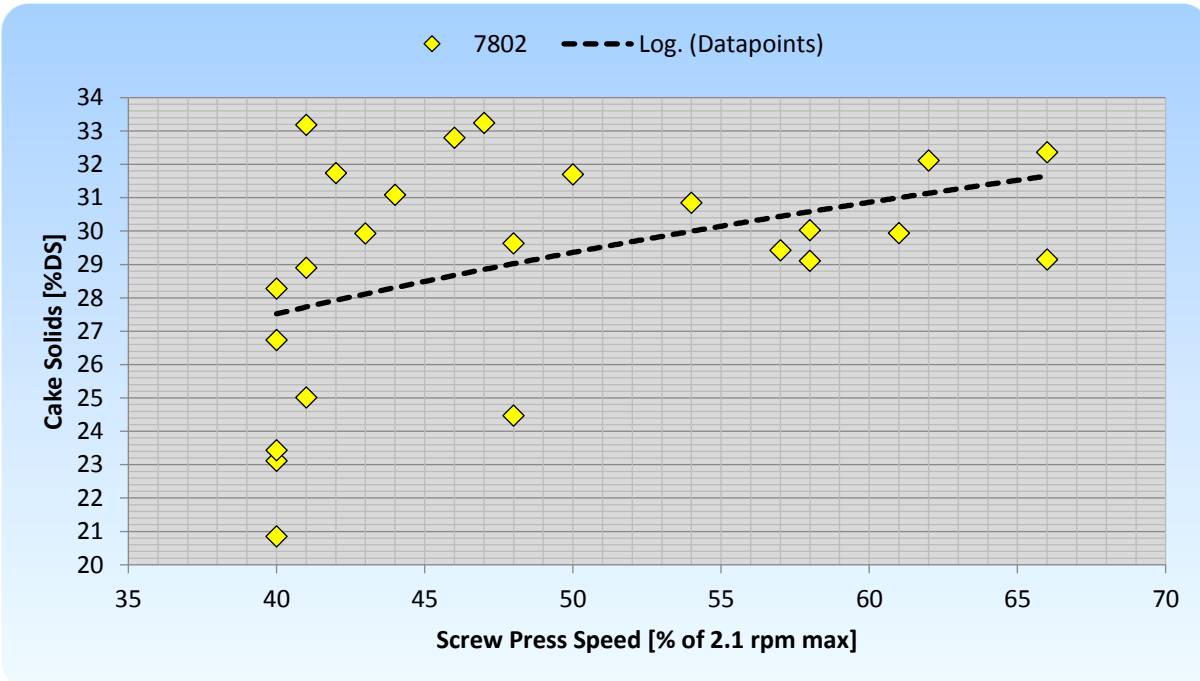
The highest performance rating is determined by the conveyance capacity of the screw press which is mainly a function of the screw speed and how fast the water can drain in the dewatering and thickening zones. The screw press is operated at its optimum when the parameters are in balance and the fill rate of the auger volume is at its maximum capacity. This means the maximum dewatering performance can be achieved as the screw press can build pressure throughout the entire length of the auger and through the discharge point. If the system is not balanced (e.g. screw speed is too high) the auger will not fill completely and the sludge will be discharged prior to building up pressure in the dewatering zone which is where the optimum dewatering occurs.

Figure 5 - Screw Speed Effect on Throughput



This point of operation changes with many parameters: polymer dosing, polymer injection and mixing system, hydraulic and solids loading, screw speed, and cone pressure. It is a very complex relationship and very sensitive to fluctuations. For peak efficiency and performance the screw press should be operated just below the point that it is overloaded.

Figure 6 - Screw Speed Effect on Cake Solids



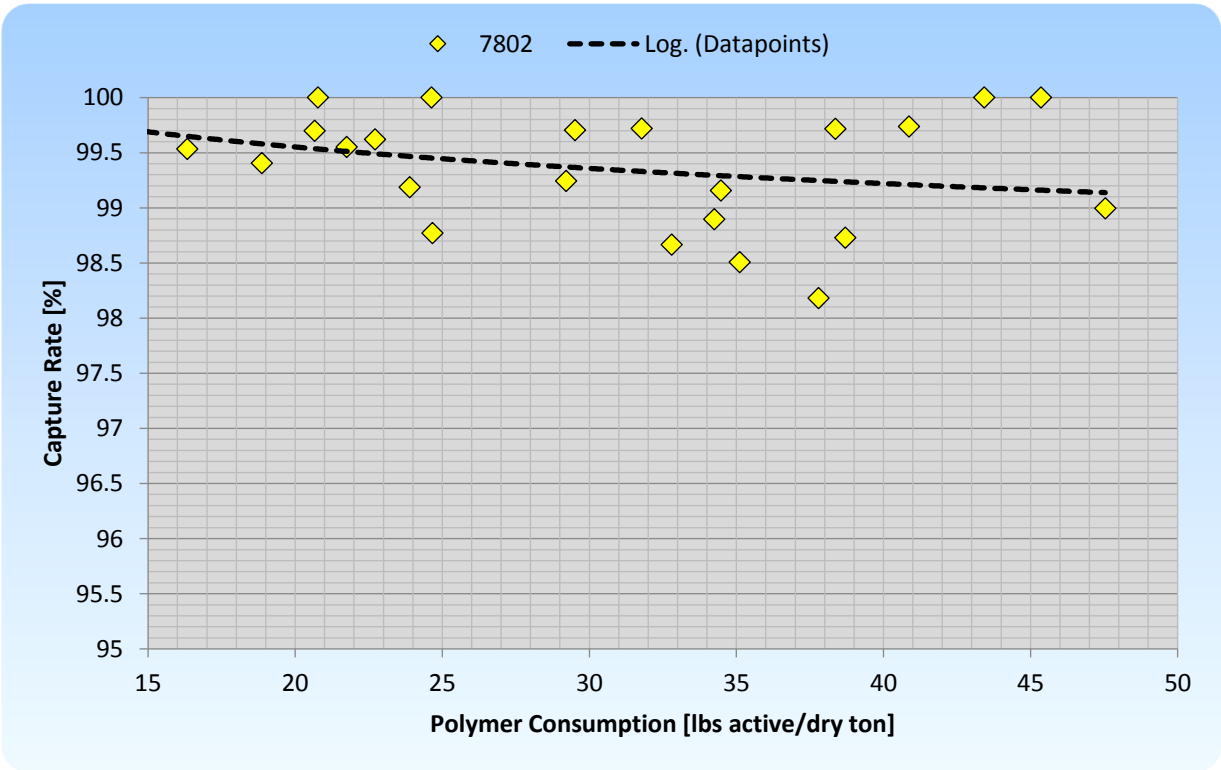
If the screw press is overloaded (i.e the screw speed is too slow for desired hydraulic loading) the pressure build up will continue down into the inlet chamber and if this happens the screw press can no longer operate in a steady state and the system will need to shut down temporarily due to the high pressure in the inlet box. Due to this it would be ideal for the feed pumps to be controlled automatically via the onboard screw press system to allow for real-time throttling thereby keeping the press(es) operational efficiency at its peak.

4.1.3 Capture Rate:

The average capture rate of 99.4% is a great result for the dewatering system. The capture rate is effected by many different elements and so three of them are represented in the following figures.

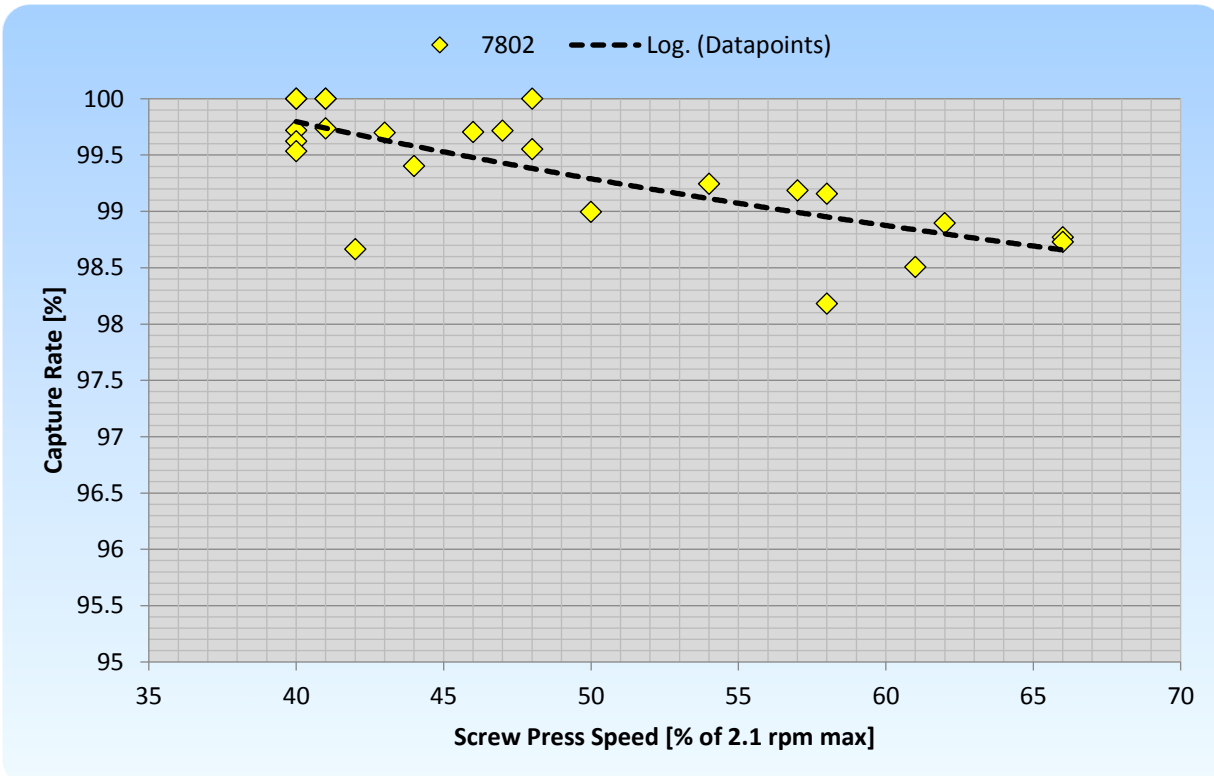
Parameters effecting the capture rate:
- Polymer Consumption (Figure 7)
- Screw Press Speed (Figure 8)
- Inlet Feed Pressure on the Inlet Flange (Figure 9)

Figure 7 - Polymer Consumption and Capture Rate



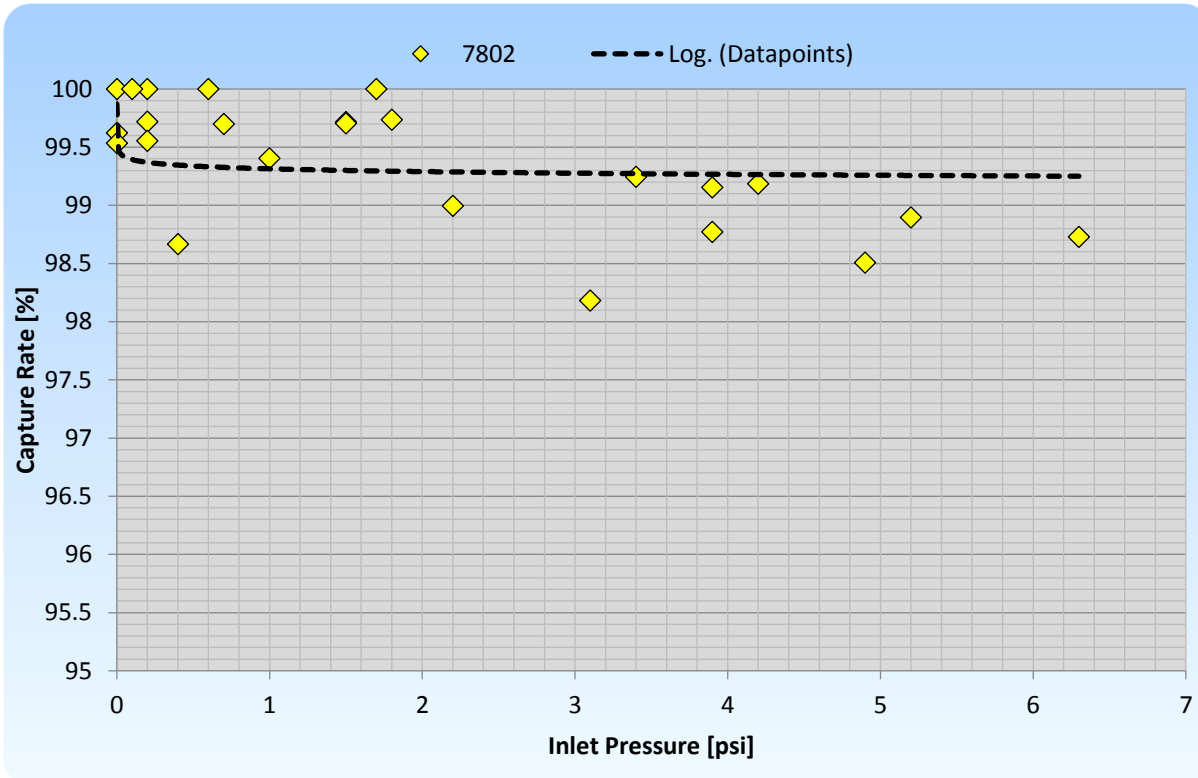
As shown in Figure 7, the capture rate slightly decreased with increasing polymer consumption. Once the optimal settings are determined, consistently high results can be expected. The capture rate was greater than 98% throughout the pilot trial.

Figure 8 - Screw Press Speed Effect on Capture Rate



The test results in Figure 8 above show a large variation in capture rate which is highly affected by the screw press speed. The capture rate drops gradually when operating the screw press with speeds ranging from 40% to 66% of its maximum 2.1 rpm.

Figure 9 - Inlet Feed Pressure Effect on Capture Rate



The pressure at the inlet flange applied to the feed did not have a large impact on the capture rate as shown in Figure 9 above. Typically the higher the pressure, the more sludge is pressed through the wedge section screen of the basket.

5. Conclusion

The pilot test proved the capability of the Huber screw press to dewater the sludge at the Enfield WPCF. The screw press is able to handle the sludge and produce cake with up to 33.2% DS.

Table 6 - Sludge Test Conclusion

Sludge Parameters	Best Result Settings	Results at Low Polymer Consumption
Flow Rate (GPM)	10	10
Solid Loading (lbs/hr) at % Feed Solid	136 at 2.72%	123 at 2.46%
Polymer Consumption (lbs. active / dry ton)	32 - 36	22 - 26
Screw Speed (% of max. 2.1 rpm)	62	57
Cake Produced (%DS)	30 - 34	28 - 30
Capture Rate (%)	98	98

For the blended primary / secondary sludge, cake can be expected in the range of 28% to 34% with a filtrate which is clear and almost without any solids during dewatering mode when using between 22 and 36 lbs. active / dry ton of the FBS 7802 polymer. The average capture rate during the pilot demonstration was 99.4%.

6. Summary of Activities

Monday - May 4th, 2015

- Traveled to the site.
- Set up the pilot unit.
- Test performed with different settings, polymer flows, and polymer concentrations.
- Cake samples analyzed for dryness, and filtrate samples analyzed for capture rate.

Tuesday - May 5th, 2015

- Test performed with different settings, polymer flows, and polymer concentrations.
- Cake samples analyzed for dryness, and filtrate samples analyzed for capture rate.

Wednesday - May 6th, 2015

- Tests performed with different settings, polymer flows, and polymer concentrations.
- Cake samples analyzed for dryness, and filtrate samples analyzed for capture rate.

Thursday - May 7th, 2015

- Tests performed with different settings, polymer flows, and polymer concentrations.
- Cake samples analyzed for dryness, and filtrate samples analyzed for capture rate.
- Began cleaning pilot trailer and pilot site.

Friday - May 8th, 2015

- Loaded the trailer and departed the facility

We here at Huber Technology would like to extend our gratitude to everyone who participated in the safe and successful Screw Press RoS3Q 280 pilot tests this week at the wastewater treatment plant in Enfield, CT. We enjoyed the opportunity to present Huber Technology's capabilities of helping your facility operate at a more sustainable and efficient level of dewatering. Huber Technology looks forward to providing your facility highly reliable products in the future.

Appendices

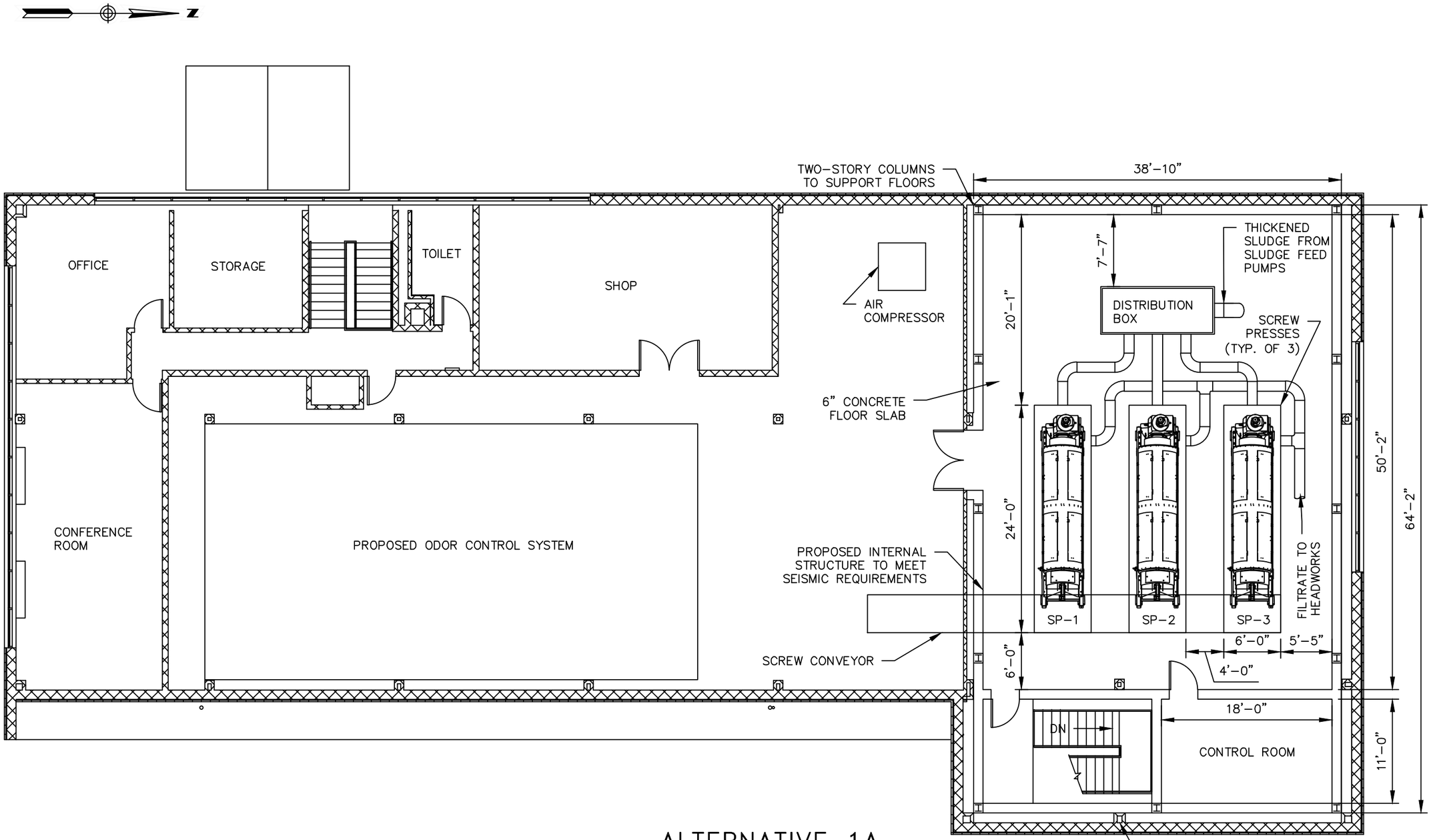
Appendix A – Screw Press RoS3Q 280 Pilot Test Photos

Pilot Unit

Pilot Unit Mobile Laboratory

Screw Press Discharged Cake Solids

Screw Press Filtrate



ALTERNATIVE 1A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION A

SCALE: 3/32" = 1'-0"

1699 King Street, Suite 406
Enfield, Connecticut 06082
855.347.6788 | www.woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION A

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OPS BLDG

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-103A

APPENDIX O: FOURNIER ROTARY PRESS PILOT TEST REPORT-CONCEPTUAL DRAWING

FOURNIER ROTARY PRESS TESTING
FOR WASTEWATER SLUDGE DEWATERING

Town of Enfield Connecticut Wastewater Treatment Plant

FOURNIER INDUSTRIES INC.
3787 West Frontenac Blvd.
Thetford Mines (Quebec) Canada G6H 2B5

Phone : (418) 423-4241
Fax : (418) 423-7366
E-mail : general@fournierindustries.com
http://www.rotary-press.com/

IT/ **May 1st 2015**

Table of Contents

I. Introduction

II. Pilot Equipment Description

III. Jar Testing and Prestart-up

Figure 1: Mobile Unit Arrangement

IV. Pilot Testing

V. Results and Discussion

Table of comparison: Hinton sludge.

Table 1-A: Pilot Results – Day 1 April 28th 2015
Table 1-B: Pilot Results – Day 2 April 29th 2015
Table 1-C: Pilot Results – Day 2 April 30th 2015
Graph 1: Production versus Cake Dryness
Graph 2: Flow Rate versus Cake Dryness

VI. Conclusion

I. Introduction

The purpose of this report is to present the results from the Fournier Rotary Press pilot trials performed at the Wastewater Treatment Facility in Enfield Connecticut on April 28th to April 30th 3015. A Fournier Rotary Press pilot test is the most efficient way to determine the suitability of its sludge dewatering capability. Ranges of operation during the trial allows us to determine the peak performance for the following values

- Cake Dryness
- Minimal Polymer Consumption
- Maximum Capture Rate
- Maximum Flow Throughput and Production per Channel

The Dewatering trials were performed on the primary and secondary blend.

In the conclusion of this report design parameters for a future Rotary Press installation will be established and presented in section V.

II. Pilot Equipment and Description

The Fournier Rotary Press pilot has two channels allowing two trial options, a CVP channel (three inch channel), used for sludge with a high throughput and easy dewatering, and a CV channel (two inch channel), used for a sludge that needs more surface area per unit volume allowing the cake to be dryer. For this pilot the channel CV was selected to test the capability with this type of sludge. The dewatering unit arrives inside a 20 foot container, hauled by truck directly to the site. Sludge from the plant was pumped to the pilot unit's holding tank, and then pumped to the flocculation tank for conditioning.

The following is a list of the components.

- Model 1-900/2000CV Rotary Press
- Model 1-900/2000CVP Rotary Press
- Flocculator Assembly
- Progressive Cavity Feed Pump
- Sludge Holding Tank and Mixer
- Progressive Cavity Polymer Feed Pump
- Two Polymer Preparation Tanks and Mixers
- Cake Conveyor
- Control Panel

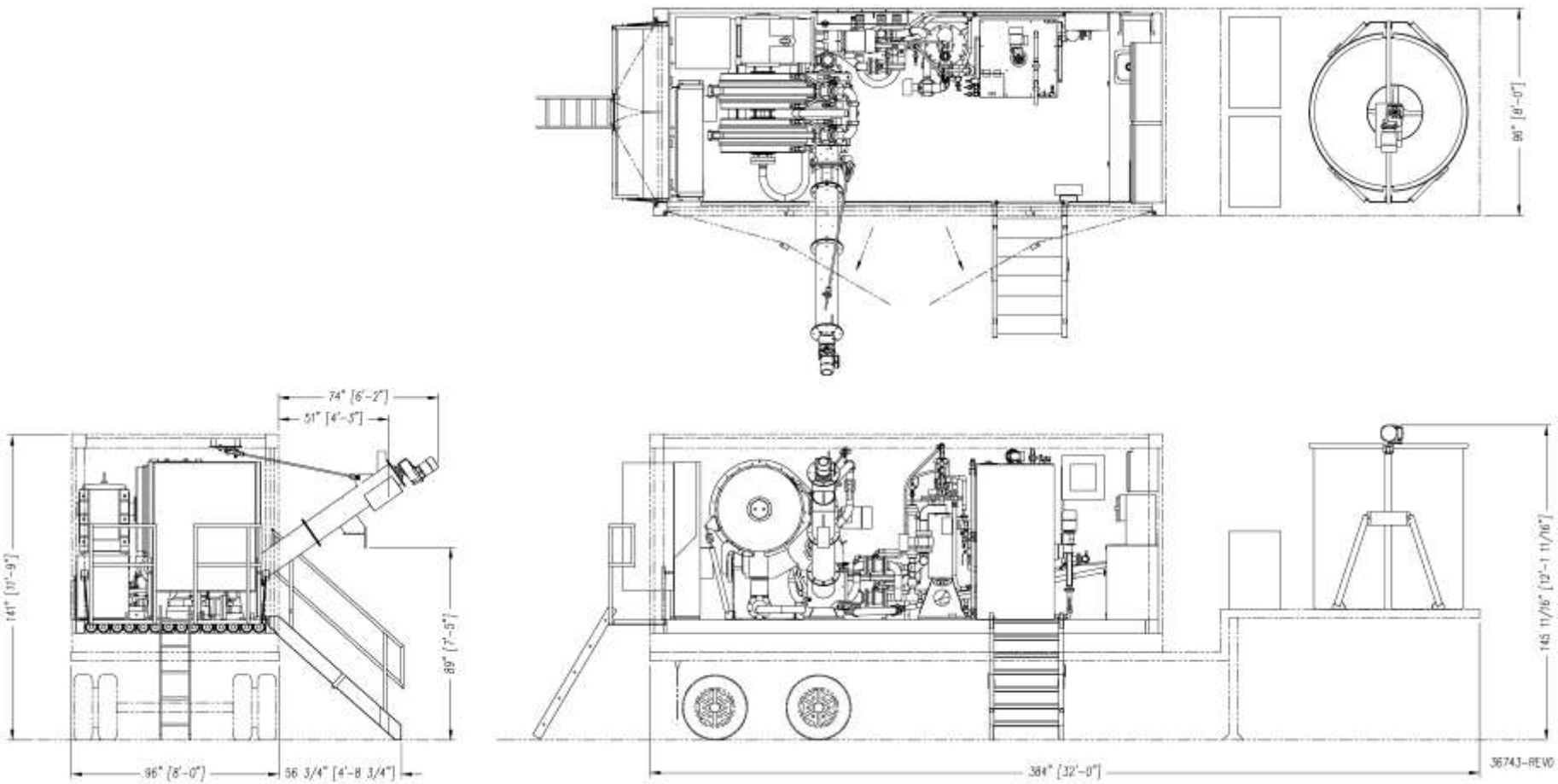
III. Jar Testing and Prestart-up

One of the first steps during the pilot, that allows us to determine the best polymer for the dewatering of that particular sludge, is a Jar Test. Two types of polymer and the facilities current polymer were selected to produce the best flocculation for the sludge. The emulsion polymer **Ashland Praestol k-274 flx**, dry polymer **Ashland Praestol 858 BS**, and the facilities manic polymer **ACP-07A**, were used.

A check list of the following components was performed before start-up to insure correct operation.

- Polymer Pump
- Polymer Flow Meter
- Sludge Pump
- Sludge Flow Meter
- Inlet Pressure Gauge
- Flocculator Tank and Mixer
- Pneumatic Recirculation Valve
- Pneumatic Dewatering Valve
- Rotary Press Channels and Motor

Figure 1: Mobile Unit General Arrangement



IV. Pilot Testing

The goal of the pilot testing is to determine the best available performance of the Fournier Rotary Press using the actual plant sludge. Operating ranges and parameters are adjusted based on results of the following:

- Cake Production
- Cake Dryness
- Capture Rate
- Energy Consumption
- Polymer Consumption (active lbs.)
- Sludge Flow Rate

Adjustments of operating parameters are made during the trial period to determine the overall range possible outcome.

Testing schedule is represented in the following table.

Date	Test Runs	Polymer
Monday, April 27th	Set up begins	
Tuesday, April 28th	Run # 1a – 1t	Ashland Praestol k-274flx
Wednesday, April 29th	Run # 2a – 2v	Ashland Praestol 858 BS
Thursday, April 30th	Run # 3a – 3xx	Facilities ACP-07A
Friday, May 1st	Trailer Pickup	

V. Results and Discussion

Presented in Table 1 thru 3 are the results of the piloting trial on primary and secondary blended sludge at the Enfield facility. The table displays operating parameters such as:

- Polymer Type, Concentration and Dosage
- Flocculator Speed
- Rotary Press Speed
- Rotary Press Inlet Pressure and Outlet Pressure
- Sludge Flow and Total Solids

The follow are the results of the testing that are also presented in the table:

- Filtrate Total Suspended Solids
- Cake Total Solids
- Production Rate per Channel
- Capture Rate

The cationic emulsion polymer Ashland Praestol k-274flx, dry polymer Ashland Praestol 858 BS, and the facilities manic polymer ACP-07A, formed an excellent flocculation with the provided sludge. Each time a new polymer solution was prepared it's diluted down to 0.2% or 0.1 % active concentration, pumped to the flocculation tank inlet, and mixed with the sludge before being fed to the Rotary Press. The polymer dosage of required to adequately flocculate the sludge, was averaging **11.3 active lbs of polymer per dry ton of solid**.

The piloting trial produced excellent cake dryness, production, and the total suspended solids measured in the filtrate demonstrated a decent capture rate. The Rotary Press start-up and shutdown procedures consist of a simple push-button operation, it's designed for unmanned operation, and presents a consistent reliable operation under automatic mode making it ideal for this application. The Rotary Press obtained cake dryness up to **32.91 % TS**, a capture rate averaging **98 %,** and production as high as **393 dry Lbs/ hour.**

Table 1: Pilot Results Blended Sludge

Day 1 April 28, 2015

FOURNIER INDUSTRIES INC.

ENVIRONMENTAL DIVISION

Location: Enfield, CT Wastewater Facility
ROTARY PRESS Model 900-1000CV
(Channel OPTIMUM)
Sludge type: Primary and Secondary Blend

Industrial waste: N
Color of Sludge: Black and Brown
Sludge Temperature: 52.2 Deg
Cloth Test: 17.709%
Sludge PH: 6.4

Technicians: Isaac Therrien
From: April 28th to 30th 2015

	GENERAL				OPERATING PARAMETERS						RESULTS				
		POLYMER			FLOCCULATOR	ROTARY PRESS									
DATE	RUN #	TYPE	CONCEN. ACTIVE	DOSAGE (Lbs/dryton) ACTIVE	SPEED (RPM)	SPEED (RPM)	ENERGY USAGE (Kw-hr/ 2000 dry lbs)	INLET PRESSURE (PSI)	OUTLET PRESSURE (PSI)	SLUDGE (USGPM)	SLUDGE TS (%)	FILTRATE TSS (%)	CAKE TS (%)	PRODUCTION PER CHANNEL (dry Lbs/hr)	CAPTURE RATE TSS (%)
April 28,2015	1a	Praestol K 274 FLX	0.20%	12.5	350	0.35	3.25	4.5	40	12.0	3.36%	0.06	29.61%	198	98.3
April 28,2015	1b	Praestol K 274 FLX	0.20%	11.0	350	0.35	3.57	4.5	40	11.0	3.47%	0.10	26.67%	185	97.0
April 28,2015	1c	Praestol K 274 FLX	0.20%	9.7	350	0.35	3.09	4.5	40	11.0	3.52%	0.03	23.68%	192	99.3
April 28,2015	1d	Praestol K 274 FLX	0.20%	8.2	350	0.30	3.16	4.5	40	9.0	3.90%	0.04	25.85%	173	99.0
April 28,2015	1e	Praestol K 274 FLX	0.20%	9.5	275	0.30	3.07	4.5	40	10.0	3.56%	0.15	26.92%	170	95.7
April 28,2015	1f	Praestol K 274 FLX	0.20%	8.4	225	0.30	3.48	5.0	40	8.0	3.56%	0.14	25.11%	137	96.2
April 28,2015	1g	Praestol K 274 FLX	0.20%	10.1	225	0.25	3.02	5.0	40	10.0	3.56%	0.09	26.91%	173	97.4
April 28,2015	1h	Praestol K 274 FLX	0.20%	10.7	300	0.25	2.87	5.0	40	10.0	3.56%	0.13	28.26%	171	96.2
April 28,2015	1i	Praestol K 274 FLX	0.20%	10.7	300	0.25	2.86	5.0	40	10.0	3.56%	0.12	29.18%	172	96.7
April 28,2015	1j	Praestol K 274 FLX	0.20%	12.0	300	0.20	3.54	5.0	40	8.0	2.99%	0.07	29.99%	117	97.8
April 28,2015	1k	Praestol K 274 FLX	0.20%	10.4	300	0.20	3.17	5.0	40	8.0	3.66%	0.02	28.67%	145	99.4
April 28,2015	1l	Praestol K 274 FLX	0.20%	11.2	300	0.20	3.17	5.0	40	8.0	3.40%	0.01	31.77%	136	99.8
April 28,2015	1m	Praestol K 274 FLX	0.20%	11.2	300	0.30	2.77	5.0	40	12.0	3.40%	0.08	28.14%	199	97.6
April 28,2015	1n	Praestol K 274 FLX	0.20%	11.2	300	0.30	2.90	5.0	40	12.0	3.40%	0.12	27.05%	197	96.4
April 28,2015	1o	Praestol K 274 FLX	0.20%	11.2	300	0.40	2.54	5.0	40	16.0	3.40%	0.12	25.94%	262	96.5
April 28,2015	1p	Praestol K 274 FLX	0.20%	11.2	300	0.40	2.52	5.0	40	16.0	3.40%	0.07	26.09%	266	97.9
April 28,2015	1q	Praestol K 274 FLX	0.20%	11.2	300	0.45	2.37	5.0	40	16.0	3.40%	0.07	22.74%	266	98.0
April 28,2015	1r	Praestol K 274 FLX	0.20%	10.6	300	0.50	2.32	5.0	40	17.0	3.40%	0.08	21.89%	282	97.8
April 28,2015	1s	Praestol K 274 FLX	0.20%	10.6	300	0.60	2.57	5.0	40	18.0	3.40%	0.07	22.15%	300	98.0
April 28,2015	1t	Praestol K 274 FLX	0.20%	9.4	300	0.70	2.31	5.0	40	21.0	3.40%	0.04	19.74%	352	98.8
AVERAGE		**Praestol K 274 FLX**	***0.20%***	***10.5***	***301.3***	***0.35***	***2.93***	***4.9***	***40.0***	***12.2***	***3.47%***	***0.08***	***26.32%***	***205***	***97.7***

Table 2: Pilot Results Blended Sludge

Day 2 April 29th 2015

FOURNIER INDUSTRIES INC.

ENVIRONMENTAL DIVISION

Location: Enfield, CT Wastewater Facility
ROTARY PRESS Model 900-1000CV
(Channel OPTIMUM)
Sludge type: Primary and Secondary Blend

Industrial waste: N
Color of Sludge: Black and Brown
Sludge Temperature: 61.2 Deg
Cloth Test: 20.582%
Sludge PH: 6.1

Technicians: Isaac Therrien
From: April 28th to 30th 2015

	GENERAL				OPERATING PARAMETERS						RESULTS				
		POLYMER			FLOCCULATOR	ROTARY PRESS									
DATE	RUN #	TYPE	CONCEN. ACTIVE	DOSAGE (Lbs/dryton) ACTIVE	SPEED (RPM)	SPEED (RPM)	ENERGY USAGE (Kw-hr/ 2000 dry lbs)	INLET PRESSURE (PSI)	OUTLET PRESSURE (PSI)	SLUDGE (USGPM)	SLUDGE TS (%)	FILTRATE TSS (%)	CAKE TS (%)	PRODUCTION PER CHANNEL (dry Lbs/hr)	CAPTURE RATE TSS (%)
April 29,2015	2a	Praestol 858 BS	0.20%	8.0	350	0.25	3.80	5.5	40	8.0	2.99%	0.08	24.67%	116	97.4
April 29,2015	2b	Praestol 858 BS	0.20%	6.7	400	0.25	5.38	5.5	40	6.0	2.98%	0.16	24.10%	85	94.7
April 29,2015	2c	Praestol 858 BS	0.20%	9.4	325	0.25	4.94	5.5	40	6.0	2.99%	0.09	25.31%	87	97.0
April 29,2015	2d	Praestol 858 BS	0.20%	9.4	325	0.25	3.65	5.5	40	9.0	2.99%	0.02	24.41%	133	99.2
April 29,2015	2e	Praestol 858 BS	0.20%	9.4	325	0.20	3.42	5.5	40	8.0	2.99%	0.07	26.35%	116	97.7
April 29,2015	2f	Praestol 858 BS	0.20%	7.4	325	0.20	3.93	5.5	40	7.0	2.99%	0.09	27.06%	101	96.9
April 29,2015	2g	Praestol 858 BS	0.20%	7.4	325	0.30	3.81	5.5	40	9.0	2.99%	0.09	23.66%	130	97.0
April 29,2015	2h	Praestol 858 BS	0.20%	7.4	325	0.30	3.30	5.5	40	10.0	2.99%	0.05	22.68%	146	98.2
April 29,2015	2i	Praestol 858 BS	0.20%	7.4	325	0.35	3.31	5.5	40	11.0	2.99%	0.07	21.76%	160	97.8
April 29,2015	2j	Praestol 858 BS	0.20%	6.6	325	0.35	2.63	5.5	40	12.0	3.33%	0.02	22.58%	198	99.3
April 29,2015	2k	Praestol 858 BS	0.20%	6.3	325	0.35	2.29	5.5	40	13.0	3.47%	0.02	21.75%	223	99.3
April 29,2015	2l	Praestol 858 BS	0.20%	8.2	325	0.40	2.42	5.5	40	14.0	3.40%	0.02	21.44%	236	99.3
April 29,2015	2m	Praestol 858 BS	0.20%	8.2	325	0.40	2.84	5.5	40	13.0	3.40%	0.14	23.38%	211	95.9
April 29,2015	2n	Praestol 858 BS	0.20%	8.2	325	0.45	2.29	5.5	40	15.0	3.40%	0.01	21.60%	254	99.7
April 29,2015	2o	Praestol 858 BS	0.20%	8.2	325	0.50	2.68	5.5	40	15.0	3.40%	0.07	21.53%	250	98.0
April 29,2015	2p	Praestol 858 BS	0.20%	8.2	325	0.50	2.67	5.5	40	15.0	3.40%	0.13	21.80%	245	96.3
April 29,2015	2q	Praestol 858 BS	0.20%	10.0	325	0.55	2.80	5.5	40	16.0	3.40%	0.13	22.11%	261	96.1
April 29,2015	2r	Praestol 858 BS	0.20%	10.0	325	0.55	2.52	5.5	40	16.0	3.40%	0.16	21.11%	259	95.2
April 29,2015	2s	Praestol 858 BS	0.20%	10.0	325	0.65	2.72	5.5	40	17.0	3.40%	0.04	19.83%	285	98.8
April 29,2015	2t	Praestol 858 BS	0.20%	10.0	325	0.65	2.44	5.5	40	17.0	3.40%	0.03	19.46%	286	99.2
April 29,2015	2u	Praestol 858 BS	0.20%	10.0	325	0.75	2.77	5.5	40	17.0	3.40%	0.04	18.32%	285	98.8
April 29,2015	2v	Praestol 858 BS	0.20%	10.0	325	0.75	2.72	5.5	40	17.0	3.40%	0.06	19.77%	284	98.2
AVERAGE		**Praestol 858 BS**	***0.20%***	***8.5***	***329.5***	***0.42***	***3.15***	***5.5***	***40.0***	***12.3***	***3.23%***	***0.07***	***22.49%***	***198***	***97.7***

Table 3: Pilot Results Blended Sludge

Day 3 April 30th 2015

FOURNIER INDUSTRIES INC.

ENVIRONMENTAL DIVISION

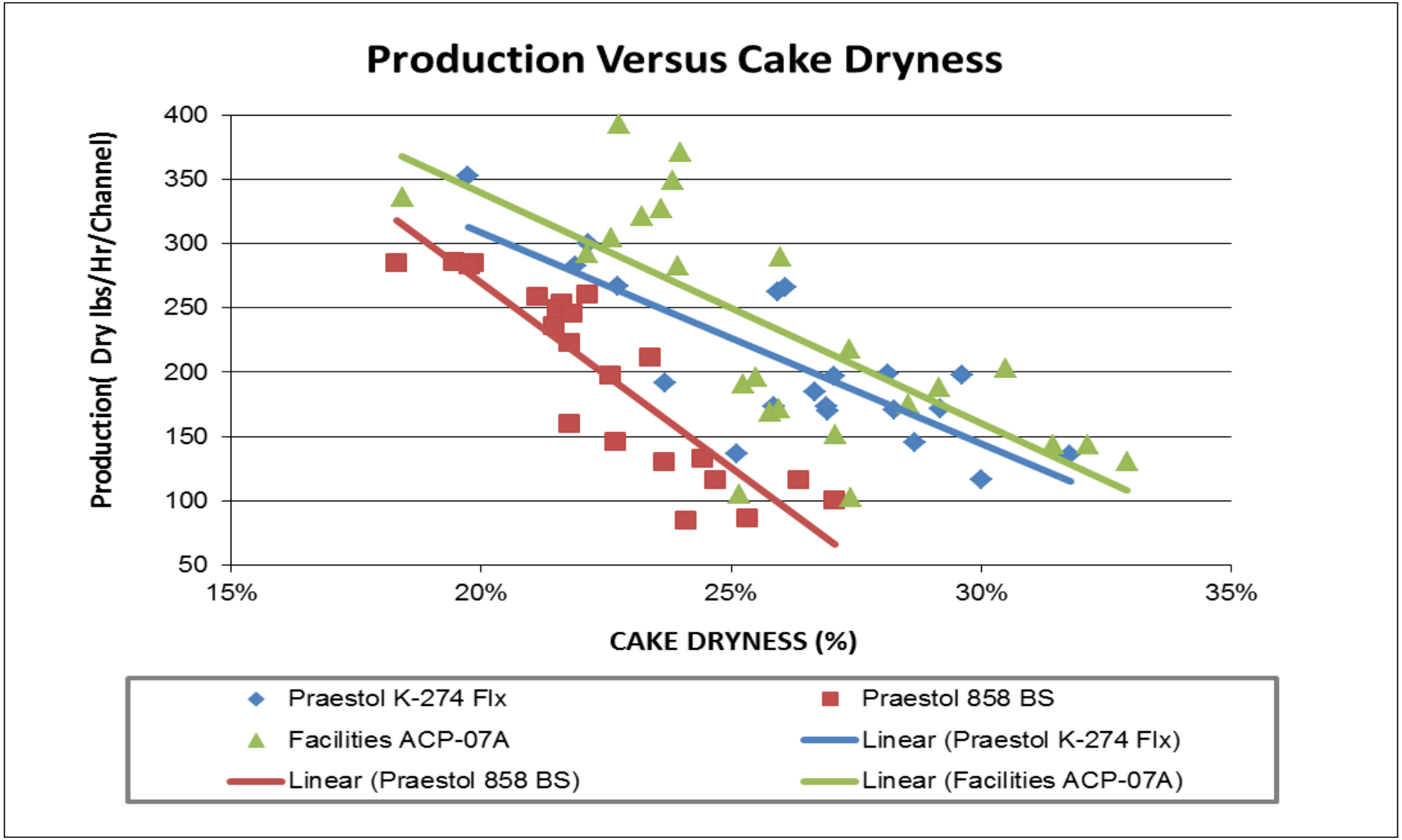
Location: Enfield, CT Wastewater Facility
ROTARY PRESS Model 900-1000CV
(Channel OPTIMUM)
Sludge type: Primary and Secondary Blend

Industrial waste: N
Color of Sludge: Black and Brown
Sludge Temperature: 56.7 Deg
Cloth Test: 19.124%
Sludge PH: 6.3

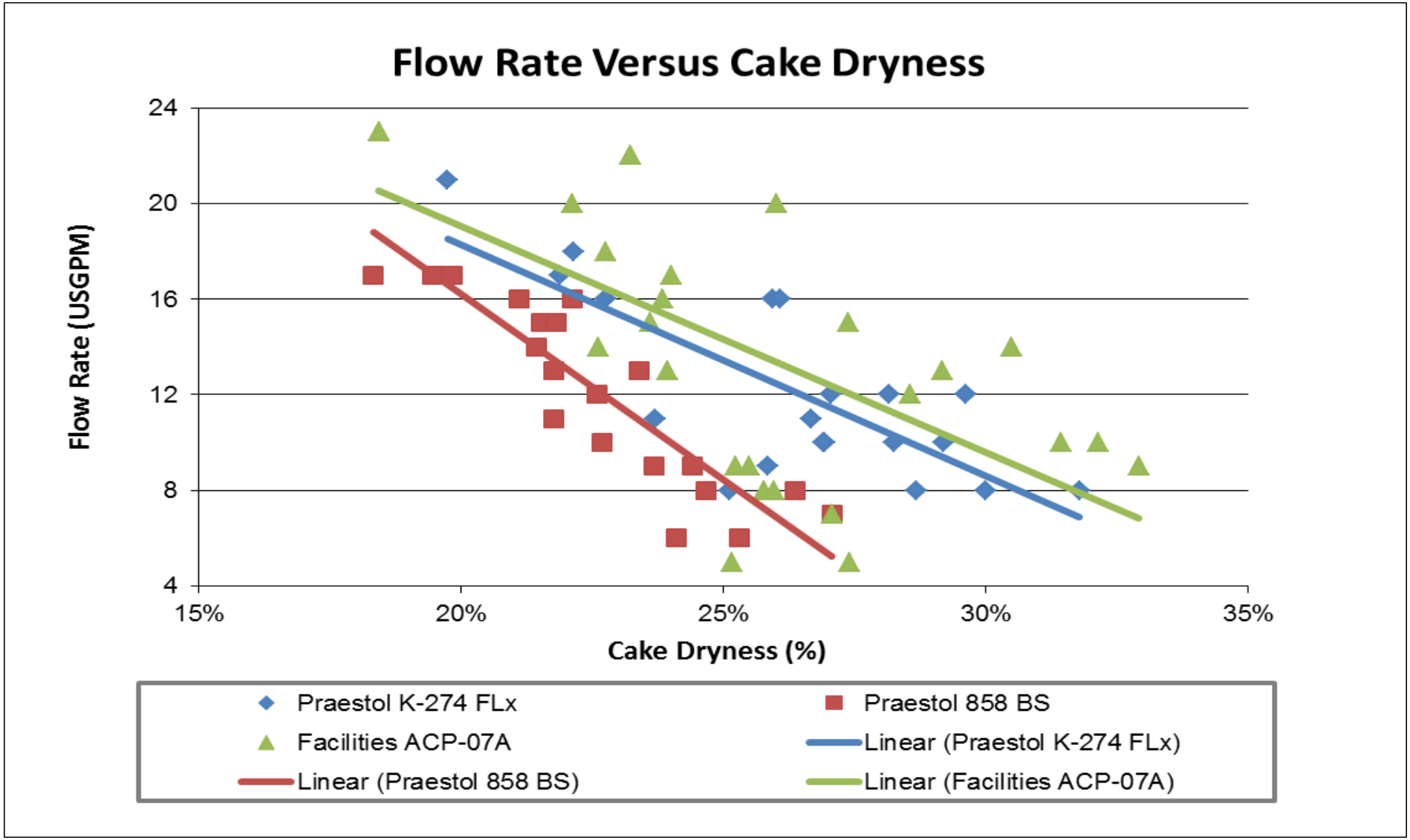
Technicians: Isaac Therrien
From: April 28th to 30th 2015

	GENERAL				OPERATING PARAMETERS						RESULTS				
		POLYMER			FLOCCULATOR	ROTARY PRESS									
DATE	RUN #	TYPE	CONCEN. ACTIVE	DOSAGE (Lbs/dryton) ACTIVE	SPEED (RPM)	SPEED (RPM)	ENERGY USAGE (Kw-hr/ 2000 dry lbs)	INLET PRESSURE (PSI)	OUTLET PRESSURE (PSI)	SLUDGE (USGPM)	SLUDGE TS (%)	FILTRATE TSS (%)	CAKE TS (%)	PRODUCTION PER CHANNEL (dry Lbs/hr)	CAPTURE RATE TSS (%)
April 30,2015	3a	Facilities ACP-07A	0.10%	15.7	325	0.30	2.93	5.5	40	9.0	4.46%	0.09	25.49%	196	97.9
April 30,2015	3b	Facilities ACP-07A	0.10%	16.2	325	0.30	3.25	5.5	40	8.0	4.33%	0.10	25.78%	169	97.8
April 30,2015	3c	Facilities ACP-07A	0.10%	15.9	325	0.25	3.13	5.5	40	7.0	4.40%	0.06	27.07%	151	98.7
April 30,2015	3d	Facilities ACP-07A	0.10%	9.1	325	0.25	4.48	5.5	40	5.0	4.40%	0.30	27.39%	102	93.1
April 30,2015	3e	Facilities ACP-07A	0.10%	13.7	325	0.35	5.15	5.5	40	5.0	4.40%	0.20	25.15%	105	95.4
April 30,2015	3f	Facilities ACP-07A	0.10%	15.9	325	0.35	3.40	5.5	40	8.0	4.40%	0.09	25.95%	172	97.9
April 30,2015	3g	Facilities ACP-07A	0.10%	15.9	325	0.40	3.24	5.5	40	9.0	4.40%	0.14	25.23%	191	96.7
April 30,2015	3h	Facilities ACP-07A	0.10%	11.4	325	0.40	2.43	5.5	40	13.0	4.40%	0.04	23.93%	283	99.2
April 30,2015	3i	Facilities ACP-07A	0.10%	11.4	325	0.40	2.29	5.5	40	14.0	4.40%	0.04	22.61%	305	99.2
April 30,2015	3j	Facilities ACP-07A	0.10%	11.4	325	0.45	2.18	5.5	40	15.0	4.40%	0.03	23.61%	327	99.4
April 30,2015	3k	Facilities ACP-07A	0.10%	11.4	325	0.45	2.10	5.5	40	16.0	4.40%	0.03	23.84%	349	99.4
April 30,2015	3l	Facilities ACP-07A	0.10%	11.4	325	0.55	2.10	5.5	40	17.0	4.40%	0.02	23.99%	371	99.5
April 30,2015	3m	Facilities ACP-07A	0.10%	11.4	325	0.55	2.01	5.5	40	18.0	4.40%	0.02	22.75%	393	99.5
April 30,2015	3n	Facilities ACP-07A	0.10%	16.9	325	0.30	3.29	5.5	40	12.0	2.96%	0.03	28.55%	175	99.0
April 30,2015	3o	Facilities ACP-07A	0.10%	17.0	325	0.20	3.49	5.5	40	9.0	2.94%	0.05	32.91%	130	98.5
April 30,2015	3p	Facilities ACP-07A	0.10%	16.9	325	0.25	3.43	5.5	40	10.0	2.95%	0.08	32.13%	143	97.4
April 30,2015	3q	Facilities ACP-07A	0.10%	16.9	325	0.25	3.49	5.5	40	10.0	2.95%	0.08	31.43%	143	97.4
April 30,2015	3r	Facilities ACP-07A	0.10%	16.9	325	0.35	3.30	5.5	40	13.0	2.95%	0.05	29.16%	188	98.5
April 30,2015	3s	Facilities ACP-07A	0.10%	16.9	325	0.35	3.03	5.5	40	14.0	2.95%	0.05	30.48%	203	98.5
April 30,2015	3t	Facilities ACP-07A	0.10%	16.9	325	0.45	3.36	5.5	40	15.0	2.95%	0.05	27.36%	217	98.5
April 30,2015	3u	Facilities ACP-07A	0.10%	16.9	325	0.55	2.61	5.5	40	20.0	2.95%	0.05	26.00%	290	98.5
April 30,2015	3v	Facilities ACP-07A	0.10%	16.9	325	0.65	2.84	5.5	40	20.0	2.95%	0.03	22.11%	292	99.1
April 30,2015	3w	Facilities ACP-07A	0.10%	16.9	325	0.75	2.67	5.5	40	22.0	2.95%	0.03	23.21%	321	99.1
April 30,2015	3ww	Facilities ACP-07A	0.10%	16.9	325	0.75	2.67	5.5	40	22.0	2.95%	0.03	23.21%	321	99.1
April 30,2015	3x	Facilities ACP-07A	0.10%	16.9	325	0.85	2.52	5.5	40	23.0	2.95%	0.03	18.42%	336	99.1
April 30,2015	3xx	Facilities ACP-07A	0.10%	16.9	325	0.85	2.52	5.5	40	23.0	2.95%	0.03	18.42%	336	99.1
AVERAGE		**Facilities ACP-07A**	***0.10%***	***15.0***	***325.0***	***0.44***	***3.00***	***5.5***	***40.0***	***13.7***	***3.67%***	***0.07***	***25.62%***	***239***	***98.3***

Graph 1: Production verses Cake Dryness



Graph 2: Flow Rate verses Cake Dryness



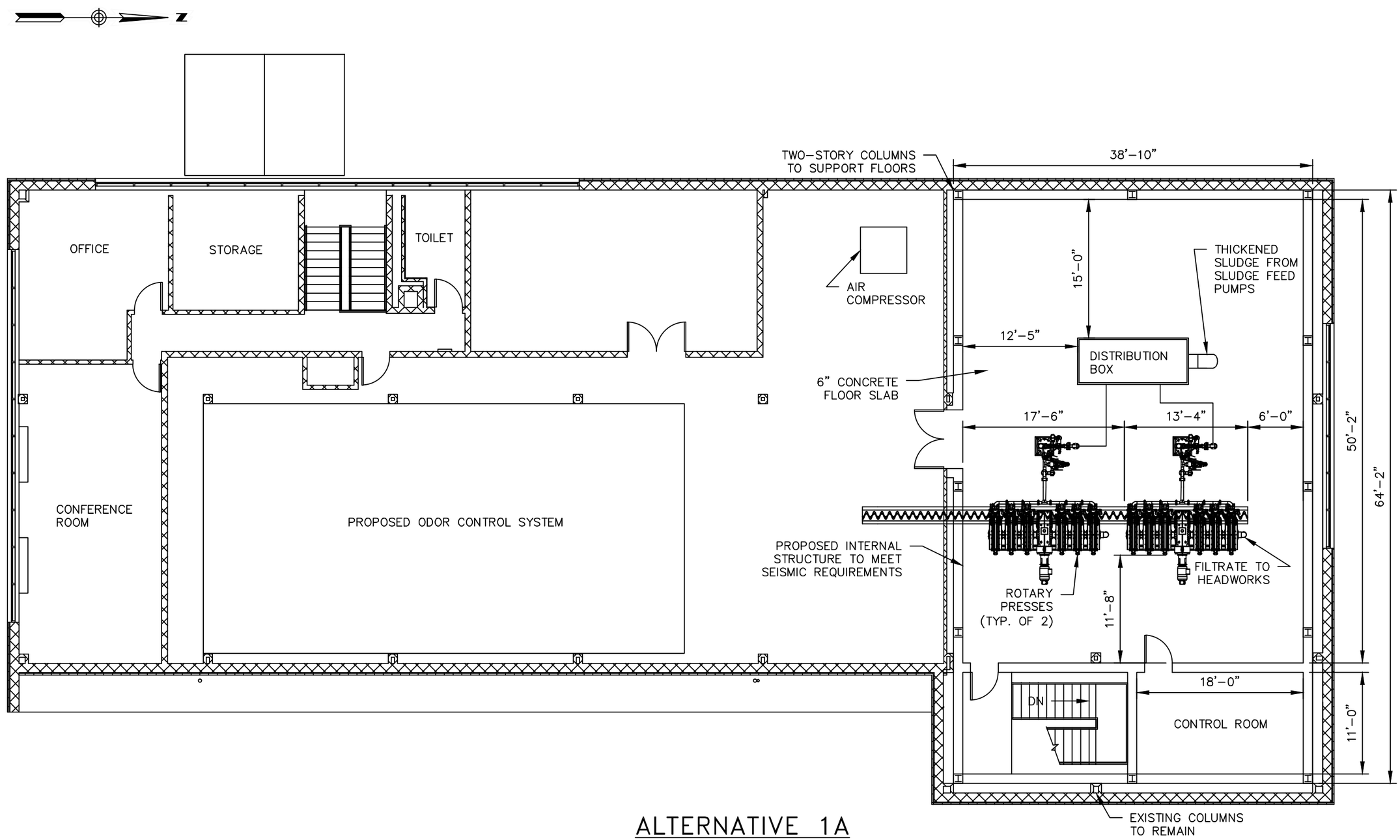
VI. Conclusion

The pilot test has proven the competence of the Fournier Rotary Press technology to efficiently dewater the sludge from the Wastewater Treatment Facility in Enfield CT.

After optimization with the polymer the CV press (2”wide channel) had demonstrated the best performance. Production ranging from 85 to 393 dry Lbs/Hr./channel translated into a flow rate ranging from 5 to 23 usgpm. This was achieved while maintaining cake solids between 18.3% to 32.9% and a capture rate averaging 98 %.

The Rotary Press is the most advanced dewatering technology available. The piloting trials performed with the blended sludge demonstrated its reliability and consistency to produce a good cake dryness using very little power and is designed to operate with minimal operator assistance. The equipment is capable of shutting down and washing itself without operator assistance. The equipment can automatically stop dewatering at a specific time or based on low sludge level availability. The Rotary Press is an extendable technology, allowing other channels to be added to the unit in order to accommodate future increases in the flow. Up to six (6) channels can be mounted on the same Press.

Fournier Industries Inc. would like to thank and express its gratitude to all the members involved at the Enfield Connecticut Wastewater Facility for helping make the piloting trials possible and for expressing their interests in the Fournier Rotary Press.



ALTERNATIVE 1A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION B

SCALE: 3/32" = 1'-0"

1699 King Street, Suite 406
Enfield, Connecticut 06082
855.347.6788 | www.woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION B

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OPS BLDG

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-103B

APPENDIX P: WESTFELIA CENTRIFUGE BENCH TEST REPORT

June 12, 2015

Town of Enfield WPCF
90 Parsons Road
Enfield, CT 06082

Kevin Shlatz
P: (860) 253-6450
kshlatz@enfield.org

Maximum Dewaterability and Polymer Dosage Test of Enfield WPCF's Sludge Sample by GEA Westfalia Separator

Attendees: GEA Westfalia: Marc Perratore

Location: GEA Westfalia, Northvale, NJ

Test Date: June 11, 2015

Report

Background:

A sample of wastewater sludge was sent to the Northvale lab from Enfield WPCF in Enfield, CT for polymer screening and jar testing. Tests were run to find the optimum polymer dosage to achieve maximum, feasible total solids dewatering.

The sludge received was a 40:60 blend of primary: secondary wastewater. Currently, they use a belt filter press for dewatering with a throughput of 25 wet tons/day feeding the BFP an average of 2.5-3.0%TS with resulting cake solids of 22% TS. They also treat the sludge with permanganate prior to polymer addition.

Test Procedure and Results:

Low G spin testing of the sludge sample was performed to characterize the sample. Figure 1 shows the spun down samples after 3 minutes in a Westfalia IEC model spinning unit with a 2,550 rpm rotor speed generating 1,230xG at the tube tip and 655xG at the 50% v/v tube level. Results show 32% v/v solids with a slightly turbid aqueous phase. The solids layer had medium compaction.

Figure 1. Low G spin results on Enfield WPCF's sludge.

Feed analysis was conducted on the raw sample to characterize it and determine the solids content. Results of the analysis are shown in Table 1.

Solids Type	Wt % in Feed
Dissolved Solids (DS)	0.19%
Total Suspended Solids (TSS)	2.43%
Fixed Solids (FS)	27.60%
Volatile Solids (VS)	72.40%
Total Solids	2.62%

Table 1. Solids analysis on Enfield WPCF's raw sludge sample.

Optimum polymer dosage was determined using polymer jar testing. Roughly 1.4 ml of charged emulsion was added to 300 ml of water to produce a 0.2% active solution. Polymer solution charges were predetermined on a large scale first (5,10,15…active lbs/ton of feed sludge) then back-calculated to determine the corresponding polymer solution volume in ml. Determination of increasing or decreasing the amount of polymer solution added depended upon the stability of the flocculation formed.

The flocculated solid mass from each beaker was transferred into a filtration cloth and squeezed until no further moisture was released. The dewatered cakes were then tested for %TS using the Ohaus model MB-25 machine.

Four polymers in total were used for this testing. The four polymers were all medium-to-high charge density with a wide range of molecular weights cationic polymers. The polymer characteristics are summarized in Table 2.

Polymer Emulsion	Activity (%)	Ionic Charge (%)	Structure	Active concentration
C-6237	29%	30% Cationic	Linear	0.20%
C-6262	40%	60% Cationic	Branched	0.20%
C-6266	41%	60% Cationic	Partial Branch	0.20%
C-6286	43%	80% Cationic	Partial Branch	0.20%

Table 2. Polymer characteristics.

An attempt was made to try and test as many polymer dosages as possible to get an idea of how the dosage affects the solids content in the cake. Table 3 below displays the results from testing various polymer dosages on the sample. Neat and active dosages are in lbs. / ton of feed sludge.

Sample Number	Polymer volume (ml)	Neat Dosage	Active Dosage	% TS Results
C-6237				
1	3.275	34.5	10	N/A*
2	6.550	69.0	20	N/A*
3	9.825	103.5	30	N/A*
C-6262				
5	3.275	25.0	10	N/A*
6	6.550	50.0	20	30.52%
7	8.188	62.5	25	29.34%
8	9.825	75.0	30	30.77%
C-6266				
9	3.275	24.4	10	N/A*
10	6.550	48.8	20	31.06%
11	8.188	61.0	25	30.08%
12	9.825	73.2	30	N/A*
C-6286				
13	3.275	23.25	10	N/A*
14	6.550	46.50	20	N/A*
15	9.825	69.75	30	N/A*

Table 3. Results from testing.
***= flocculent was not stable enough to test for %TS**

As seen in Table 3, the polymers tested flocculated the sludge properly within a narrow range of dosages. The polymer that worked across the broadest range was C-6262.

The worst results came from polymers C-6237 and C-6286. There were not any dosages that could properly flocculate the sludge. It appears that C-6237 has too low of a charge density and C-6286 has too high of a charge density for this sludge. Both C-6262 and C-6266 have charge densities in between the other two polymers and they performed much better.

Both polymers C-6262 and C-6266 properly flocculated the sludge but the one stark difference between the two was that the resulting cakes from dosing the sludge with C-6262 were noticeably less sticky; they remained very stable even after applying compressive forces to it, whereas the resulting cakes from dosing the sludge with C-6266, aside from the dosage of 20 lbs. active/ton, stuck to the filtration cloth and were not stable under the compressive forces.

For the dosages that led to “N/A” results in Table 3, the results showed that instead of flocculating the sludge, the polymer thickened the sludge, as can be seen below in some of the illustrations.

The pictures on the following pages are the results from the testing. Not every dosage is pictured in an attempt to avoid the repetitiveness of some results.

C-6237

Figure 2. 20 active lbs. C-6237/ton of feed sludge.

C-6262

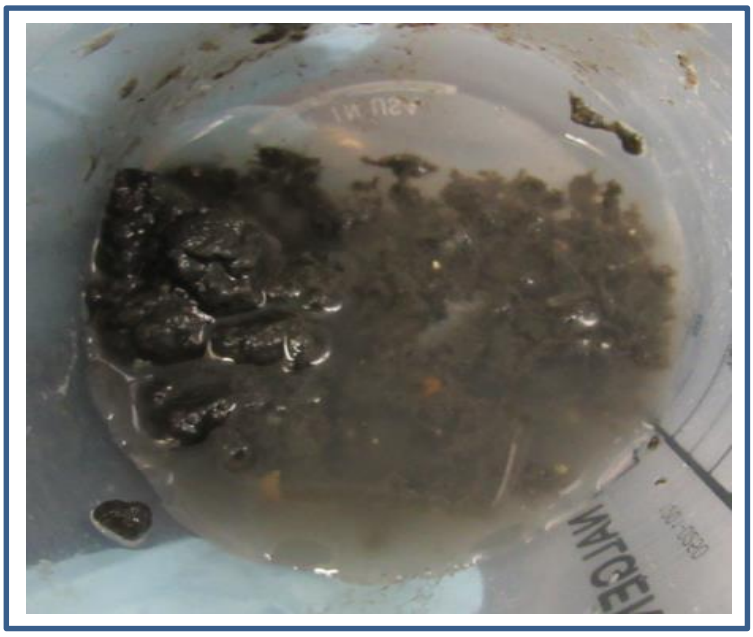


Figure 3. 20 active lbs. C-6262/ton of feed sludge. %TS=30.52%

Figure 4. 25 active lbs. C-6262/ton of feed sludge. %TS=29.34%

Figure 5. 30 active lbs. C-6262/ton of feed sludge. %TS=30.77%

C-6266

Figure 6. 20 active lbs. C-6266/ton of feed sludge. %TS= 31.06%

Conclusions:

The dewaterability testing of Enfield WPCF's wastewater sludge was proven to be successful using a medium charge, high MW cationic polymer emulsion for optimal processing conditions. An active dosage of 25 lbs. active of SNF Polydyne Clarifloc C-6262/ton of feed solids is recommended for maximum dewaterability of Enfield WPCF's wastewater sludge.

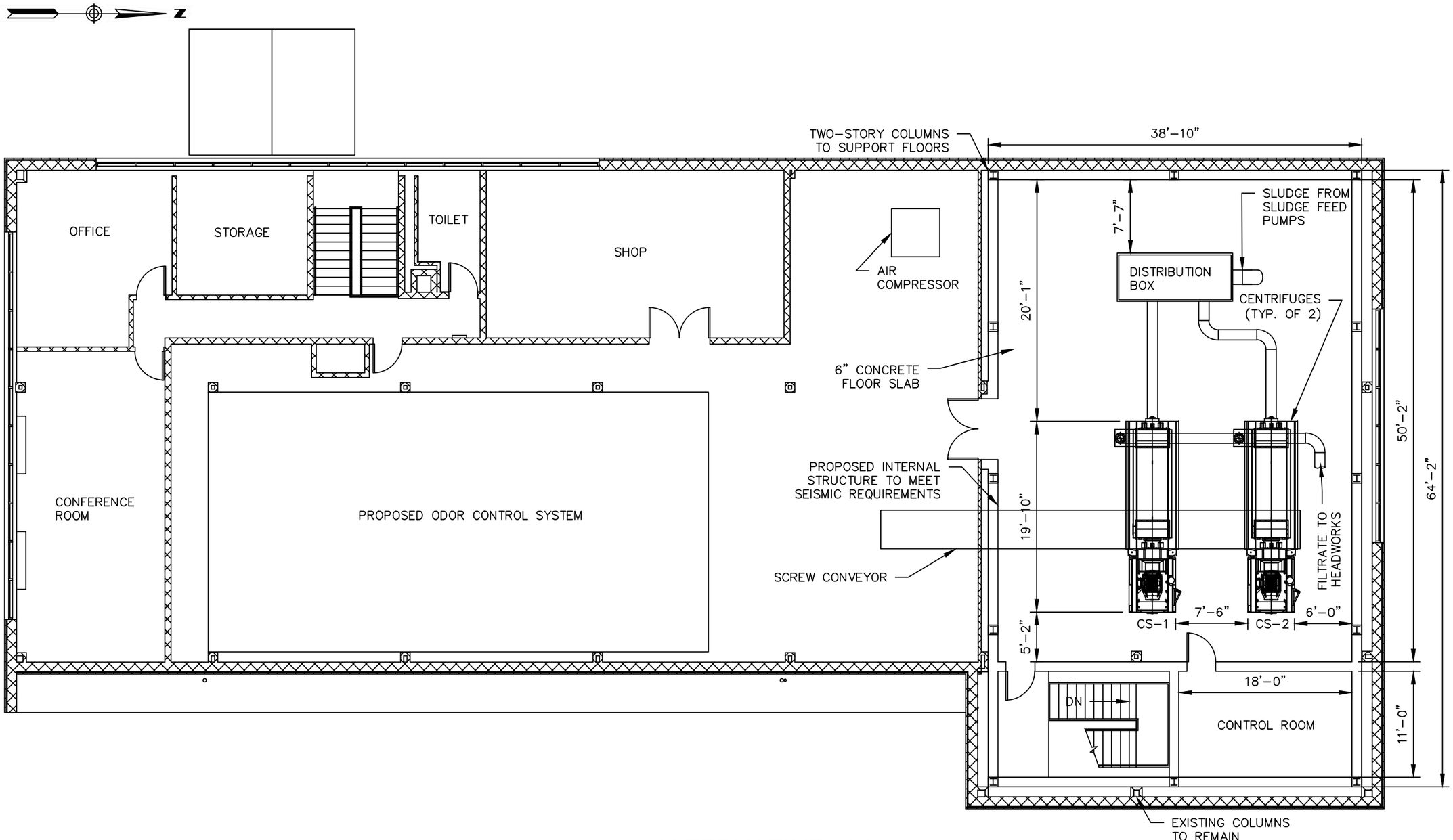
Marc Perratore

_____

Marc Perratore

Process Support Specialist

Sales Contact: Rick Seaburg



ALTERNATIVE 1A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION C

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION C

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OPS BLDG

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-103C

APPENDIX Q: ODOR CONTROL EVALUATION REPORT

BOWKER & ASSOCIATES, INC
CONSULTING ENGINEERS
477 Congress Street
Suite 1004
Portland, Maine 04101

Office (207) 874-8077 www.bowkerandassoc.com FAX (207) 874-8022

MEMORANDUM

Subject: Odor Control Recommendations for the Upgraded Enfield WPCF

From: Robert P.G. Bowker

To: Mike Burns
Cc: Amine Hanafi

Date: July 16, 2015

BACKGROUND

The Town of Enfield, CT has contracted with Woodward & Curran to prepare a Facilities Plan for the Enfield Water Pollution Control Facility (WPCF). In addition to wastewater treatment and solids handling process upgrades, the Town needs to address odor control at the facility. The plant is equipped with a 14,000 cfm cross-flow chemical scrubber, but the system has been out of service for several years, resulting in a Notice of Violation from CT DEEP. Bowker & Associates is serving as a sub-consultant to Woodard & Curran for evaluating and recommending odor control improvements at the Enfield WPCF.

SAMPLING

Bowker & Associates conducted limited sampling and monitoring at the Enfield WPCF to serve as a basis for evaluating appropriate technology to control odors. Without any data, it is difficult to assess which processes will require odor control and how best to treat the air. Sampling was limited to monitoring hydrogen sulfide (H_2S) levels using dataloggers, spot checks of H_2S concentrations at various locations, and field-tests on influent wastewater samples.

Table 1 shows the results of the testing. Overall, sulfide levels in the influent wastewater were low at 0.1 mg/L, and H_2S levels in the headspaces were also low. The aerated grit chamber, which was monitored using an H_2S datalogger (Odalog) showed levels ranging from 0 to 35 ppm (see Figure 1). A spot check of H_2S levels under the covered primary clarifier launders revealed

TABLE 1
RESULTS OF PRELIMINARY FIELD TESTING,
ENFIELD, CT WPCF
September 11, 2014

Air Testing

Time	Location	H_2S, ppm
9:45 AM	Primary clarifier weirs (covered)	5 – 6
10:00 AM	Distribution box	20 – 25
10:45 AM	Sludge cake garage	0.3
11:00 AM	Belt press room	1 - 3
9/11 – 9/18	Belt press room (datalogger)	0 – 3 avg. 0.0
10/7 – 10/14	Grit chamber (covered) (datalogger)	0 – 32 avg. 0.8

Influent Wastewater Testing

Time	pH	ORP, mV	Temp. °C	Total Sulfide, mg/L
9:30 AM	7.3	-120	19.4	0.1
10:30 AM	7.5	-220	19.8	0.1
11:30 AM	7.4	-170	20.2	0.1

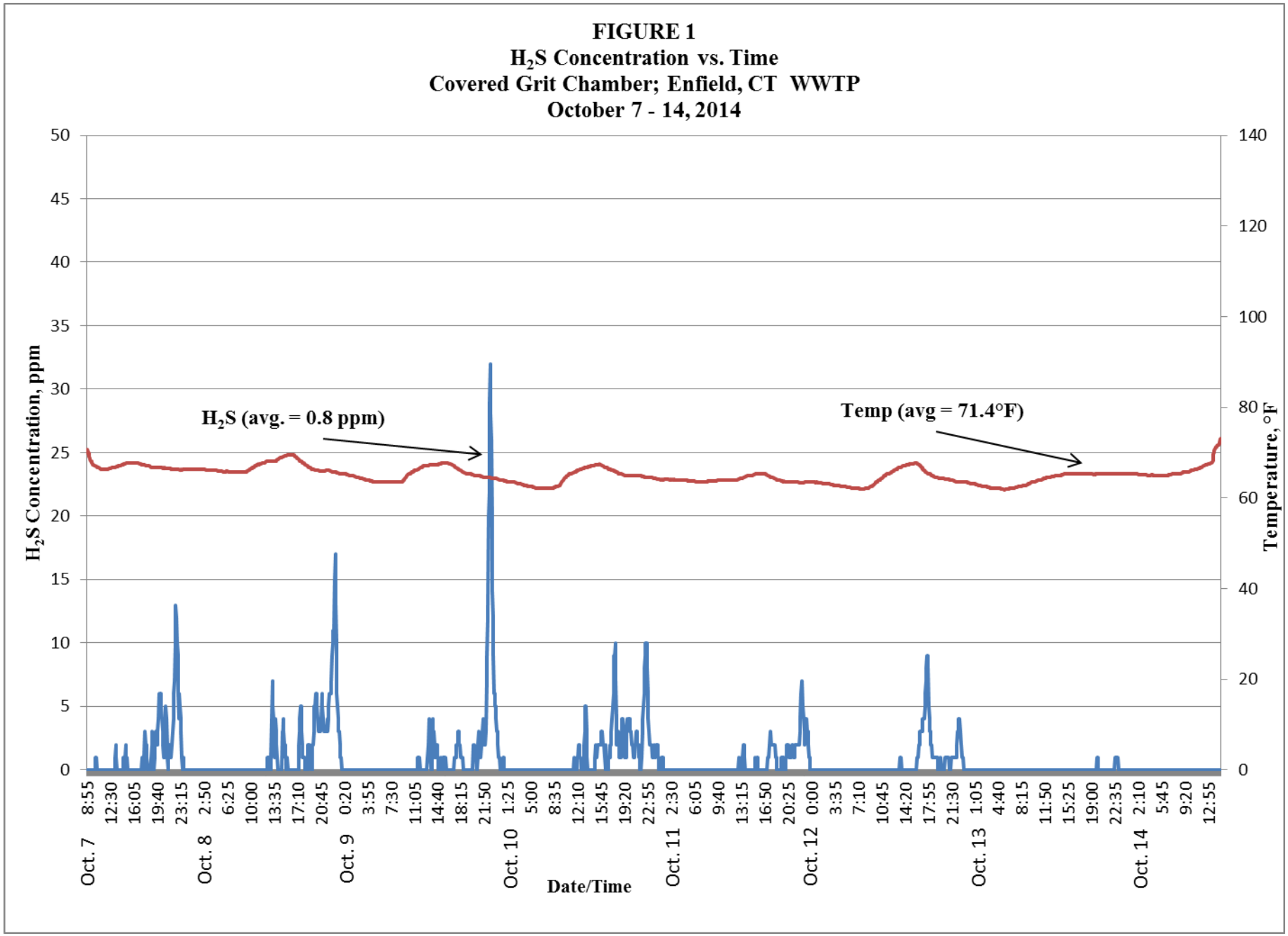


FIGURE 1
H2S Concentration vs. Time
Covered Grit Chamber; Enfield, CT WWTP
October 7 - 14, 2014
H2S Concentration, ppm
Temperature, °F
H2S (avg. = 0.8 ppm)
Temp (avg = 71.4°F)
Date/Time
Oct. 7
Oct. 8
Oct. 9
Oct. 10
Oct. 11
Oct. 12
Oct. 13
Oct. 14

concentrations of 5 to 6 ppm. H_2S levels in the primary clarifier distribution box were 20 to 25 ppm. This structure also receives return streams from sludge dewatering operations.

An H_2S datalogger suspended in the belt press room showed levels ranging from 0 to 3 ppm. These data are shown in Figure 2. The injection of sodium permanganate into the feed sludge helps maintain low levels of H_2S. Woodard & Curran will be recommending replacement of the belt presses with screw presses or rotary presses.

ODOR SOURCES RECOMMENDED FOR CONTROL

1. Screen building – A new building to house the raw wastewater screens is proposed, with dimensions of 45'L x 30'W x 15' H. Given that the building will house the raw wastewater screens, the grit/screenings dewatering equipment, and the container(s) of residuals, it is recommended that the entire room be ventilated to an odor control system. Ventilating the room at 12 air changes per hour would result in an air flowrate of approximately 4,100 cfm.

2. Aerated grit chamber – Although the grit chambers are covered, the headspace is currently not ventilated. The grit chambers should be ventilated at approximately 1 cfm per square foot of covered surface area plus the aeration rate, or approximately 1,400 cfm.

3. Primary distribution box – The distribution box should be ventilated at 1.5 cfm per square foot, or about 100 cfm.

4. Primary clarifier effluent launders – The effluent launders of the primary clarifiers are covered, but the headspace is not ventilated. Given that there appears to be little or no corrosion of the concrete below the covers, and that the covers alone are effective in containing the odors, it is not necessary to ventilate the covered launders.

5. Dewatering room – The belt room and sludge garage were served by a cross-flow chemical scrubber that is no longer in service. The belt presses will be replaced with screw-presses or rotary presses, both of which are completely enclosed. It is recommended that an enclosed conveyor be used to convey the dewatered sludge, and that a small volume of air be extracted (approximately 200 cfm) to prevent fugitive odor emissions from the cake conveyor.

6. Sludge cake garage – Depending on the configuration selected it is proposed that the sludge cake garage be ventilated to odor control at 6 air changes per hour. This would result in an air flow rate ranging from 750 to 2,400 cfm. An air flow rate of 1,700 cfm has been assumed.

7. Gravity thickeners – Two, 35-ft diameter gravity thickeners are proposed. Assuming flat covers rather that domes, the required air flow rate to ventilate the headspace and capture the odors is approximately 800 cfm per thickener, or 1,600 cfm.

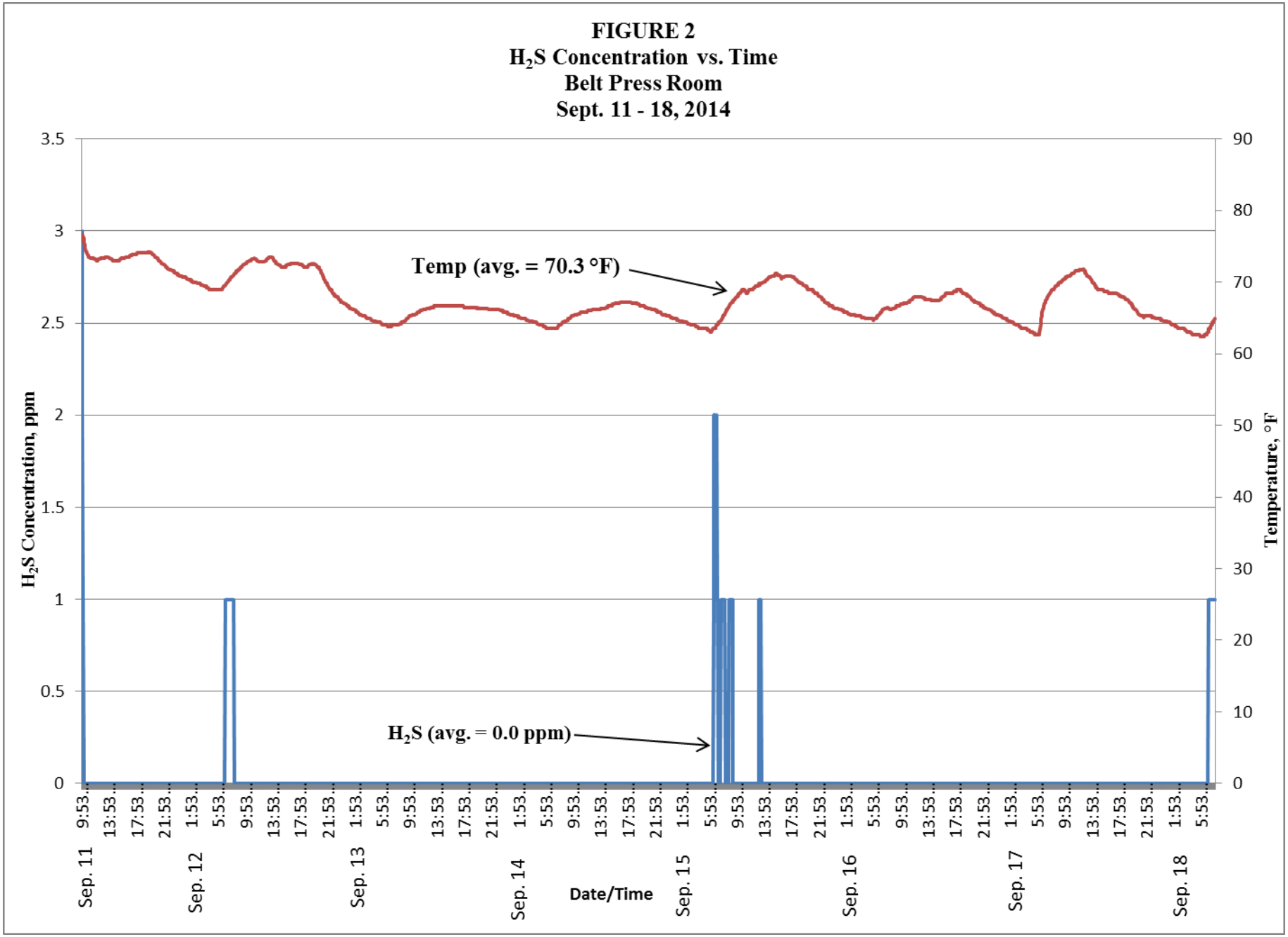


FIGURE 2
H2S Concentration vs. Time
Belt Press Room
Sept. 11 - 18, 2014
Temp (avg. = 70.3 °F)
H2S (avg. = 0.0 ppm)
H2S Concentration, ppm
Temperature, °F
Date/Time
Sep. 11
Sep. 12
Sep. 13
Sep. 14
Sep. 15
Sep. 16
Sep. 17
Sep. 18

EVALUATION OF ODOR CONTROL ALTERNATIVES

Summary of Air Flows and Loadings

The following is a summary of expected air flowrates and hydrogen sulfide loadings to a new odor control system:

Source	Air Flow Rate, cfm	H_2S Conc'n., ppm
1. Screen building	4,100	1
2. Aerated grit chamber	1,400	5
3. Primary d-box	100	5
4. Gravity thickeners	1,600	2
5. Dewatered sludge conveyor and truck bay	1,900	1
TOTAL	9,100 cfm	1.8 ppm

Odor Treatment Alternatives

There are many options for treating odorous air, from traditional chemical scrubbers to novel photo-catalytic systems. Table 2 summarizes the commonly-used treatment technologies for odorous air. Assuming use of a single odor control system to treat the estimated 9,100 cfm of foul air, either a biofilter or activated carbon adsorber are the recommended technology for the following reasons:

- They are simple, low maintenance systems that require no chemicals.
- Using proprietary engineered media, biofilter media replacement frequency is over 10 years.
- At the estimated loadings, high H_2S–capacity activated carbon media is likely to have a replacement frequency of 3 to 4 years.
- Both biofilter and activated carbon systems are reliable, with odor removal efficiency of approximately 90 percent.
- Although the footprint of the biofilter is larger than traditional technologies such as chemical scrubbers and activated carbon adsorbers, use of non-degradable manufactured

TABLE 2

SUMMARY OF ODOROUS AIR TREATMENT ALTERNATIVES
Bowker & Associates, Inc.

Technique	Frequency of Use	Cost Factors	Advantages	Disadvantages
Packed tower wet scrubbers	High	Moderate capital, high O&M cost	Effective and reliable; long track record; small footprint	High chemical consumption, high O&M
Activated carbon adsorbers	High	Cost-effectiveness depends on carbon replacement frequency	Simple; few moving parts; effective; several media options	Applicable to relatively dilute air streams in order to ensure long carbon life
In-ground biofilters	High	Low to moderate capital; low O&M costs	Simple; low O&M; effective; no chemicals	Large footprint; design criteria varies; some failures due to short-circuiting, overloading
Pre-engineered biofilters	Medium	Moderate to high capital; low O&M	Low O&M, no chemicals; longer media life and smaller footprint than in-ground systems	Higher capital costs than in-ground biofilters
Bioscrubbers, Biotrickling filters	Medium	Moderate capital; low O&M	Smaller footprint than biofilters, high H_2S loadings possible; little or no chemicals	Reduced performance at low temperatures; not as effective for non-H_2S odors
Thermal oxidizers	Low	Very high capital and O&M (energy) costs	Effective for wide spectrum of odors and VOCs	Only economical for high-strength, difficult to treat air streams
Diffusion into activated sludge basins	Low	Economical if use existing blowers or diffusers	Simple; low O&M; effective, reliable	Potential for corrosion of blower inlet components; add'l air filtration required
Odor counteractants	High	Operating cost dependent on chemical usage	Low capital cost	Limited odor removal efficiency (<40%); only applicable for dilute air streams

media allows greater media depth and reduced footprint compared to conventional, wood-chip biofilters. The biofilter would be approximately 30 ft. x 40 ft.

An activated carbon adsorber is a viable option to treat the air stream. It is a simple technology with the only moving part being on the fan. The concern with activated carbon is the longevity of the media. If subjected to high loadings of reduced sulfur compounds, the activated carbon can become exhausted prematurely resulting in costly replacement of the media. Under the proposed scenario of a central 9,100 cfm odor control system, a 3 to 4 year media life is expected using the high H_2S –capacity activated carbon media. The vessel would be 9 ft.-diameter and approximately 10 ft. tall. The total footprint of the carbon adsorber system would be approximately 24 ft. x 15 ft.

Table 3 provides a comparison of the capital and O&M costs for a 9,100 cfm biofilter vs. a 9,100 cfm activated carbon adsorber. Estimates do not include the cost of ductwork. As can be seen, the capital cost of the activated carbon adsorber is 50 percent less than the biofilter, but the operating cost of the carbon system is higher than that of the biofilter. The higher O&M cost of the carbon alternative is due to replacement of the media at an assumed interval of three years. The engineered biofilter media is not expected to require a change-out in the assumed twenty year lifetime, but an annual cost of $2,500 has been assumed for biofilter media replacement after 10 years. Because the proposed carbon adsorber has lower estimated capital cost, lower life-cycle costs, and reduced footprint, it is the recommended odor control technology for the Enfield WPCF. The proposed biofilter has a larger footprint than the carbon adsorber, does not fit within the existing Operations Building, and requires more excavation, concrete, and site work. Vendor proposals and brochures are attached to this memorandum.

RECOMMENDATIONS

The following are the recommendations to control odor emissions from an upgraded Enfield WPCF:

1. Ventilate proposed screen building at 4,100 cfm to a central, 9,100 cfm activated carbon adsorber system.

2. Evacuate air from existing covered aerated grit chamber at 1,400 cfm to central carbon adsorber.

3. Ventilate covered primary clarifier distribution box at 100 cfm to central carbon adsorber. Coat concrete to protect against corrosion.

4. Ventilate proposed gravity thickeners (2) at 800 cfm each to central, 9,100 cfm carbon adsorber.

5. Ventilate dewatered sludge conveyor and truck bay at 1,900 cfm to central carbon adsorber.

6. Use 9,100 cfm radial flow carbon adsorber system. Footprint of carbon adsorber with 9-ft diameter FRP vessel and fan enclosure is approximately 24 ft. x 15 ft.

7. Discontinue co-settling of waste activated sludge.

TABLE 3 ECONOMIC ANALYSIS 9,100 CFM BIOFILTER VS. ACTIVATED CARBON Enfield, CT WPCF		
	BIOFILTER	**ACTIVATED CARBON**
CAPITAL COST, $		
Mobilization	$10,000	$10,000
Site work	35,000	3,000
Concrete	151,000	5,000
Equipment	218,000	175,000
Installation	109,000	53,000
Plumbing	11,000	4,000
Electrical	44,000	35,000
Subtotal	**578,000**	**285,000**
Eng'r'g & contingencies @ 40%	231,000	114,000
TOTAL CAPITAL COST, $	**$809,000**	**$399,000**
O & M COST $/yr		
Power @ 12¢/kwh (25 HP)	$17,000	$17,000
Media replacement	2,500	17,200
Operation	4,700	3,100
Maintenance	6,500	5,300
TOTAL O & M COST, $/yr	**$31,000**	**$43,000**
ANNUALIZED CAPITAL 2%; 20 YR	**$49,000**	**$24,000**
TOTAL ANNUALIZED COST, $/yr	**$80,000**	**$67,000**

Note 1. Capital cost does not include ductwork
Note 2. Installation cost assumed to be 50% of equipment cost for built-in-place biofilter and 30% of equipment cost for activated carbon adsorber.

Concrete Biofilter
Budget Proposal
#15-4015 Enfield, CT

May 7, 2015

To: Robert P.G. Bowker, President
Bowker & Associates, Inc.
Consulting Engineers
Suite 1004
477 Congress Street
Portland, ME 04101

RE: Enfield, CT

Bob,

Biorem is please to provide the following budgetary design and quote for the Enfield, CT odor control project. This built in place biofilter uses Biosorbens, our permanent, engineered media that comes with a 10 year warranty. Please communicate with me any specific requirement the customer may have regarding design requirements or footprint and I can incorporate into our design. Let me know if you have any question and I look forward to working with you on this project.

Regards,

Dean Parker
Sales Manager
BIOREM Technologies Inc.
585-455-0129
dparker@biorem.biz

1.0 Product Description

The biofilter system extracts foul air for subsequent preconditioning in the humidification stage and oxidation through the Biosorbens media bed prior to atmospheric discharge.

Odorous compounds in the air entering the biofilter are solubilized into the moisture layer surrounding the individual media particles or are adsorbed directly to their surface. Bacteria present within this moisture film utilize the compounds as substrate. The compounds are biologically oxidized to CO_2, H_2O and inorganic salts and clean air is discharged to atmosphere. It is critical that the biofilter creates an optimal environment to enhance microbial development. Maintaining proper air temperature, pH, moisture and nutrient levels are essential for favorable biofilter performance and removal efficiency.

2.0 Project Details

Process Parameter	Value	
Flow Rate:	9,100 CFM	Given
Inlet Air Temperature:	40 - 100 °F	Assumed
Water Hardness:	50 ppm maximum allowed	Required
Average Inlet H_2S:	5 ppm	Given
Peak Inlet H_2S:	25 ppm	Given

Design Parameter	Value
Material of Construction:	Concrete
Biofilter EBRT:	30 seconds
Media Volume:	4550 ft^3
*Footprint Dimensions:	40 ft length : 30 ft width (approx.)
Water Recirculation:	48 GPM
Water Consumption:	600 GPD
Electrical - Main Power supply:	480V, 3Ph, 60Hz
**Concrete Volume (estimate):	130 $yrds^3$

*footprint length includes housekeeping pad to support fan, control panel, inlet duct support
**Concrete not in Biorem's scope of supply, to be provided and installed by contractor.

3.0 System Performance

A. When loaded under average conditions the biofiltration system will achieve at least 99 percent removal of H_2S when operating within the process parameters shown above.

B. When loaded under average conditions the biofilter system shall provide at least 90 percent odor removal for inlet concentration levels between 6,000 and 15,000 OU. For inlet concentration levels less than 6,000 OU, the outlet concentration levels shall be less than 600 OU. Odor concentrations to be determined using ASTM-E679 with a 20 litre/minute odor panel presentation rate.

4.0 Warranties

A. The Manufacturer warrants that the biofilter media will not compact, degrade or decompose for a period of 10 years from the date of Substantial Completion, provided that the system is operated in accordance with the Manufacturer's printed Operation and Maintenance Manuals.

B. All mechanical components will be warranted free of manufacturing defects for a period of 12 months from Substantial Completion, or 18 months from shipment, whichever occurs first.

5.0 Scope of Supply

1. Humidification packing media, supplied in bulk boxes approximately 10 cubic feet in size.
2. Engineered Biosorbens biofilter media, supplied in loose bulk.
3. 760 ft^2 biofilter media support flooring, corrosion resistant slotted aeration deck baseplates and air distribution trench covers, BioAer floor components by BacTee Systems.
4. (1) 1.5 HP recirculation pump, Make/Model: Grundfos CRN
5. Schedule 80 PVC manifold and spray nozzles for optimized coverage of humidifier packing media.
6. Schedule 80 PVC manifold and spray nozzles for optimized coverage of biofilter media bed.
7. (1) 25 HP centrifugal FRP exhaust fan rated at 8" WC, TEFC, Class 1, Division 2 motor.
8. Control Panel:
    i. NEMA 4X 304 stainless steel enclosure with pedestal legs.
    ii. Door mounted fused disconnect.
    iii. System ON pilot light.
    iv. Hand/Off/Auto selector switch for exhaust fan.
    v. Motor starter and Hand/Off/Auto selector switch for recirculation pump.
    vi. Status lights (on when running) for fan and recirculation pump.
    vii. Recirculation low flow alarm light.
    viii. Alarm reset push button.
    ix. Dry contacts for transmitting signals to remote location.
9. (1) Water panel housing the following instrumentation and fluid control valves:
    i. (1) Pressure indicator on water supply line.
    ii. (1) Temperature indicator in water recirculation line.
    iii. (1) Flow indicator/switch, to display recirculated water flow rate, signal alarm and shut off recirculation pump in case of reduced water flow.
    iv. (1) Flow indicator to display blow down water flow rate.

   v. (1) Flow totalizer, to display biofilter irrigation volume.
   vi. (1) Lot fluid control valves and strainers.

10. Instrumentation and fluid control valves external to water panel:
    i. (1) Differential pressure gauge to measure pressure drop across biofilter media.
    ii. (1) Inlet air temperature indicator (local read).
    iii. (1) Pressure indicator (water), on outlet side of recirculation pump.
    iv. (1) Lot fluid control valves and strainers.
11. Winterization system: (All heaters come complete with thermostat for temperature control)
    i. (1) 25 kW immersion heater for humidifier sump.
    ii. (1) Space heater for control panel.
    iii. (1) Space heater for water panel.
12. Engineering Submittal Packages.
13. Operation and Maintenance Manuals.
14. Field Services will consist of two (2) consecutive days (1 trip) for system commissioning and operator training.
15. Performance testing will consist of two (2) consecutive days (1 trip) for system measurements including H_2S as well as taking four (4) air samples for odor panel analysis.

Note: System equipment proposed is designed for a NFPA 820 2012 Type C ventilation environment.

The following items listed are to be supplied by the Contractor and are not in the Manufacturer's Scope of Supply.

1. Provide all equipment offloading, temporary storage and placement.
2. Provide labor, materials and equipment for the installation and assembly of all Biorem supplied equipment and instrumentation. Supply and install all other materials or equipment required for a complete operational system.
3. Site preparation and clearing of materials.
4. Design and supply an appropriately sized concrete basin as per design criteria. Provide collection and analysis of any geo-technical data as required.
5. Supply and install all required protective coatings or paint such as UV paint for piping or concrete paint.
6. Supply and install all external water piping and drain piping to and from the odor control vessel, water panel and other fluid equipment including heat tracing, insulation, piping supports, drainage traps where necessary and / or UV protective paint. If winterizing system, contractor to insulate and heat-trace differential pressure gauge enclosures and associated piping.
7. Supply and install air ductwork to and from the odour control system including exhaust stack, flexible connectors, interconnecting ducting, manual or actuated dampers, filters, insulation and piping supports, unless otherwise indicated above.
8. Supply and install all hardware, supports, guide wires, duct gaskets, expansion joints and connectors needed for a complete and operational system.
9. Supply make-up water at a minimum pressure of 40 psi. Water analysis for hardness or other parameters as necessary.
10. Provide main electrical service and system field wiring outside the main odor control panel. All electrical requirements for heat tracing and equipment not specifically provide by Biorem to be provided by others.
11. Provide duct balancing, and system functional, hydrostatic, vibration and performance testing to be conducted by OTHERS as may be specified.

BUDGET QUOTATION **May 7, 2015**

	QUOTATION #: 15-4015	Budget Price (US$)
01	**Concrete biofilter odor control system (Please refer to Section 0 for Scope of Supply)**	**$218,000**
01	Freight	**INCLUDED**
01	Commissioning and Training	**INCLUDED**

NOTES:
1. All components are FOB jobsite.
2. Payment Terms: 10% upon approvals, 80% upon equipment delivery, 10% upon system commissioning.
3. Applicable taxes are extra.
4. Prices are guaranteed for 90 days, from date of quotation.
5. Submittals typically provided 4-6 weeks after acknowledgment of order and with confirmation of Biorem's Project Manager. Shipment is 12-14 weeks after approved submittals.

TERMS & CONDITIONS

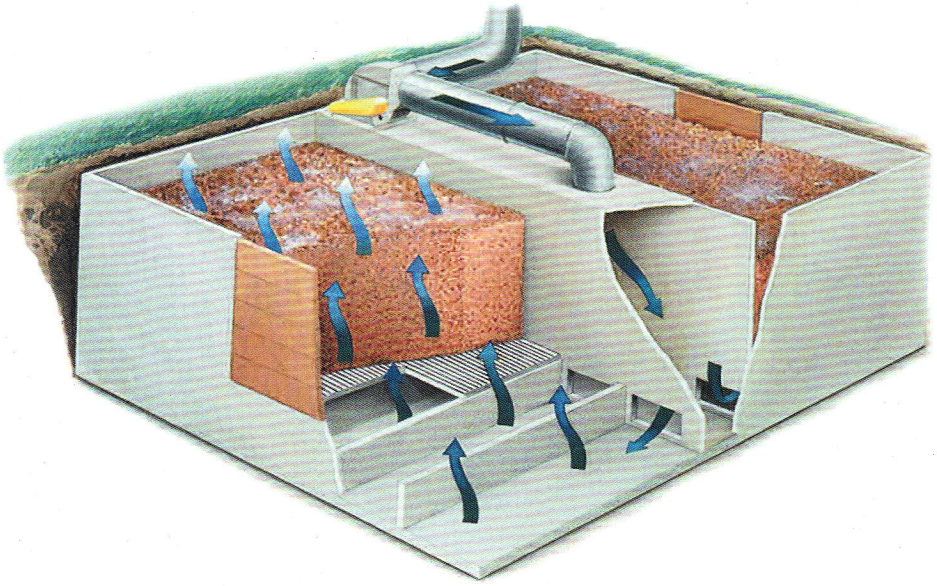
PRICING
Unless otherwise specified in writing by BIOREM® Technologies Inc, (BIOREM®) price does not include any taxes, excises, duties, tariffs or other governmental charges which BIOREM® may be required to pay or collect under existing or future law with respect to the sale, transportation, delivery, storage, installation or use of any of the equipment sold by BIOREM®.

CANCELLATION
Unless otherwise agreed in writing by the parties, the Buyer may not cancel the Order, except upon written notice and payment to Seller of an amount covering all costs incurred under the Order, all costs which arose out of the cancellation, and a cancellation fee of 50% of the Order Price. Materials received and Goods manufactured in part or whole under the Order prior to the time of cancellation shall be retained by and shall be property of the seller. When calculating the cancellation related costs, payments made by buyer to seller prior to cancellation shall be taken into account.

LIMITATION OF LIABILITY –SELLER'S LIABILITY TO THE PRICE ALLOCABLE TO THE GOODS DETERMINED DEFECTIVE, AND IN NO EVENT WILL SELLER'S CUMULATIVE LIABILITY BE IN EXCESS OF THE TOTAL SALES ORDER PRICE, WHETHER ARISING UNDER WARRANTY, CONTRACT, NEGLIGENCE, STRICT LIABILITY, INDEMNIFICATION, OR ANY OTHER CAUSE OR COMBINATION OF CAUSES WHATSOEVER. SELLER WILL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR INDEMNIFICATION, OR ANY OTHER CAUSE OR COMBINATION OF CAUSES WHATSOEVER. THIS LIMITATION SHALL APPLY NOTWITHSTANDING ANY FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY. BUYER'S REMEDIES ARE SPECIFICALLY LIMITED TO THE REPAIR OR REPLACEMENT OF THE GOODS AND IS EXCLUSIVE OF ALL OTHER REMEDIES. SHOULD THESE REMEDIES BE FOUND INADEQUATE OR TO HAVE FAILED THEIR ESSENTIAL PURPOSE FOR ANY REASON WHATSOEVER, BUYER AGREES THAT RETURN OF THE FULL SALES ORDER PRICE TO IT BY SELLER SHALL PREVENT REMEDIES FROM FAILING THEIR ESSENTIAL PURPOSE AND SHALL BE CONSIDERED BY BUYER AS A FAIR AND ADEQUATE REMEDY.

CUSTOM ENGINEERED BIOFILTER

BIOFILTAIR™ is a custom engineered biofilter system built at your facility. This system is suited for large airflows where total odor solutions are required. The BIOFILTAIR™ is a cost effective way to treat high flow airstreams consisting of H2S, VOCs and Total Reduced Sulfur (TRS). Utilizing BIOSORBENS® permanent inorganic media with a 10 year warranty, the BIOFILTAIR™ has the lowest life cycle cost of any biofiltration system on the market.



BIOFILTAIR™ Applications:

- Large flow applications
- Total odor removal applications
- Waste water treatment plants
- Agribusiness
- Rendering plants
- Industrial applications
- Sewage sludge
- Septage
- Biosolids managements
- Stringent total odor requirements

BIOREM

Breathe Easy...

BIOFILTAIR™

Ultra Compact, High Efficiency H_2S Control

FEATURE	BENEFIT
Custom Built Unit	Unit is built on site and custom engineered to meet individual specific requirements. The systems can be designed open top or closed, with up flow or down flow configurations depending on the application.
High Airflow Applications	Air flows up to 500,000 cfm (849,325 m3/hr).
Superior Performance	Greater than 99% H2S removal and greater than 90% total odor removal.
Concrete Construction	Reinforced, corrosion resistant ternary-blend concrete. The entire system is guaranteed against corrosion for 10 years.
Permanent Media	BIOSORBENS® a non-biodegradable, permanent media guaranteed for 10 years that will not break down or compact.
Pre- humidification	Custom designed pre-humidification, which conditions and humidifies the air stream and ensure greater than 99% relative humidity at all times.
Access Gate	Quick and easy access for media handling and testing.

BIOSERVE™

BIOREM® offers a comprehensive service program. Your new BIOREM® unit comes packaged with one of our innovative BIOSERVE™ programs, which includes two site visits from our fully trained service engineers to review the system operation and provide any required performance optimization recommendations. Ongoing support and monitoring continues throughout the life of your system. Following the first year of the complimentary BIOSERVE™ package, many options are available which allow you to customize a BIOSERVE™ package that will suit your needs.

BIOREM

BIOREM® is an environmental biotechnology company which manufacturers a comprehensive line of high efficiency, biologically-based, air pollution control systems that are used to eliminate odors, H_2S, NH3, TRS, VOCs and other hazardous air pollutants. With more than 500 installed systems worldwide, and over 15 years of experience, BIOREM® not only offers state-of-the-art technology based products but provides engineered solutions for total odor and VOC control.

www.biorem.biz

CANADA
7496 Wellington Road 34, RR#3
Guelph, Ontario, Canada N1H 6H9
Toll Free: 1.800.353.2087 • Tel: 519.767.9100
Fax: 519.767.1824 • Email: info@biorem.biz

UNITED STATES
100 Rawson Road, STE 230
Victor, NY, 14564
Toll Free: 1.877.299.2108
Tel: 519.767.9100 • Fax: 519.767.1824

BIOREM

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CANADA

Biorem Environmental Inc.
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1-877-299-2108

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FAX: 585-924-8280
230-100 Rawson Road
Victor, NY, 14564
USA

BIOREM

AIR EMISSIONS CONTROL

OUR FILTRATION MEDIA

Engineered Permanent Inorganic Biofiltration Media

Biosorbens®

Biosorbens® is designed as a permanent, engineered, inorganic media which delivers consistent performance. Biosorbens® is ideal for applications where H2S and total odor removal is required.

- Engineered media manufactured to exacting specifications, ensuring predictable and consistent performance
- Low-pressure drop maintains an even flow distribution throughout the biofilter media, minimizing power costs
- Consistent and stable, readily achieving greater than 90% total odor removal and greater than 99% H2S removal
- Mineral structure provides rigid support to minimize the compaction and consolidation effects
- Greater water holding capacity provides superior elimination capacity while resisting degrading, decomposition and compaction.
- 70% reduction in footprint as compared to typical organic media biofilter
- Warranted for 10 years

XLD

XLD is a high performance engineered biofiltration media specifically designed for maximum removal efficiency of odorous contaminants, (such as reduced sulfur compounds), that are typically more difficult to remove than H2S.

- Engineered media manufactured to exacting specifications thus ensuring predictability and consistent removal efficiencies
- Extremely large surface area increases removal efficiency. >95% removal of total odors in 20 seconds; achieves removal of most reduced sulfur compounds to below the detection limits
- Lightweight substrate allows for the design of unique bed configurations to meet site specific requirements
- Lower EBRT allows for reduced footprint
- Warranted for 10 years

LWE

LWE is an engineered synthetic, media specifically designed for Biorem's biotrickling filters. LWE is an extremely lightweight rigid material that allows for increased bed depth within the vessel.

- The rigidity of the media eliminates compaction which prevents damage during shipping and loading
- Random particle size allows for complete surface area coverage, thus eliminating air channeling through the vessel
- High available surface area creates greater amount of biomass growth for higher removal efficiency
- H2S removal efficiencies of greater than 99%
- Will not degrade due to acid, solvent or biological attack
- Low shipping and handling costs due to the low density of the media
- Reduces the problems associated with peaks and diurnal variations, through accelerated response

PUF

PUF is a biotrickling filter media is a polyurethane foam (PUF). It offers different properties than LWE and is therefore preferred for some applications.

- The rigid foam structure provides support to minimize compaction, which results in low frictional resistance to airflow
- Low pressure drop, even at high flow velocities
- Excellent mechanical and chemical properties provides good system stability and long work life
- High available surface area to support bacterial growth
- The media has optimum water retention capacity, which supports microbial colonies for biological treatment or waste gas streams

ABOUT BIOREM

Established in 1991, Biorem is a clean technology company that designs, manufactures and distributes a comprehensive line of high-efficiency air emissions control systems used to eliminate odors, volatile organic compounds (VOCs), and hazardous air pollutants (HAPs).

At Biorem, we understand that odors are a complex mixture of various compounds and chemicals, which is why we offer an array of products that can be tailored to suit application-specific requirements. Biorem ensures optimized long-term performance on every application by custom-designing any one of our systems to meet the individual needs of our clients.

We have sales and manufacturing offices across the continent, a dedicated research facility, an analytical and microbial laboratory, a worldwide sales representative network, and a dedicated service division. As a result, Biorem has the resources available to ensure that your project is handled promptly and professionally from conception to completion.

With more than 800 installed systems worldwide, continued extensive research efforts, and over 21 years of experience, Biorem offers state-of-the-art, technology-based products - and also peace of mind for municipalities, industrial companies and their surrounding communities.

Compounds Treated

- Hydrogen Sulfide
- Reduced Sulfur Compounds (methyl mercaptan [MM], dimethyl disulfide [DMS], dimethyl disulfide [DMDS])
- Volatile Organic Compounds (VOCs)
- Ammonia (NH3)
- Nitrogen-bearing compounds (amines, skatole, indole)
- Organic acids (Oleic, Butyric, etc.)
- Aromatics
- Aliphatics

SPECIFICALLY DESIGNED FOR EACH APPLICATION

Custom-built, field-erected systems

Compact, modular designs

Unique bed configurations

Vertical systems reduce overall footprint requirements

MUNICIPAL EMISSIONS CONTROL

Applications

- Wastewater Treatment
- Sewage Sludge
- Headworks
- Biosolids
- Bar Screens
- Pumping Stations
- Lift Stations
- High Level H2S
- Indoor Applications
- Septage

Wastewater Treatment

During different phases of the wastewater treatment and collection process various gasses – such as H2S, reduced sulfur compounds (which are made up of many different containments), NH3, and VOCs – are released at different concentrations. These compounds are extremely odorous and can potentially be hazardous to your health.

Our products are designed to meet specific needs of the municipal wastewater process. Whether you are looking for H2S removal only or total odor control, we have a solution to meet your needs. With products to treat airflows ranging from as little as 50 cfm (for small applications), to as great as 500,000 cfm, Biorem has a custom-engineered solution for your application. Our application-specific design allows us to create an odor control system to remove and destroy the various odorous causing compounds, resulting in cleaner air streams for you and your surrounding communities.

Our Offerings

- Custom designed biofiltration and biotrickling filters to meet your size and application requirements
- Treatment flows ranging from 50 cfm of air up to 500,000 cfm
- Modular and custom field-erected systems
- Compact systems reduce overall footprint requirements
- Low life-cycle costs
- Designed to meet specific, stringent municipal requirements
- Flexible vessel options such as Stainless Steel, FRP and Rigid Geon® Vinyl
- Permanent Inorganic media guaranteed to 10 years

Flexible Vessel Options

99% H2S removal

95% total odor removal

A variety of treatment flow options are available

Paint manufacturing

Composting

Food and beverage

INDUSTRIAL EMISSIONS CONTROL

Applications

- VOC removal
- Rendering Plant
- Paint manufacturing
- Animal and Pet Feed
- Plastic Industry
- Food & Beverage
- Pulp & Paper
- Composting Facilities

Volatile Organic Compounds and Hazardous Air Pollutants

Biorem has a wide variety of biologically-based technologies and solutions available to address your specific emission abatement needs. Whether you require an 80% reduction in emission levels or a 95% reduction, we have the appropriate solution for your specific application. Using a Biorem engineered solution can help save thousands of dollars and can generate paybacks of less than two years, while reducing greenhouse gas emissions and other combustion related air pollutants.

Industrial Wastewater Treatment

Wastewater generated from industrial sources, such as agriculture, and food and beverage, can be difficult to treat, as they have distinctive characteristics, setting them apart from the municipal wastewater managed by public or private plants.

Biorem's air emission control solutions are ideal for treating H2S, VOCs and reduced sulfur compounds commonly discharged from industrial air streams. We offer many solution options, and our ability to custom-design each application means you are receiving the best air emission control solution for your specific treatment needs, ensuring complete compliance with every application.

Odor and Nuisance Conditions

Does your plant face problems with urban encroachment? Increased regulatory scrutiny? Incensed community activists?

Biorem has a proven and effective solution to help eliminate all of these potential obstacles to a positive corporate relationship with your community and regulators and to a healthy and profitable bottom line. Odor control can be critical when you are trying to expand a facility or construct a new facility near a populated area.

Whether you need to meet 1 OU/m3 at the property boundary or 5 OU/m3, we have a proven approach to help you achieve your objectives.

Project Name: Enfield, CT	Date: 5/6/2015
Local Representative:	Location:
Specification Section: N/A	Equipment: Odor Control

ODOR CONTROL EQUIPMENT

Scope :

- One (1) ECS VX-9 adsorber system:
  - Rated for 9,100 cfm
  - 9' diameter FRP Vessel
  - Flanged inlet and outlet
  - SMACNA No-Loss Stack
  - Three (3) 2" carbon sample ports with PVC ball valves
  - One (1) 2" drain/fill port with PVC ball valve
  - One (1) 2" overflow port with PVC ball
  - Two (2) ½" air sample ports with PVC ball valve and Magnehelic gauge
  - 316 SST grounding rod in media bed
  - 336 ft^3 of ECS-HC/4.8P.3C high capacity carbon media
  - 138 ft^3 of ECS-PP/G.13 permanganate media
  - Interconnecting ductwork between the fan and vessel

- One (1) ECS Grease/Mist Eliminator:
  - Rated for 9,100 cfm
  - FRP housing with support legs
  - Pad sized to keep velocity at 400 fpm
  - Flanged inlet and outlet to match ductwork
  - One (1) 2" drain port with CPVC ball valve
  - Two (2) ½" air sample ports with CPVC ball valve
  - Dwyer Magnehelic differential pressure gauge

- One (1) FRP Centrifugal Fan:
  - Rated for 9,100 cfm @ 10" w.c.
  - Flanged inlet and outlet
  - Viton shaft seal
  - 316 SST fan shaft
  - 3-60-460v; Class 1 Div 2 motor
  - Outlet flexible connector

- One (1) Sound Attenuation Package:
  - FRP housing fabricated using the same resin system as the vessel
  - 65 dBA sound level at 3 feet
  - Split flange design to allow access to fan without removing air inlet ducting
  - FRP flashing for enclosure openings
  - Four (4) intake/exhaust louvers

2201 Taylors Valley Road
Belton, Texas 76513
(254) 933-2270 office
(866) 928-1864 fax

• One (1) NEMA 4X FRP Control Panel:
  ○ 3-60-480v supply power
  ○ Main disconnect switch and H-O-A for fan
  ○ Run and alarm pilot lights
  ○ Dry contacts for fan run status and fan fail status

Price for the above equipment, including freight to the jobsite, is $175,000.00

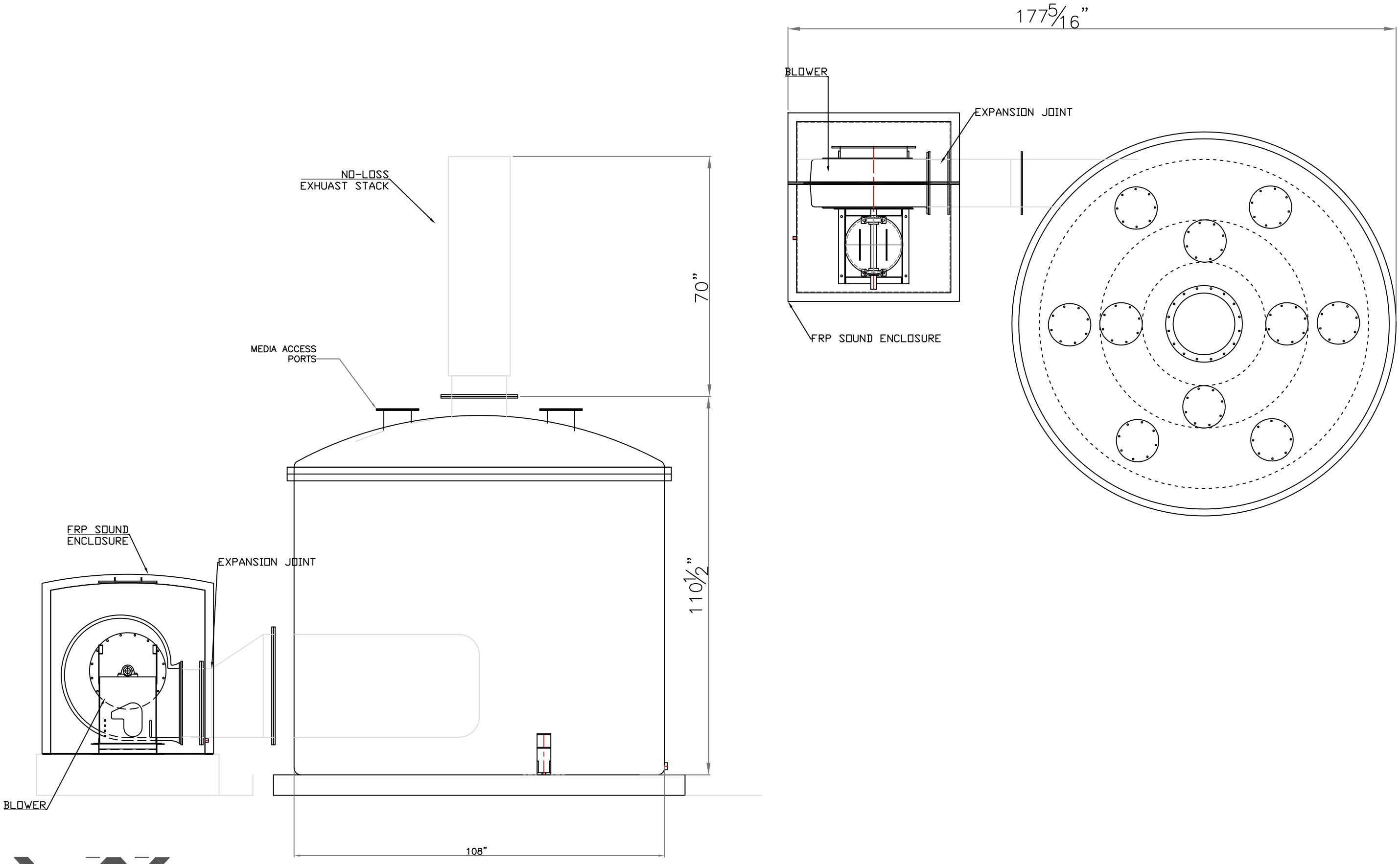
Additional items or services included:

- Design calculations, fabrication drawings, submittals and O&M manuals
- Warranty
- Start-up and training

Items **NOT** included in the ECS scope of supply:

- Offloading, storage or installation
- Anchor bolts
- Ductwork supports or hangers
-

Terms and Conditions
1. FOB manufacturing facility. Freight to be prepaid. Pricing includes freight to job site listed in proposal.
2. The pricing included with this offer sheet is valid for sixty (60) days from date of submission.
3. Payment terms are NET 30.
4. All pricing provided is exclusive of any taxes (Sales, GST, or PST), tariffs, and duties of any kind which either party may be required to pay with respect to the sale of goods described in the proposal. Buyer shall be responsible for the payment of all taxes, tariffs, and duties related hereto, except for income taxes imposed on Seller.



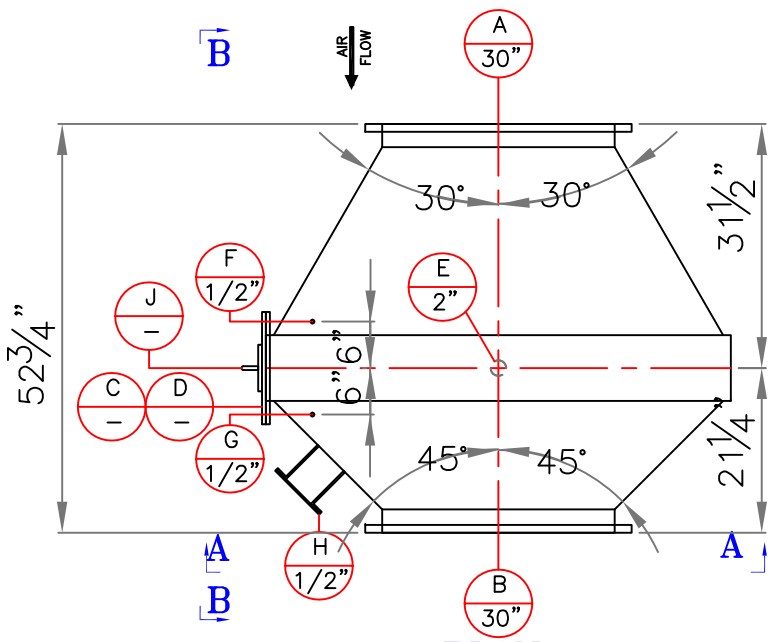
RADIAL FLOW CARBON ADSORBER SYSTEM

ECS
ENVIORNMENTAL SOLUTIONS
2201 TAYLORS VALLEY RD
BELTON TX 76513
254.933.2270 / 254.933.2212
WWW.ECS-ENV.COM

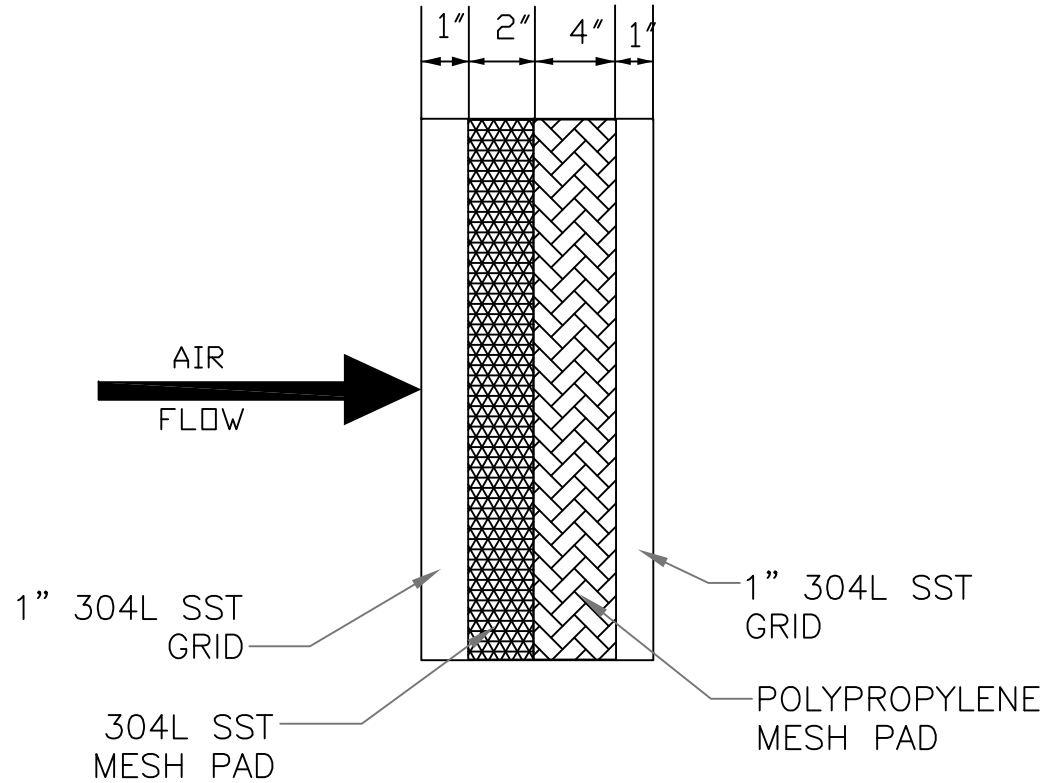
SCALE:	ECS VX-9 RADIAL FLOW
	PLANT:
	PROJECT NO:
	DWG NO: REV

NOZZLE SCHEDULE					
MARK NO.	QTY	SIZE	CPLG TYPE	CONN TYPE	DESCRIPTION
A	1	30"	–	PS 15–69	AIR INLET
B	1	30"	–	PS 15–69	AIR OUTLET
C	1	–	–	CUSTOM FLANGE	PAD ACCESS
D	1	–	–	CUSTOM FLANGE	PAD ACCESS COVER
E	1	2"	FULL	FNPT	DRAIN
F	1	1/2"	HALF	FNPT	D.P. GAUGE CONNECTION
G	1	1/2"	HALF	FNPT	D.P. GAUGE CONNECTION
H	1	–	–	–	D.P. GAUGE BRACKET
J	1	–	–	–	316 SST HANDLE

FLANGE TABLE								
FLG	QTY	I.D.	DRILLING PATTERN	B.C.	O.D.	HOLE DIA.	FLG THK	HOLE NO.
FLG A	1	30"	PS 15–69	33"	34 3/8"	1/2"	1"	28
FLG B	1	30"	PS 15–69	33"	34 3/8"	1/2"	1"	28



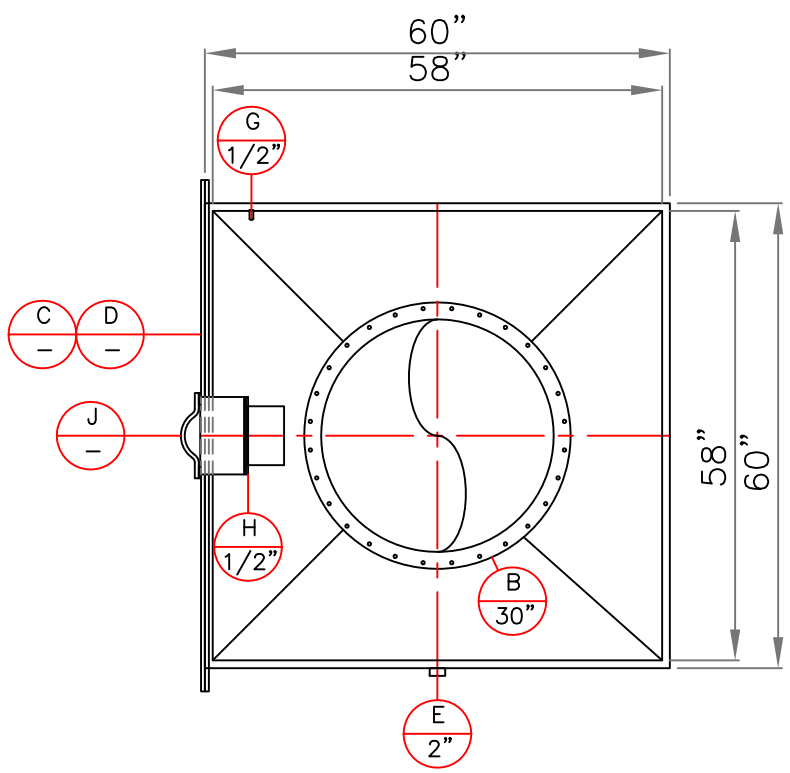
PLAN



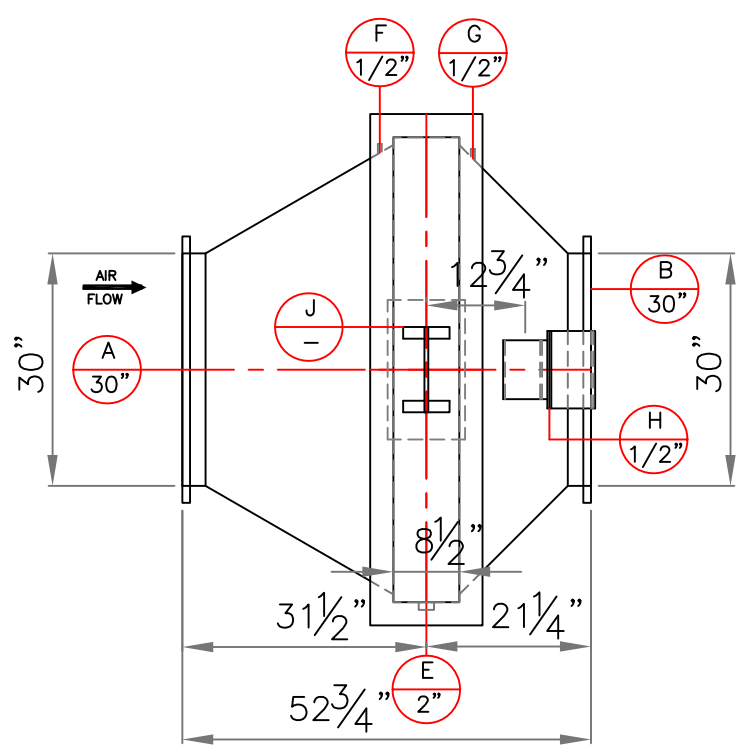
GME PAD DETAIL

GENERAL NOTES

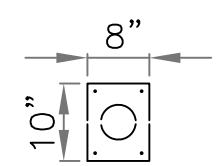
1. COLOR: VALSPAR 5786D90250 SANDSTONE (TAN)
2. HOUSING THICKNESS – 0.250"
3. HOUSING TO BE GEL COAT W/UV INHIBITOR AFTER FABRICATION IS COMPLETE.
4. UNIT TO BE SHIPPED WITH MIST ELIMINATOR PAD INSTALLED.
5. UNIT TO BE SUPPLIED WITH 316 SST BOLTING AND 1/8" NEOPRENE GASKETS FOR ALL FLANGES.
6. UNIT TO BE SUPPLIED WITH A MAGNEHELIC PRESSURE GAUGE WITH TUBING AND FITTINGS AS REQUIRED TO ALLOW FIELD ASSEMBLY BY OTHERS.
7. PAD: 60" LENGTH x 60" DEPTH WITH 2" OF 304 SST MESH FOLLOWED BY 4" THICK POLYPROPYLENE PAD WITH 1" THICK 304 SST GRID ON EITHER SIDE FOR A TOTAL THICKNESS (HEIGHT) OF 8"
   –PAD SUPPLIED IN THREE SEGMENTS.
8. CORROSION BARRIER
   – NEXUS VEIL: 1 LAYER
   – 1.5oz MATT: 2 LAYER
9. FOR PAD REMOVAL: ALLOW 30" CLEARANCE
10. ASSEMBLED WEIGHT INCLUDING PAD: 555lbs



ELEVATION A–A



SECTION B–B



D.P. GAUGE PLATE

ECS
ENVIRONMENTAL SOLUTIONS
2201 TAYLORS VALLEY RD
BELTON TX 76513
254.933.2270 /
254.933.2212
WWW.ECS-FRP.COM

SCALE:NONE

PRE–FILTER
9000 CFM

PLANTECS – TX

PROJECT NO:

DWG NO:

REV P

ECS
ENVIRONMENTAL SOLUTIONS

OFFERING A COMPLETE LINE OF ODOR CONTROL PRODUCTS AND ACCESSORIES

VX CARBON ADSORBER

The VX radial flow is an efficient, highly effective system for removing H_2S and other compounds from municipal wastewater applications. These systems can utilize a wide variety of adsorbent media for specific treatment needs with lower capital and operating cost than Deep Bed or Up-Flow Systems all with a small footprint and low pressure drop requiring lower horsepower blowers.

- Lower capital cost and reduced operating costs
- High efficiencies of H_2S and organic odor removal
- Small foot-print and the ability to treat up to 40,000 cfm in a single 12' Diameter vessel
- High quality FRP construction manufactured to exceed industry standards
- Proprietary plug-flow air distribution system maximizing flow efficiency

WWW.ECS-ENV.COM

VX

SIMPLE, EASY, COST EFFECTIVE SOLUTION UP TO 3000 CFM

FEATURES	BENEFIT
Small Footprint	Up to 40,000 cfm can be treated in a single 12' Diameter vessel.
Proprietary Plenum Diffuser	Through extensive CFD and practical modeling the VX is designed with a special air diffuser system that creates even air distribution through the carbon bed.
High-Quality Construction	Vessel and internal components are manufactured using high quality, corrosion resistant materials to provide an indefinite service life.
Operator-Friendly	Besides fan components, the VX has no moving parts. Carbon is removed, filled and self-levels in the top access ports so man-entry is not required under normal circumstances.
High Quality Media	The ECS VX is available with a wide variety of media including Calgon Minotaur, one of only two A-Grade carbons with a .3 HPB capacity and Calgon Centaur, a water regenerable carbon with ultimate H_2S capacity of .69.
ECS Ring Cap	Simplifies removal of the vessel lid by reducing the number of fasteners. Special O-ring seal with built in groove ensures a proper seal.
FRP Flanged Carbon Ports	High-quality FRP flanged ports providing a better seal and longevity.

ECS Offers the Following Complete Line of Odor Control Products

- V1 Single Bed
- V2 Dual-Bed
- VX Radial Flow
- X-Pac Chemical Scrubber
- BioPure Biofilter Media
- FRP Ductwork Systems
- AMCA Certified Dampers
- Grease Filter / Mist Eliminators
- Control Panels
- FRP Fans
- Activated Carbon Media
- FRP Chemical Storage Tanks
- FRP Hoods / Covers
- Sound Enclosures and Silencers
- Field Services

ECS
ENVIRONMENTAL SOLUTIONS

ECS is based out of a 100,000 sq/ft manufacturing / design facility located in central Texas. We offer a complete line of odor control equipment and services including carbon adsorbers, wet scrubbers, biofilters with the unique capability to manufacture and supply system components.

P.O. BOX 127 / 2201 TAYLORS VALLEY RD / BELTON, TX 76513
P. 254.933.2270 / F. 254.933.2212

WWW.ECS-ENV.COM

APPENDIX R: COST ESTIMATES

CLIENT: Enfield WPCF
Enfield, CT
PROJECT: Facilities Plan
PROJECT #: 227363

DATE: 05/18/15
DATE: 05/18/15

COST SUMMARY (2015 COSTS)
ALTERNATIVE 1A - REHAB OB BLDG

Item No.	Item	Building/Structure Demolition	Operations Building (OB) Rehabilitation	TOTAL
1	**CAPITAL COST SUMMARY**			
1.1	Excavation and Backfill	$ -	$ -	$ -
1.2	Demolition	$ 57,000	$ -	$ 57,000
1.3	Concrete	$ -	$ 1,095,000	$ 1,095,000
1.4	Process Piping	$ -	$ 284,000	$ 284,000
1.5	Building Construction	$ -	$ 1,929,000	$ 1,929,000
1.6	Equipment	$ -	$ 2,979,000	$ 2,979,000
1.7	Site/Miscellaneous	$ -	$ 53,000	$ 53,000
1.8	**CONSTRUCTION BASE COST**	**$ 57,000**	**$ 6,340,000**	**$ 6,397,000**
1.9	Overhead, Insurance & General Conditions (25%)	$ 14,000	$ 1,585,000	$ 1,599,000
1.10	Engineering and Contingency (40%)	$ 29,000	$ 3,170,000	$ 3,198,000
1.11	**TOTAL CAPITAL COST**	**$ 100,000**	**$ 11,095,000**	**$ 11,194,000**
2	**O&M COST SUMMARY**			
2.1	Electricity	$ -	$ 196,000	$ 196,000
2.2	Chemicals	$ -	$ 407,000	$ 407,000
2.3	Operation	$ -	$ 46,800	$ 46,800
2.4	Maintenance	$ -	$ 50,800	$ 50,800
2.5	**TOTAL ANNUAL O&M COST**	**$ -**	**$ 701,000**	**$ 701,000**

LEGEND	
OB	Operations Building

CLIENT:	Enfield WPCF	**PREPARED BY:**	ACB, AH	**DATE:**	05/18/15
	Enfield, CT	**CHECKED BY:**	JB, MJB	**DATE:**	05/18/15
PROJECT:	Facilities Plan	**ESTIMATE:**	**Building Alternatives - Alternative 1B**		
PROJECT #:	227363				

COST SUMMARY (2015 COSTS)
ALTERNATIVE 1B - REHAB OB BLDG & NEW GT

Item No.	Item	Building/Structure Demolition	Operations Building (OB) Rehabilitation	Gravity Thickeners (GT)	TOTAL
1	**CAPITAL COST SUMMARY**				
1.1	Excavation and Backfill	$ -	$ -	$ 128,000	$ 128,000
1.2	Demolition	$ 57,000	$ -	$ -	$ 57,000
1.3	Concrete	$ -	$ 1,095,000	$ 724,000	$ 1,819,000
1.4	Process Piping	$ -	$ 284,000	$ 51,000	$ 335,000
1.5	Building Construction	$ -	$ 1,929,000	$ -	$ 1,929,000
1.6	Equipment	$ -	$ 2,994,000	$ 1,141,000	$ 4,135,000
1.7	Site/Miscellaneous	$ -	$ 53,000	$ 267,000	$ 320,000
1.8	**CONSTRUCTION BASE COST**	**$ 57,000**	**$ 6,355,000**	**$ 2,311,000**	**$ 8,723,000**
1.9	Overhead, Insurance & General Conditions (25%)	$ 14,000	$ 1,589,000	$ 578,000	$ 2,181,000
1.10	Engineering and Contingency (40%)	$ 29,000	$ 3,178,000	$ 1,155,000	$ 4,362,000
1.11	**TOTAL CAPITAL COST**	**$ 100,000**	**$ 11,122,000**	**$ 4,044,000**	**$ 15,266,000**
2	**O&M COST SUMMARY**				
2.1	Electricity	$ -	$ 196,000	$ 16,000	$ 212,000
2.2	Chemicals	$ -	$ 407,000	$ -	$ 407,000
2.3	Operation	$ -	$ 50,700	$ 7,800	$ 58,500
2.4	Maintenance	$ -	$ 51,000	$ 20,200	$ 71,200
2.5	**TOTAL ANNUAL O&M COST**	**$ -**	**$ 705,000**	**$ 44,000**	**$ 749,000**

LEGEND	
OB	Operations Building
GT	Gravity Thickener

CLIENT:	Enfield WPCF	**PREPARED BY:**	ACB, AH	**DATE:**	05/11/15
	Enfield, CT	**CHECKED BY:**	JB, MJB	**DATE:**	05/11/15
PROJECT:	Facilities Plan	**ESTIMATE:**	**Building Alternatives - Alternative 2**		
PROJECT #:	227363				

COST SUMMARY (2015 Costs)
ALTERNATIVE 2 - PROPOSED ADMIN BLDG, BB, SHB & GT

Item No.	Item	Building/Structure Demolition	Blower Building (BB)	Sludge Handling Building (SHB)	Administration Building (AB)	Gravity Thickeners (GT)	TOTAL
1	**CAPITAL COST SUMMARY**						
1.1	Excavation / Backfill	$ -	$ 73,000	$ 78,000	$ 118,000	$ 212,000	$ 481,000
1.2	Demolition	$ 735,000	$ -	$ -	$ -	$ -	$ 735,000
1.3	Concrete	$ -	$ 334,000	$ 527,000	$ 567,000	$ 1,127,000	$ 2,555,000
1.4	Process Piping	$ -	$ 35,000	$ 38,000	$ 26,000	$ 51,000	$ 150,000
1.5	Building Construction	$ -	$ 835,000	$ 1,948,000	$ 1,225,000	$ 364,000	$ 4,372,000
1.6	Equipment	$ -	$ 1,061,000	$ 1,917,000	$ 91,000	$ 1,080,000	$ 4,149,000
1.7	Site / Miscellaneous	$ -	$ 20,000	$ 60,000	$ 166,000	$ 267,000	$ 513,000
1.8	**CONSTRUCTION BASE COST**	**$ 735,000**	**$ 2,358,000**	**$ 4,568,000**	**$ 2,193,000**	**$ 3,101,000**	**$ 12,955,000**
1.9	Overhead, Insurance & General Conditions (25%)	$ 184,000	$ 590,000	$ 1,142,000	$ 548,000	$ 775,000	$ 3,239,000
1.10	Engineering and Contingency (40%)	$ 368,000	$ 1,179,000	$ 2,284,000	$ 1,096,000	$ 1,550,000	$ 6,478,000
1.11	**TOTAL CAPITAL COST**	**$ 1,287,000**	**$ 4,127,000**	**$ 7,994,000**	**$ 3,837,000**	**$ 5,426,000**	**$ 22,672,000**
2	**O&M COST SUMMARY**						
2.1	Electricity	$ -	$ 147,000	$ 45,000	$ 4,000	$ 15,000	$ 211,000
2.2	Chemicals	$ -	$ 47,000	$ 359,000	$ -	$ -	$ 406,000
2.3	Operation	$ -	$ 11,700	$ 31,200	$ 7,800	$ 7,800	$ 58,500
2.4	Maintenance	$ -	$ 18,200	$ 32,500	$ 1,600	$ 19,100	$ 71,400
2.5	**TOTAL ANNUAL O&M COST**	**$ -**	**$ 224,000**	**$ 468,000**	**$ 13,000**	**$ 42,000**	**$ 747,000**

LEGEND	
BB	Blower Building
SHB	Sludge Handling Building
AB	Administration Building
GT	Gravity Thickener

CLIENT:	Enfield WPCF Enfield, CT	**PREPARED BY:**	ACB, AH	**DATE:**	05/11/15
PROJECT:	Facilities Plan	**CHECKED BY:**	JB, MJB	**DATE:**	05/11/15
PROJECT #:	227363	**ESTIMATE:**	**Building Alternatives - Alternative 3A**		

COST SUMMARY (2015 COSTS)
ALTERNATIVE 3A - REHAB OB, NEW SHB & GT

Item No.	Item	Building/Structure Demolition	Operations Building (OB) Rehabilitation	Gravity Thickeners (GT)	Sludge Handling Building (SHB)	Chemical Building	TOTAL
1	**CAPITAL COST SUMMARY**						
1.1	Excavation and Backfill	$ -	$ -	$ 212,000	$ 78,000	$ 21,000	$ 311,000
1.2	Demolition	$ 263,000	$ -	$ -	$ -	$ -	$ 263,000
1.3	Concrete	$ -	$ 986,000	$ 1,127,000	$ 527,000	$ 112,000	$ 2,752,000
1.4	Piping	$ -	$ 256,000	$ 51,000	$ 38,000	$ 3,000	$ 348,000
1.5	Building Construction	$ -	$ 1,964,000	$ 364,000	$ 1,948,000	$ 209,000	$ 4,485,000
1.6	Equipment	$ -	$ 977,000	$ 1,080,000	$ 1,917,000	$ 105,000	$ 4,079,000
1.7	Site/Miscellaneous	$ -	$ 31,000	$ 267,000	$ 60,000	$ 25,000	$ 383,000
1.8	**CONSTRUCTION BASE COST**	**$ 263,000**	**$ 4,214,000**	**$ 3,101,000**	**$ 4,568,000**	**$ 475,000**	**$ 12,621,000**
1.9	Overhead, Insurance & General Conditions (25%)	$ 66,000	$ 1,054,000	$ 775,000	$ 1,142,000	$ 119,000	$ 3,155,000
1.10	Engineering and Contingency (40%)	$ 132,000	$ 2,107,000	$ 1,550,000	$ 2,284,000	$ 238,000	$ 6,310,000
1.11	**TOTAL CAPITAL COST**	**$ 461,000**	**$ 7,375,000**	**$ 5,426,000**	**$ 7,994,000**	**$ 832,000**	**$ 22,086,000**
2	**O&M COST SUMMARY**						
2.1	Electricity	$ -	$ 151,000	$ 15,000	$ 45,000	$ 1,000	$ 212,000
2.2	Chemicals	$ -	$ -	$ -	$ 359,000	$ 47,000	$ 406,000
2.3	Operation	$ -	$ 11,700	$ 7,800	$ 31,200	$ 7,800	$ 58,500
2.4	Maintenance	$ -	$ 16,700	$ 19,100	$ 32,500	$ 1,800	$ 70,100
2.5	**TAOTAL ANNUAL O&M COST**	**$ -**	**$ 179,000**	**$ 42,000**	**$ 468,000**	**$ 58,000**	**$ 747,000**

LEGEND	
OB	Operations Building
GT	Gravity Thickener
SHB	Sludge Handling Building

CLIENT:	Enfield WPCF Enfield, CT	**PREPARED BY:**	ACB, AH	**DATE:**	05/11/15
PROJECT:	Facilities Plan	**CHECKED BY:**	JB, MJB	**DATE:**	05/11/15
PROJECT #:	227363	**ESTIMATE:**	**Building Alternatives - Alternative 3B**		

COST SUMMARY (2015 COSTS)
ALTERNATIVE 3B - REHAB OB, NEW BB & NEW GT

Item No.	Item	Building/Structure Demolition	Operations Building (OB) Rehabilitation	Gravity Thickeners (GT)	Blower Building (BB)	TOTAL
1	**CAPITAL COST SUMMARY**					
1.1	Excavation and Backfill	$ -	$ -	$ 212,000	$ 63,000	$ 275,000
1.2	Demolition	$ 57,000	$ -	$ -	$ -	$ 57,000
1.3	Concrete	$ -	$ 1,095,000	$ 1,127,000	$ 292,000	$ 2,514,000
1.4	Piping	$ -	$ 341,000	$ 51,000	$ 35,000	$ 427,000
1.5	Building Construction	$ -	$ 1,929,000	$ 364,000	$ 716,000	$ 3,009,000
1.6	Equipment	$ -	$ 1,934,000	$ 1,080,000	$ 1,061,000	$ 4,075,000
1.7	Site/Miscellaneous	$ -	$ 64,000	$ 267,000	$ 40,000	$ 371,000
1.8	**CONSTRUCTION BASE COST**	**$ 57,000**	**$ 5,363,000**	**$ 3,101,000**	**$ 2,207,000**	**$ 10,728,000**
1.9	Overhead, Insurance & General Conditions (25%)	$ 14,000	$ 1,341,000	$ 775,000	$ 552,000	$ 2,682,000
1.10	Engineering and Contingency (40%)	$ 28,000	$ 2,682,000	$ 1,550,000	$ 1,104,000	$ 5,364,000
1.11	**TOTAL CAPITAL COST**	**$ 99,000**	**$ 9,386,000**	**$ 5,426,000**	**$ 3,863,000**	**$ 18,774,000**
2	**O&M COST SUMMARY**					
2.1	Electricity	$ -	$ 48,000	$ 15,000	$ 147,000	$ 210,000
2.2	Chemicals	$ -	$ 359,000	$ -	$ 47,000	$ 406,000
2.3	Operation	$ -	$ 39,000	$ 7,800	$ 11,700	$ 58,500
2.4	Maintenance	$ -	$ 32,800	$ 19,100	$ 18,200	$ 70,100
2.5	**TOTAL ANNUAL O&M COST**	**$ -**	**$ 479,000**	**$ 42,000**	**$ 224,000**	**$ 745,000**

LEGEND	
OB	Operations Building
BB	Blower Building
GT	Gravity Thickener

CLIENT:	Enfield WPCF Enfield, CT	**PREPARED BY:**	ACB, AH	**DATE:**	05/11/15
PROJECT:	Facilities Plan	**CHECKED BY:**	JB, MJB	**DATE:**	05/11/15
PROJECT #:	227363	**ESTIMATE:**	**Building Alternatives - Alternative 3C**		

COST SUMMARY (2015 COSTS)
ALTERNATIVE 3C - REHAB OB, NEW AB & GT

Item No.	Item	Building/Structure Demolition	Operations Building (OB) Rehabilitation	Gravity Thickeners (GT)	Administration Building (AB)	Chemical Building	TOTAL
1	**CAPITAL COST SUMMARY**						
1.1	Excavation and Backfill	$ -	$ -	$ 212,000	$ 62,000	$ 21,000	$ 295,000
1.2	Demolition	$ 82,000	$ -	$ -	$ -	$ -	$ 82,000
1.3	Concrete	$ -	$ 1,095,000	$ 1,127,000	$ 289,000	$ 112,000	$ 2,623,000
1.4	Piping	$ -	$ 562,000	$ 51,000	$ -	$ 3,000	$ 616,000
1.5	Building Construction	$ -	$ 1,827,000	$ 364,000	$ 712,000	$ 209,000	$ 3,112,000
1.6	Equipment	$ -	$ 2,890,000	$ 1,080,000	$ -	$ 105,000	$ 4,075,000
1.7	Site/Miscellaneous	$ -	$ 64,000	$ 267,000	$ 136,000	$ 25,000	$ 492,000
1.8	**CONSTRUCTION BASE COST**	**$ 82,000**	**$ 6,438,000**	**$ 3,101,000**	**$ 1,199,000**	**$ 475,000**	**$ 11,295,000**
1.9	Overhead, Insurance & General Conditions (25%)	$ 21,000	$ 1,610,000	$ 775,000	$ 300,000	$ 119,000	$ 2,824,000
1.10	Engineering and Contingency (40%)	$ 41,000	$ 3,219,000	$ 1,550,000	$ 600,000	$ 238,000	$ 5,648,000
1.11	**TOTAL CAPITAL COST**	**$ 144,000**	**$ 11,267,000**	**$ 5,426,000**	**$ 2,099,000**	**$ 832,000**	**$ 19,767,000**
2	**O&M COST SUMMARY**						
2.1	Electricity	$ -	$ 196,000	$ 15,000	$ -	$ 1,000	$ 212,000
2.2	Chemicals	$ -	$ 359,000	$ -	$ -	$ 47,000	$ 406,000
2.3	Operation	$ -	$ 42,900	$ 7,800	$ -	$ 7,800	$ 58,500
2.4	Maintenance	$ -	$ 49,200	$ 19,100	$ -	$ 1,800	$ 70,100
2.5	**TOTAL ANNUAL O&M COST**	**$ -**	**$ 647,000**	**$ 42,000**	**$ -**	**$ 58,000**	**$ 747,000**

LEGEND	
OB	Operations Building
GT	Gravity Thickener
AB	Administration Building

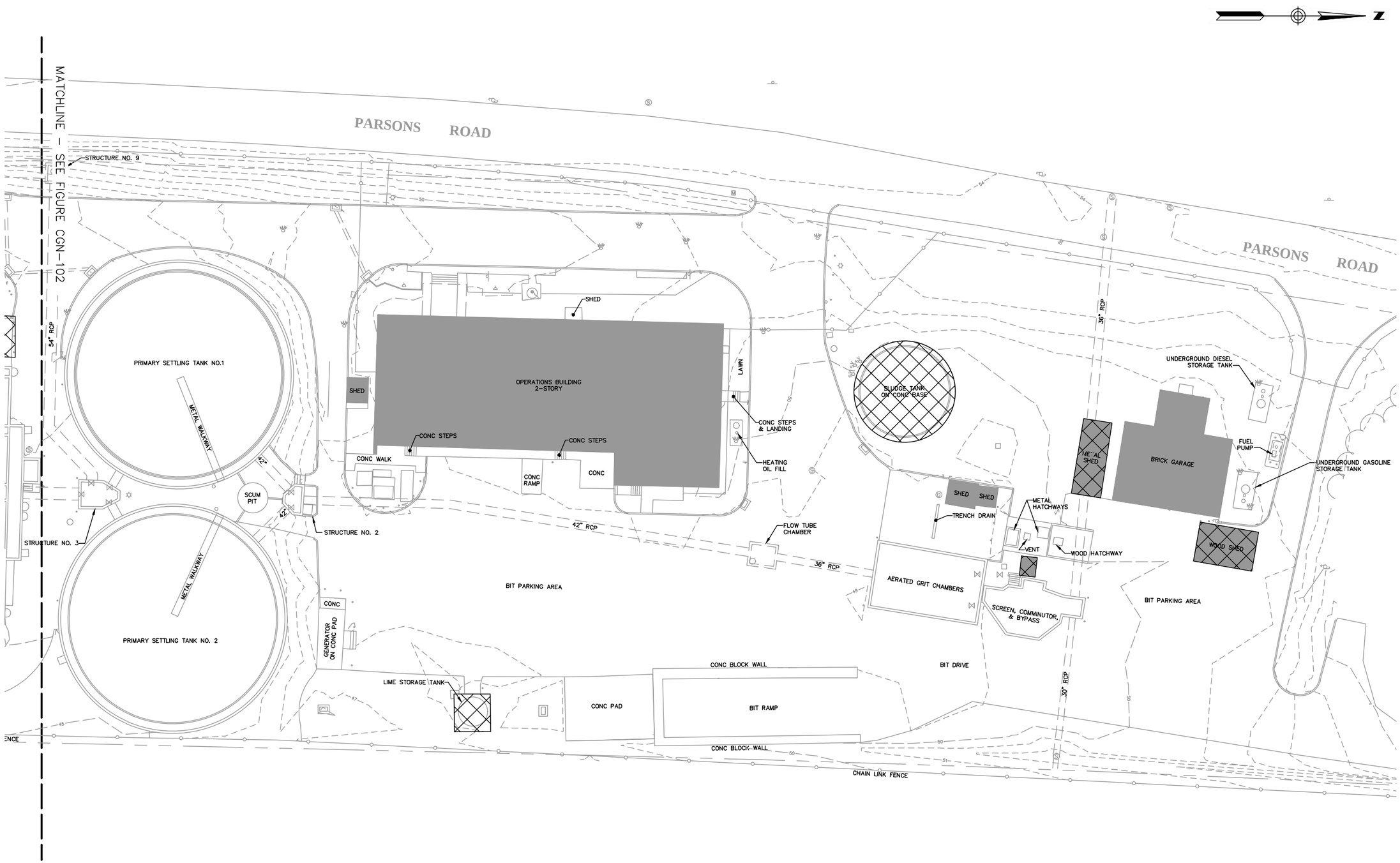
CLIENT:	Enfield WPCF	**PREPARED BY:**	AH	**DATE:**	12/14/15
	Enfield, CT	**CHECKED BY:**	JB, MJB	**DATE:**	12/14/15
PROJECT:	Facilities Plan	**ESTIMATE:**	**Common Items**		
PROJECT #:	227363				

COST SUMMARY (2015 Costs)
COMMON ITEMS

Item No.	Item	Headworks Building Upgrades	Primary Clarifiers Upgrades	Aeration Tanks Upgrades	Secondary Clarifiers Upgrades	Sludge Pumping Station Upgrades	Miscellaneous Items	TOTAL
1	**CAPITAL COST SUMMARY**							
1.1	Excavation / Backfill	$ 14,000	$ -	$ -	$ -	$ -	$ -	$ 14,000
1.3	Concrete	$ 145,000	$ 83,000	$ 333,000	$ -	$ -	$ -	$ 561,000
1.4	Process Piping	$ -	$ -	$ 147,000	$ -	$ -	$ -	$ 147,000
1.5	Building Construction	$ 262,000	$ -	$ -	$ -	$ 128,000	$ -	$ 390,000
1.6	Equipment	$ 1,139,000	$ 676,000	$ 2,300,000	$ 1,500,000	$ 837,000	$ 361,000	$ 6,813,000
1.7	Site / Miscellaneous	$ 117,000	$ 90,000	$ 203,000	$ 138,000	$ 30,000	$ -	$ 578,000
1.8	**CONSTRUCTION BASE COST**	**$ 1,677,000**	**$ 849,000**	**$ 2,983,000**	**$ 1,638,000**	**$ 995,000**	**$ 361,000**	**$ 8,503,000**
1.9	Overhead, Insurance & General Conditions (25%)	$ 419,000	$ 212,000	$ 746,000	$ 410,000	$ 249,000	$ 90,000	$ 2,126,000
1.10	Engineering and Contingency (40%)	$ 838,000	$ 424,000	$ 1,492,000	$ 819,000	$ 498,000	$ 180,000	$ 4,252,000
1.11	**TOTAL CAPITAL COST**	**$ 2,934,000**	**$ 1,485,000**	**$ 5,221,000**	**$ 2,867,000**	**$ 1,742,000**	**$ 631,000**	**$ 14,881,000**
2	**O&M COST SUMMARY**							
2.1	Electricity	$ 10,000	$ 5,000	$ 42,000	$ 9,000	$ 95,000	$ 500	$ 161,500
2.2	Chemicals	$ 48,000	$ -	$ -	$ -	$ 23,000	$ -	$ 71,000
2.3	Operation	$ 11,700	$ 7,800	$ 15,600	$ 7,800	$ 23,400	$ 3,900	$ 70,200
2.4	Maintenance	$ 19,800	$ 12,100	$ 40,900	$ 25,700	$ 14,300	$ 6,100	$ 118,900
2.5	**TOTAL ANNUAL O&M COST**	**$ 90,000**	**$ 25,000**	**$ 99,000**	**$ 43,000**	**$ 156,000**	**$ 11,000**	**$ 422,000**

APPENDIX S: CONCEPTUAL LAYOUTS FOR BUILDING ALTERNATIVES

- **Appendix S-1: Alternative 1A - Rehab Operations Building**
- **Appendix S-2: Alternative 1B - Rehab Operations Building and New Gravity Thickeners**
- **Appendix S-3: Alternative 2 - New Admin Building, Sludge Handling Building and GTs**
- **Appendix S-4: Alternative 3A - Rehab Operations Building, New Sludge Handing Building and GTs**
- **Appendix S-5: Alternative 3B - Rehab Operations Building, New Blower Building and GTs**
- **Appendix S-6: Alternative 3C - Rehab Operations Building, New Admin Building and GTs**
- **Appendix S-7: Common Items**



NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 1A – NORTH

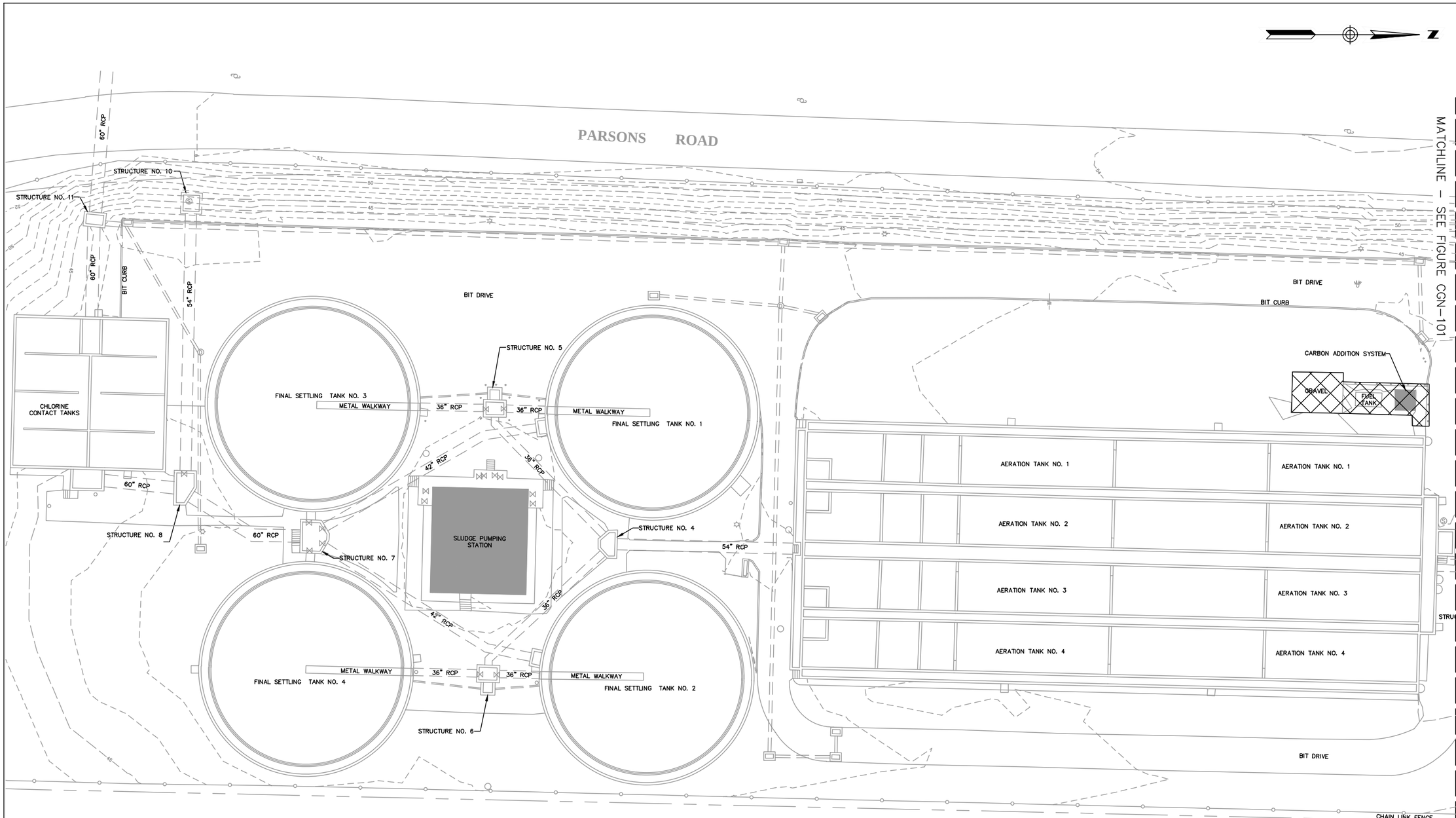
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-100 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OB

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-101



EXISTING STRUCTURE TO BE DEMOLISHED

NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 1A – SOUTH

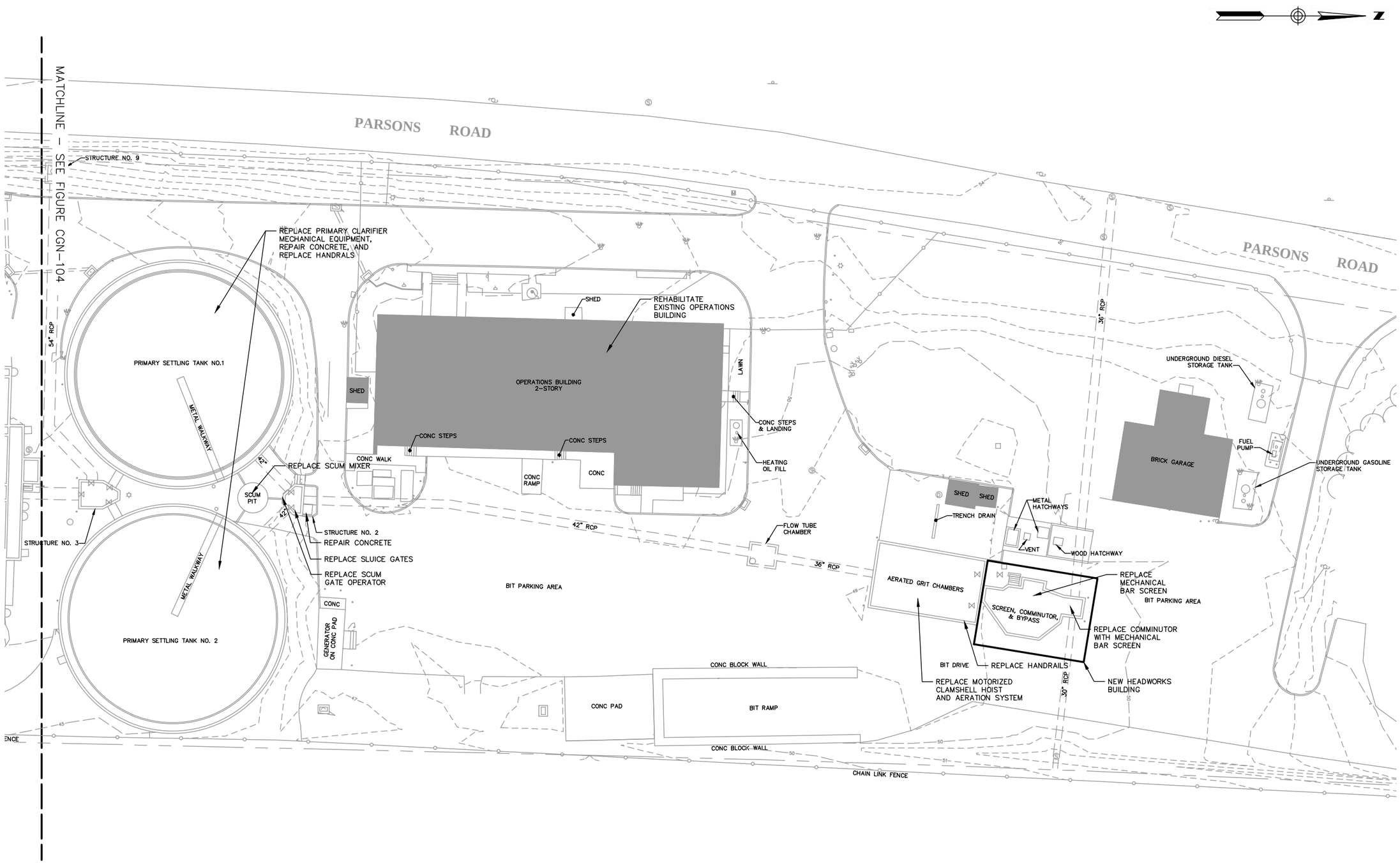
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23 CGN-100 DEMO*.dwg	

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OB

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-102



NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 1A – NORTH

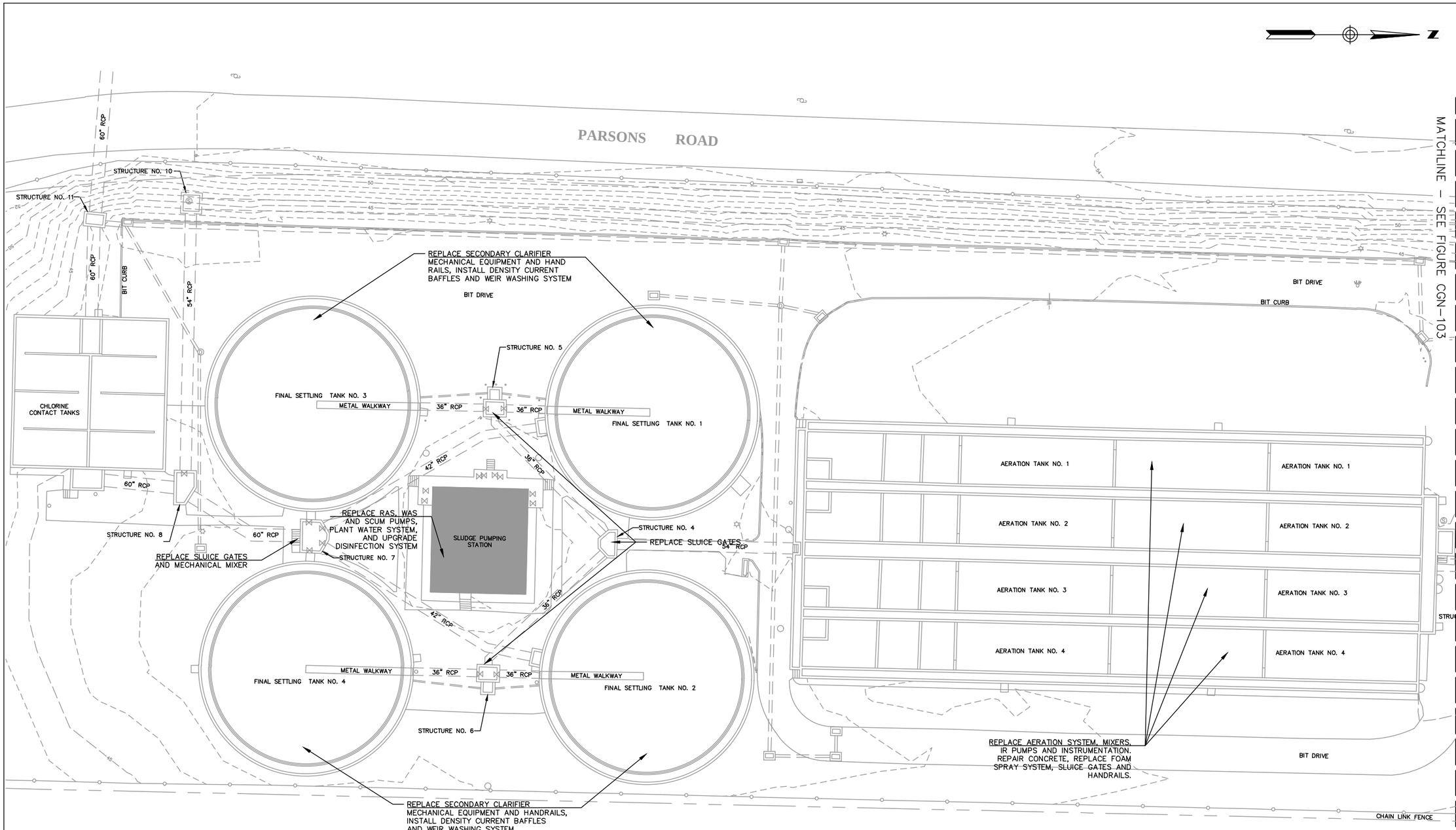
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-110.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OB

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-103



NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 1A – SOUTH

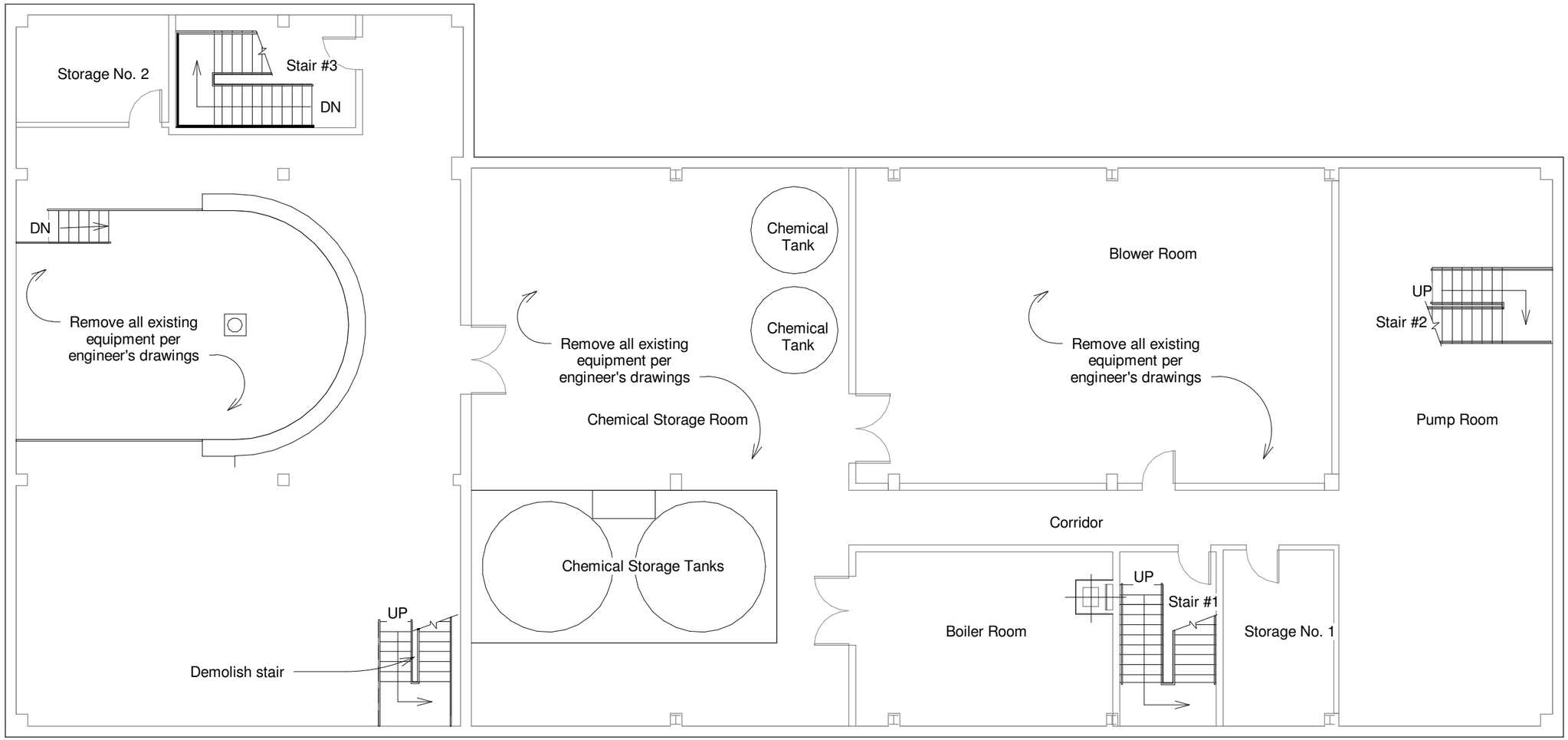
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23	CGN-110.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OB

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-104



1 Basement Demo Plan
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

Steffian Bradley Architects
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www.steffian.com

Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000
DATE
May 2015

Scale
3/32" = 1'-0"

N

Date | Issue

Title
ALTERNATE 1
Renovated OB
Basement Demo

AD101

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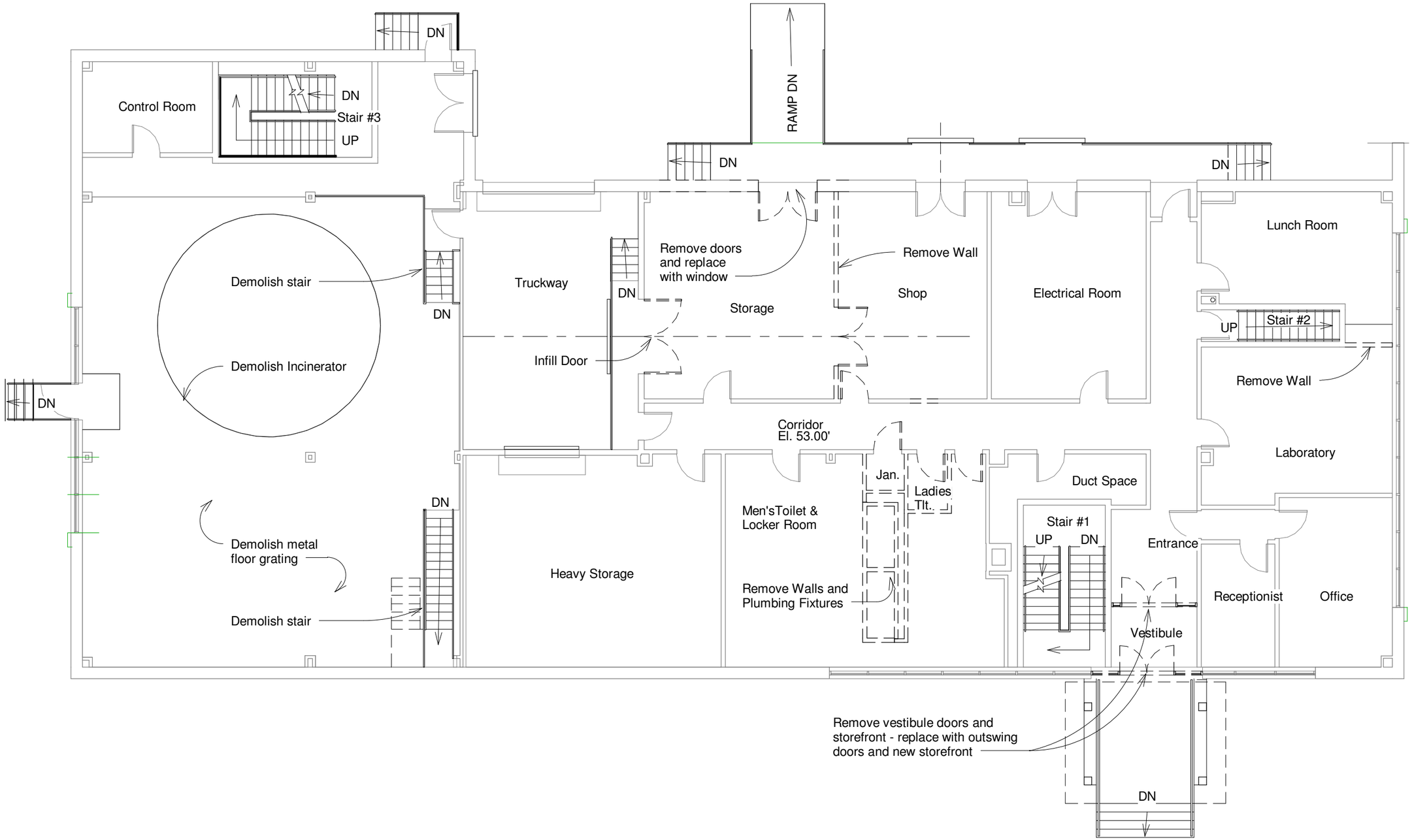

1 First Floor Demo Plan
3/32" = 1'-0"

WOODARD & CURRAN

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TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 1
Renovated OB
First Floor Demo

AD102

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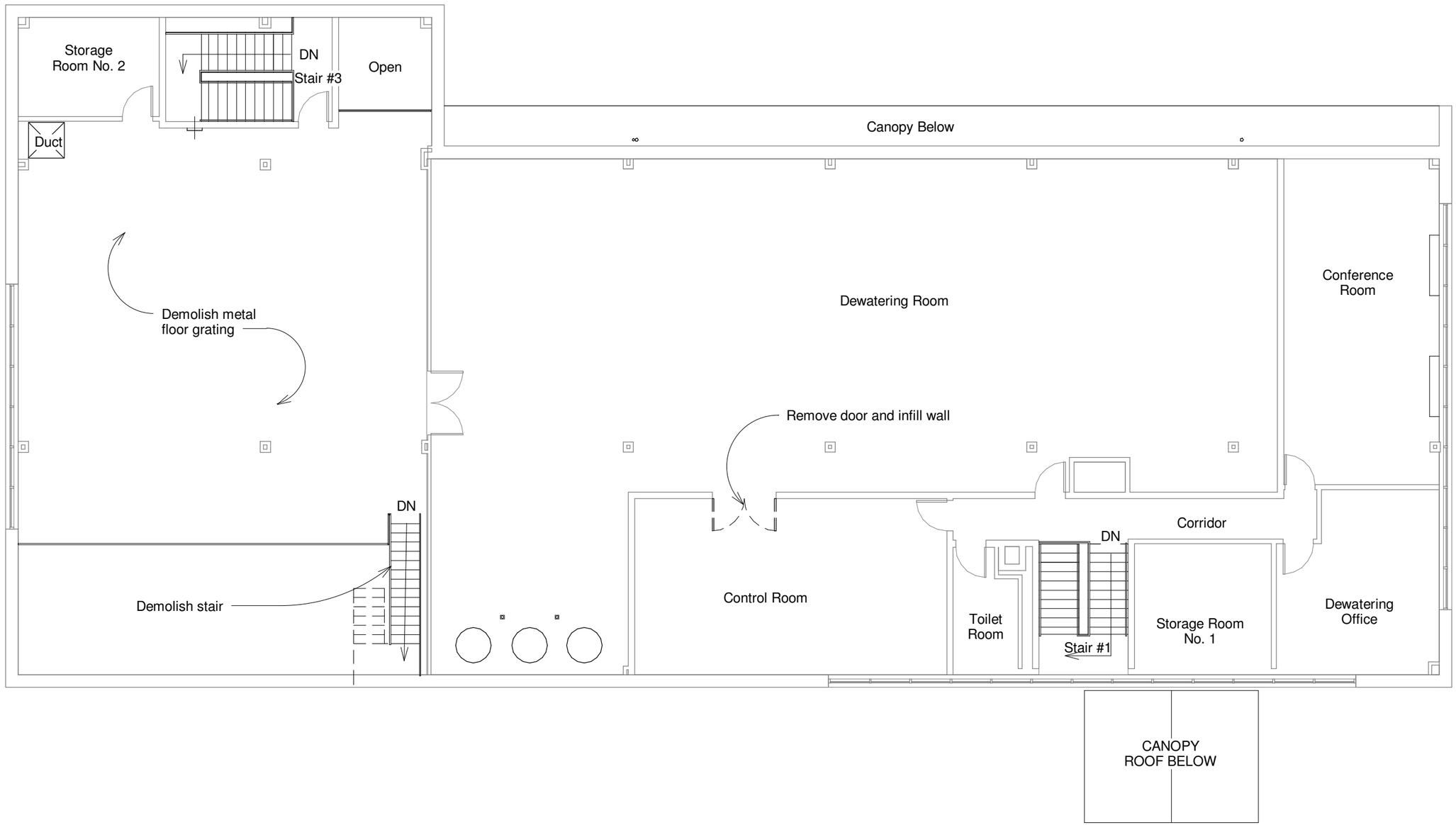

1 Second Floor Demo Plan
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date

Issue

Title

ALTERNATE 1
Renovated OB
Second Floor Demo

AD103

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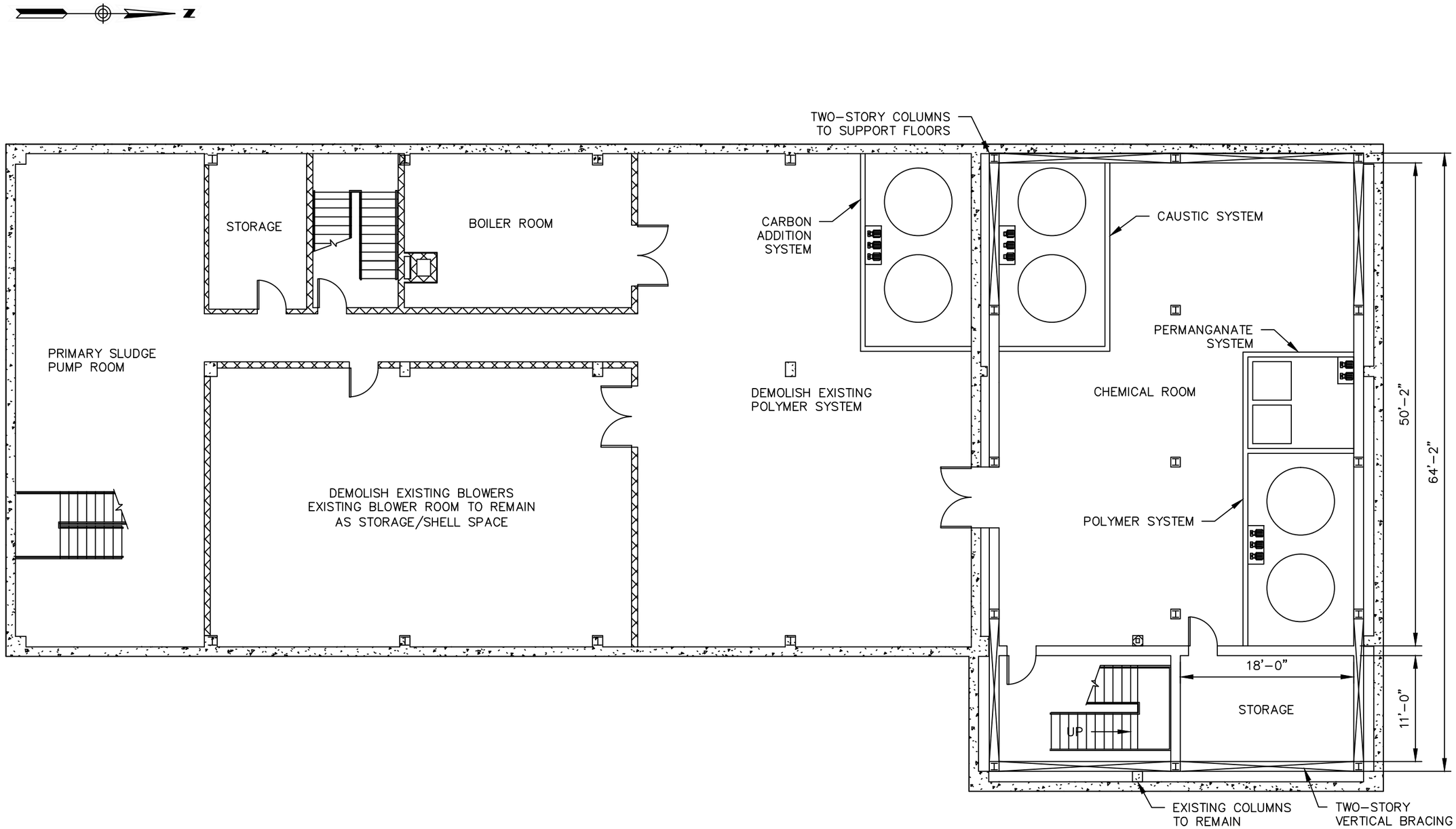

ALTERNATIVE 1A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OPS BLDG

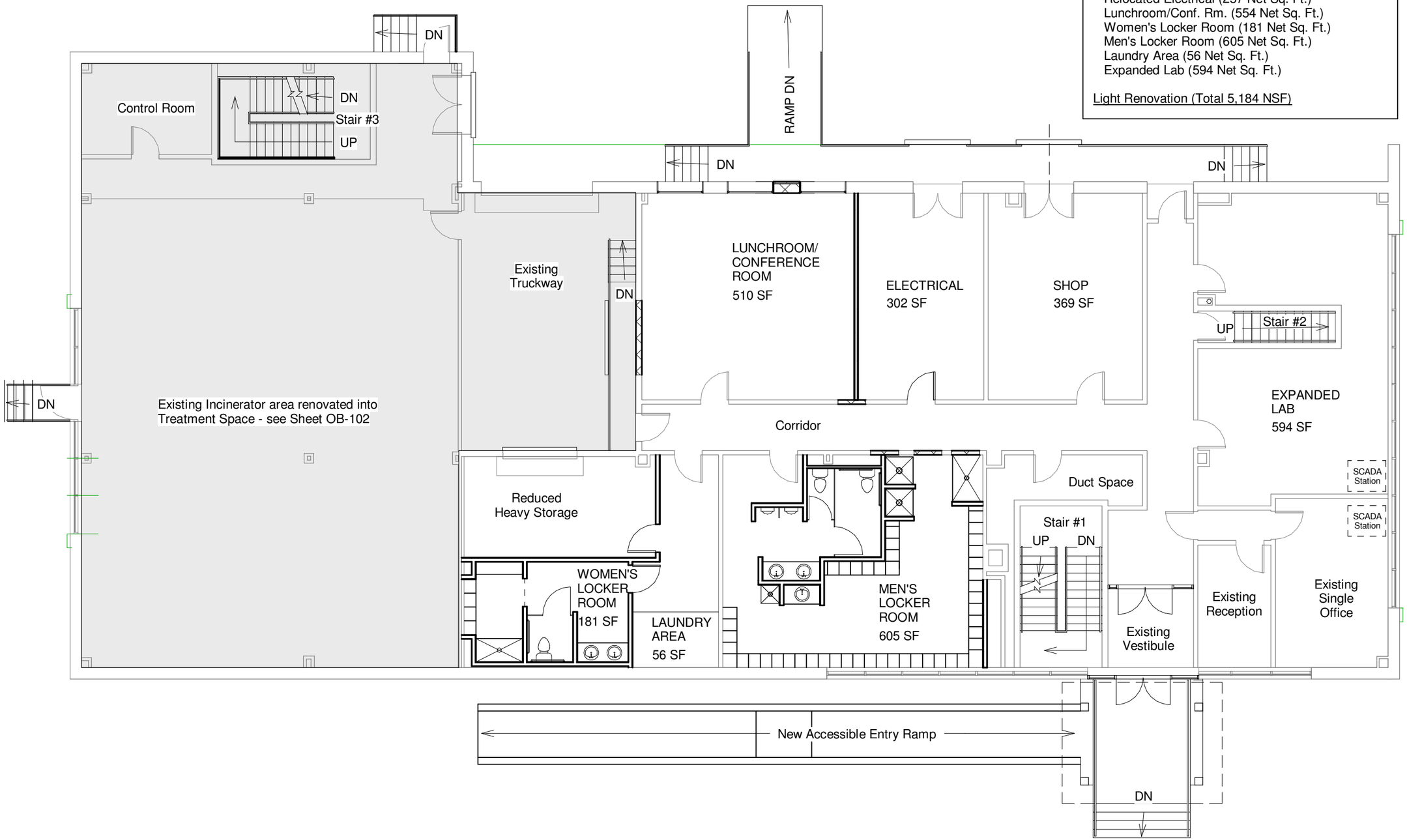
JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-101

OB Renovation - 1st Floor Summary

Heavy Renovation (Total 2,616 NSF):
- Relocated Shop (369 Net Sq. Ft.)
- Relocated Electrical (257 Net Sq. Ft.)
- Lunchroom/Conf. Rm. (554 Net Sq. Ft.)
- Women's Locker Room (181 Net Sq. Ft.)
- Men's Locker Room (605 Net Sq. Ft.)
- Laundry Area (56 Net Sq. Ft.)
- Expanded Lab (594 Net Sq. Ft.)

Light Renovation (Total 5,184 NSF)



1 OB First Floor Revised Layout
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

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One Corporate Road
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Enfield, CT 06082.6036
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www.steffian.com

Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date	Issue

Title
ALTERNATE 1 Renovated OB First Floor Layout

A102

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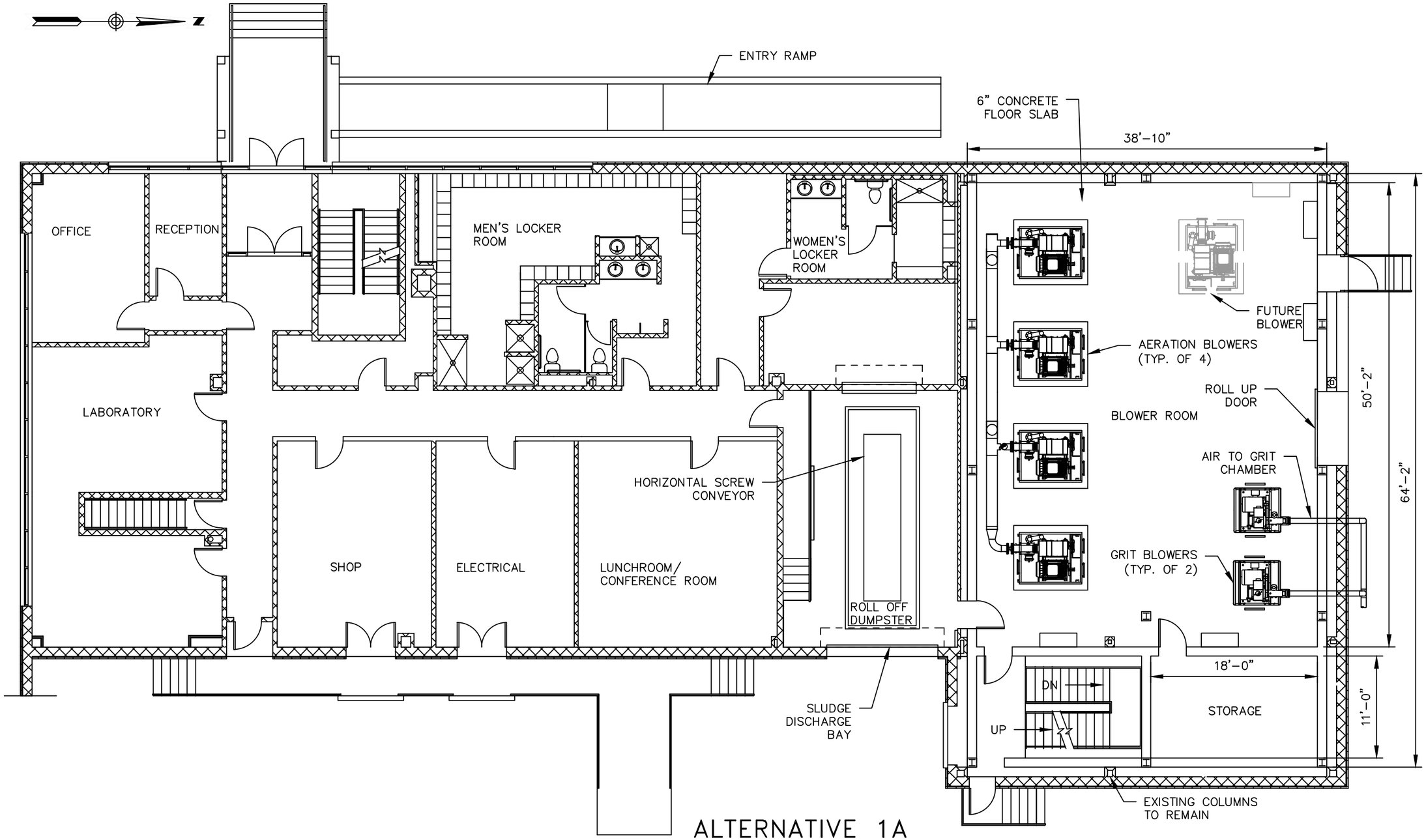
Plotted: 5/5/2015 11:05:54 PM



ALTERNATIVE 1A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OPS BLDG

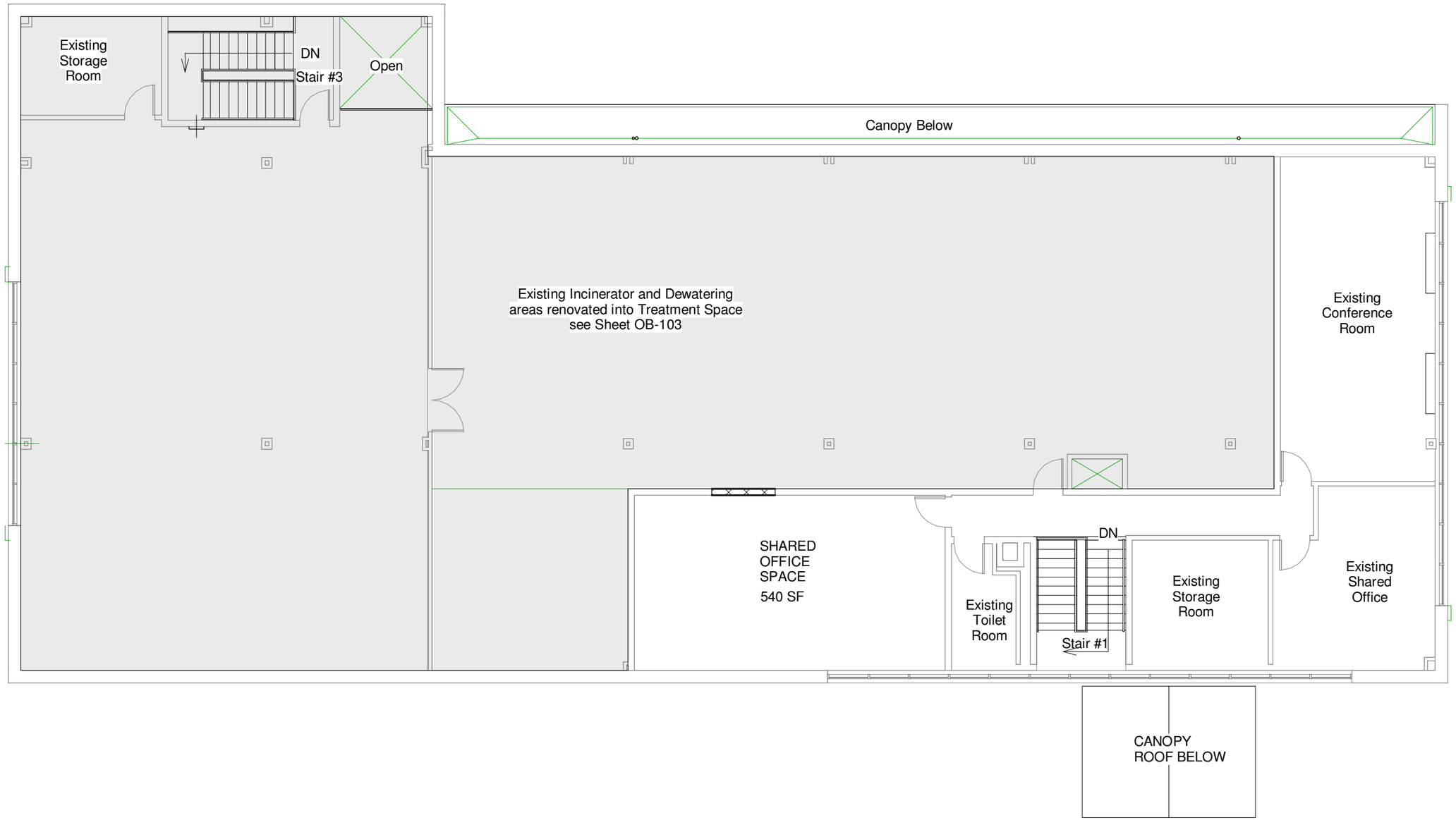
JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-102

OB Renovation - 2nd Floor Summary

Heavy Renovation (Total 540 NSF):
New Shared Offices (540 Net Sq. Ft.)

Light Renovation (Total 7,260 NSF)



1 OB Second Floor Revised Layout
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

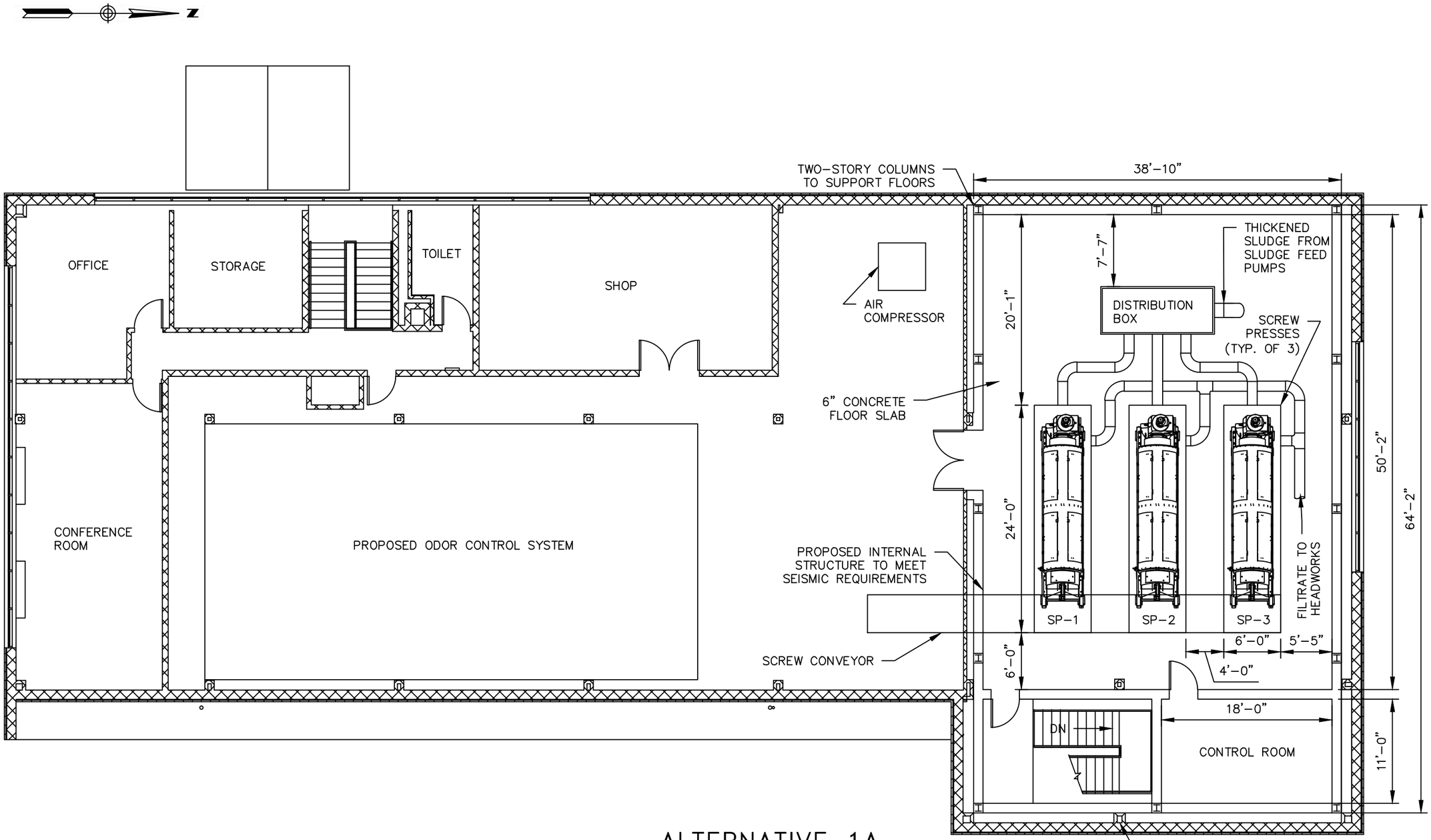
N

Date | Issue

Title
ALTERNATE 1
Renovated OB
Second Floor Layout

A103

© Steffian Bradley Architects
Plotted: 5/5/2015 11:05:55 PM



ALTERNATIVE 1A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION A

SCALE: 3/32" = 1'-0"

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WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION A

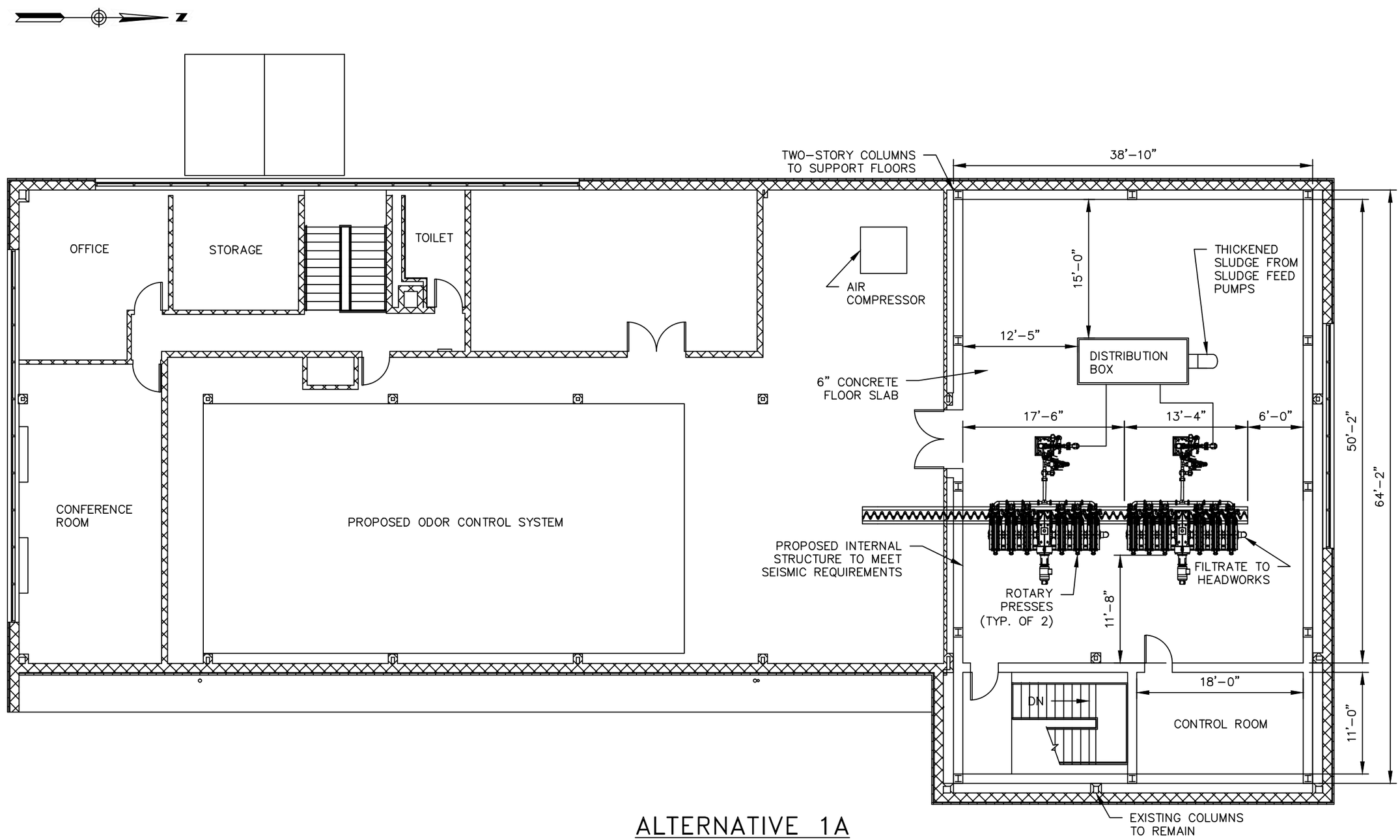
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OPS BLDG

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-103A



ALTERNATIVE 1A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION B

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION B

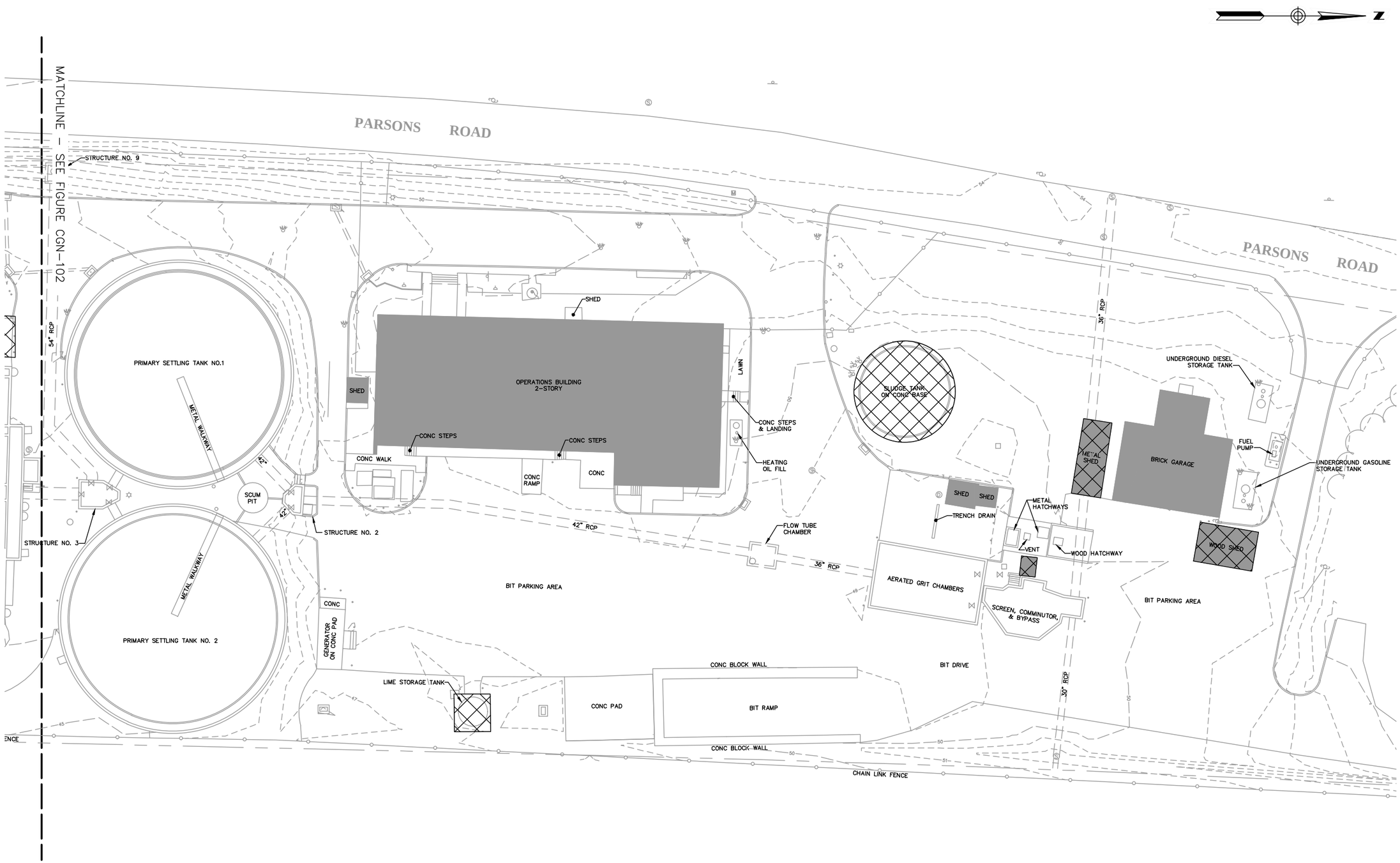
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1A
REHAB OPS BLDG

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-103B



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 1B – NORTH

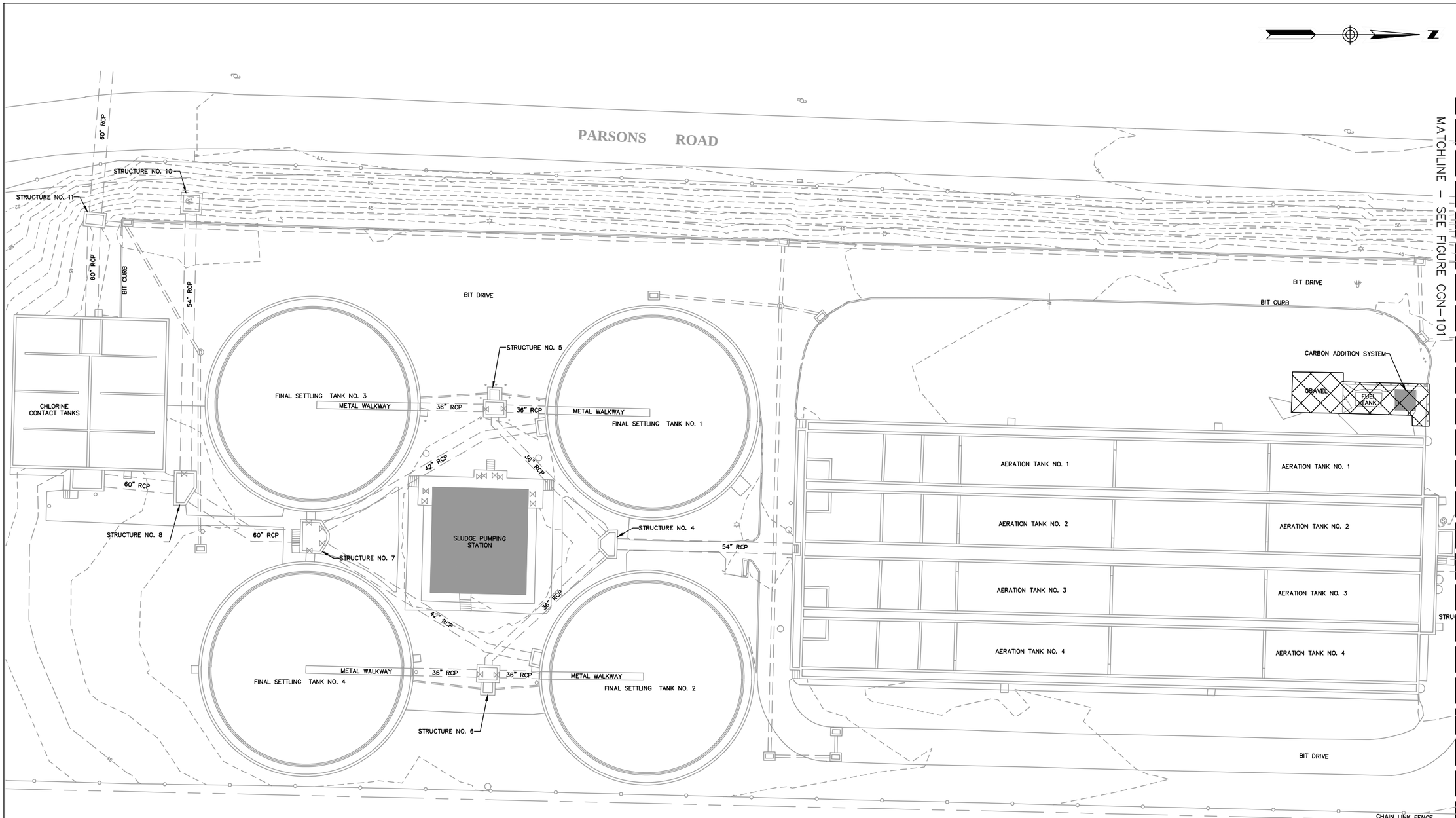
DESIGNED BY: AH/ACB	CHECKED BY: MJB
DRAWN BY: ACB	2015.03.23 CGN-100 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OB AND NEW GT

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-101



EXISTING STRUCTURE TO BE DEMOLISHED

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 1B – SOUTH

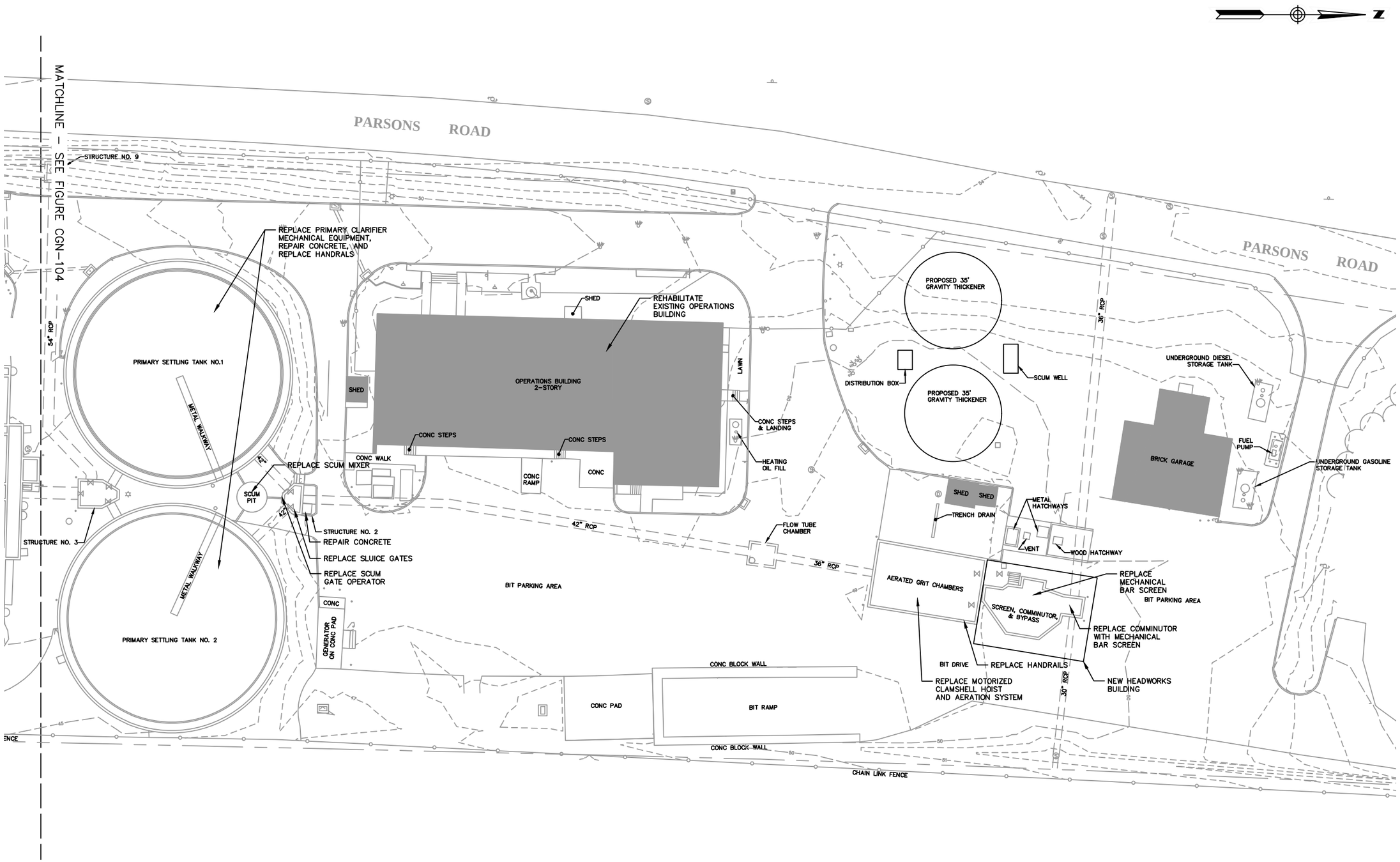
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23 CGN-100 DEMO*.dwg	

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OB AND NEW GT

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-102



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT ALTERNATIVE 1B – NORTH

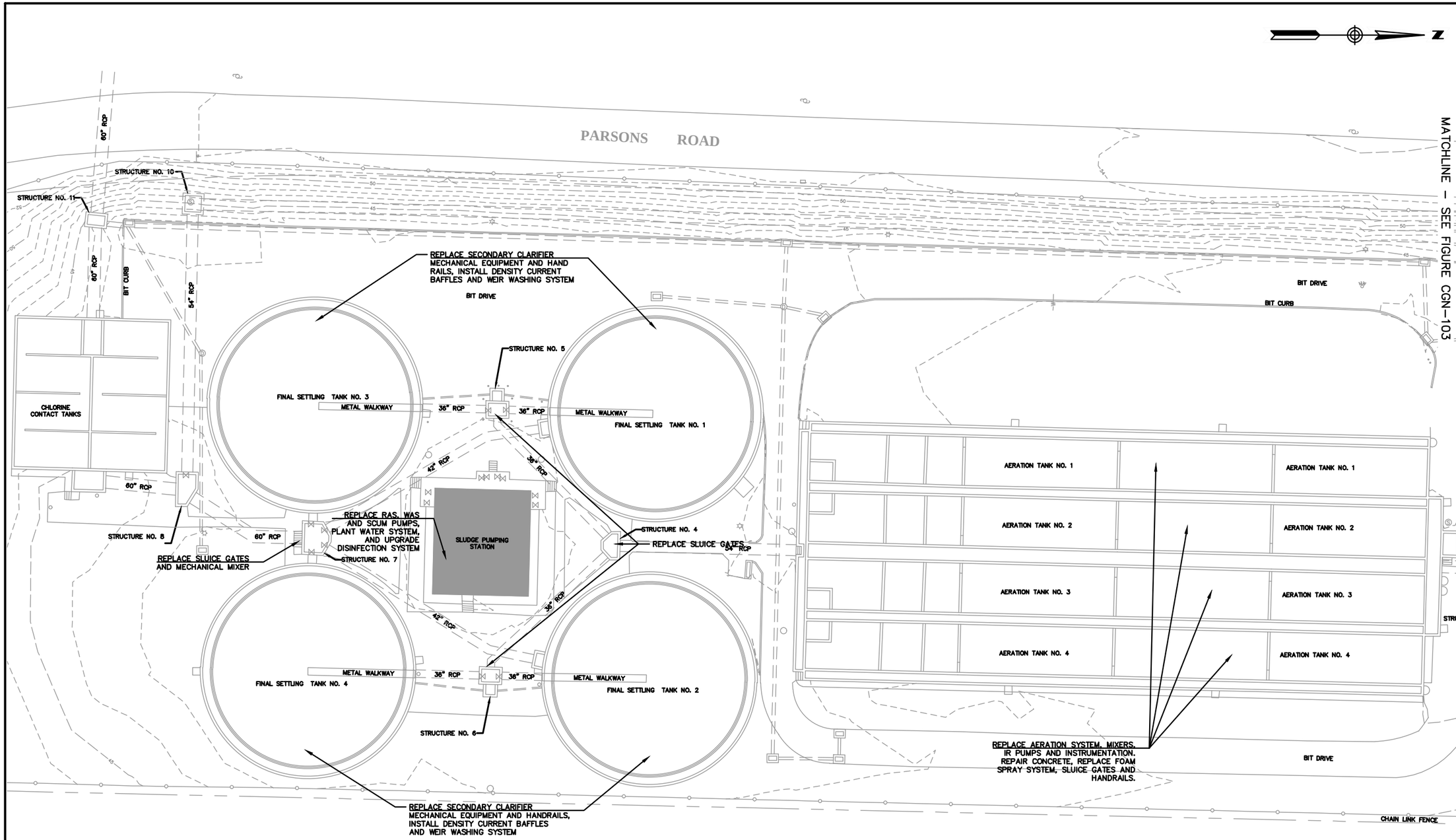
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-110.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OB AND NEW GT

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-113



NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT ALTERNATIVE 1B – SOUTH

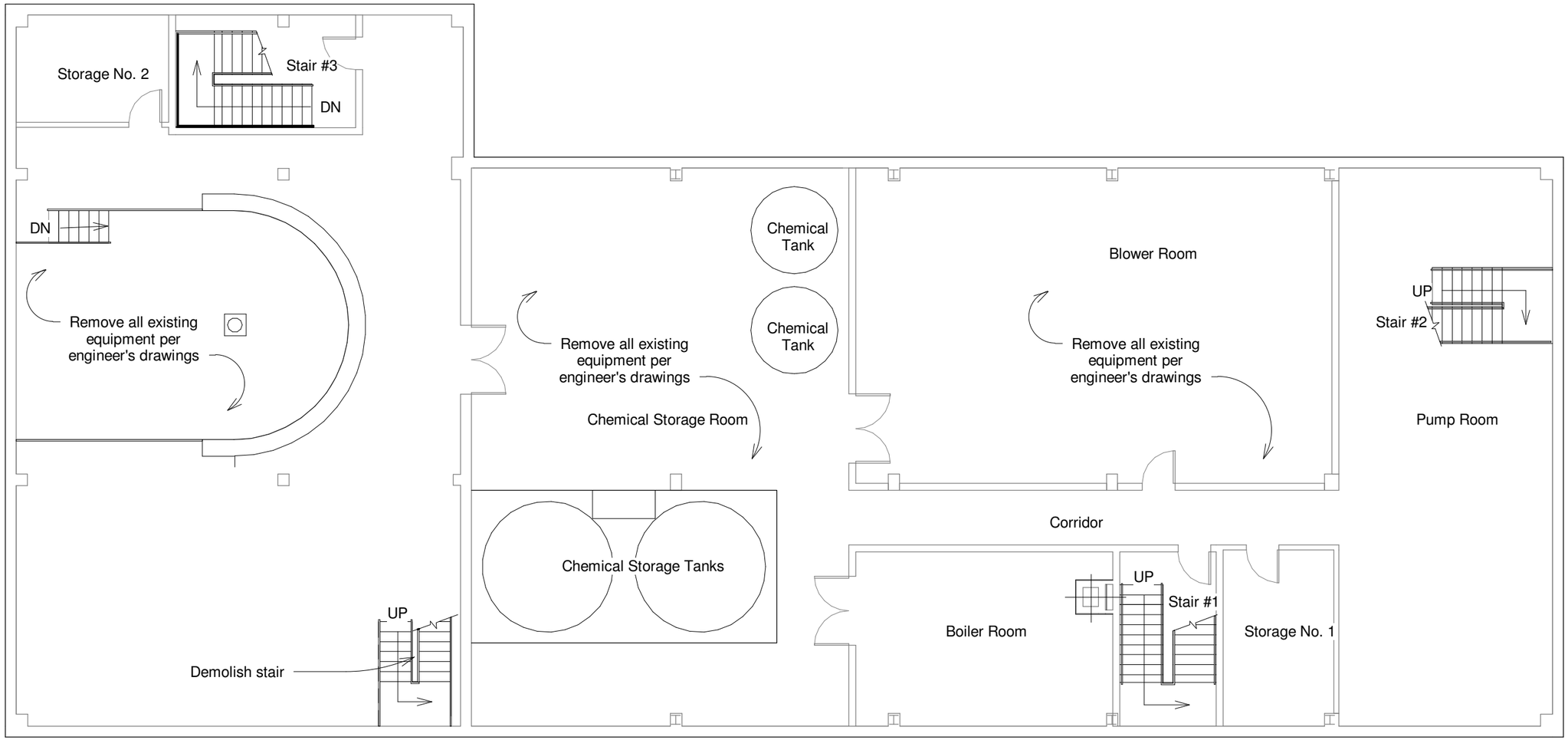
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23	CGN-110.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OB AND NEW GT

JOB NO: 227363
DATE: MAY 2015
SCALE: 1" = 40'

CGN-114



1 Basement Demo Plan
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000
DATE
May 2015

Scale
3/32" = 1'-0"

N

Date | Issue

Title
ALTERNATE 1
Renovated OB
Basement Demo

AD101

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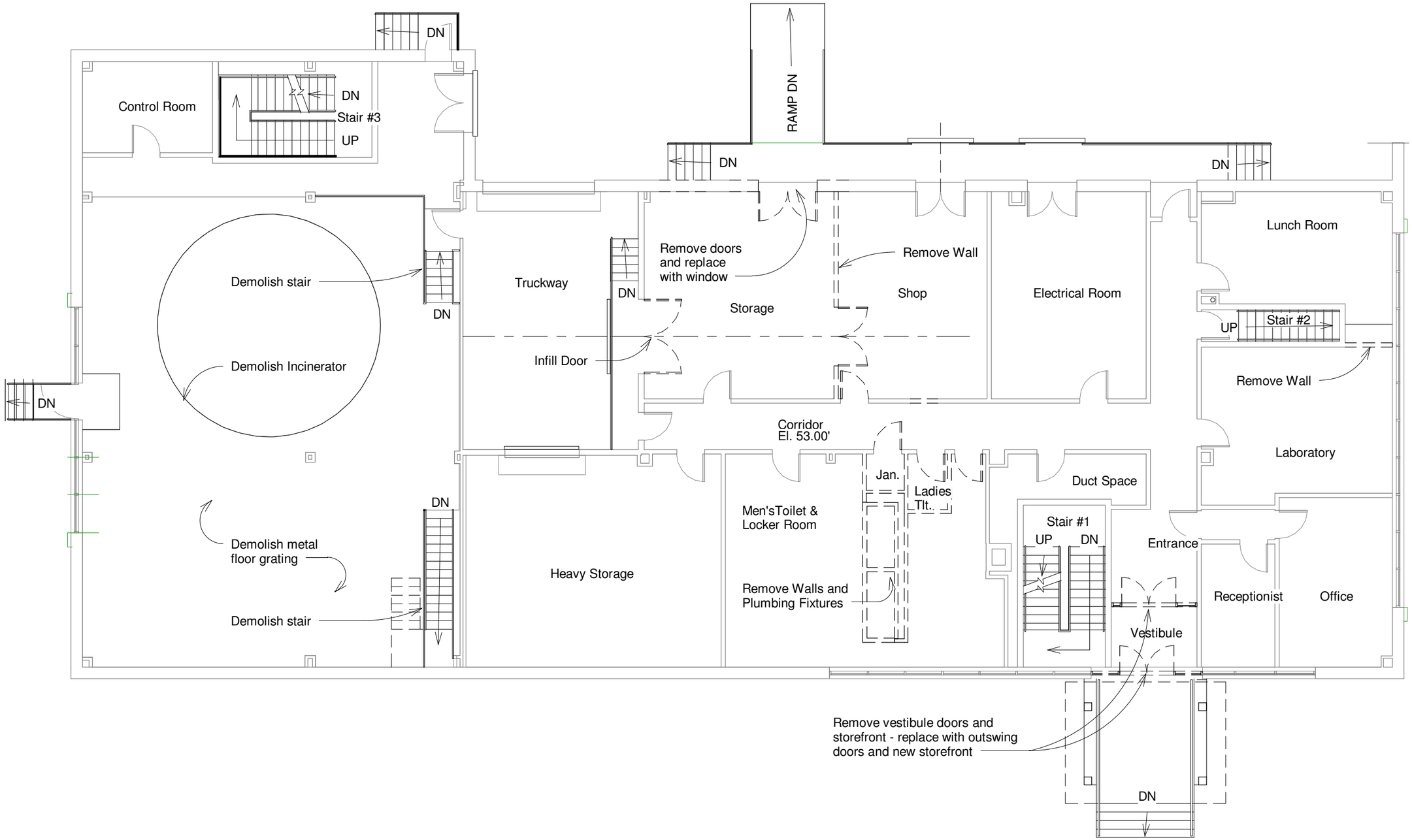

1 First Floor Demo Plan
3/32" = 1'-0"

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TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 1
Renovated OB
First Floor Demo

AD102

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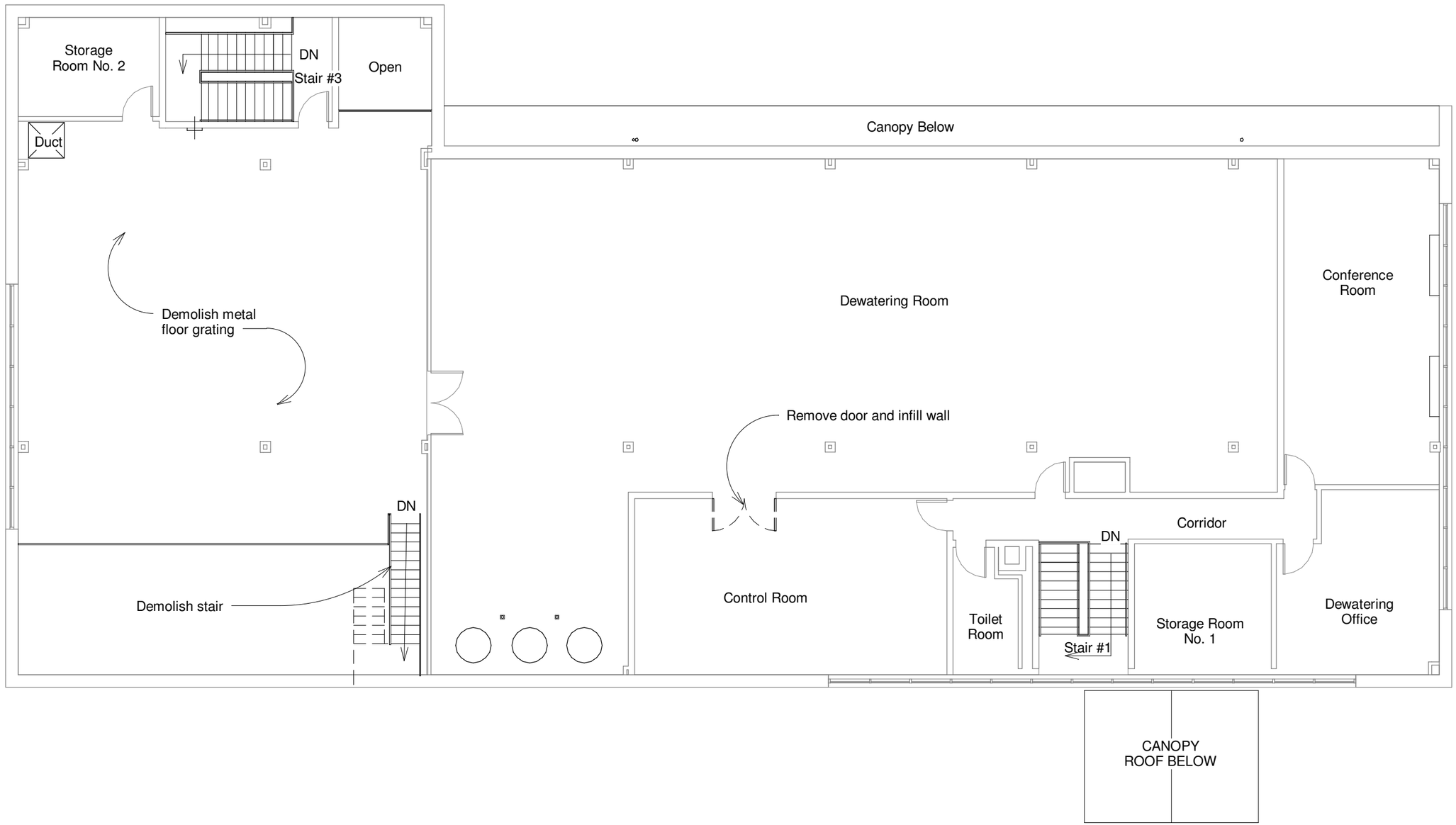

1 Second Floor Demo Plan
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date

Issue

Title

ALTERNATE 1
Renovated OB
Second Floor Demo

AD103

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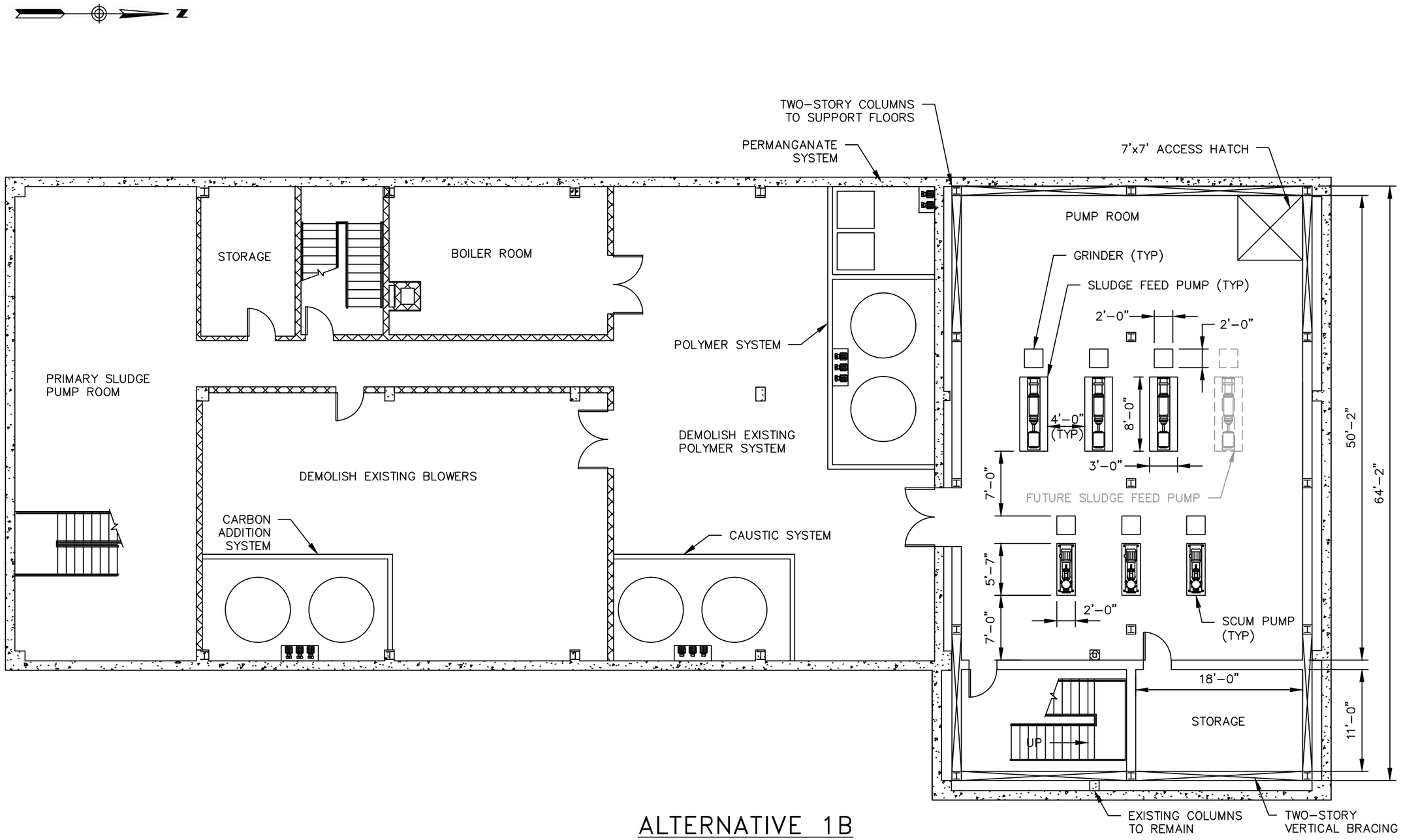
Plotted: 5/5/2015 11:05:55 PM



ALTERNATIVE 1B
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OPS BLDG AND NEW GT

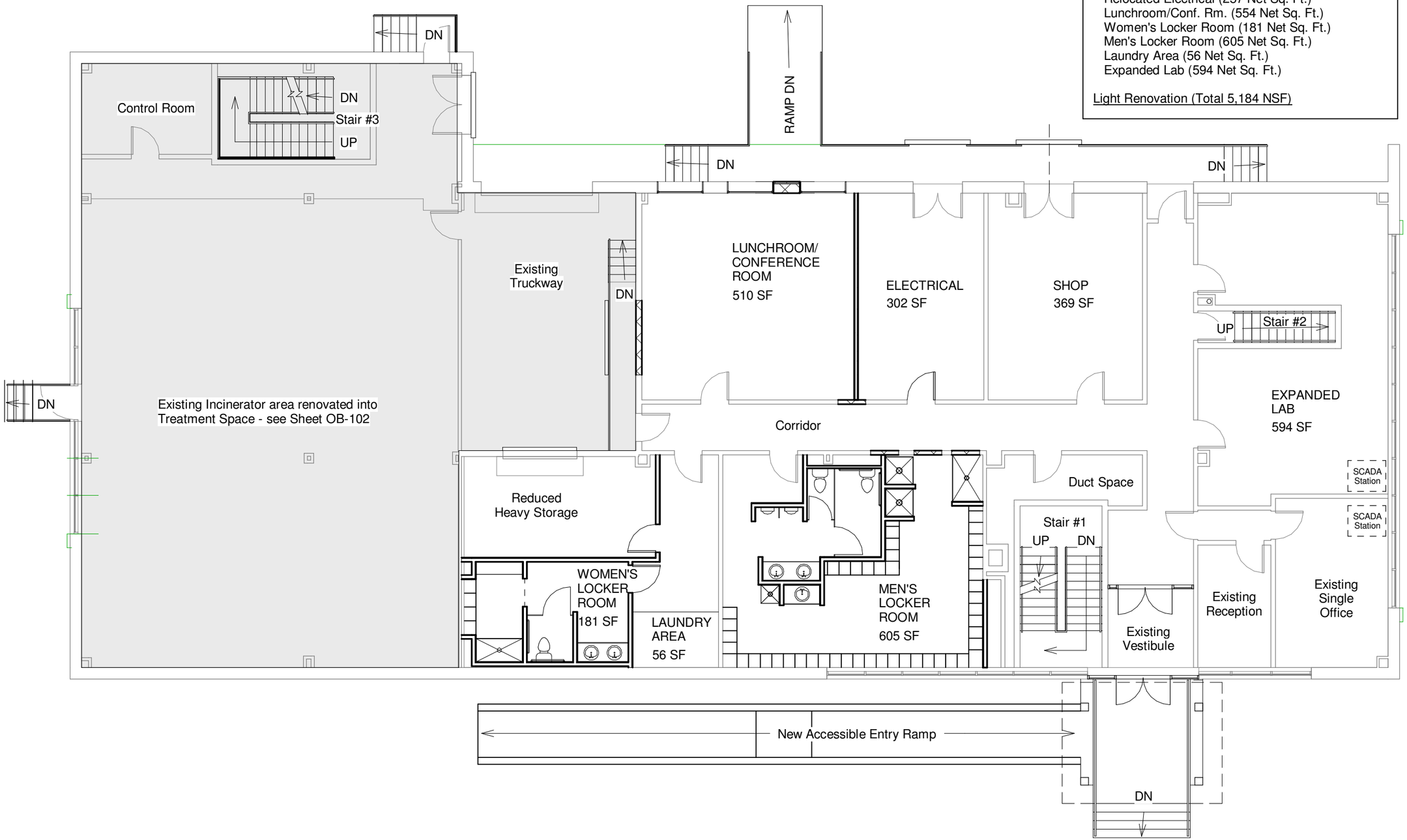
JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-111

OB Renovation - 1st Floor Summary

Heavy Renovation (Total 2,616 NSF):
- Relocated Shop (369 Net Sq. Ft.)
- Relocated Electrical (257 Net Sq. Ft.)
- Lunchroom/Conf. Rm. (554 Net Sq. Ft.)
- Women's Locker Room (181 Net Sq. Ft.)
- Men's Locker Room (605 Net Sq. Ft.)
- Laundry Area (56 Net Sq. Ft.)
- Expanded Lab (594 Net Sq. Ft.)

Light Renovation (Total 5,184 NSF)



1 OB First Floor Revised Layout
3/32" = 1'-0"

WOODARD & CURRAN

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date	Issue

Title
ALTERNATE 1 Renovated OB First Floor Layout

A102

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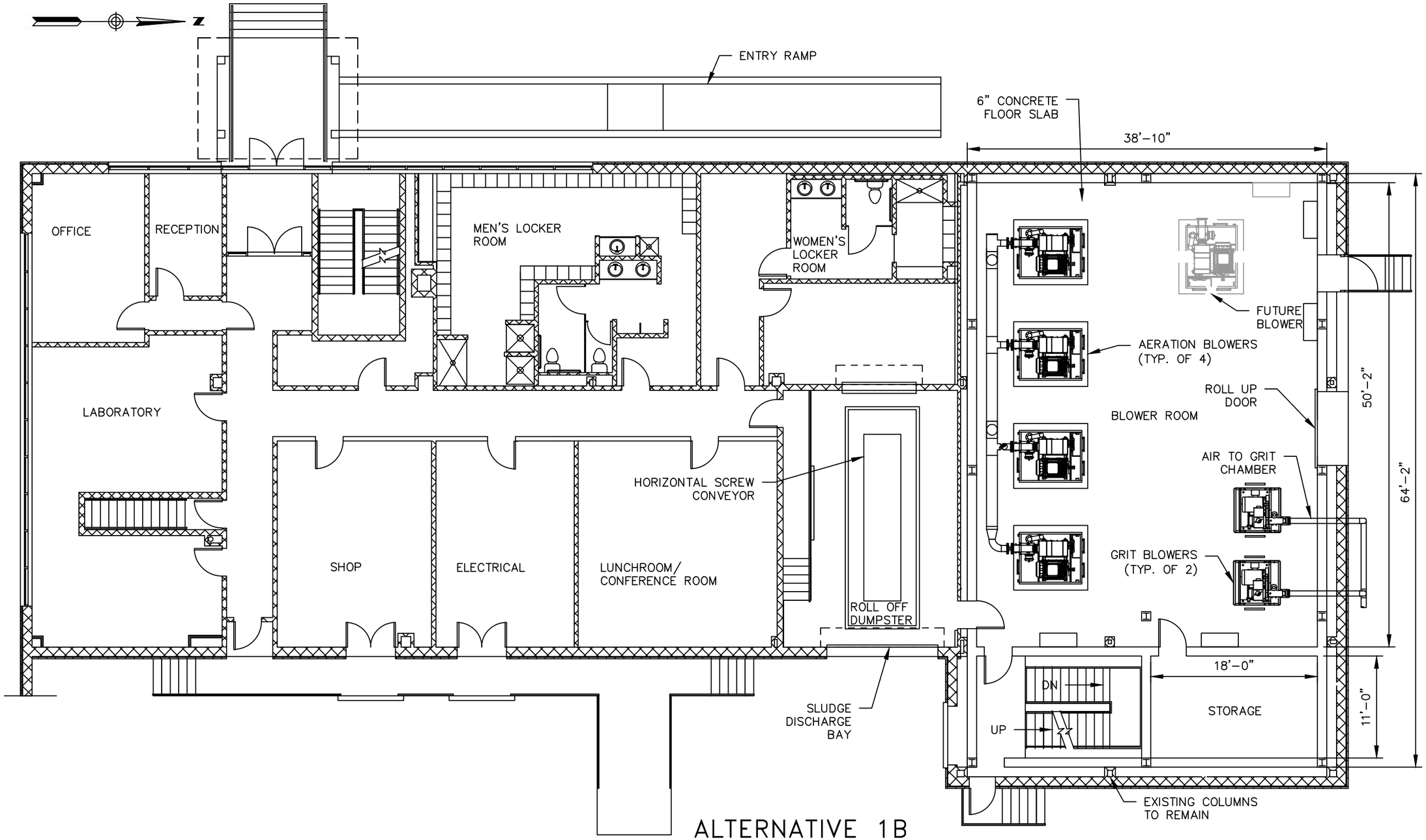
Plotted: 5/5/2015 11:05:54 PM



ALTERNATIVE 1B
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OPS BLDG AND NEW GT

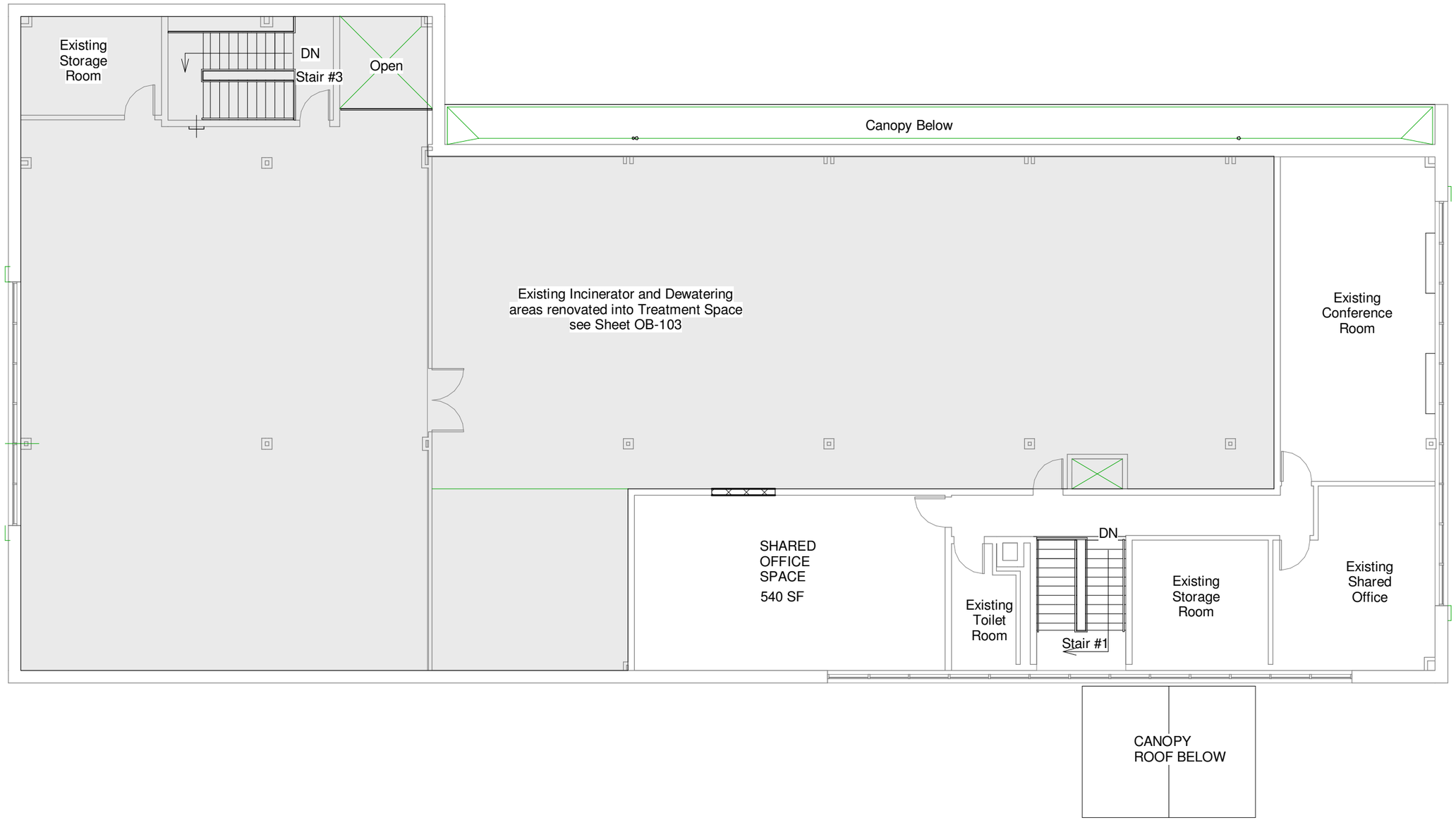
JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-112

OB Renovation - 2nd Floor Summary

Heavy Renovation (Total 540 NSF):
New Shared Offices (540 Net Sq. Ft.)

Light Renovation (Total 7,260 NSF)



1 OB Second Floor Revised Layout
3/32" = 1'-0"

WOODARD & CURRAN

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 1
Renovated OB
Second Floor Layout

A103

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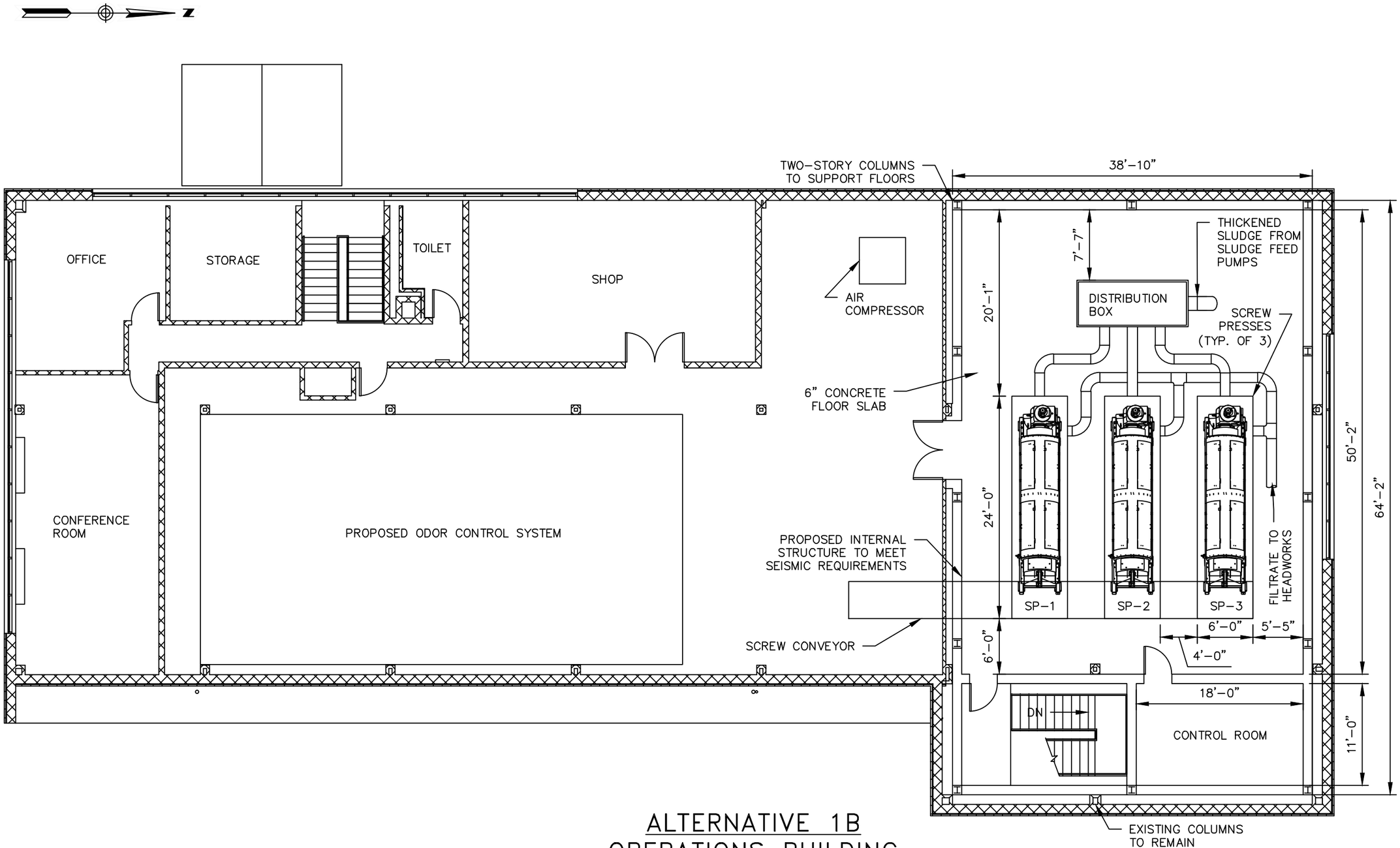

ALTERNATIVE 1B
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION A

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION A

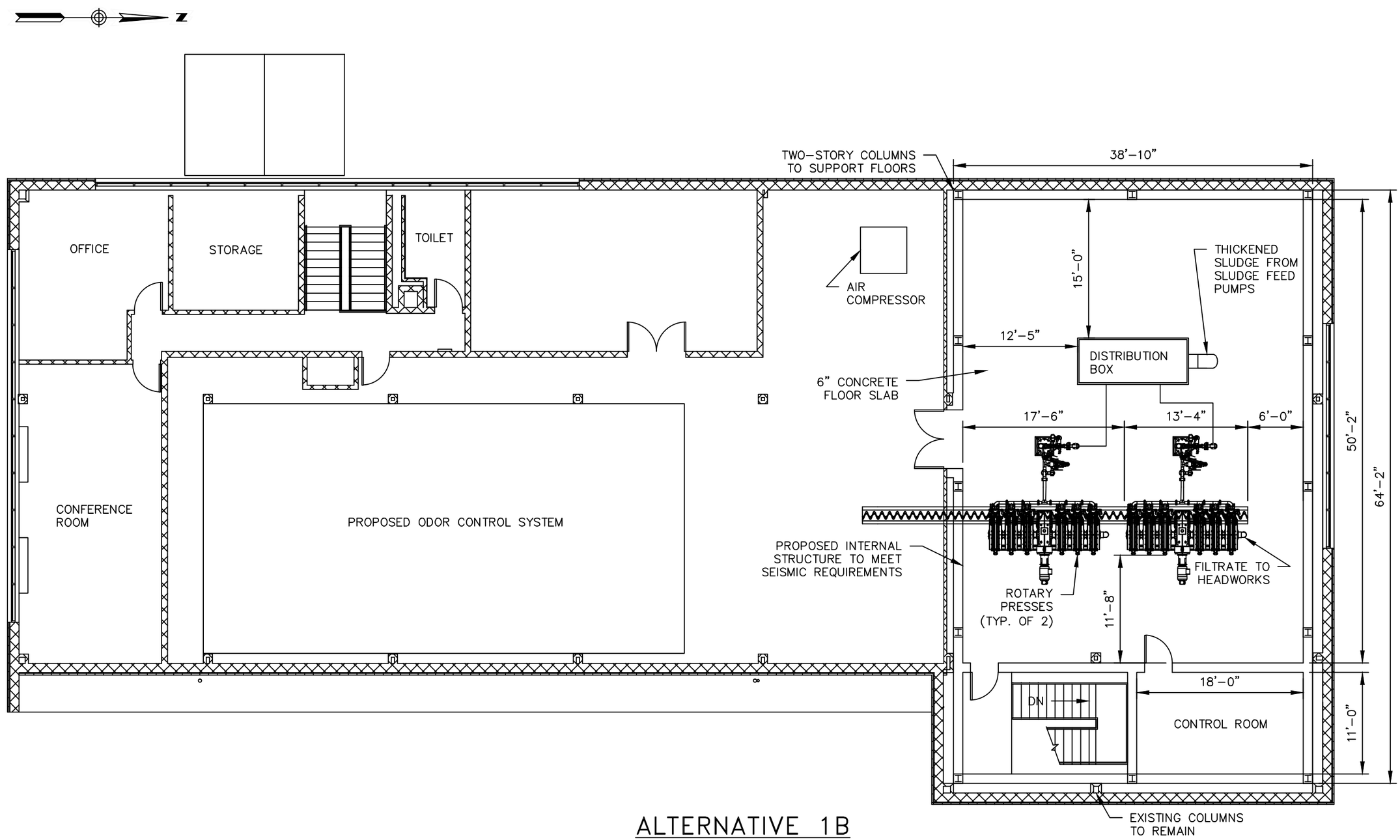
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OPS BLDG AND NEW GT

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-113A



ALTERNATIVE 1B
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION B

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION B

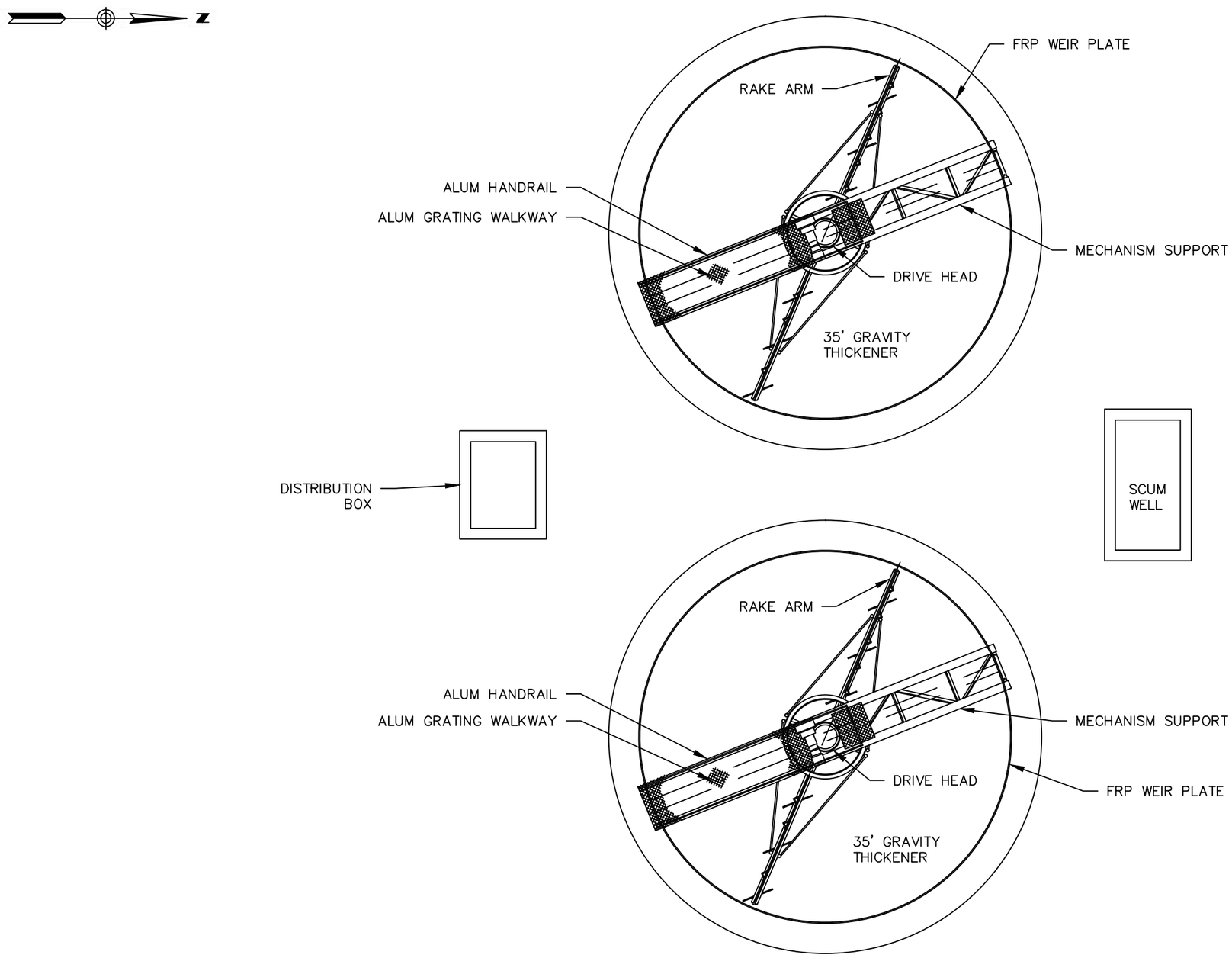
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23 OPS BLDG.dwg	

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OPS BLDG AND NEW GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-113B



ALTERNATIVE 1B
GRAVITY THICKENERS
CONCEPTUAL LAYOUT

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

GRAVITY THICKENERS
CONCEPTUAL LAYOUT

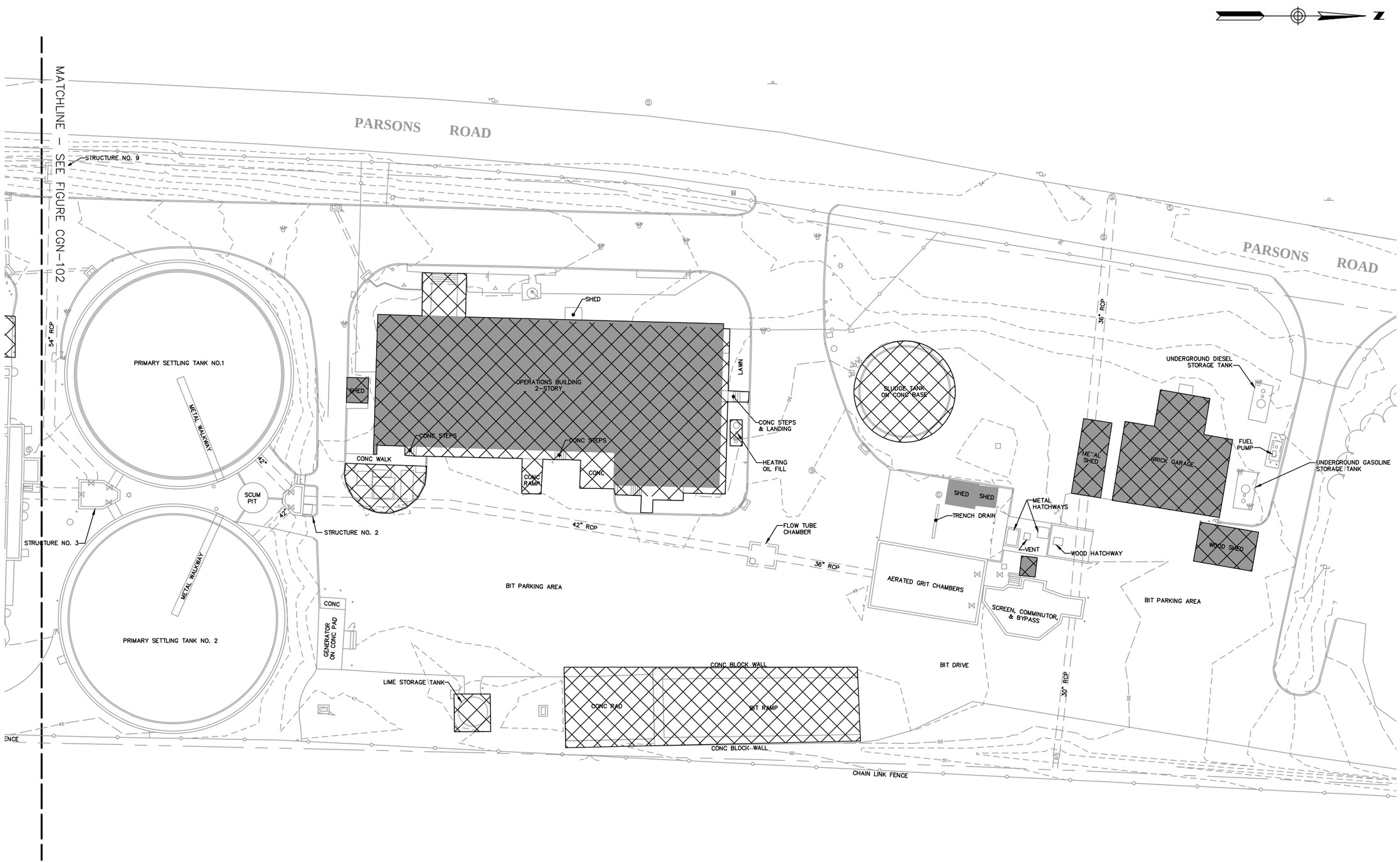
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 GRAVITY THIC*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 1B
REHAB OPS BLDG AND NEW GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

GT-111



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 2 – NORTH

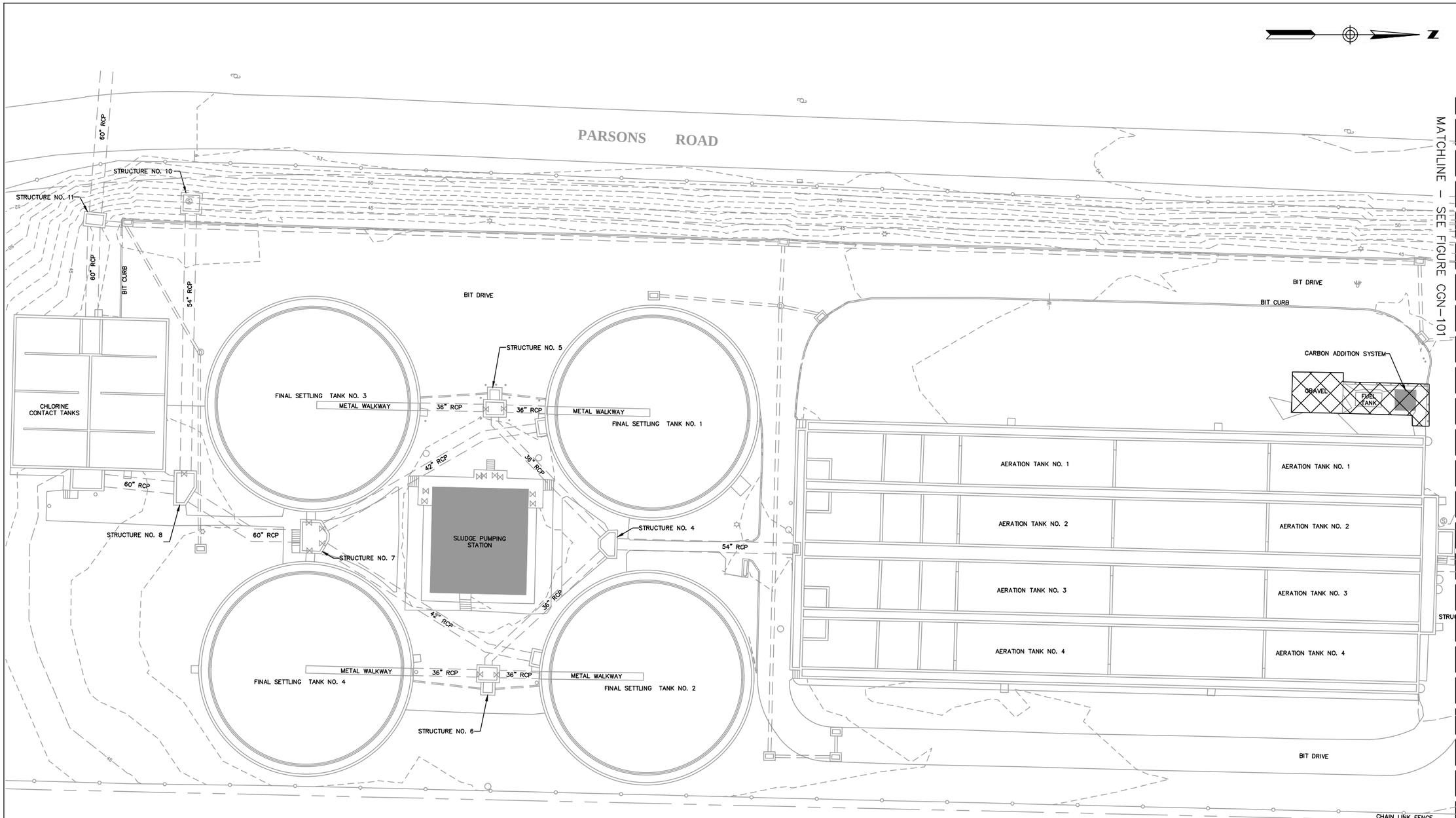
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-200 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 2
PROPOSED ADM BLDG, BB, SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-201



EXISTING STRUCTURE TO BE DEMOLISHED

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 2 – SOUTH

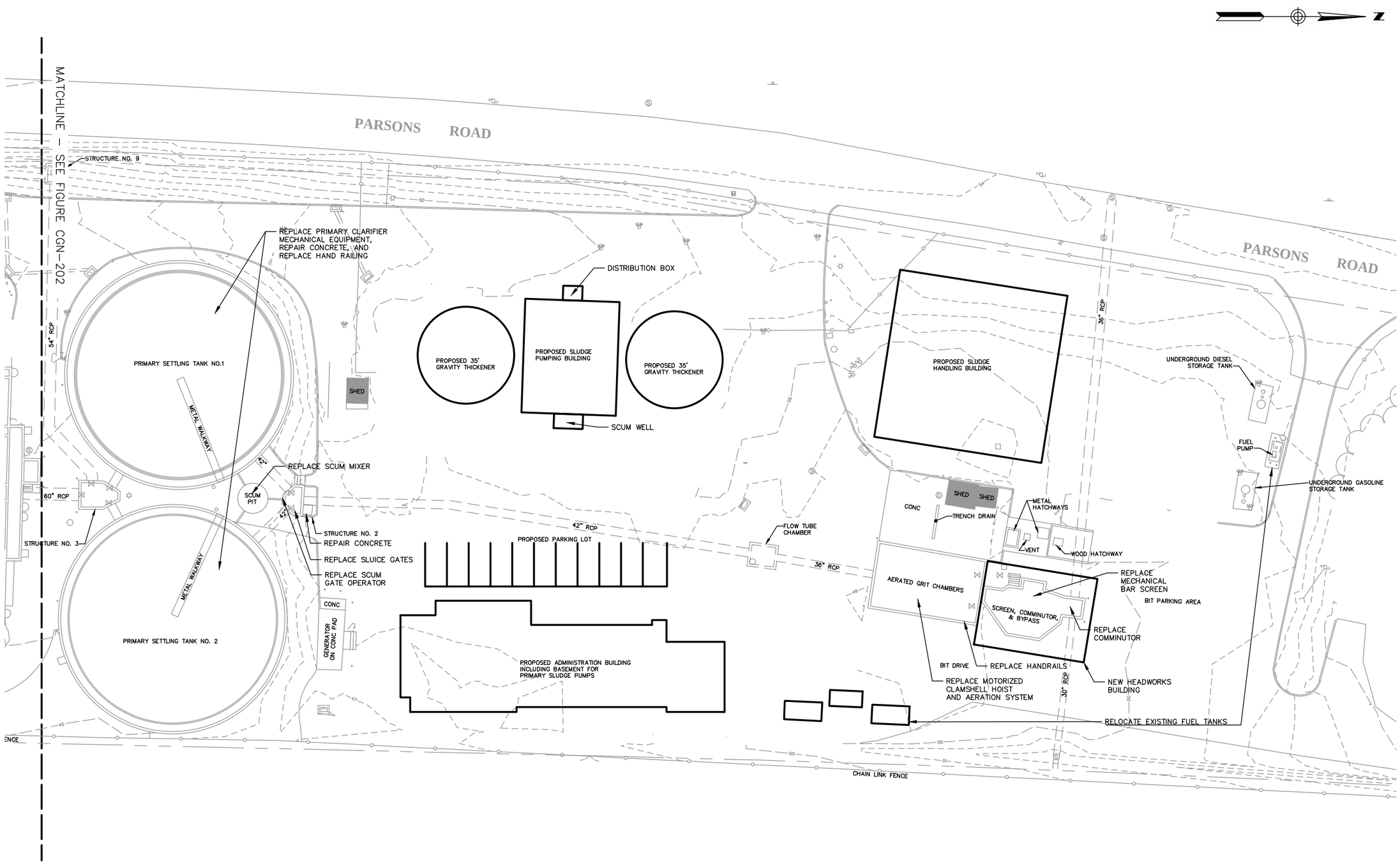
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23	CGN-200 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 2
PROPOSED ADM BLDG, BB, SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-202



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 2 – NORTH

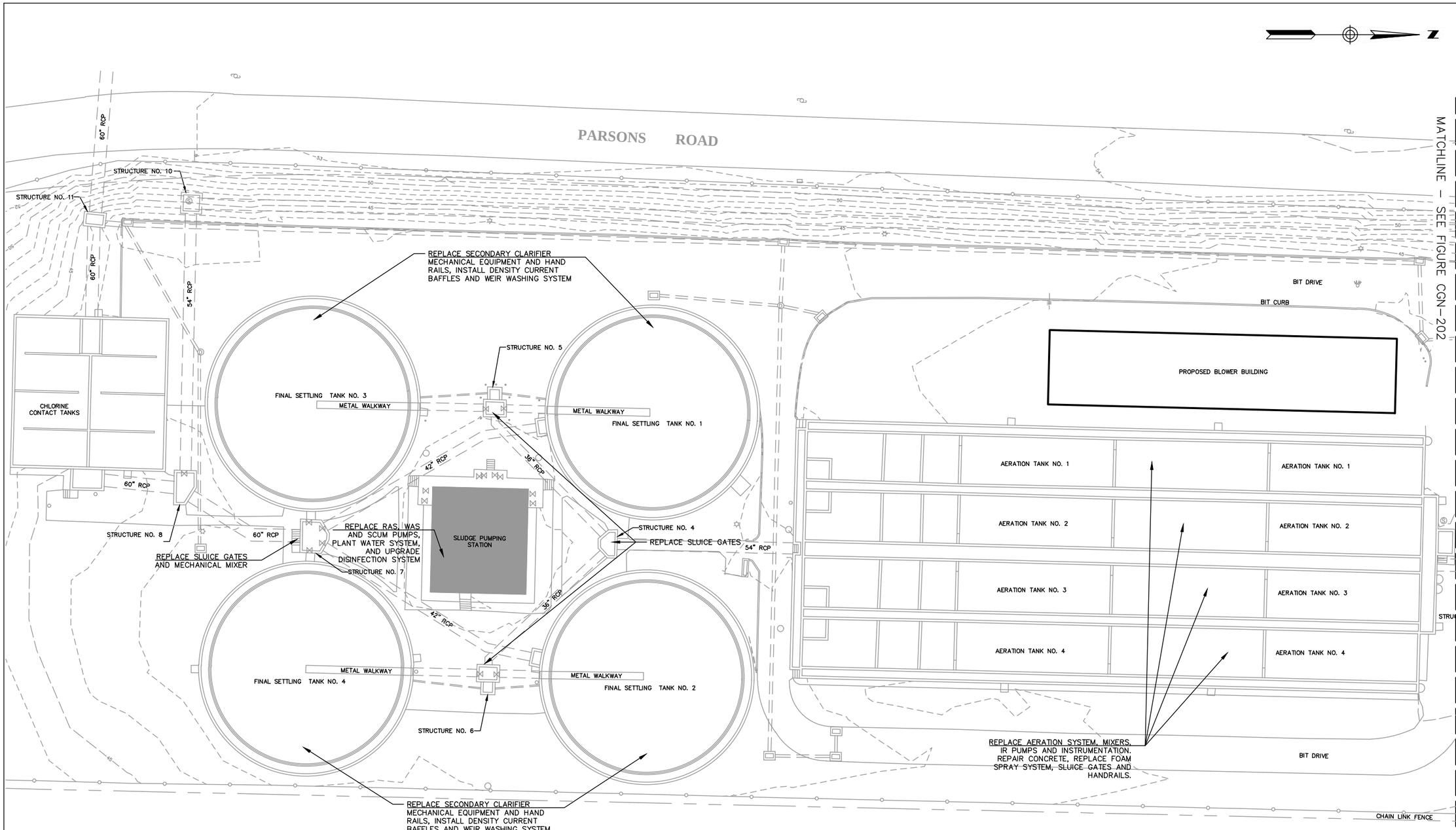
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-200.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 2
PROPOSED ADM BLDG, BB, SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-203



NOTE: SURVEY PERFORMED BY PEREIRA ENGINEERING, LLC OCTOBER, 2014

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 2 – SOUTH

DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23	CGN-200.dwg

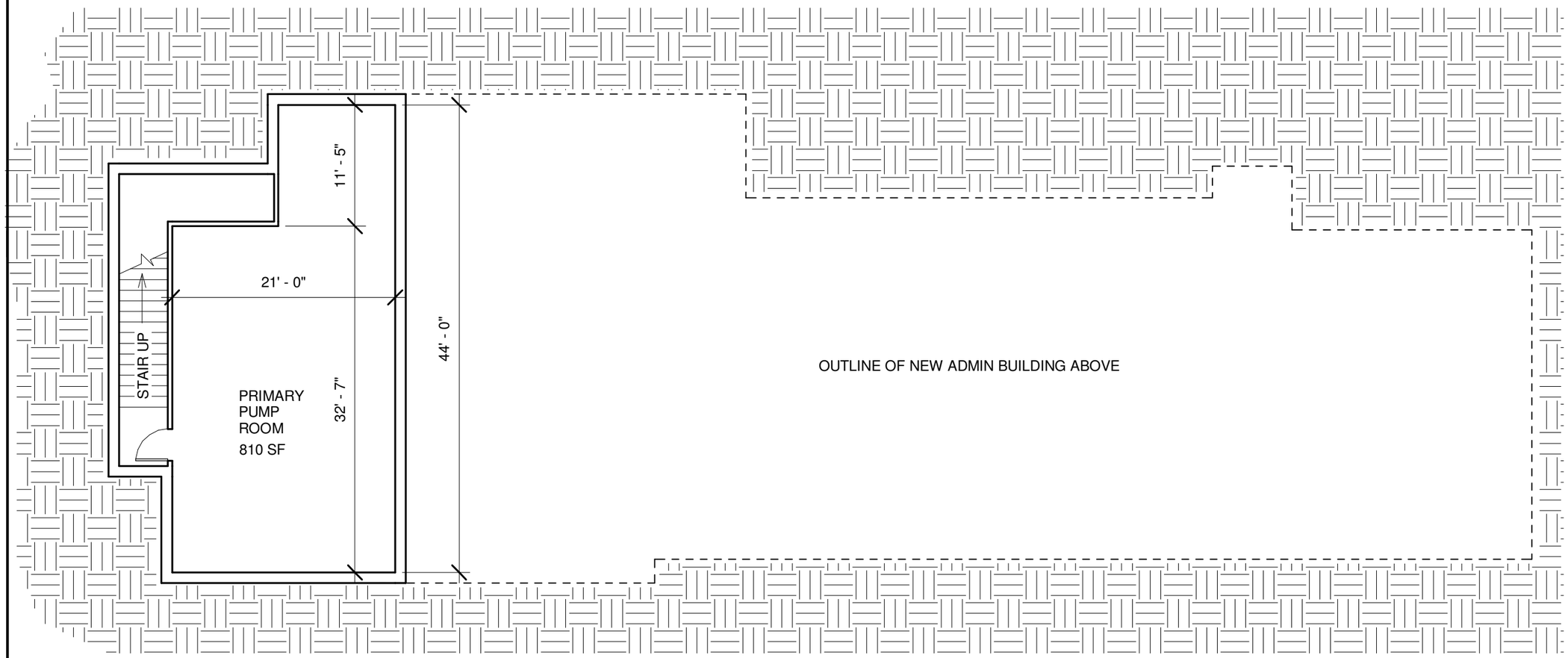
TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 2
PROPOSED DM BLDG, BB, SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-204

New Administration Building (6,200 GSF)
First Floor = 5,060 Gross Square Feet
Basement = 1,140 Gross Square Feet



1 Admin Bulding Basment Conceptual Layout
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

Steffian Bradley Architects
One Corporate Road
Suite 102
Enfield, CT 06082.6036
T 860.627.1920
www.steffian.com

Notes

TOWN of ENFIELD
WPCF

Project Number
2775-000
DATE
May 2015

Scale
3/32" = 1'-0"

N

Date | Issue

Title
ALTERNATE 2
New Admin Building
Basement

A201

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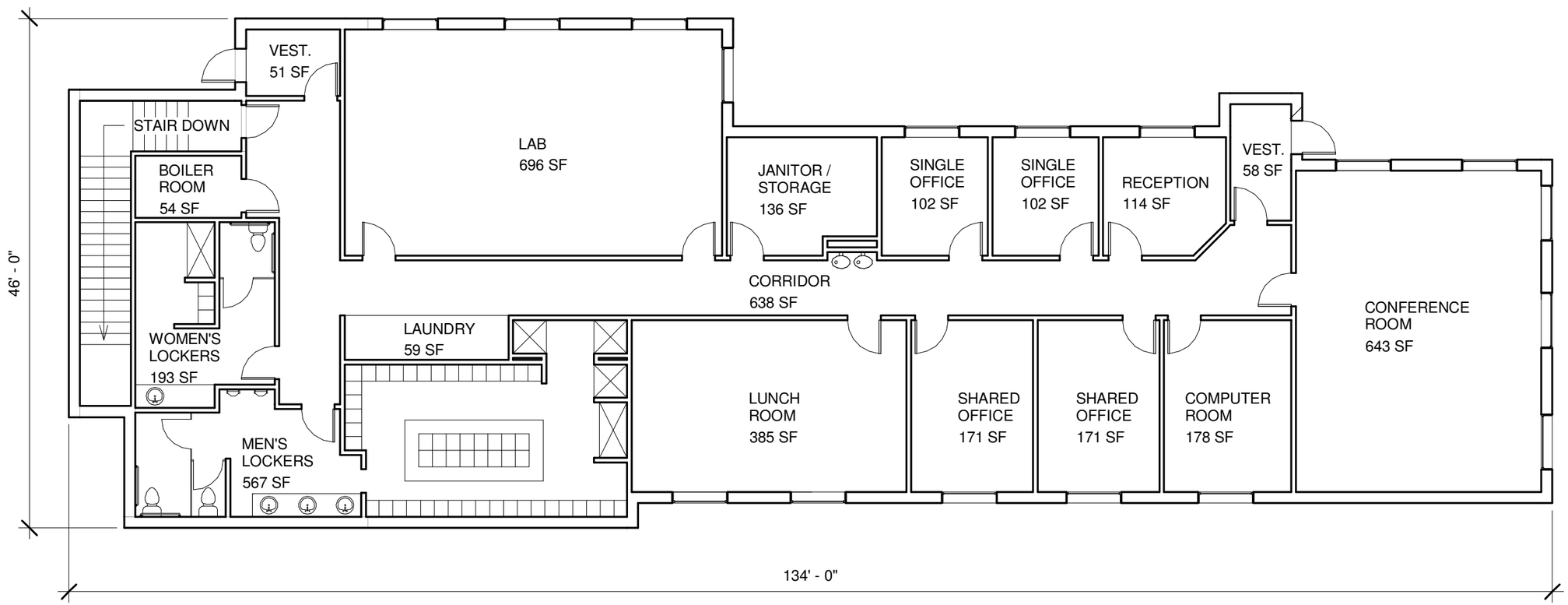
Plotted: 5/5/2015 11:09:50 PM

New Administration Building (6,200 GSF)
First Floor = 5,060 Gross Square Feet
Basement = 1,140 Gross Square Feet



1 Admin Building First Floor Conceptual Layout
3/32" = 1'-0"

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Notes

TOWN of ENFIELD
WPCF

Project Number
2775-000
DATE
May 2015

Scale
3/32" = 1'-0"
N

Date	Issue

Title
ALTERNATE 2
New Admin Building
First Floor

A202

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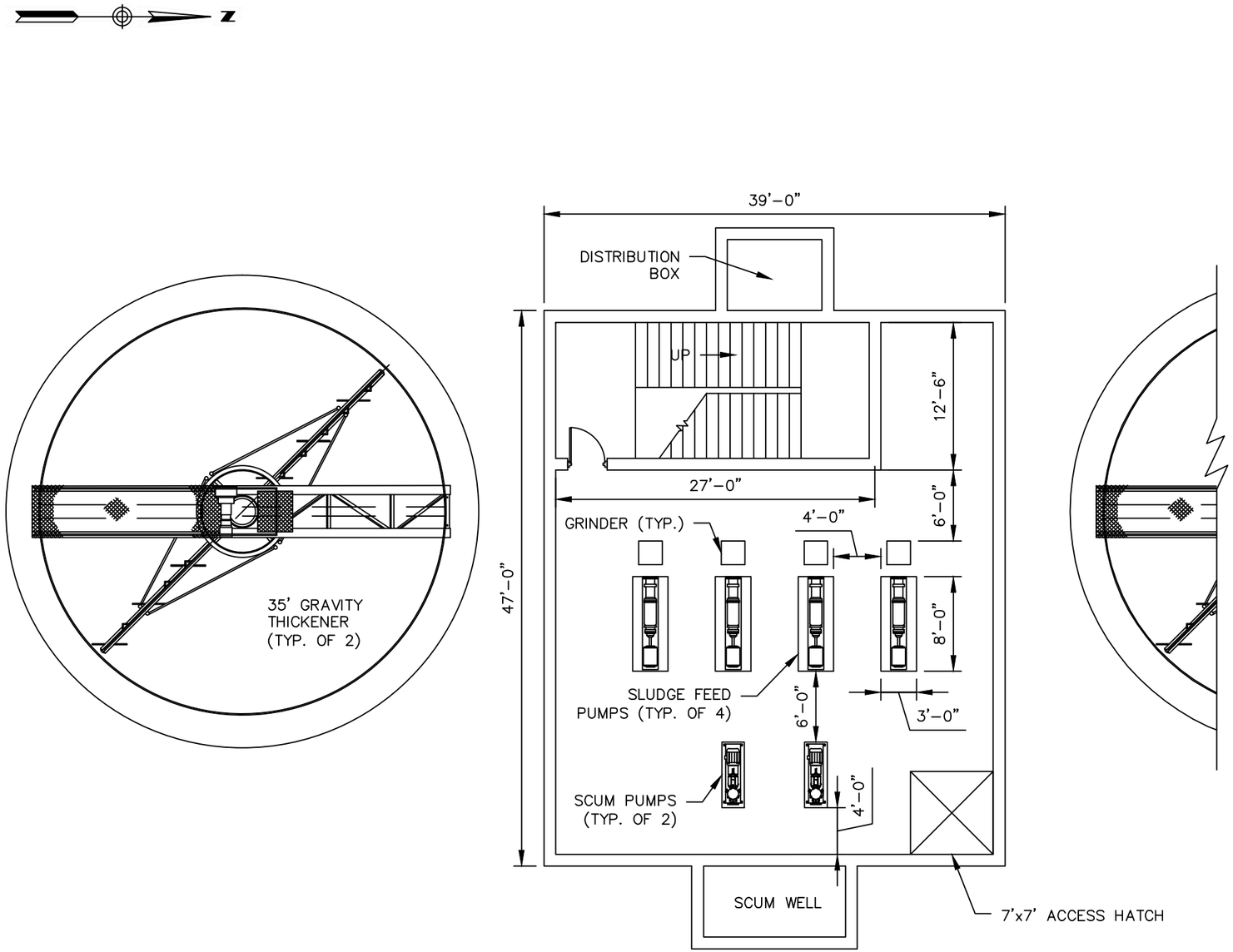
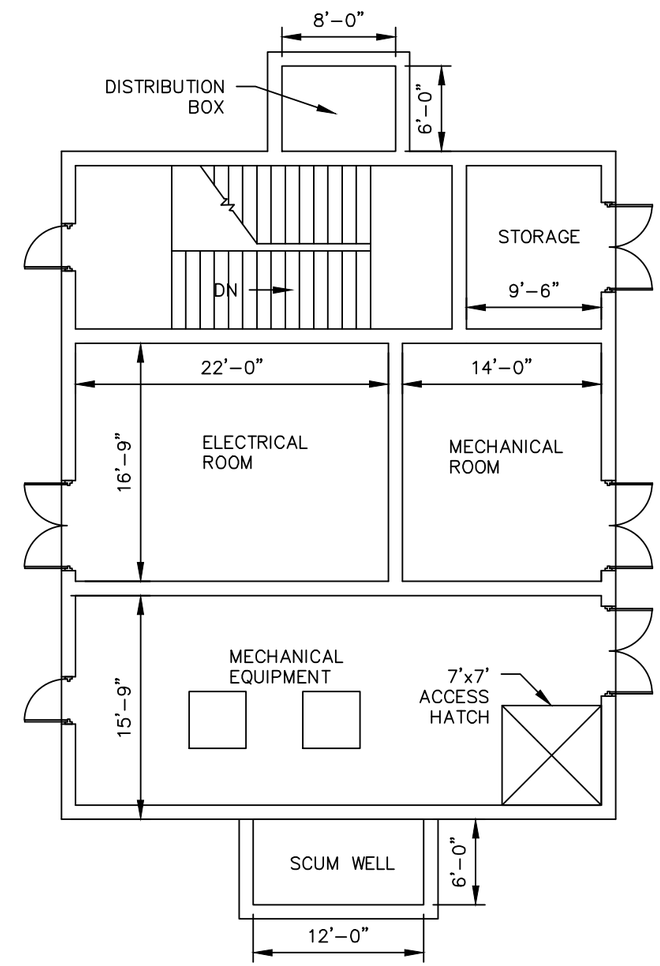
Plotted: 5/5/2015 11:09:50 PM



GRAVITY THICKENERS
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"



GRAVITY THICKENERS
CONCEPTUAL LAYOUT
GROUND FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

GRAVITY THICKENERS
CONCEPTUAL LAYOUT

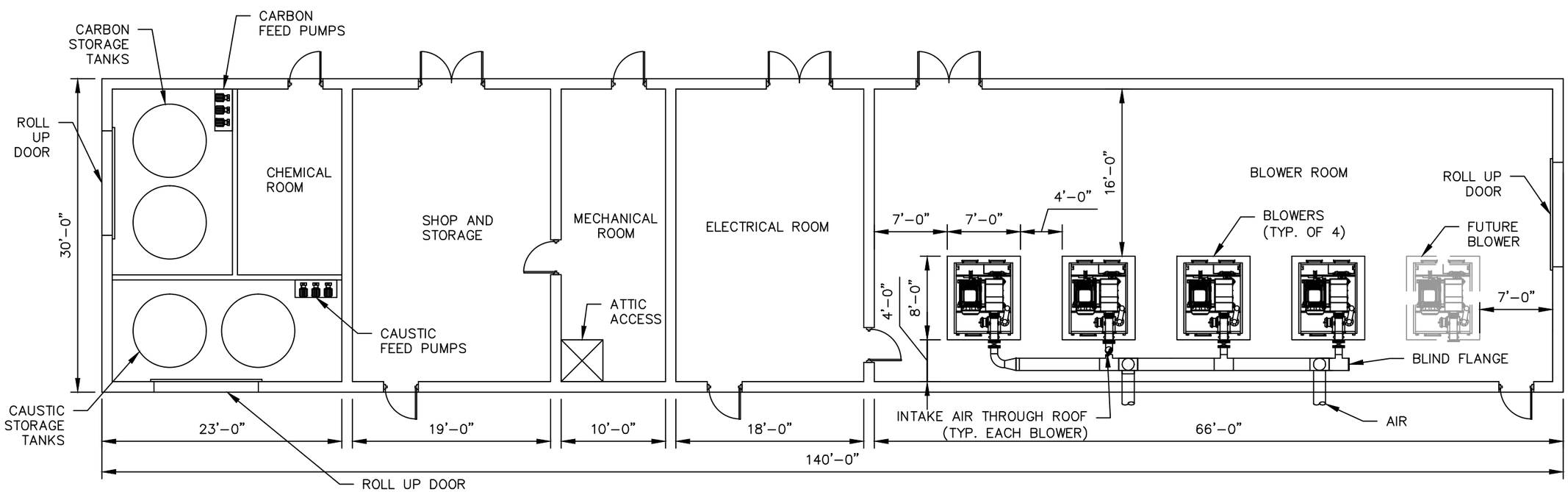
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 GRAVITY THIC*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 2
PROPOSED ADM BLDG, BB, SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

GT-201



ALTERNATIVE 2
BLOWER BUILDING
CONCEPTUAL LAYOUT

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

BLOWER BUILDING
CONCEPTUAL LAYOUT

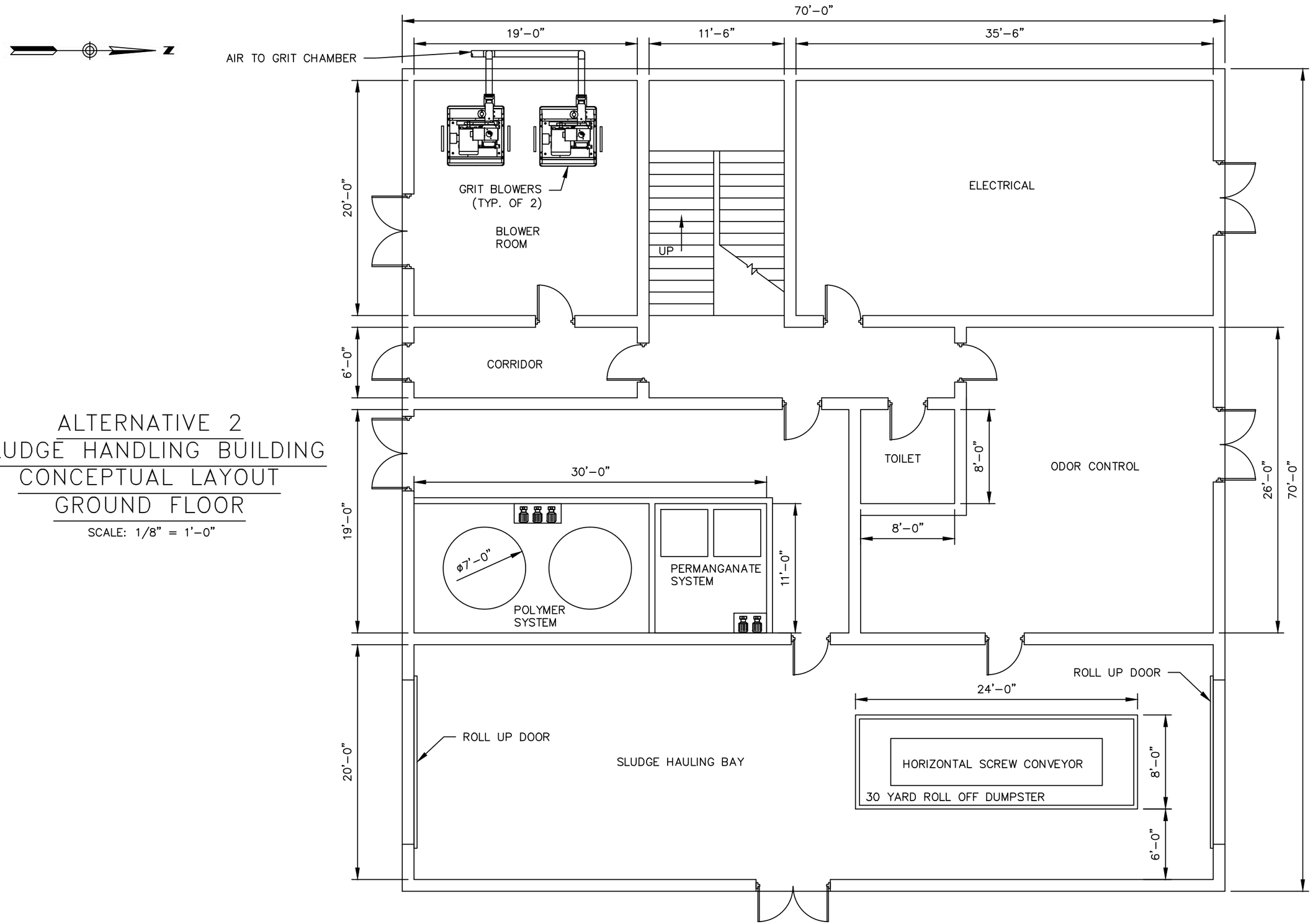
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 BLOWER BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 2
PROPOSED ADM BLDG, BB, SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

BB-201



ALTERNATIVE 2
SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
GROUND FLOOR

SCALE: 1/8" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
GROUND FLOOR

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 SHB.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

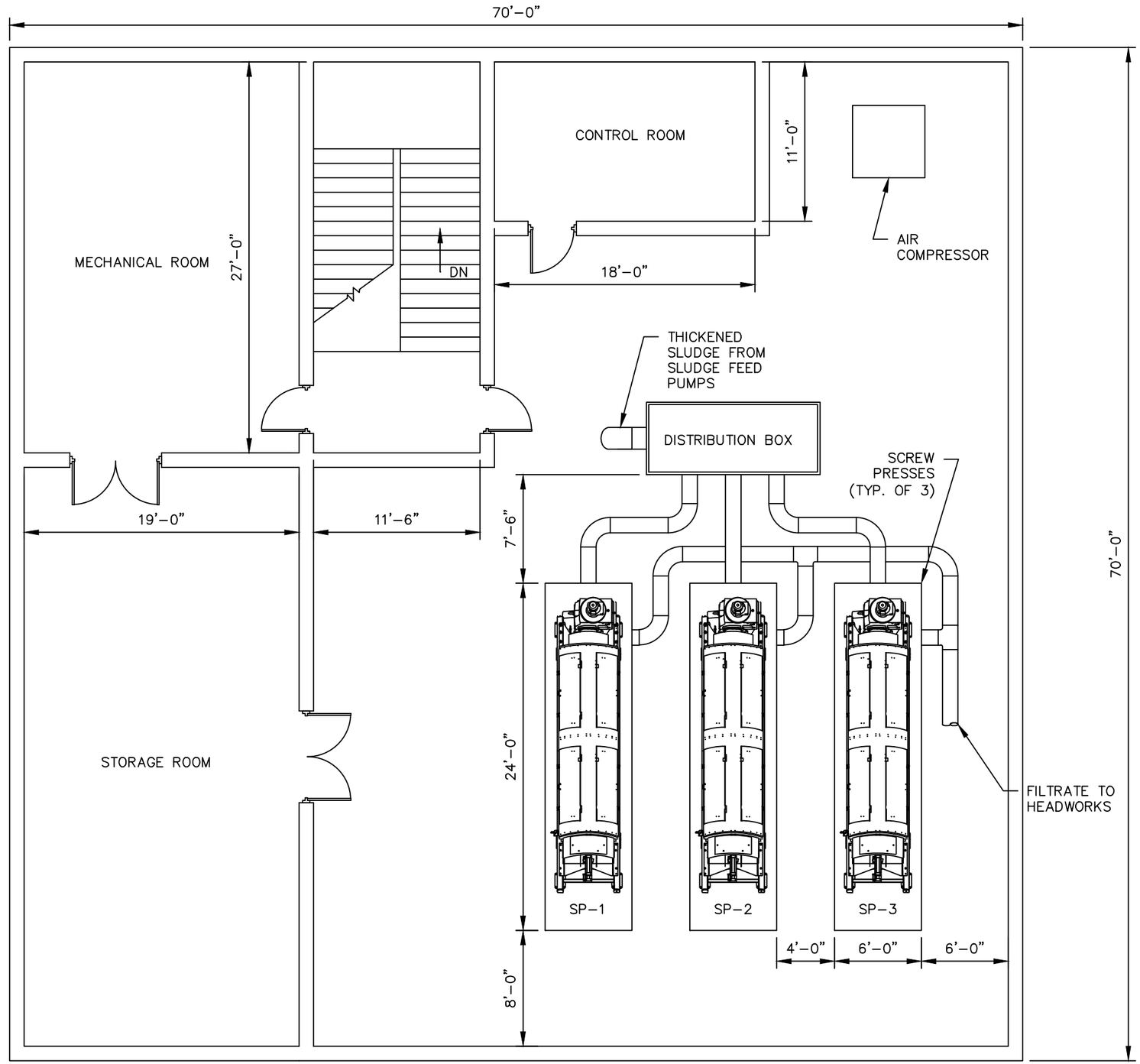
FACILITIES PLAN
ALTERNATIVE 2
PROPOSED OPS BLDG, BB, SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1/8" = 1'-0"

SHB-201

ALTERNATIVE 2
SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION A

SCALE: 1/8" = 1'–0"



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COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN

SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION A

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 SHB.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

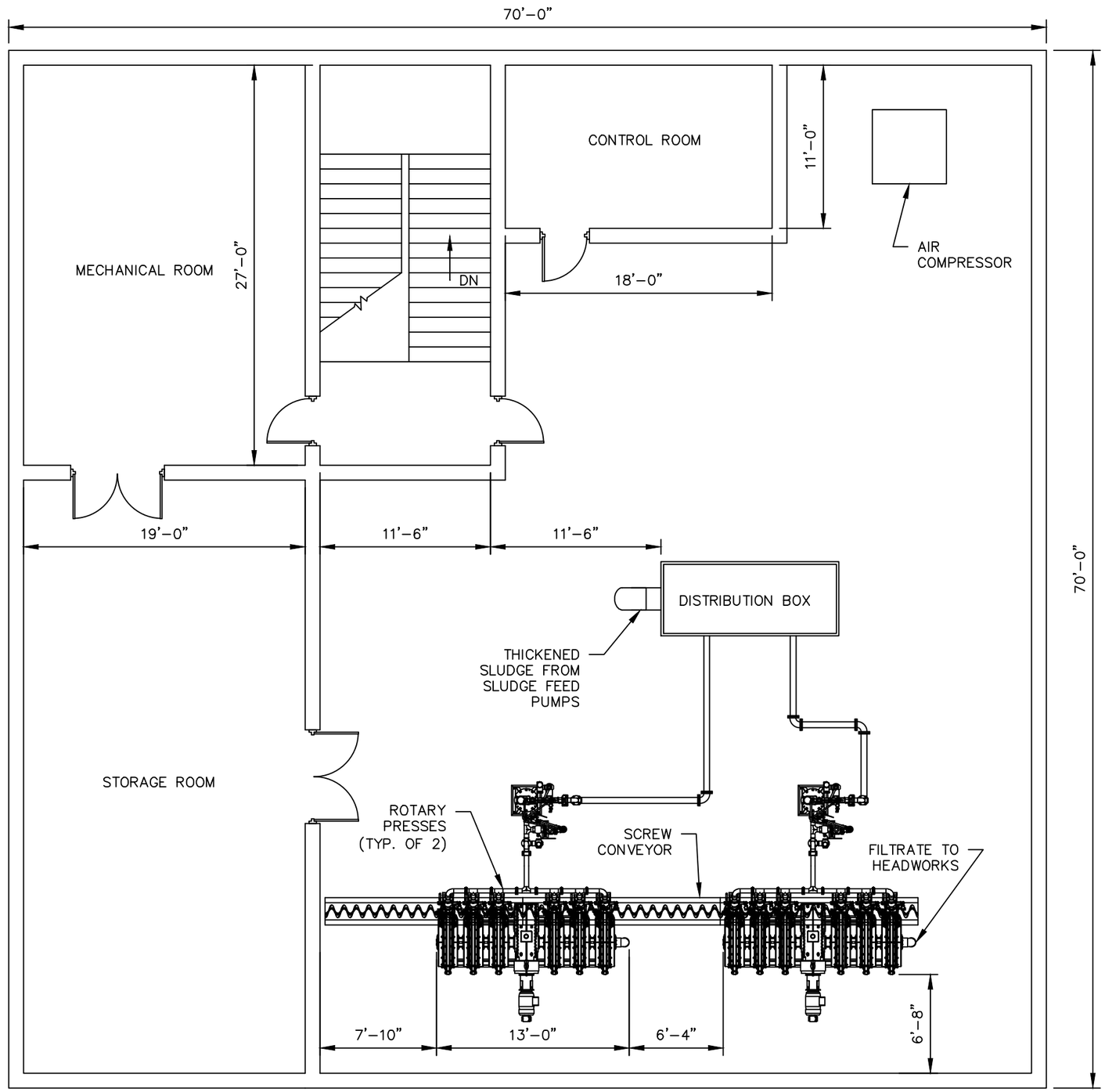
FACILITIES PLAN
ALTERNATIVE 2
PROPOSED OPS BLDG, BB, SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1/8" = 1'–0"

SHB-202A

ALTERNATIVE 2
SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION B

SCALE: 1/8" = 1'–0"



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COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN

SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION B

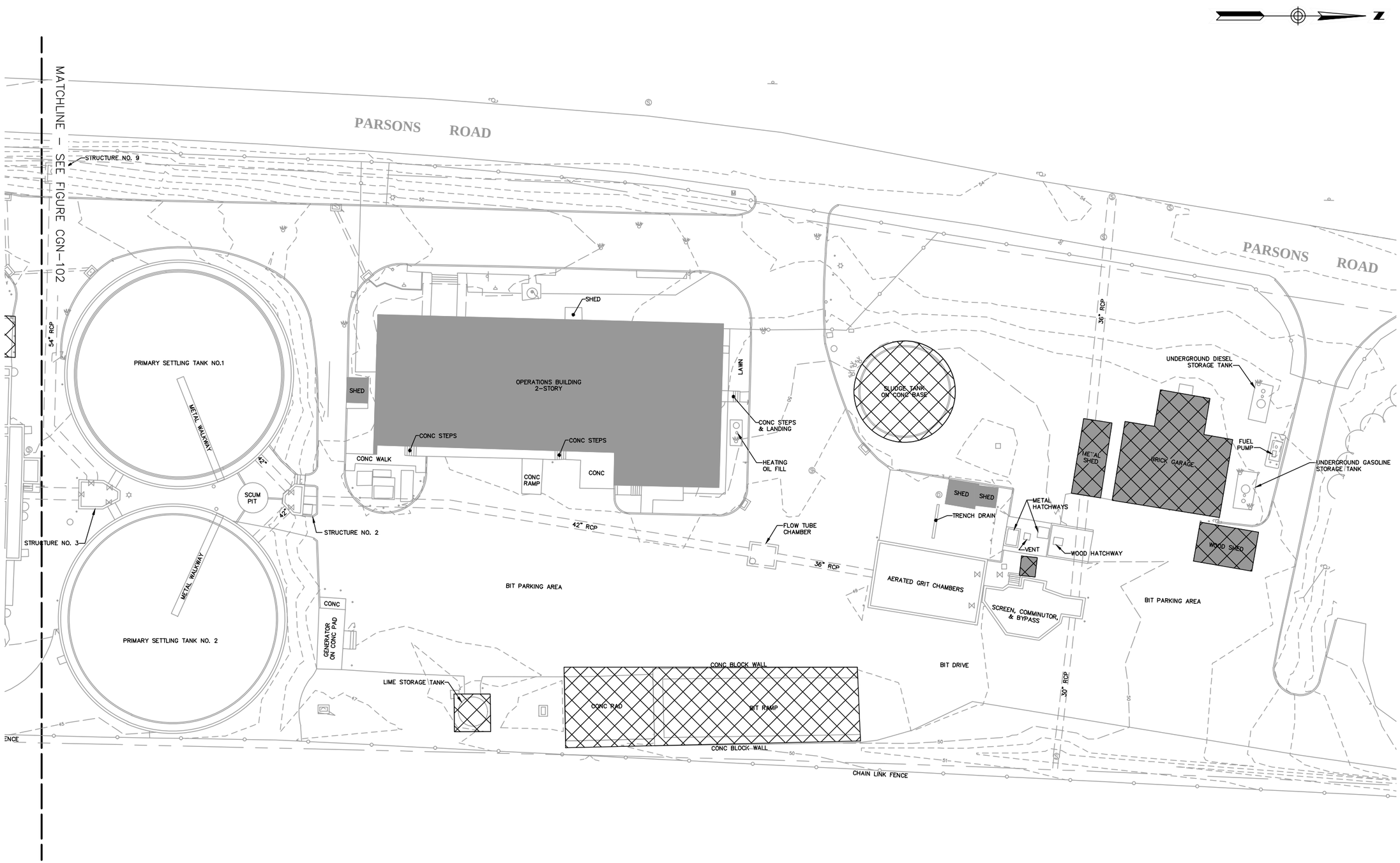
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 SHB.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 2
PROPOSED OPS BLDG, BB, SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1/8" = 1'–0"

SHB-202B



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 3A – NORTH

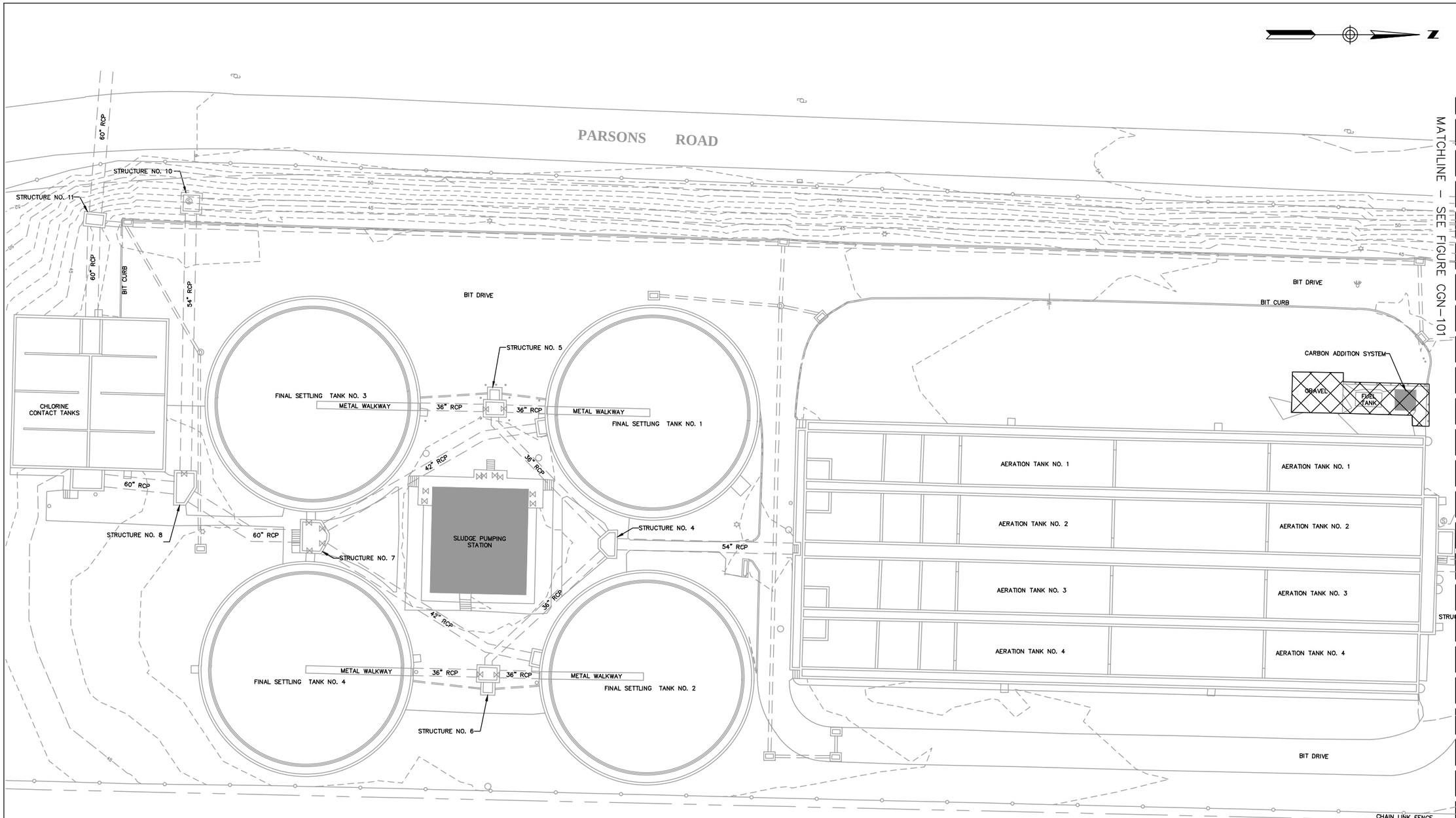
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-300 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-301



EXISTING STRUCTURE TO BE DEMOLISHED

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 3A – SOUTH

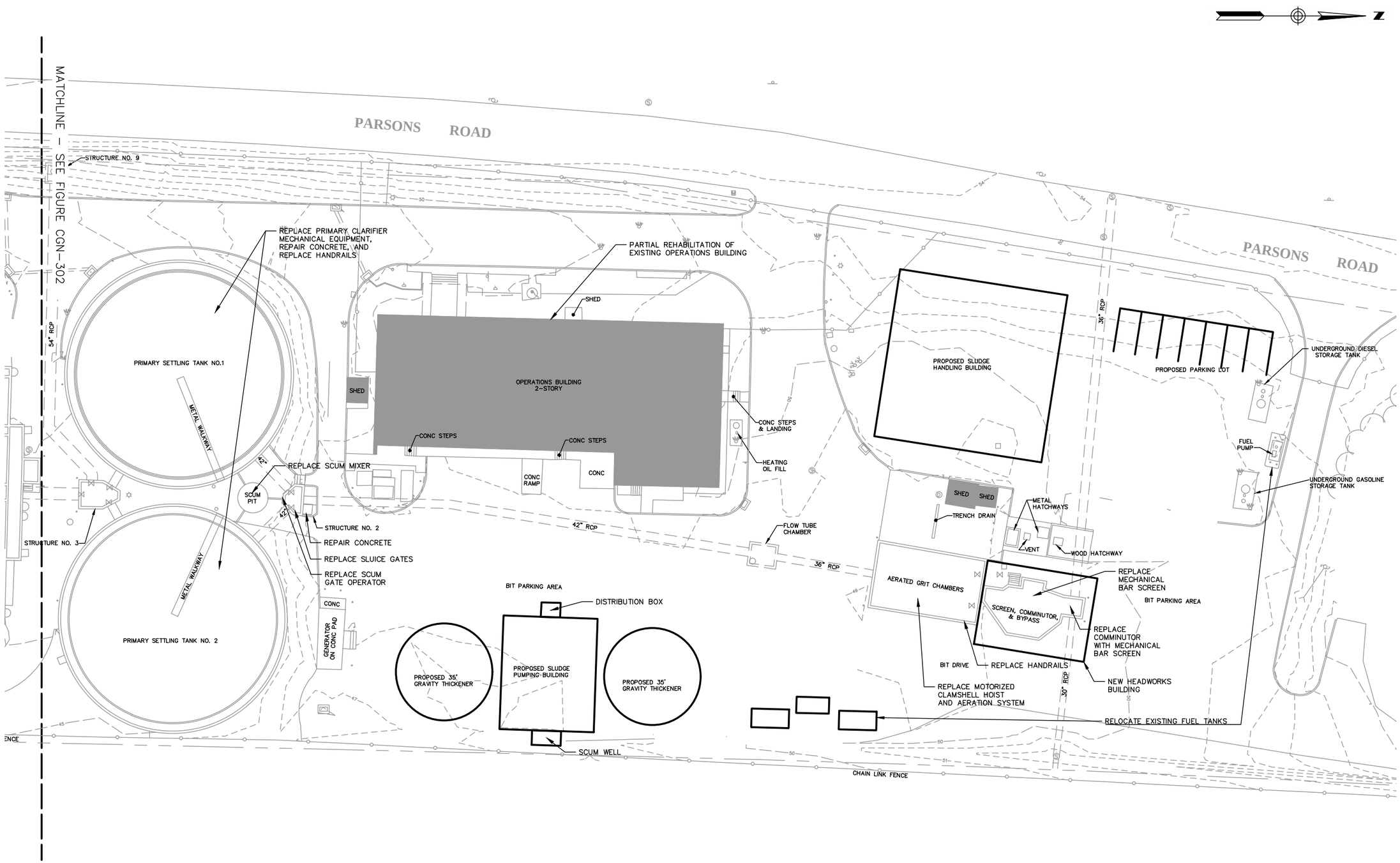
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23	CGN-300 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-302



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 3A – NORTH

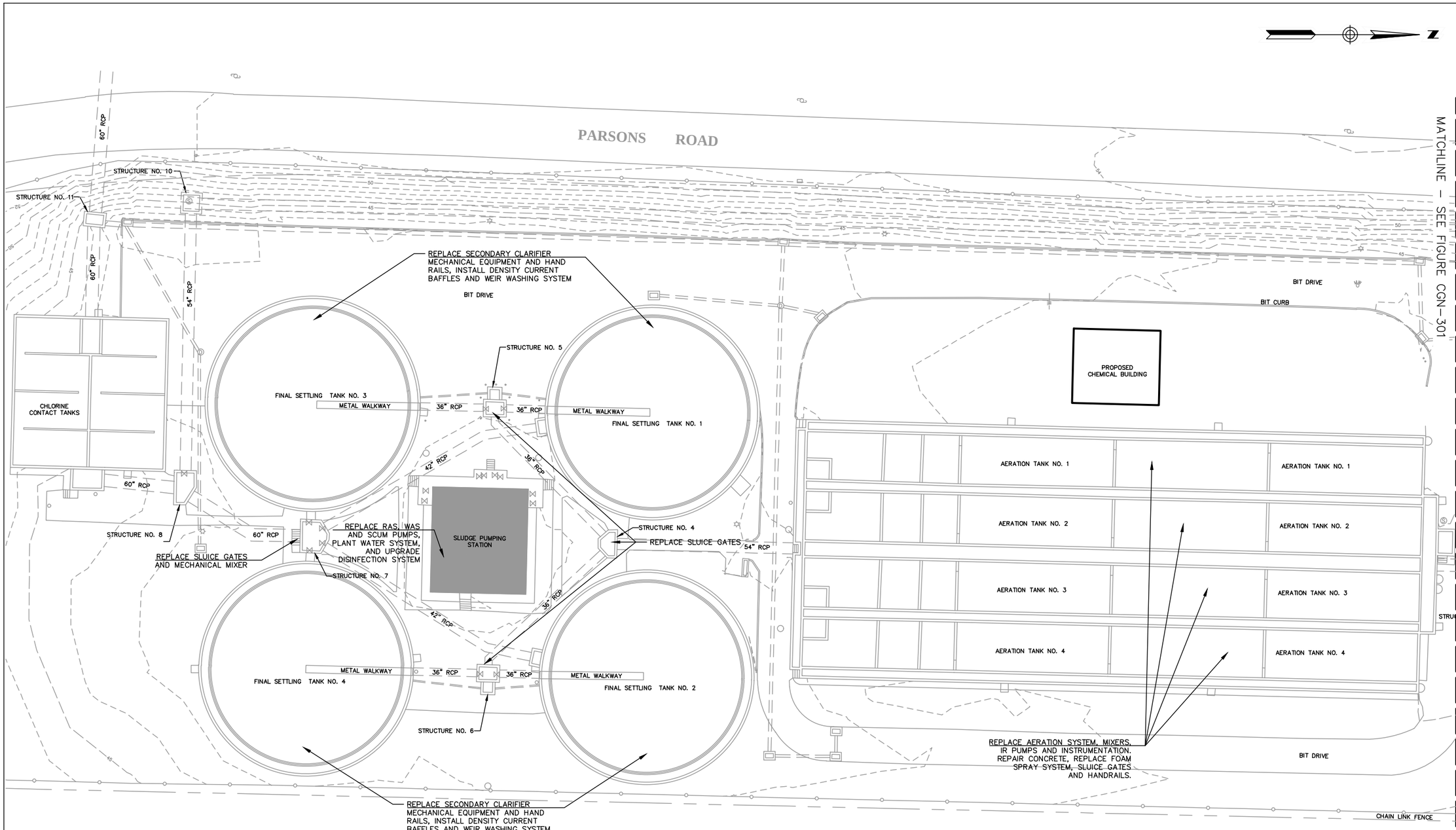
DESIGNED BY:	AH/ACB
DRAWN BY:	ACB
CHECKED BY:	MJB
	2015.03.23 CGN-300.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-303



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COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 3A – SOUTH

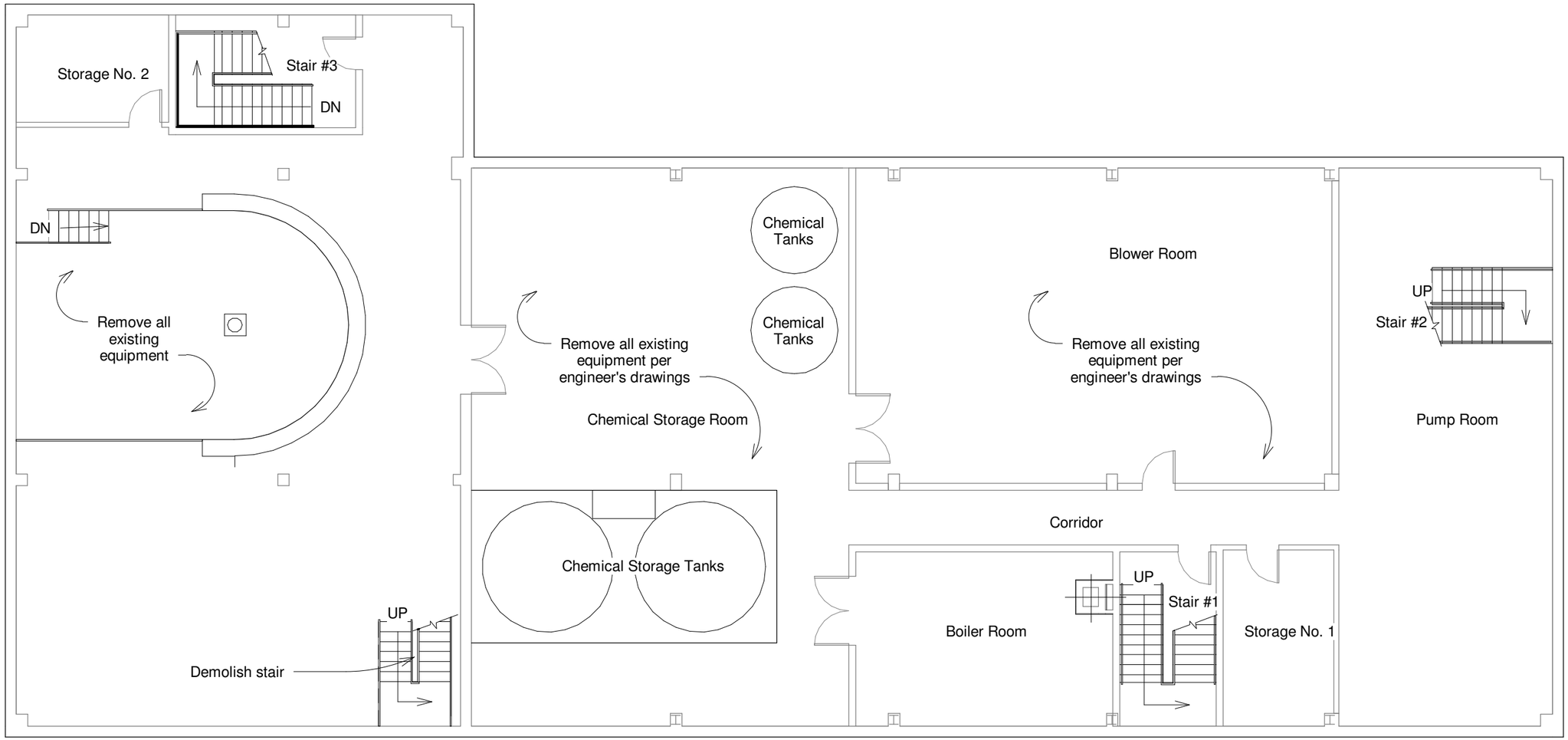
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-300.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB AND GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-304



1 Basement Demo Plan
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

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One Corporate Road
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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date

Issue

Title
ALTERNATE 3A
Renovated OB
Basement Demo

AD301

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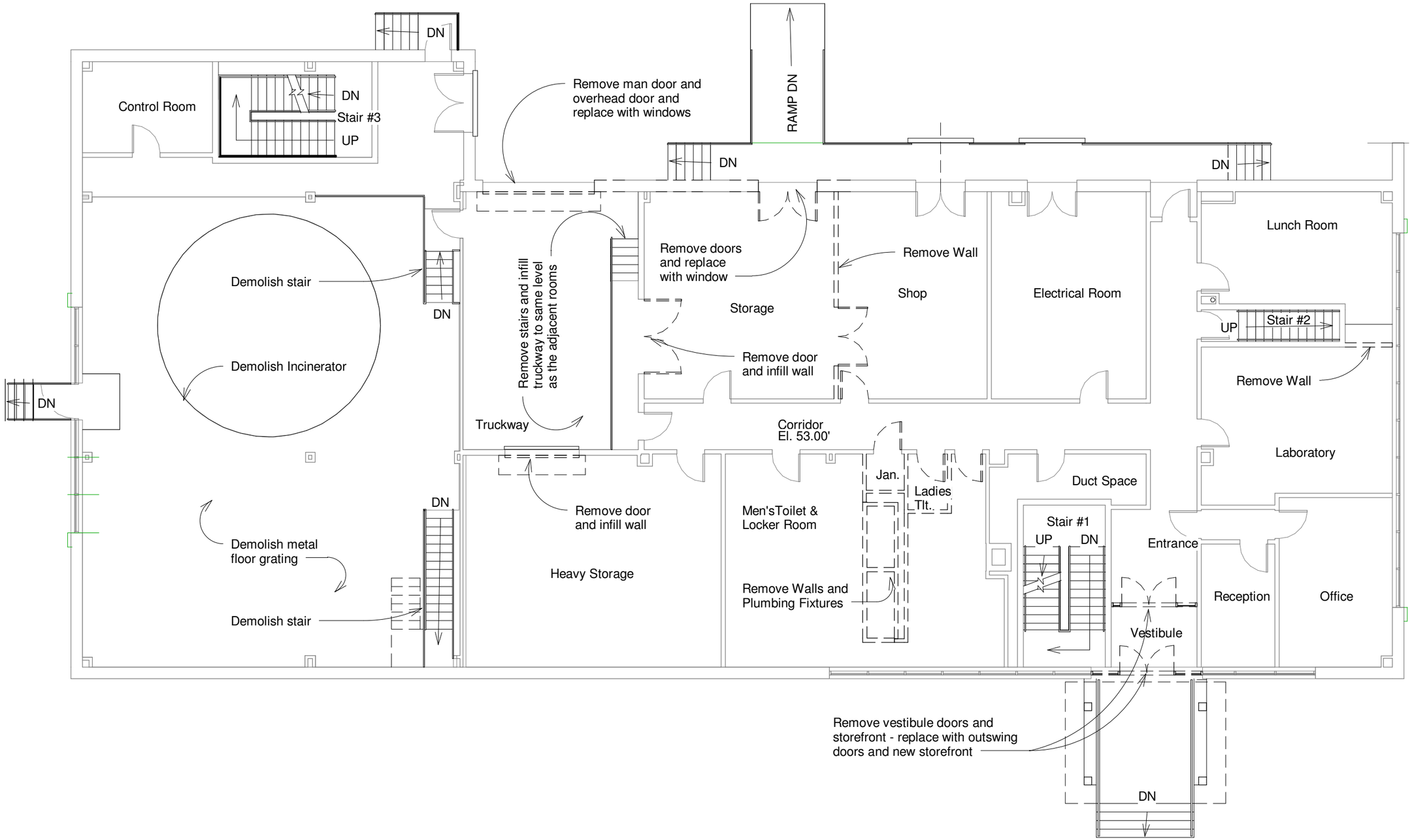
Plotted: 5/5/2015 11:11:11 PM



1 First Floor Demo Plan
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 3A
Renovated OB
First Floor Demo

AD302

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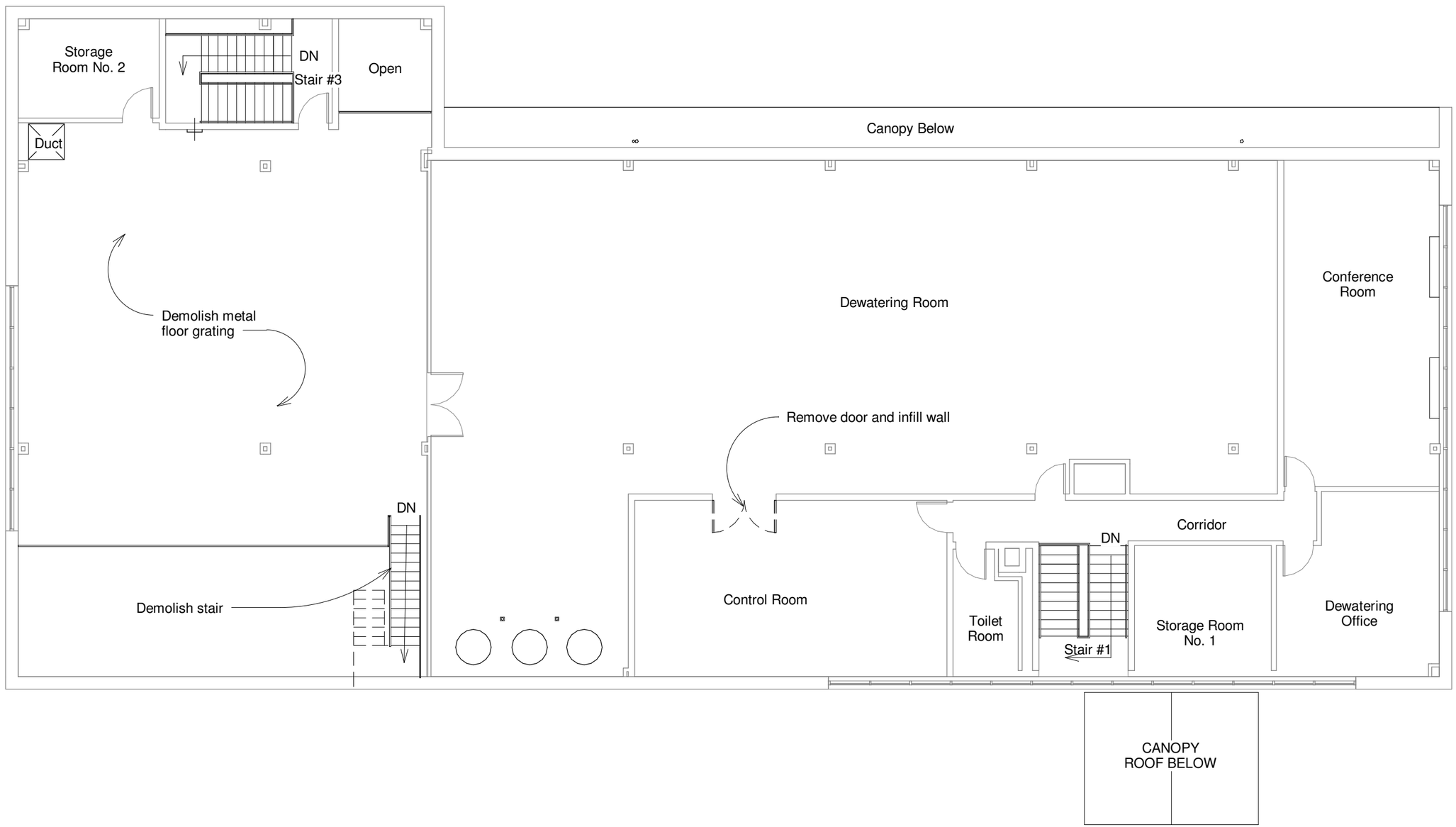
Plotted: 5/5/2015 11:11:12 PM



1 Second Floor Demo Plan
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date

Issue

Title

ALTERNATE 3A
Renovated OB
Second Floor Demo

AD303

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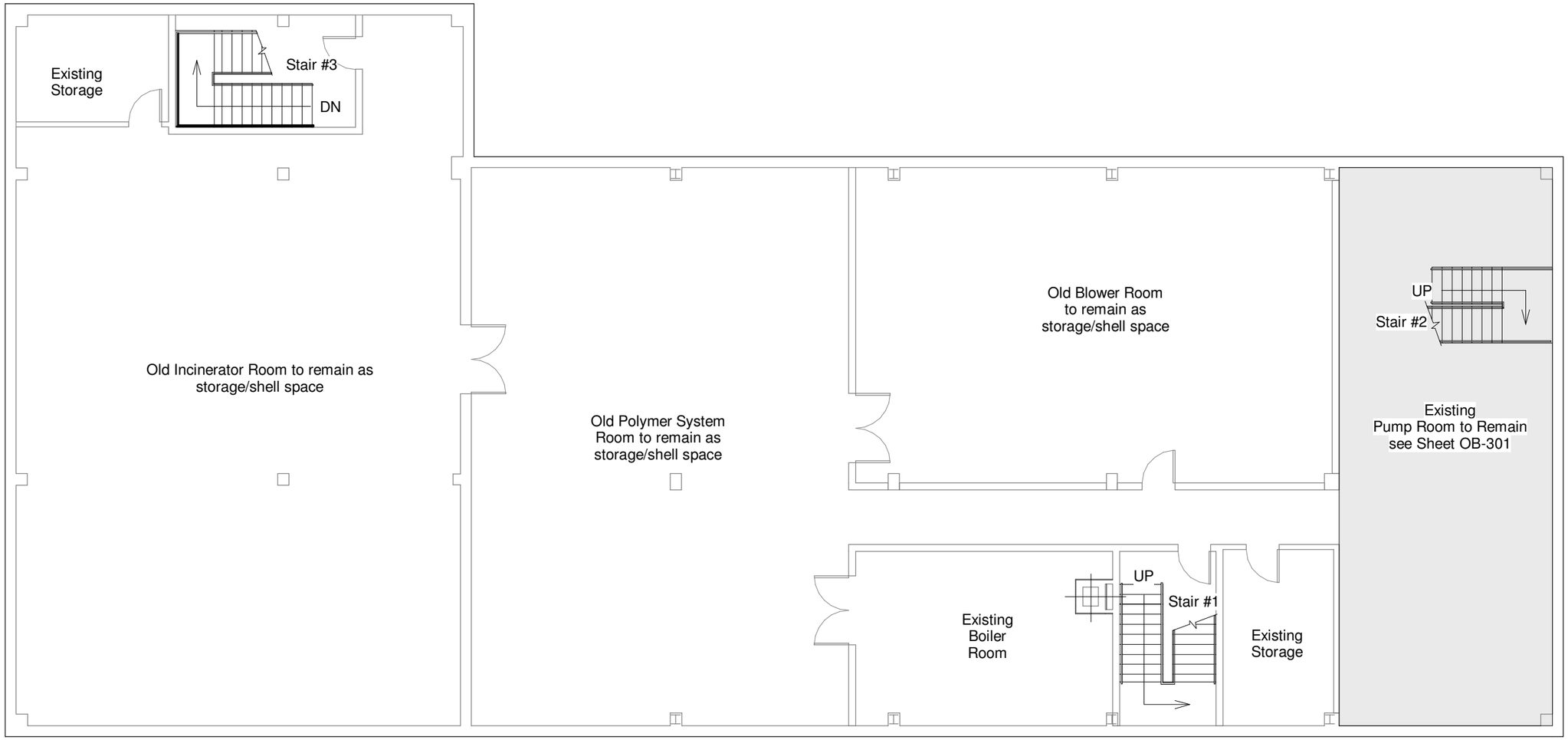
Plotted: 5/5/2015 11:11:12 PM

OB Renovation Summary - Basement

Light Renovation (Total 7,800 NSF)



1 OB Basement Revised Layout
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 3A Renovated OB Basement Layout

A301

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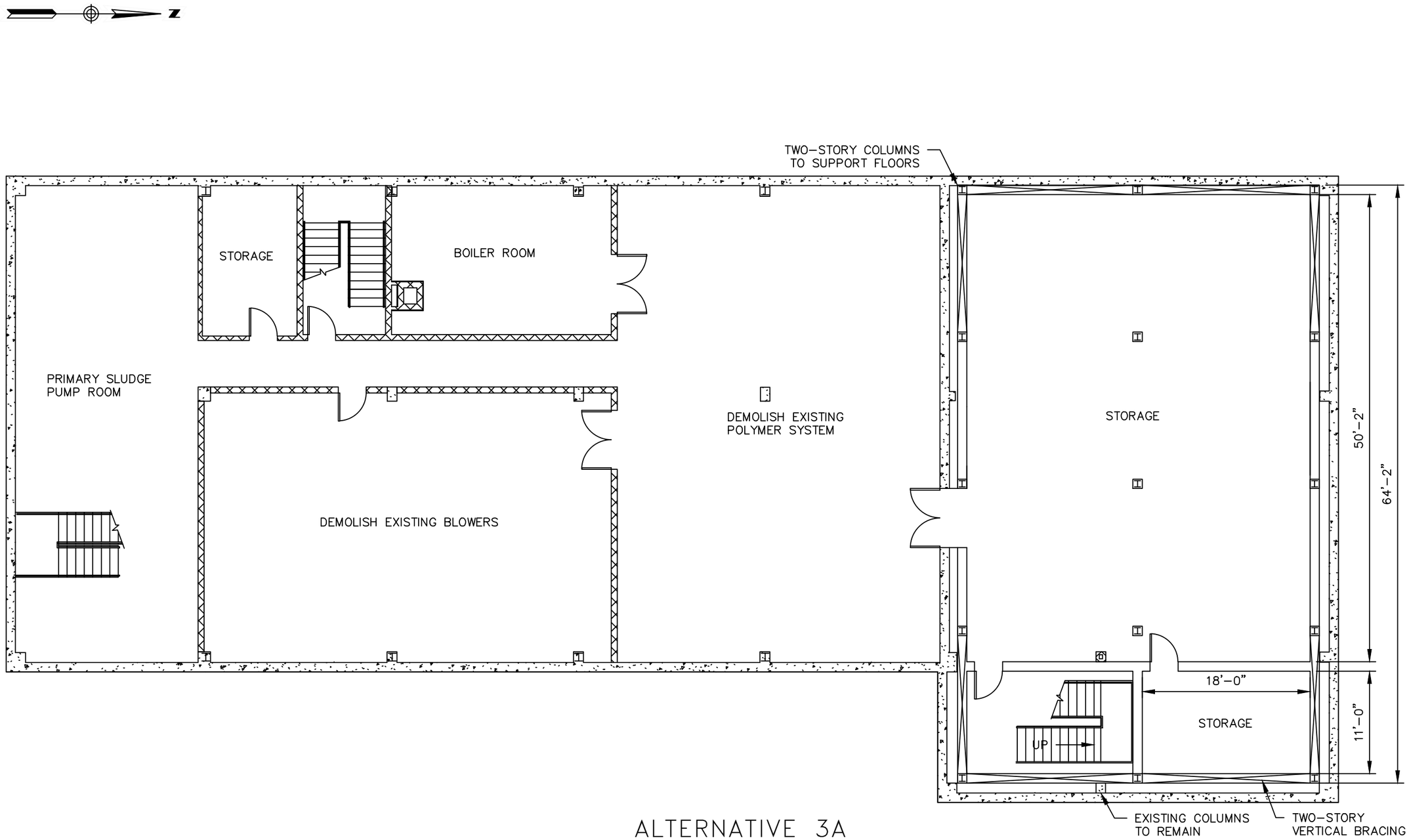

ALTERNATIVE 3A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

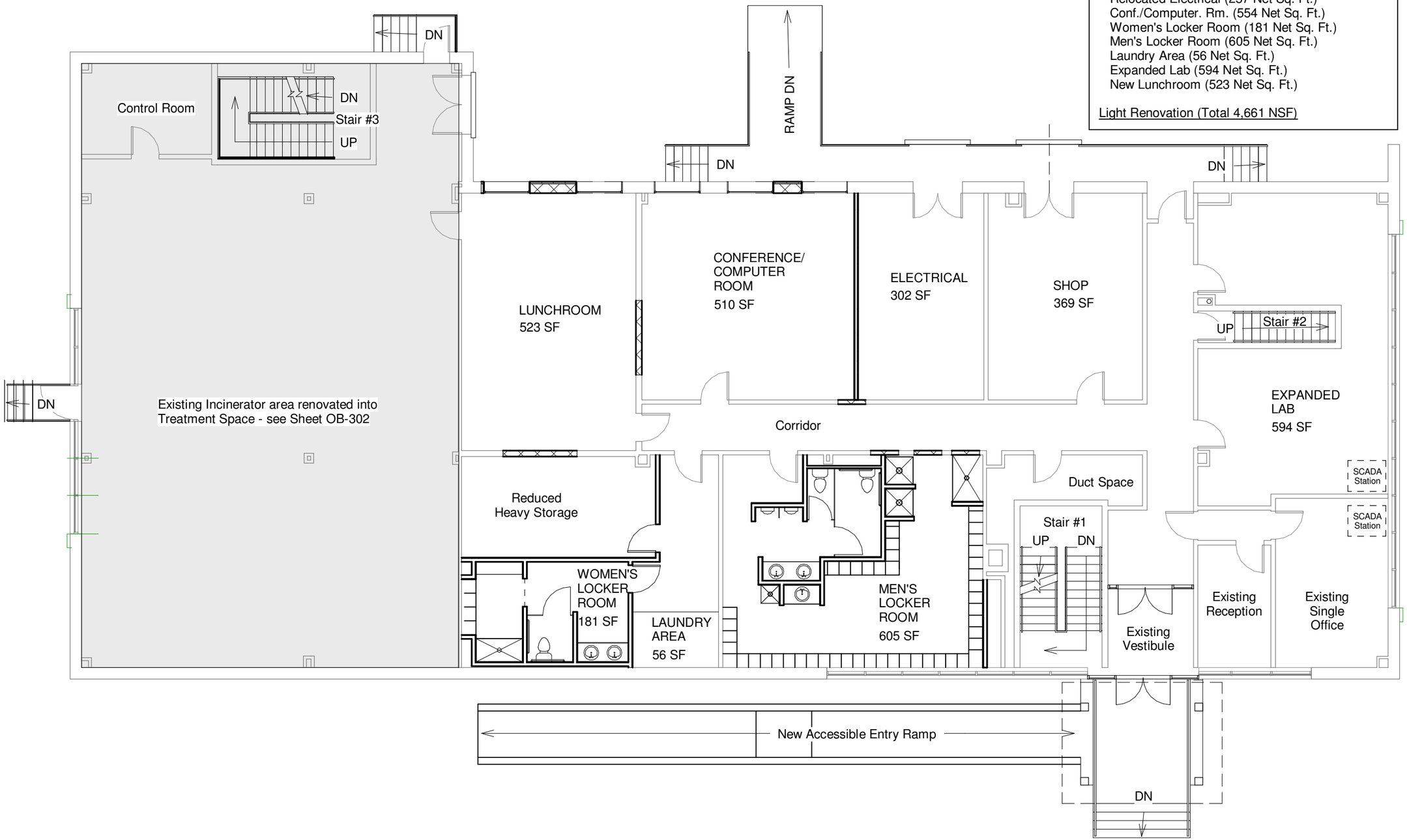
JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-301

OB Renovation - 1st Floor Summary

Heavy Renovation (Total 3,139 NSF):
- Relocated Shop (369 Net Sq. Ft.)
- Relocated Electrical (257 Net Sq. Ft.)
- Conf./Computer. Rm. (554 Net Sq. Ft.)
- Women's Locker Room (181 Net Sq. Ft.)
- Men's Locker Room (605 Net Sq. Ft.)
- Laundry Area (56 Net Sq. Ft.)
- Expanded Lab (594 Net Sq. Ft.)
- New Lunchroom (523 Net Sq. Ft.)

Light Renovation (Total 4,661 NSF)



1 OB First Floor Revised Layout
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date	Issue

Title
ALTERNATE 3A
Renovated OB
First Floor Layout

A302

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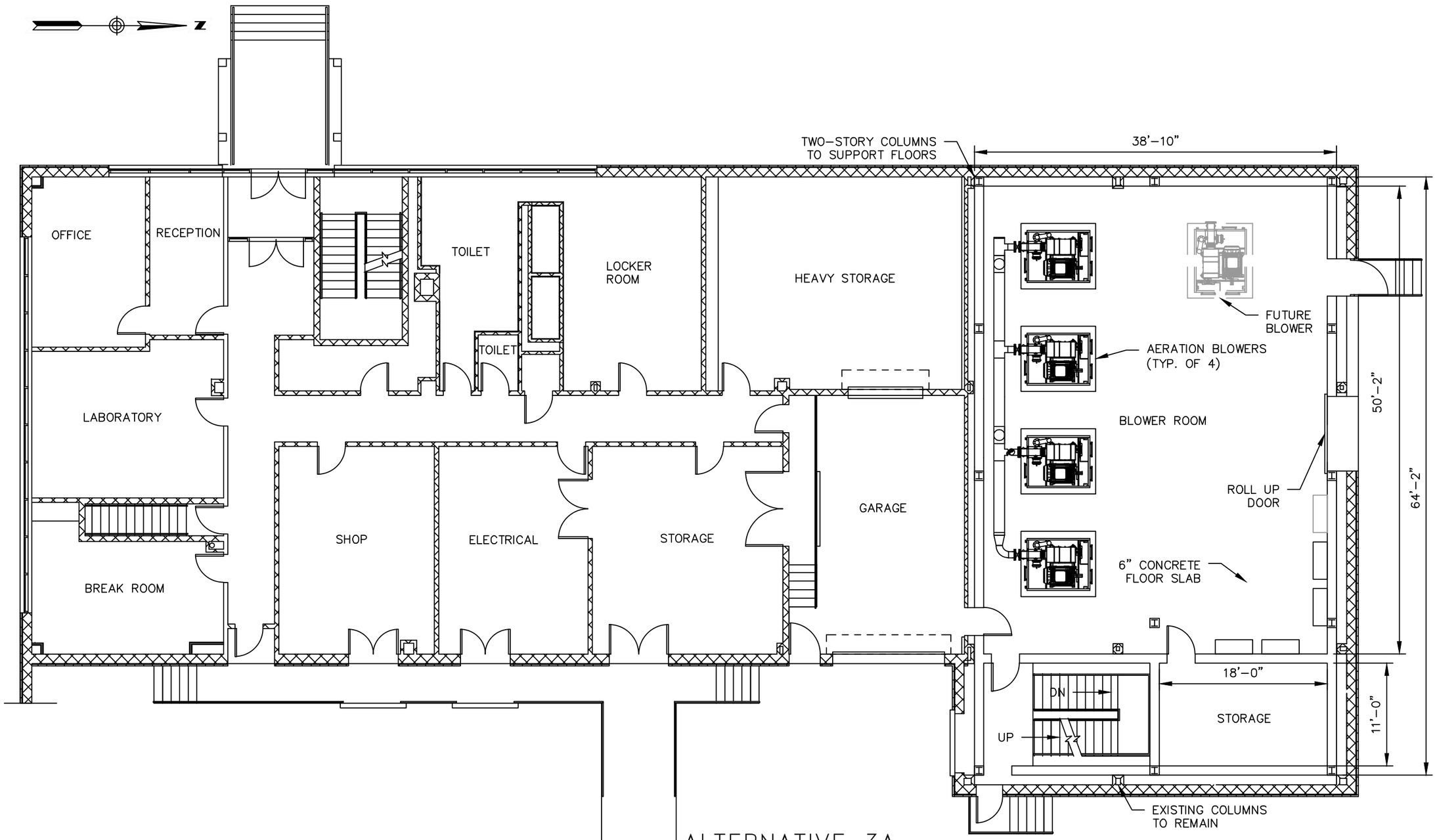

ALTERNATIVE 3A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23	OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

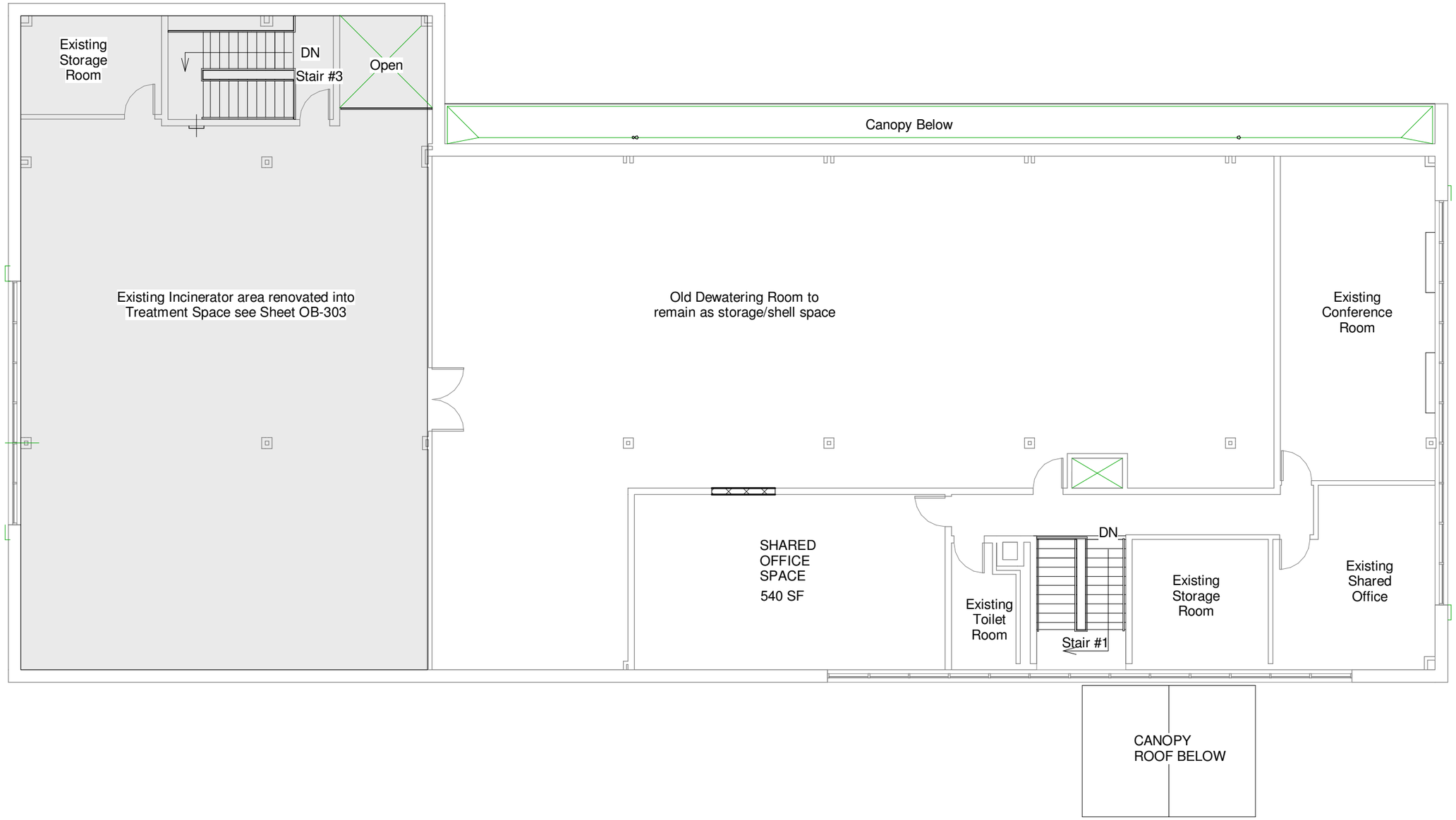
JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-302

OB Renovation - 2nd Floor Summary

Heavy Renovation (Total 540 NSF):
New Shared Offices (540 Net Sq. Ft.)

Light Renovation (Total 7,260 NSF)



1 OB Second Floor Revised Layout
3/32" = 1'-0"

WOODARD & CURRAN

ARCHITECTS STEFFIAN BRADLEY sba

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 3A Renovated OB Second Floor Layout

A303

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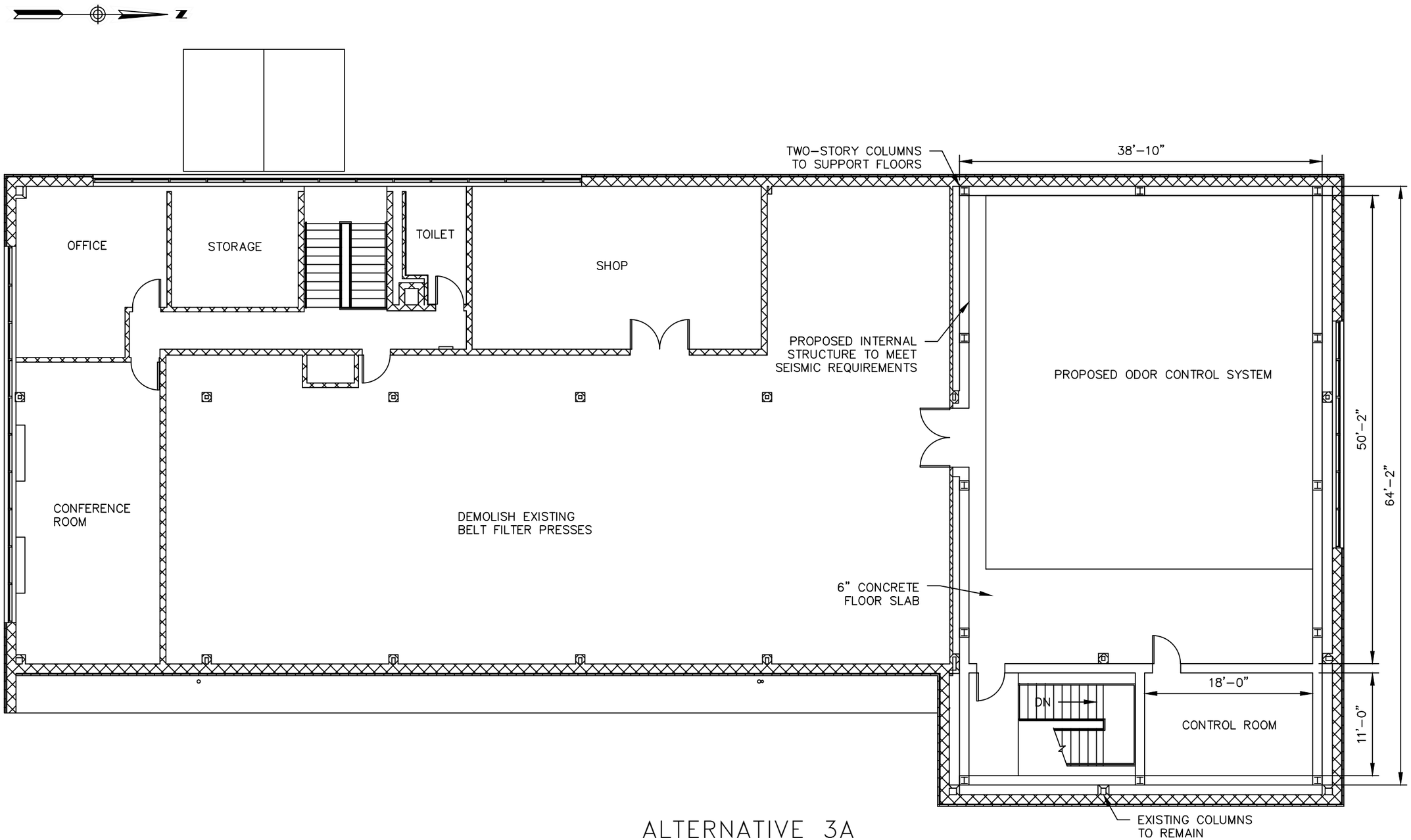

ALTERNATIVE 3A
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR

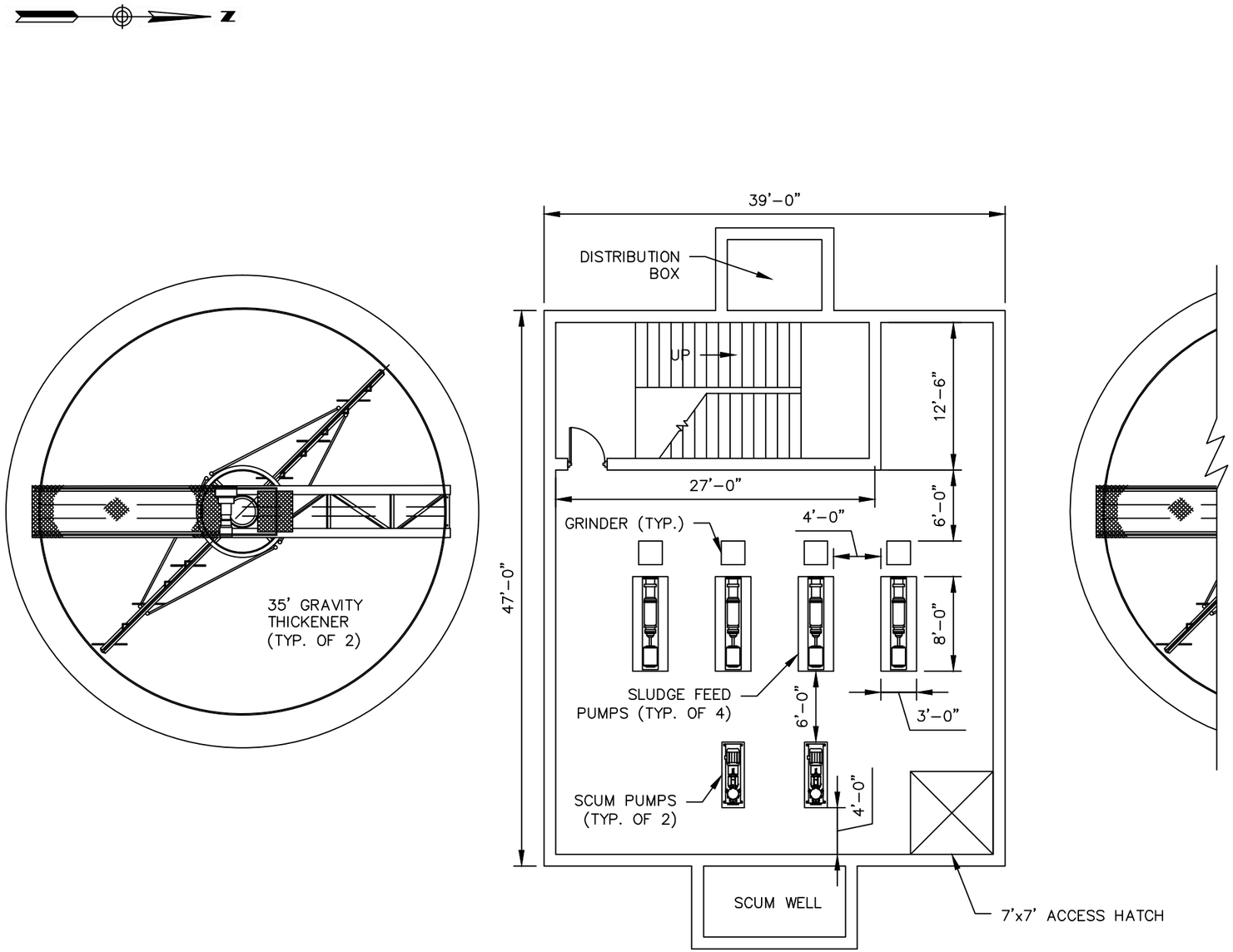
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

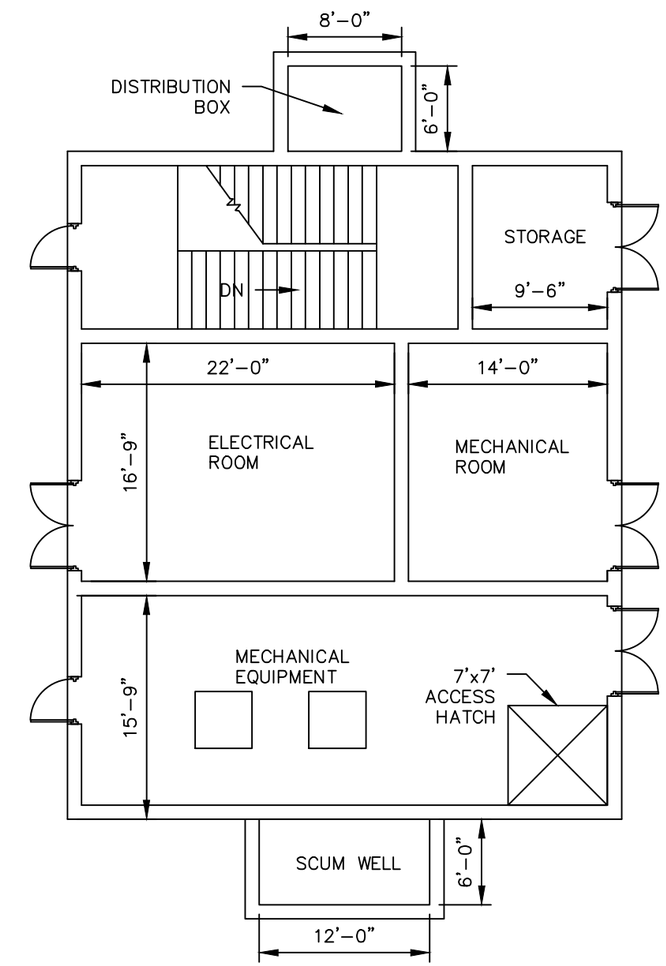
JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-303



GRAVITY THICKENERS
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"



GRAVITY THICKENERS
CONCEPTUAL LAYOUT
GROUND FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

GRAVITY THICKENERS
CONCEPTUAL LAYOUT

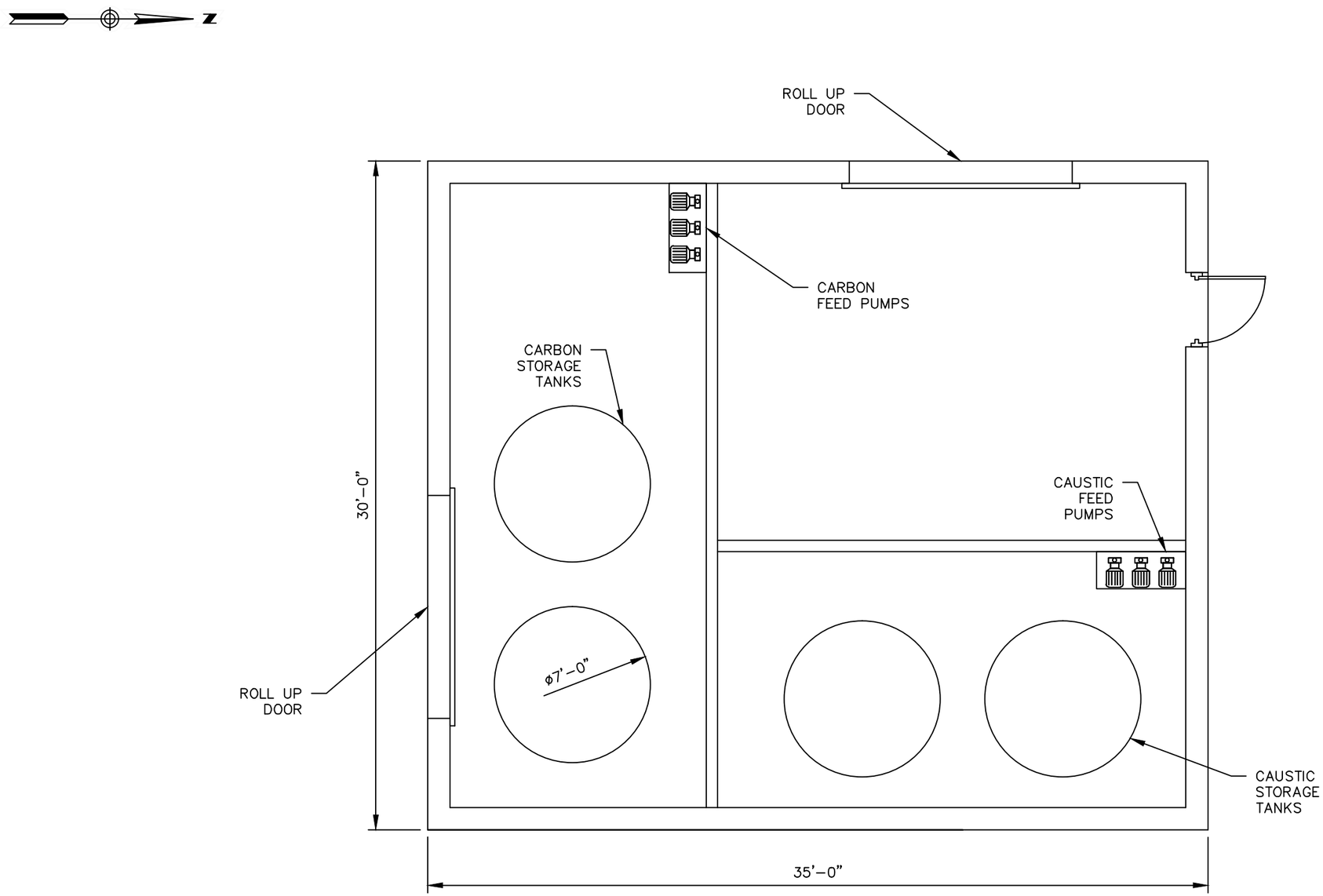
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 GRAVITY THIC*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

GT-301



ALTERNATIVE 3A
CHEMICAL BUILDING
CONCEPTUAL LAYOUT
SCALE: 3/16" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

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CHEMICAL BUILDING
CONCEPTUAL LAYOUT

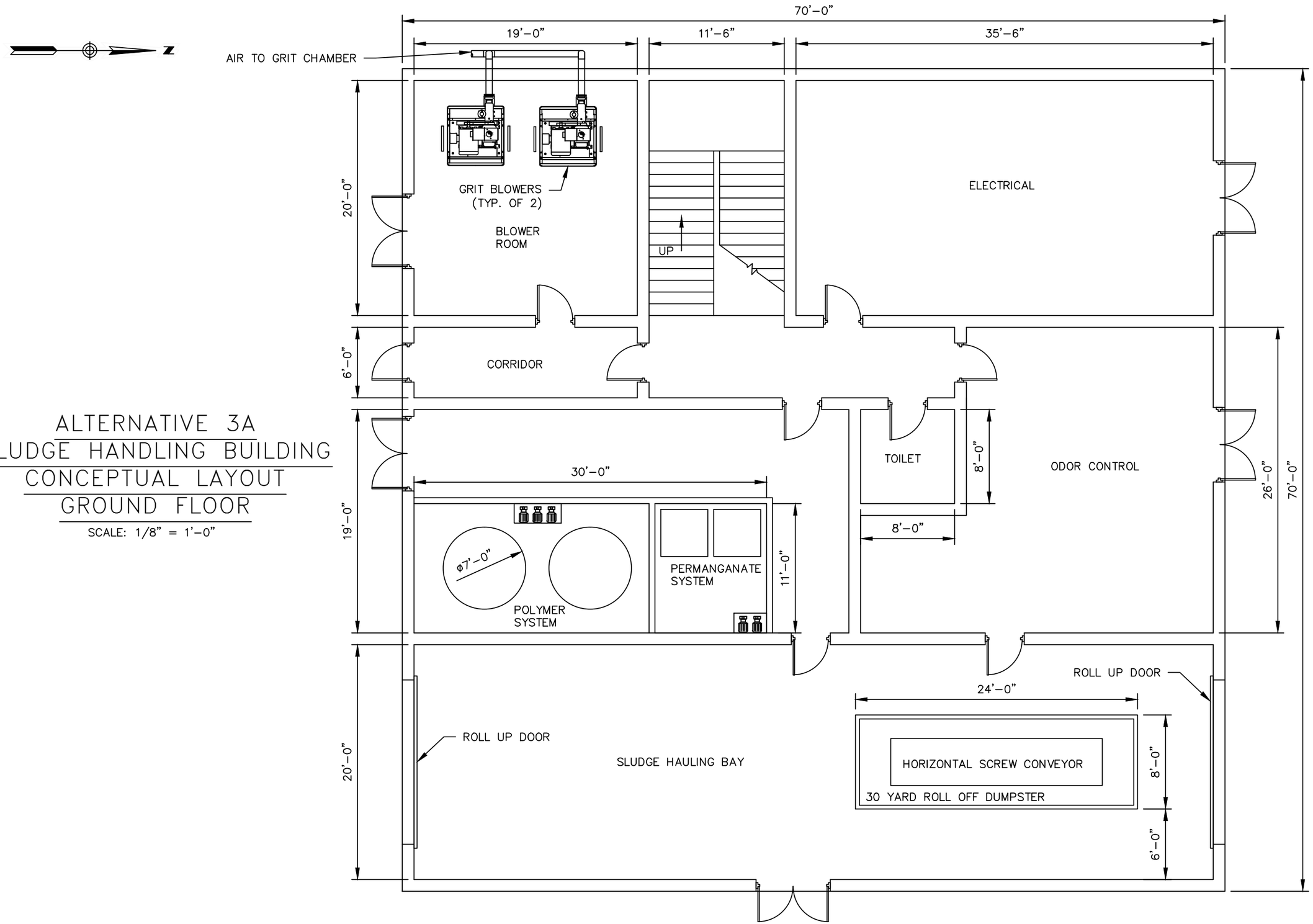
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CHEM BLDG LA*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/16" = 1'-0"

CB-301



ALTERNATIVE 3A
SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
GROUND FLOOR

SCALE: 1/8" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
GROUND FLOOR

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 SHB.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

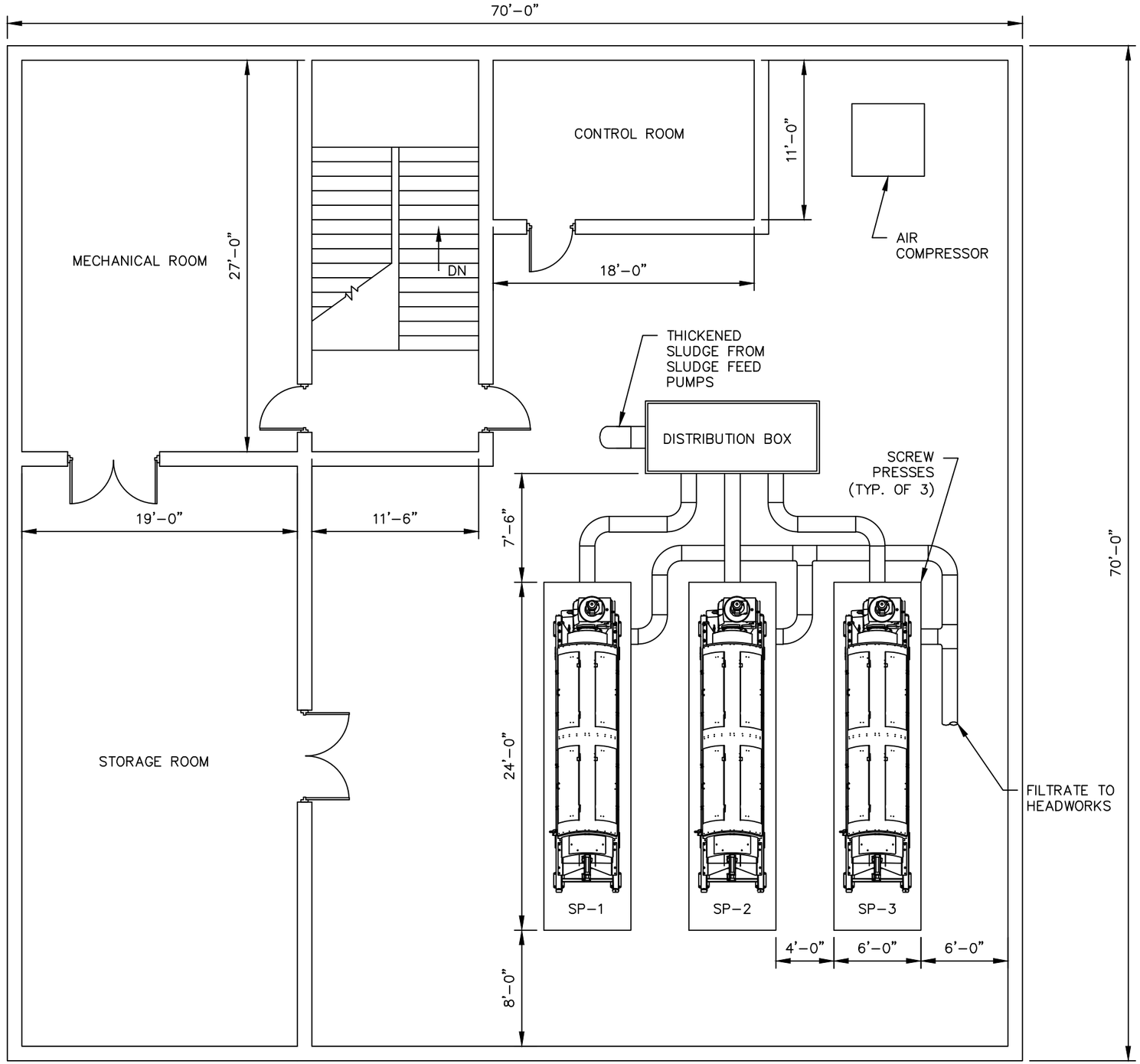
FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1/8" = 1'-0"

SHB-301

ALTERNATIVE 3A
SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION A

SCALE: 1/8" = 1'–0"



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COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN

SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION A

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 SHB.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

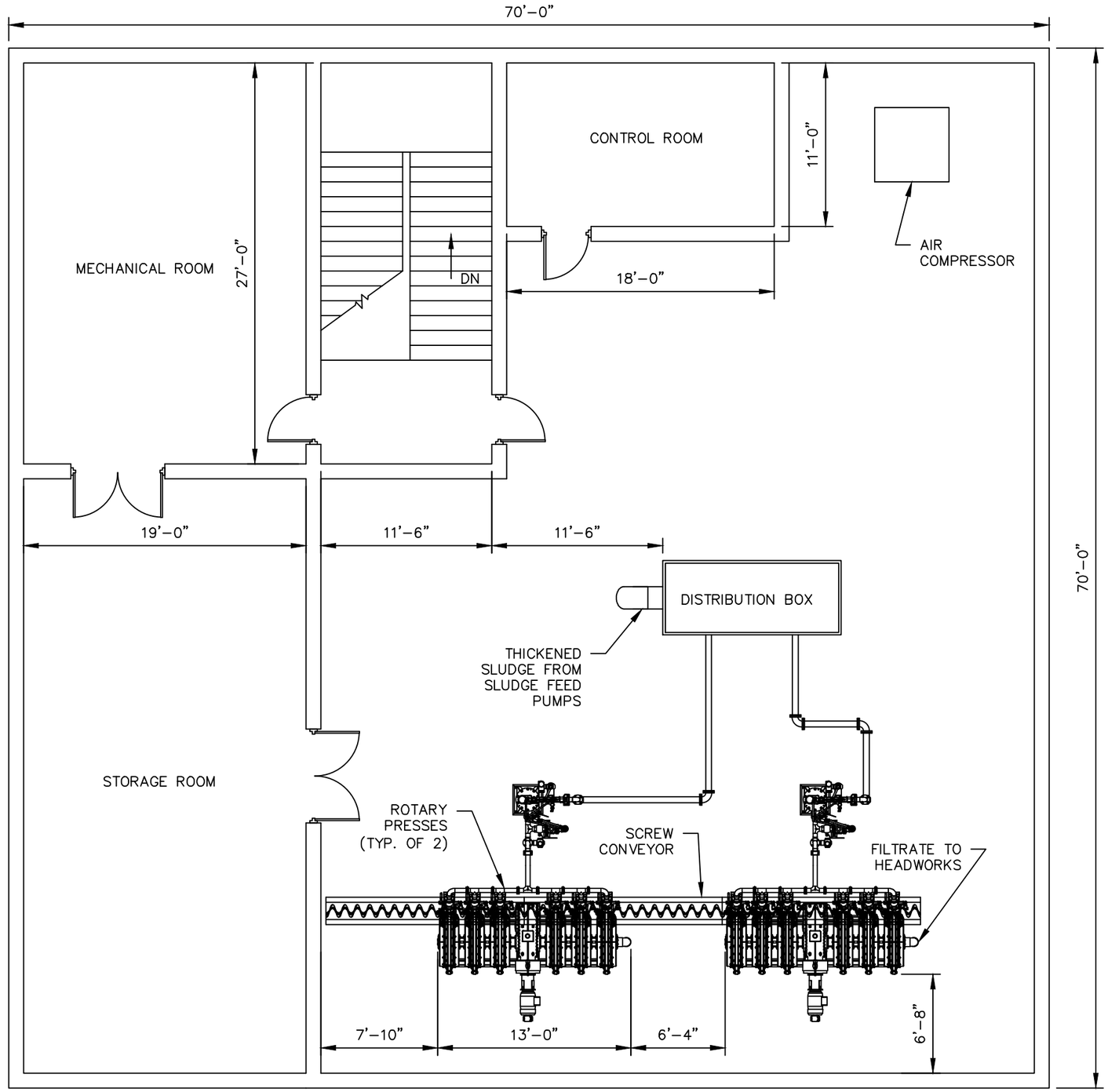
FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1/8" = 1'–0"

SHB-302A

ALTERNATIVE 3A
SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR – OPTION B

SCALE: 1/8" = 1'–0"



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COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN

SLUDGE HANDLING BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR - OPTION B

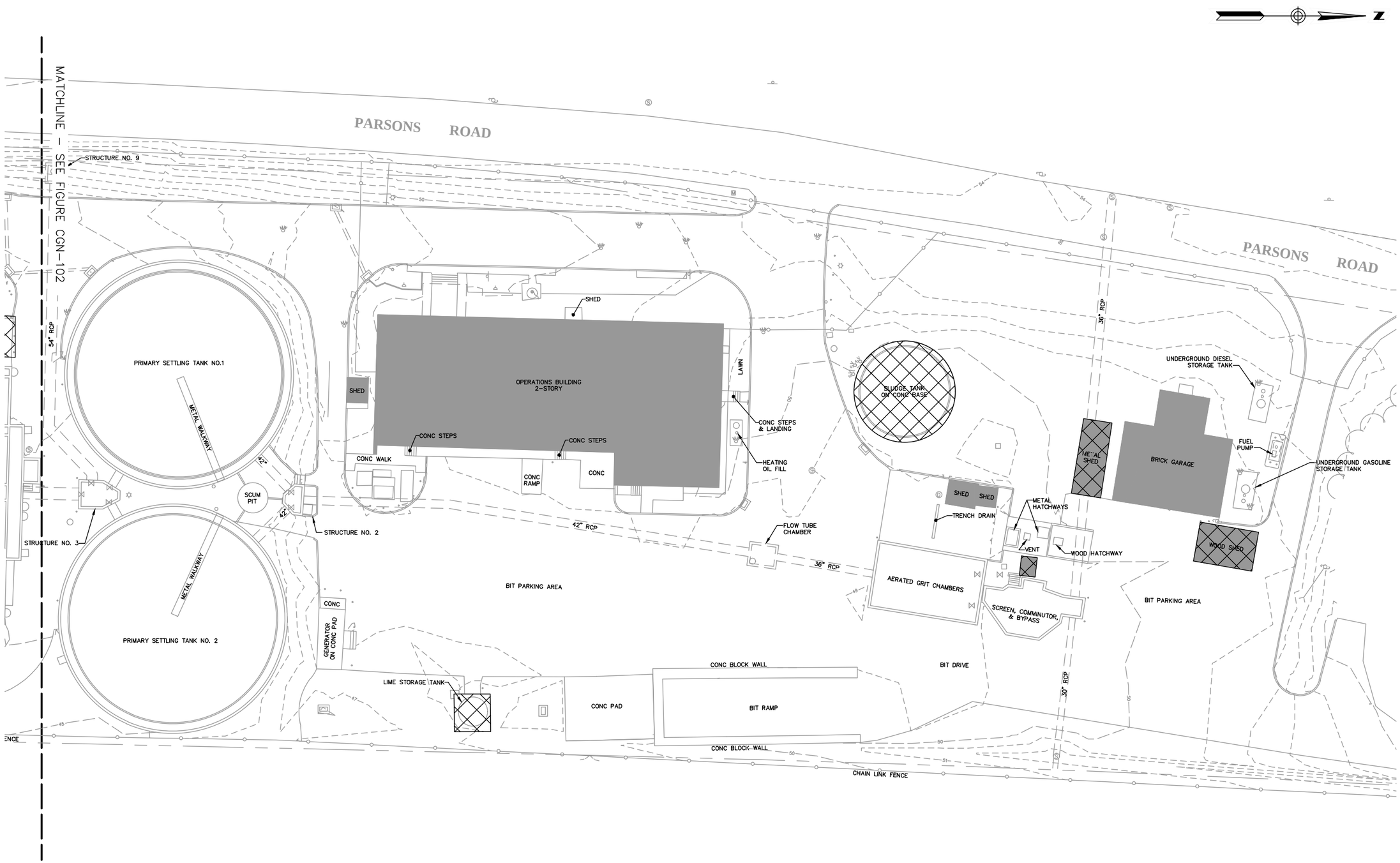
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 SHB.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3A
PARTIAL REHAB OB, NEW SHB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1/8" = 1'–0"

SHB-302B



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 3B – NORTH

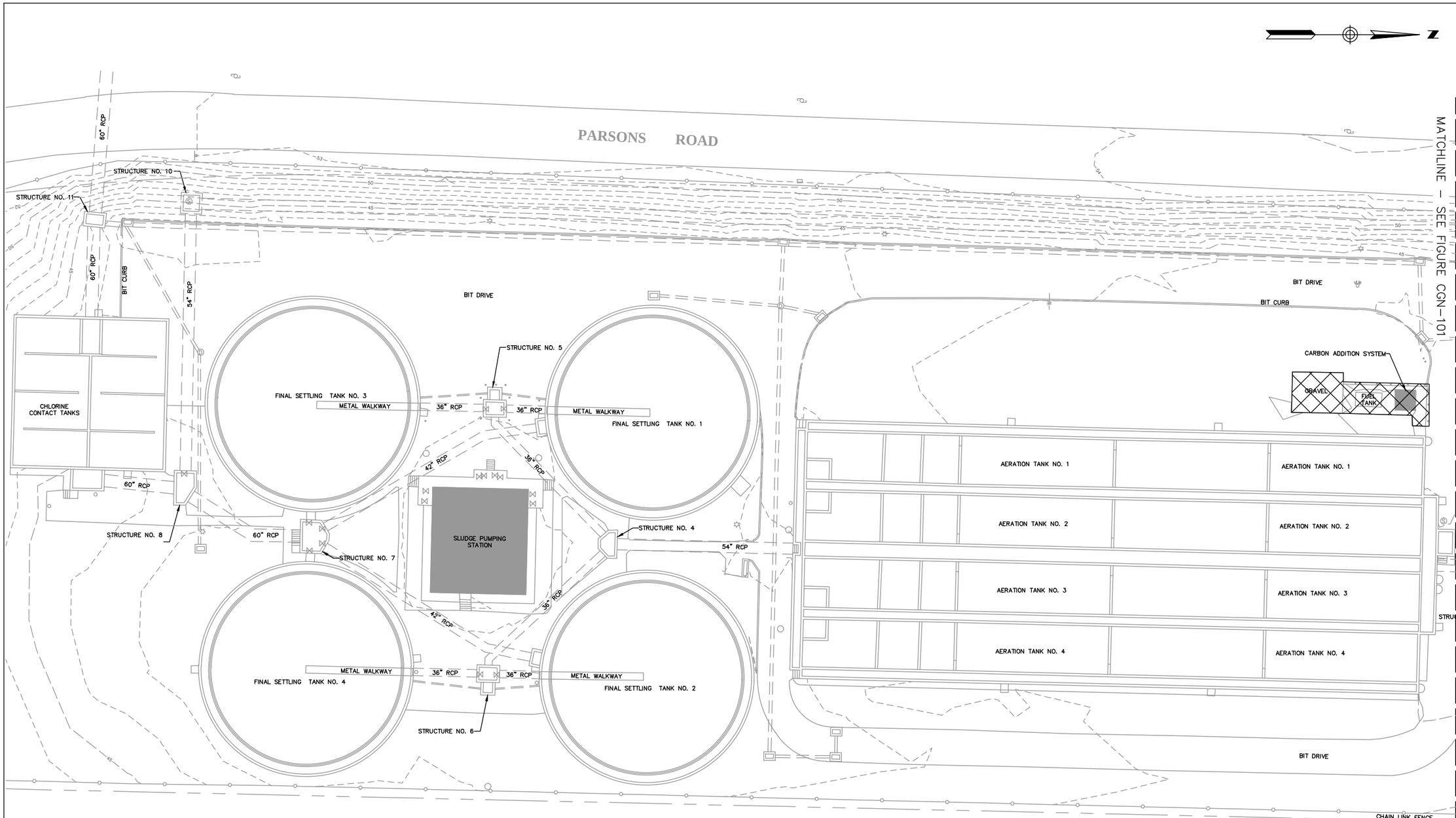
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-310 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-311



EXISTING STRUCTURE TO BE DEMOLISHED

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF DEMOLITION PLAN ALTERNATIVE 3B – SOUTH

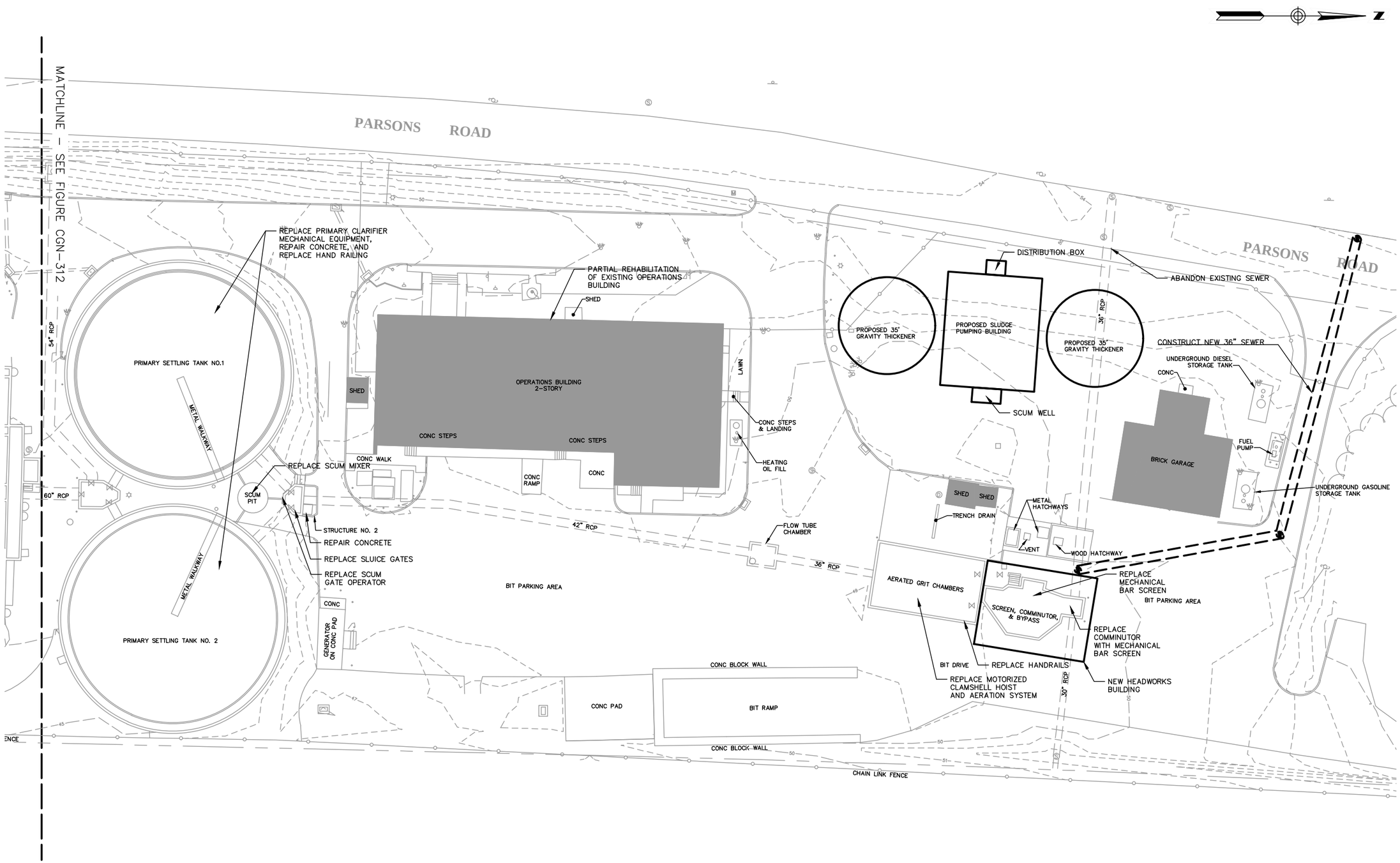
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-310 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-312



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 3B – NORTH

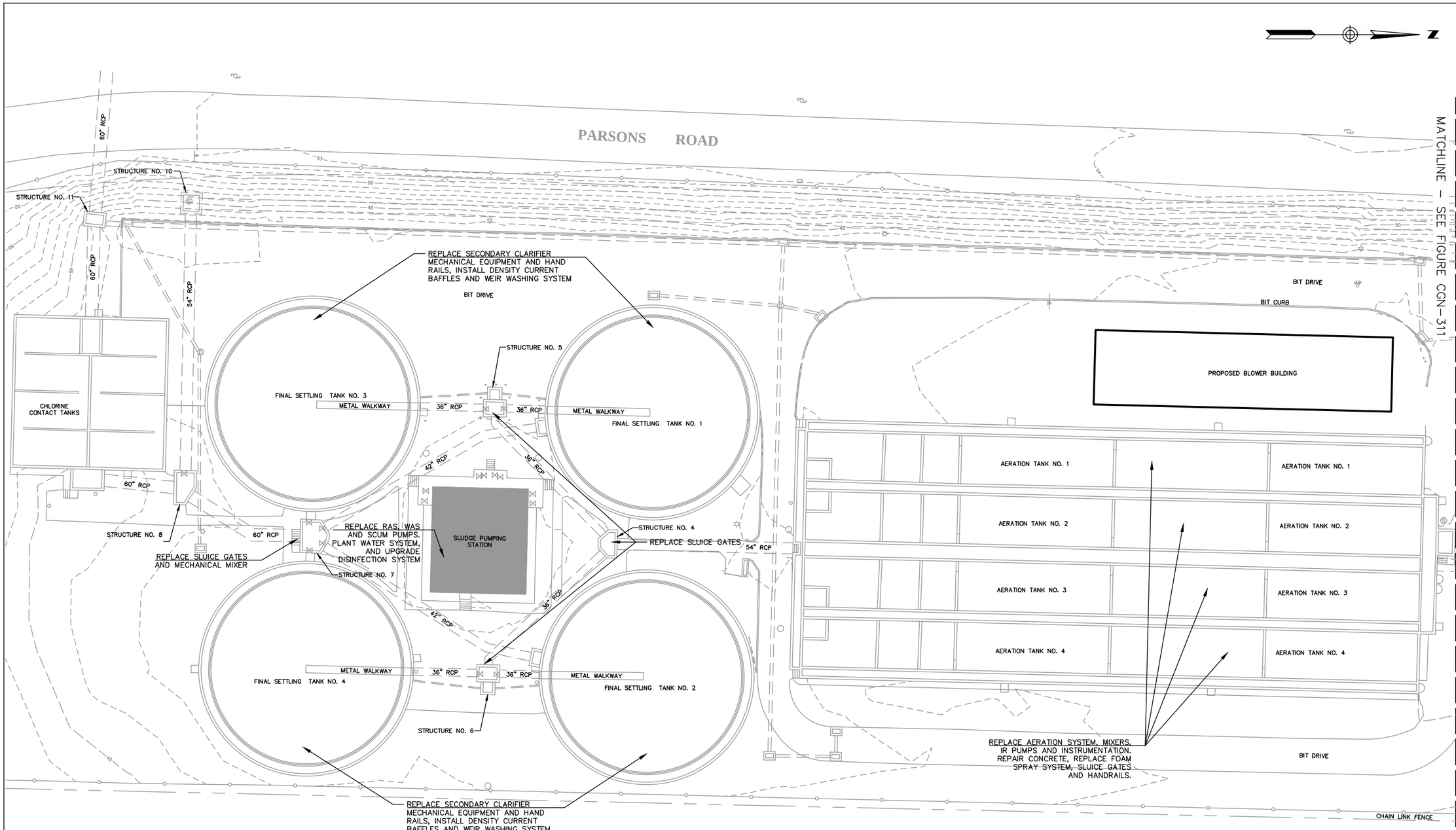
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 CGN-310.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-313



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

WPCF SITE LAYOUT
ALTERNATIVE 3B – SOUTH

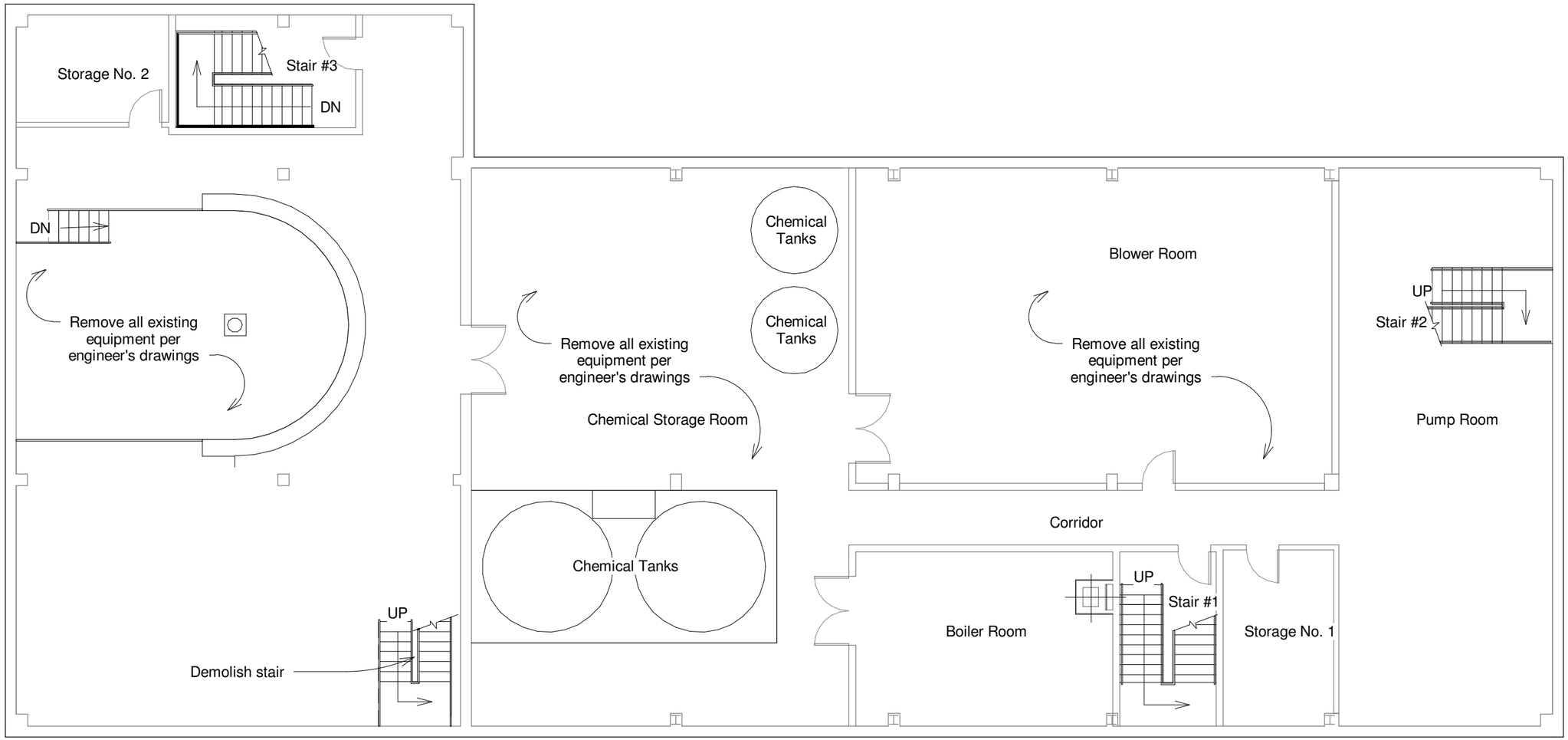
DESIGNED BY:	AH/ACB	CHECKED BY:	MJB
DRAWN BY:	ACB	2015.03.23	CGN-310.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-314



1 Basement Demo Plan
3/32" = 1'-0"

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Steffian Bradley Architects
One Corporate Road
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Enfield, CT 06082.6036
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www.steffian.com

Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000
DATE
May 2015

Scale
3/32" = 1'-0"

N

Date | Issue

Title
ALTERNATE 3B
Renovated OB
Basement Demo

AD311

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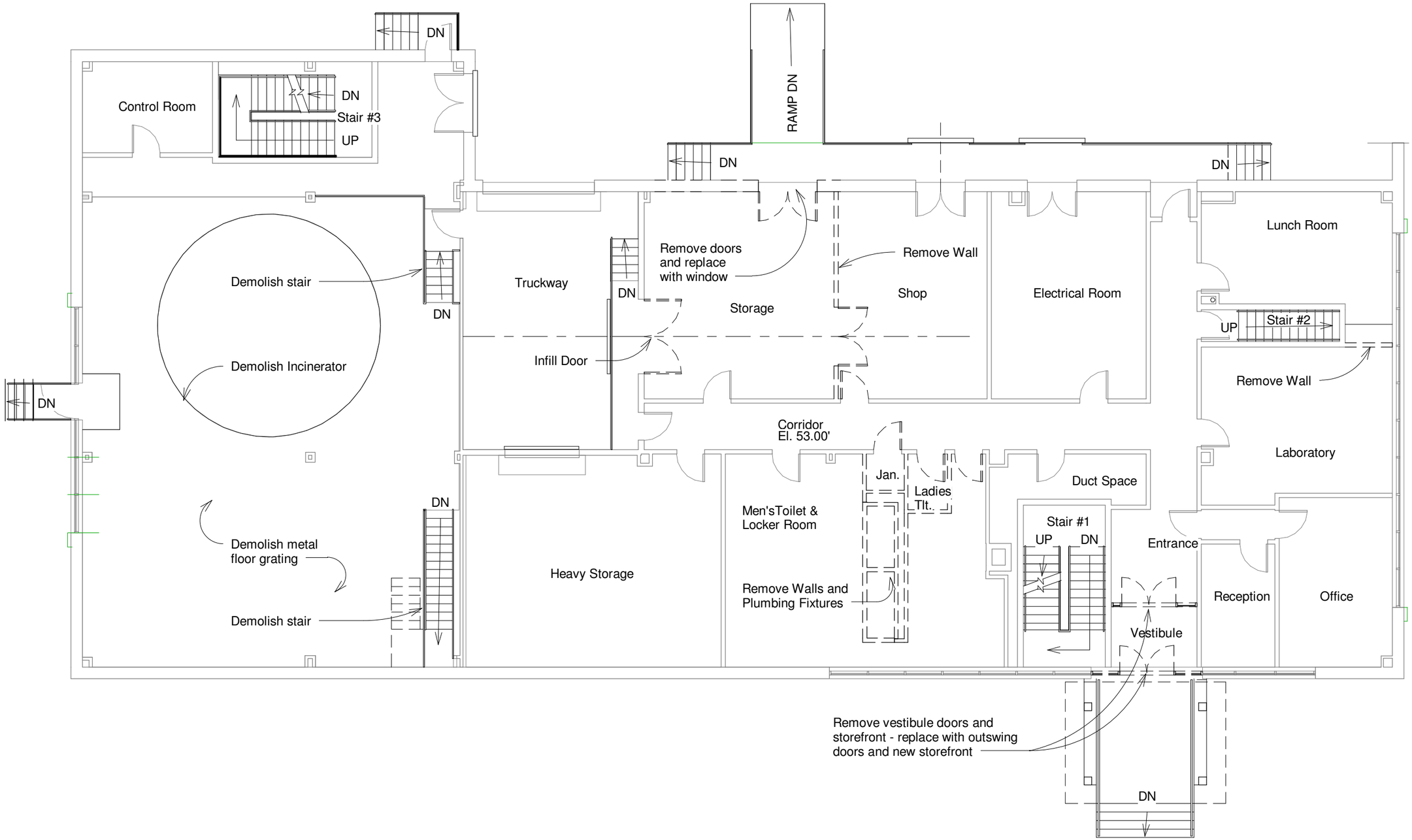

1 First Floor Demo Plan
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 3B
Renovated OB
First Floor Demo

AD312

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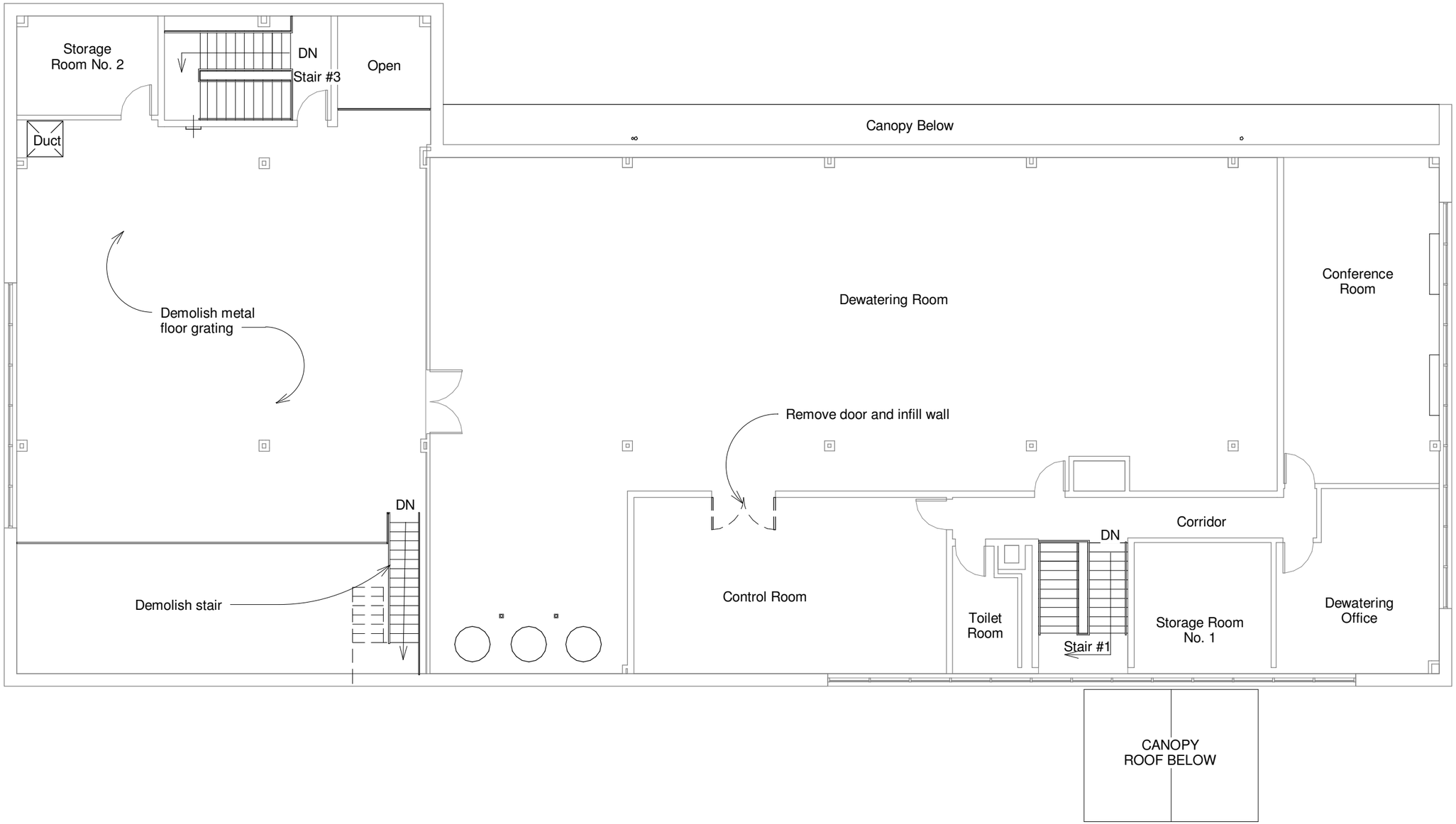
Plotted: 5/5/2015 11:12:29 PM



1 Second Floor Demo Plan
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date

Issue

Title
ALTERNATE 3B
Renovated OB
Second Floor Demo

AD313

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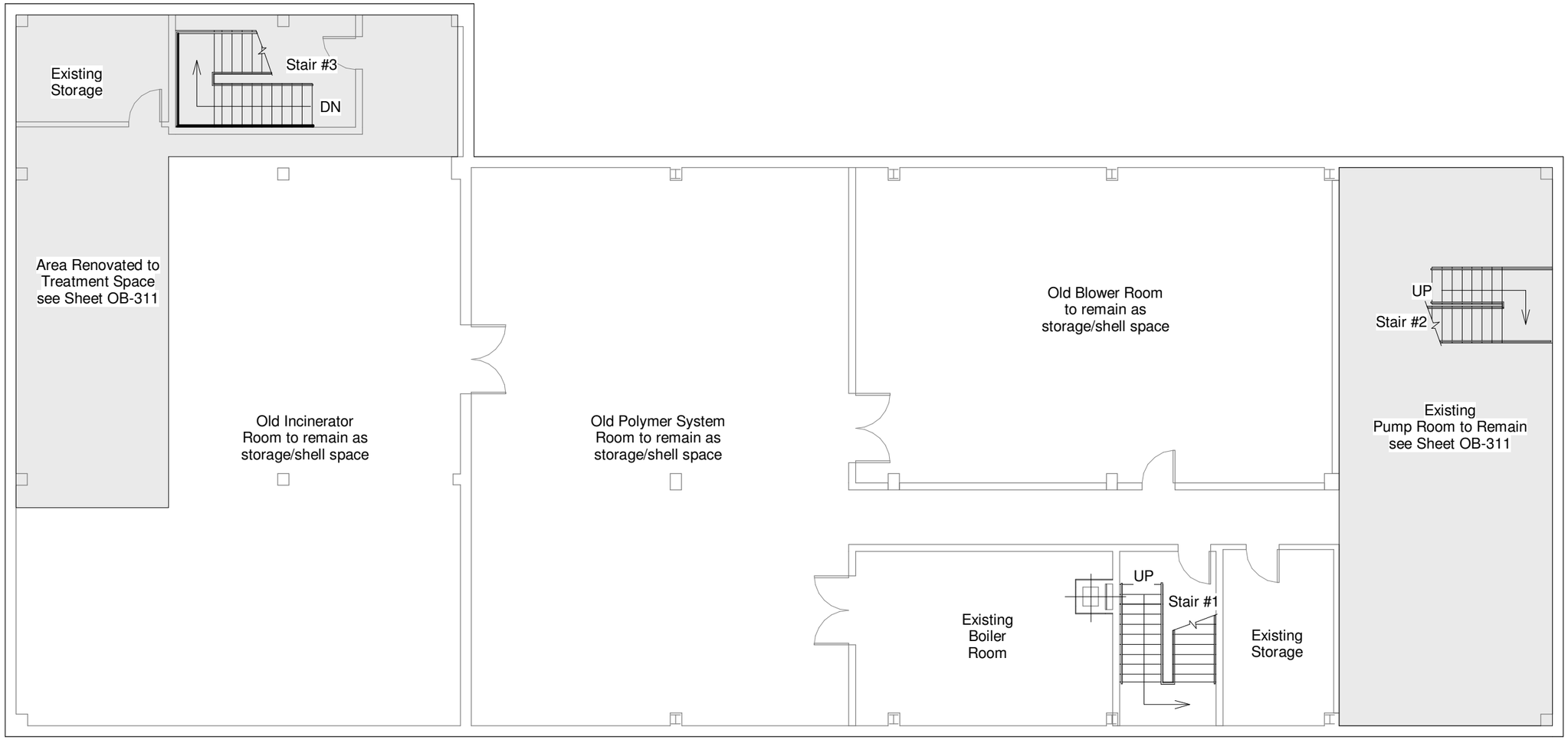
OB Renovation Summary - Basement

Light Renovation (Total 7,800 NSF)



1 OB Basement Revised Layout
3/32" = 1'-0"

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ARCHITECTS STEFFIAN BRADLEY sba

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TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 3B Renovated OB Basement Layout

A311

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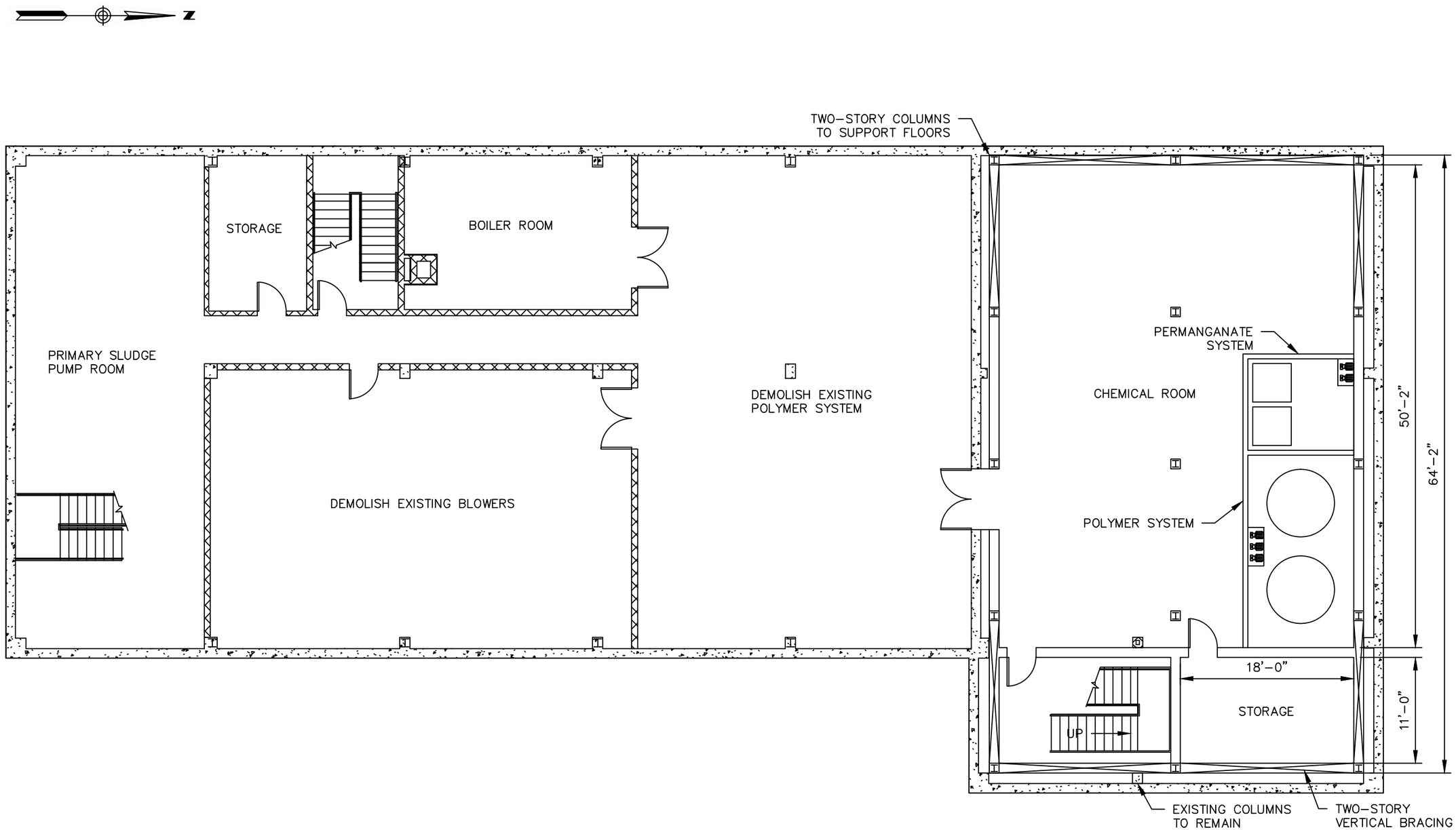

ALTERNATIVE 3B
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

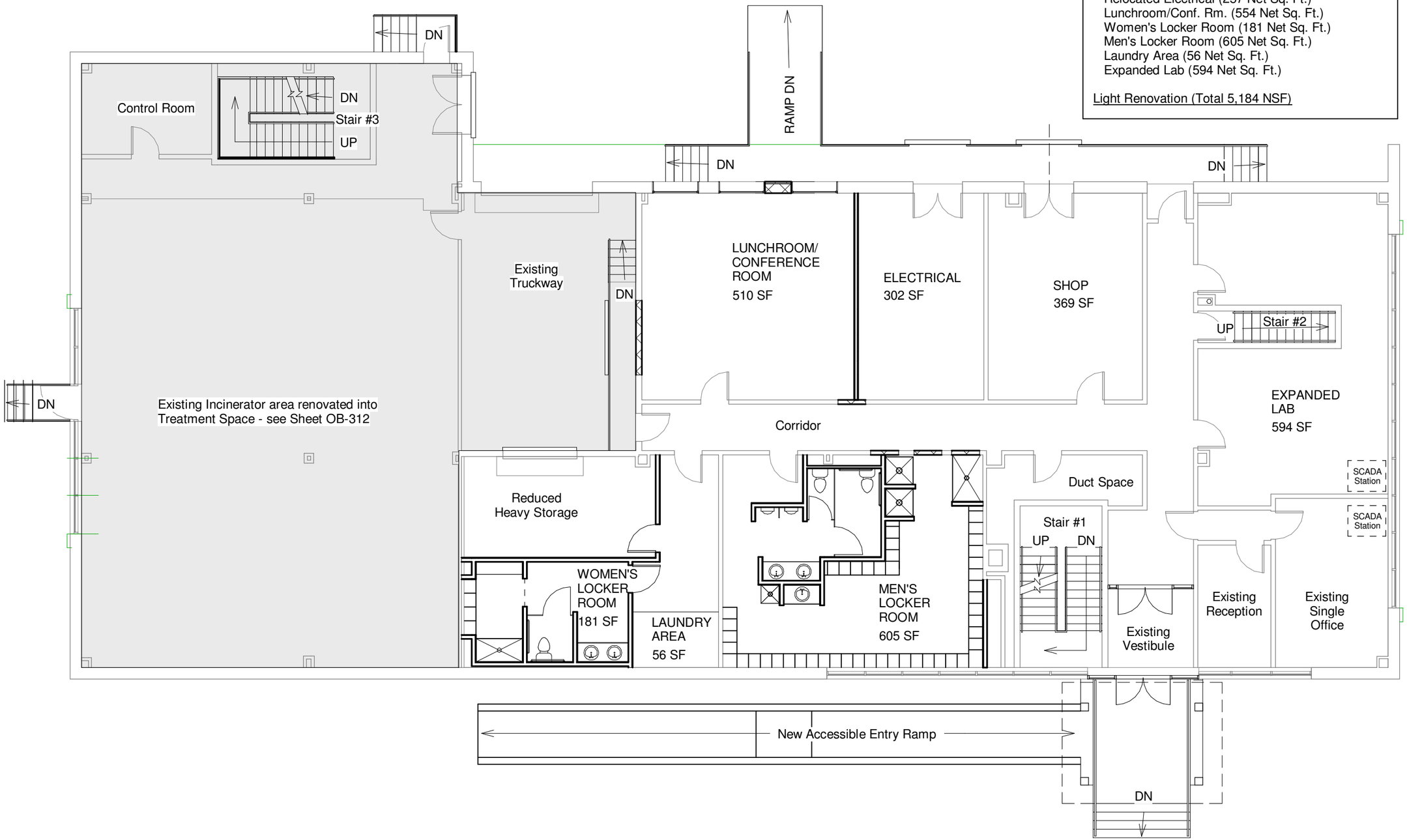
JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-311

OB Renovation - 1st Floor Summary

Heavy Renovation (Total 2,616 NSF):
- Relocated Shop (369 Net Sq. Ft.)
- Relocated Electrical (257 Net Sq. Ft.)
- Lunchroom/Conf. Rm. (554 Net Sq. Ft.)
- Women's Locker Room (181 Net Sq. Ft.)
- Men's Locker Room (605 Net Sq. Ft.)
- Laundry Area (56 Net Sq. Ft.)
- Expanded Lab (594 Net Sq. Ft.)

Light Renovation (Total 5,184 NSF)



1 OB First Floor Revised Layout
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date	Issue

Title
ALTERNATE 3B Renovated OB First Floor Layout

A312

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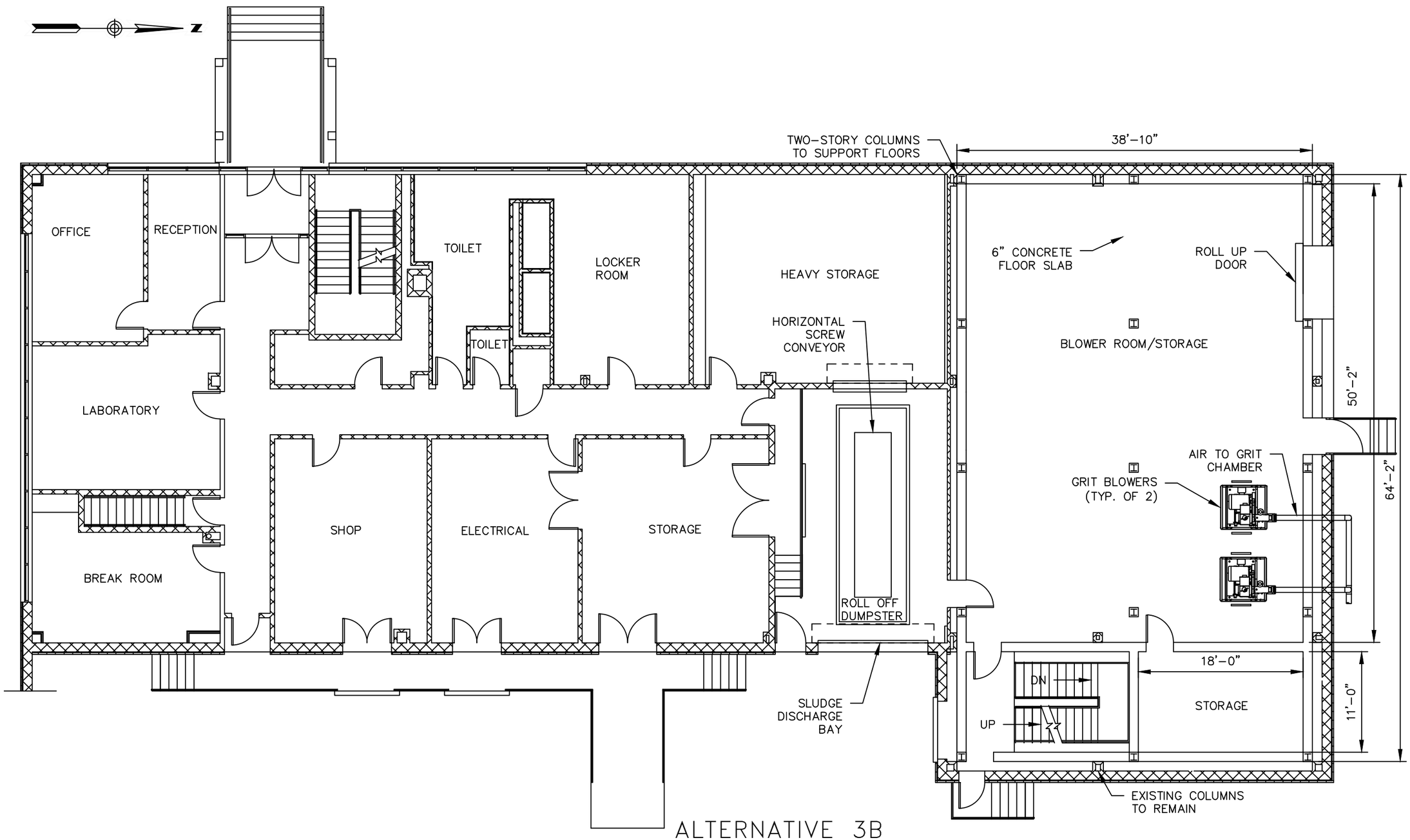

ALTERNATIVE 3B
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

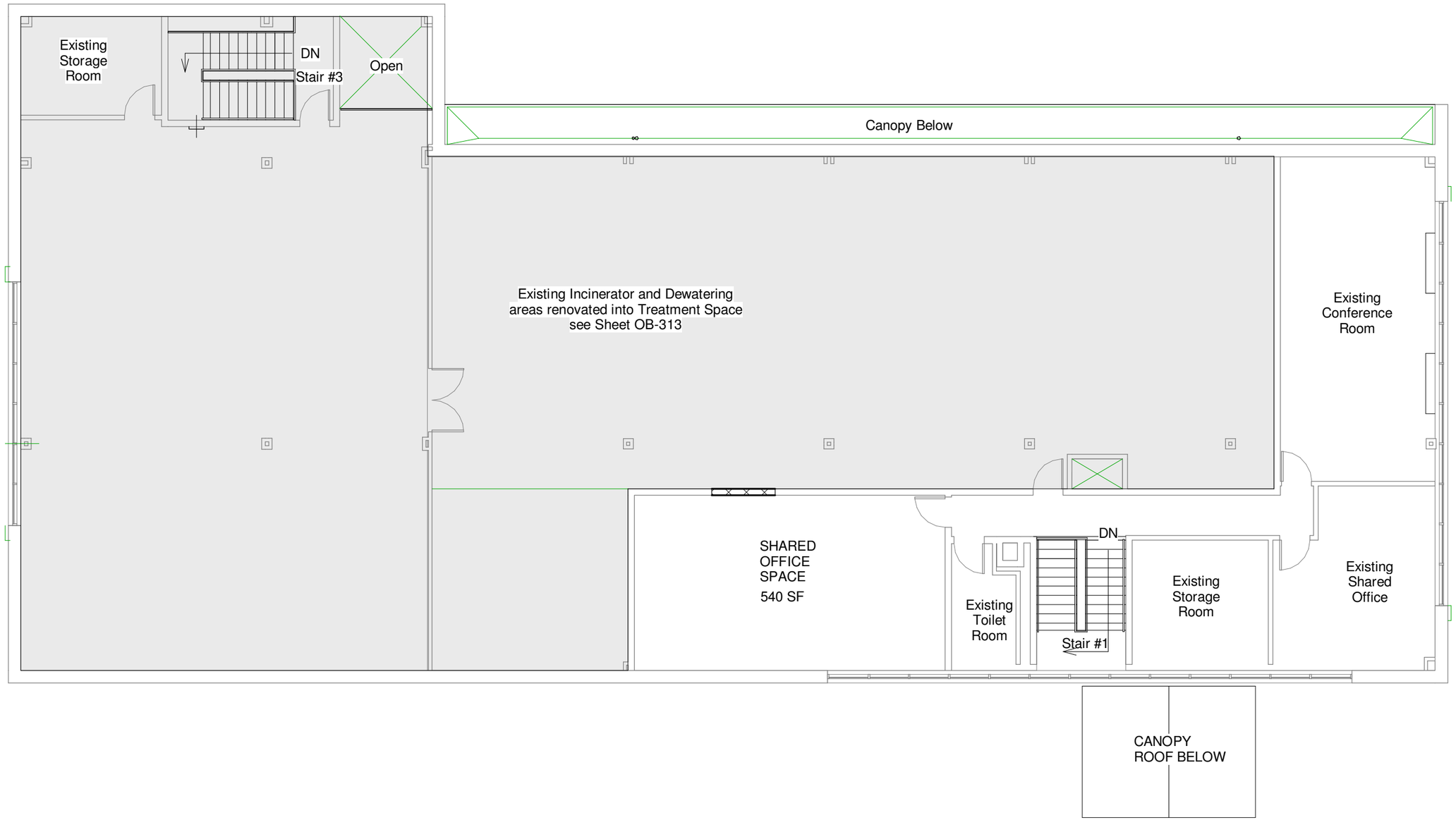
JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

OB-312

OB Renovation - 2nd Floor Summary

Heavy Renovation (Total 540 NSF):
New Shared Offices (540 Net Sq. Ft.)

Light Renovation (Total 7,260 NSF)



1 OB Second Floor Revised Layout
3/32" = 1'-0"

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Notes

TOWN of ENFIELD

WPCF

Project Number
2775-000

Scale
3/32" = 1'-0"

DATE
May 2015

N

Date | Issue

Title
ALTERNATE 3B
Renovated OB
Second Floor Layout

A313

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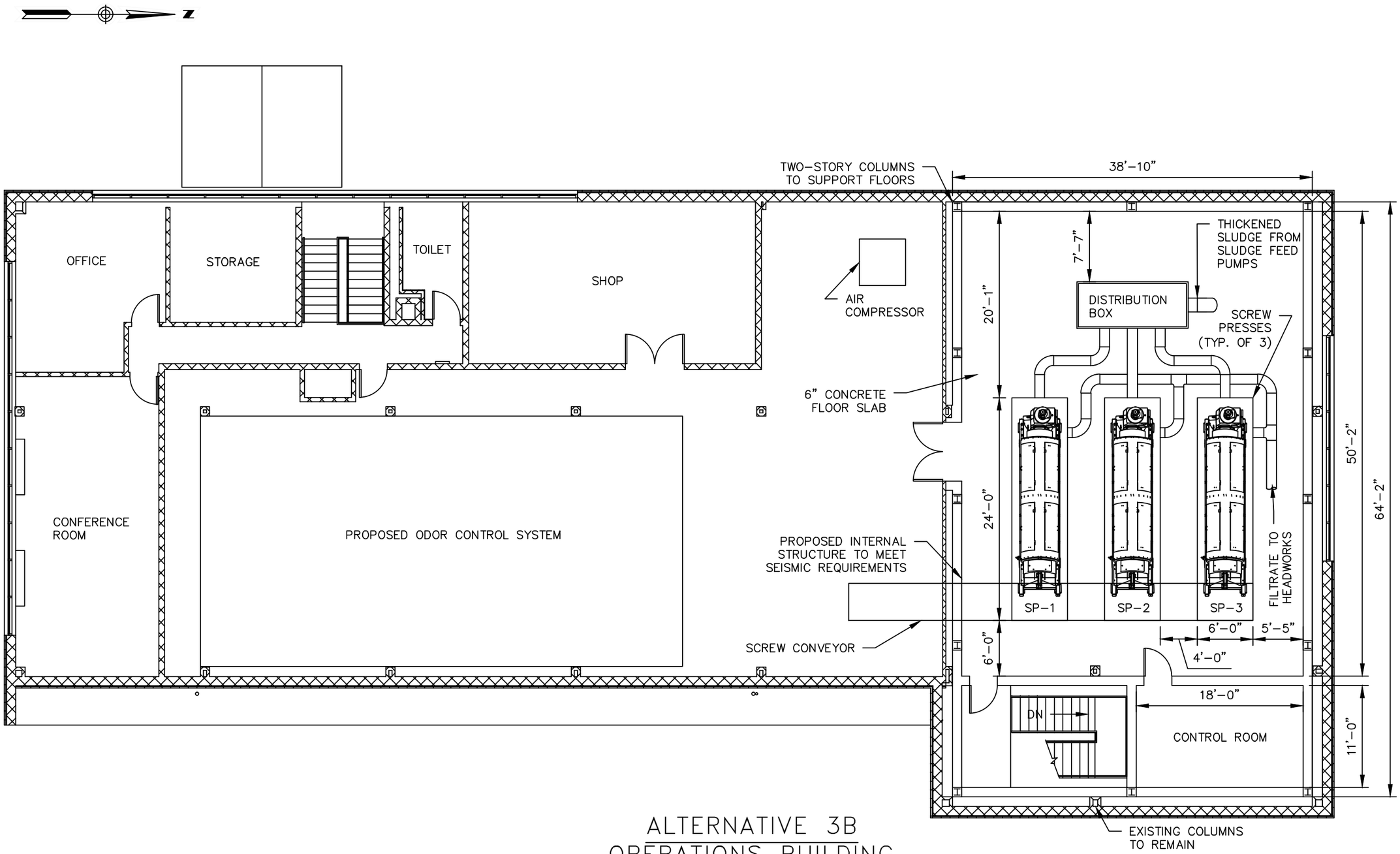

ALTERNATIVE 3B
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR

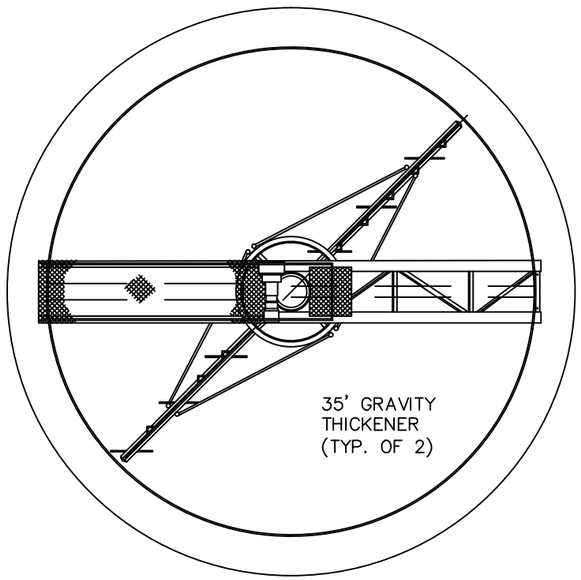
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 OPS BLDG.dwg

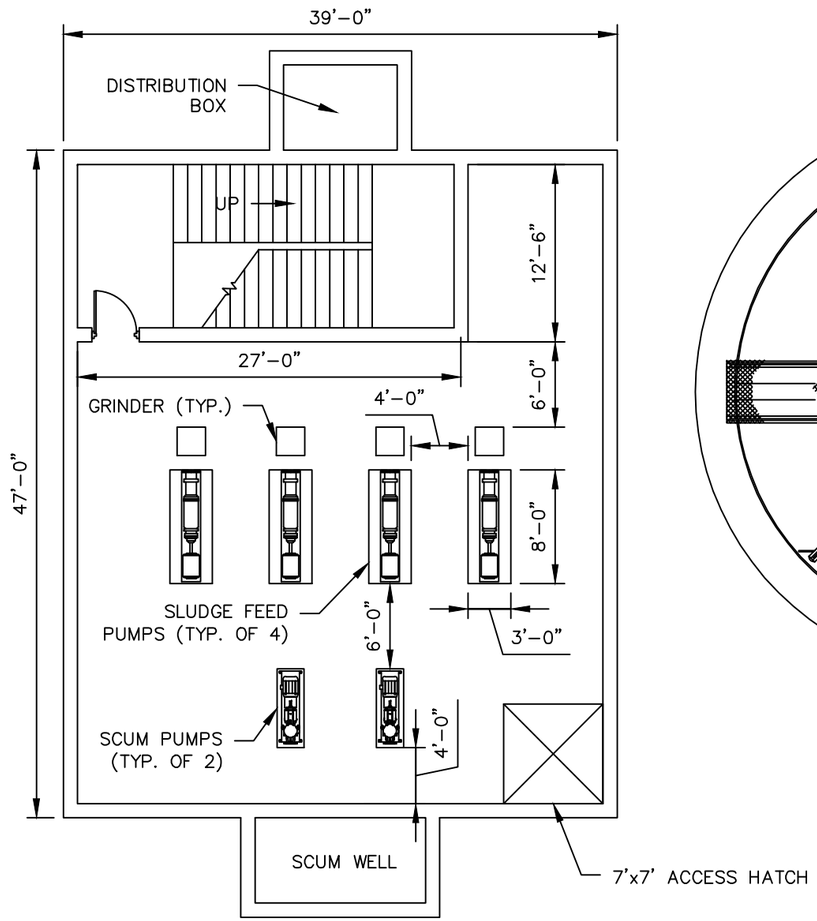
TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

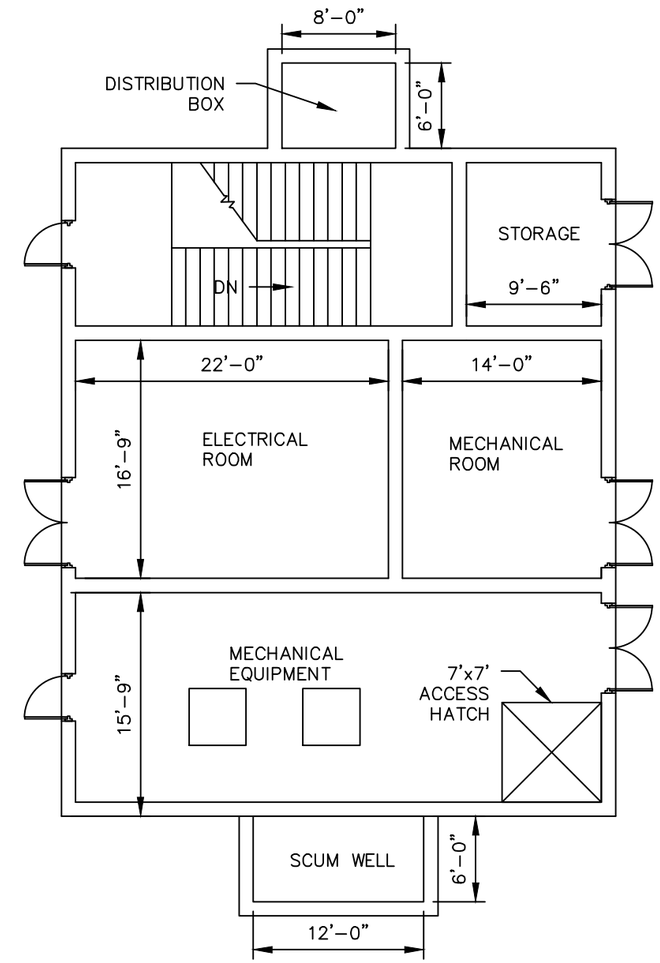
FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-313







GRAVITY THICKENERS
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"

GRAVITY THICKENERS
CONCEPTUAL LAYOUT
GROUND FLOOR

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

GRAVITY THICKENERS
CONCEPTUAL LAYOUT

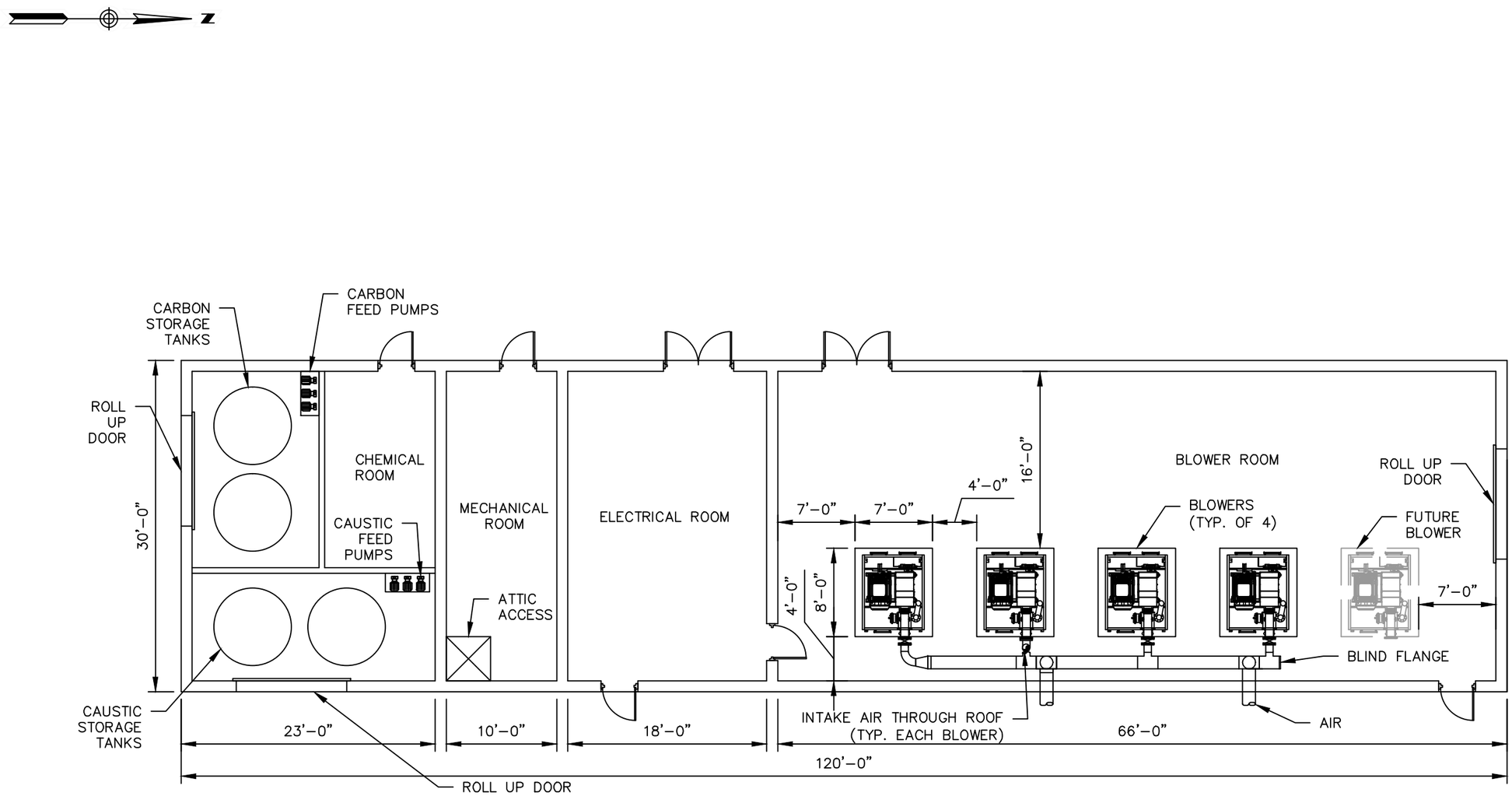
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 GRAVITY THIC*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

GT-311



ALTERNATIVE 3B
BLOWER BUILDING
CONCEPTUAL LAYOUT

SCALE: 3/32" = 1'-0"

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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

BLOWER BUILDING
CONCEPTUAL LAYOUT

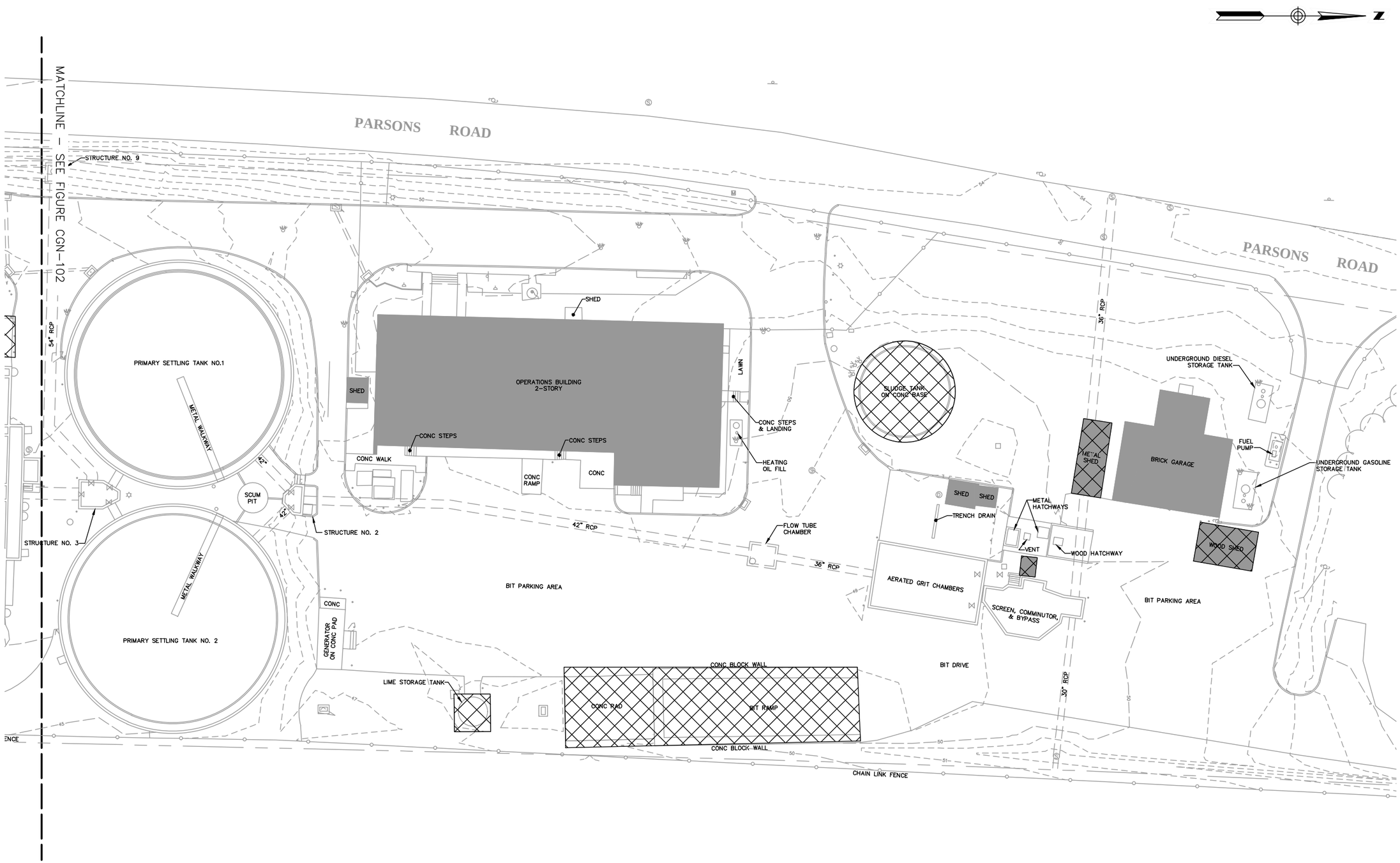
DESIGNED BY: AH/ACB
DRAWN BY: ACB
CHECKED BY: MJB
2015.03.23 BLOWER BLDG.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW BB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

BB-311



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COMMITMENT & INTEGRITY DRIVE RESULTS

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WPCF DEMOLITION PLAN ALTERNATIVE 3C – NORTH

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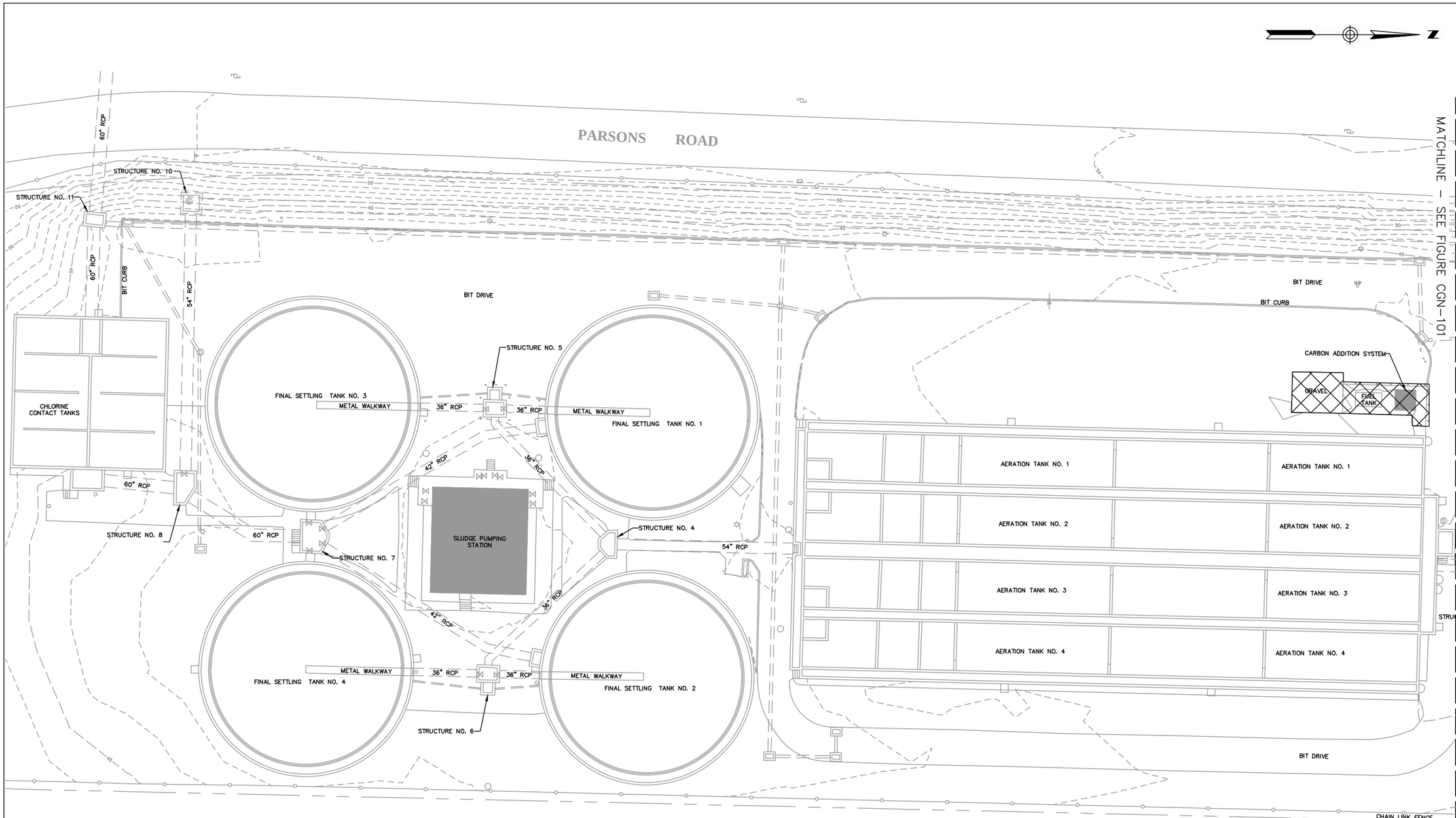
DRAWN BY: ACB	2015.03.23 CGN-320 DEMO*.dwg

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3C
PARTIAL REHAB OB, NEW AB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-321



EXISTING STRUCTURE TO BE DEMOLISHED

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ALTERNATIVE 3C – SOUTH

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ENFIELD, CONNECTICUT

FACILITIES PLAN
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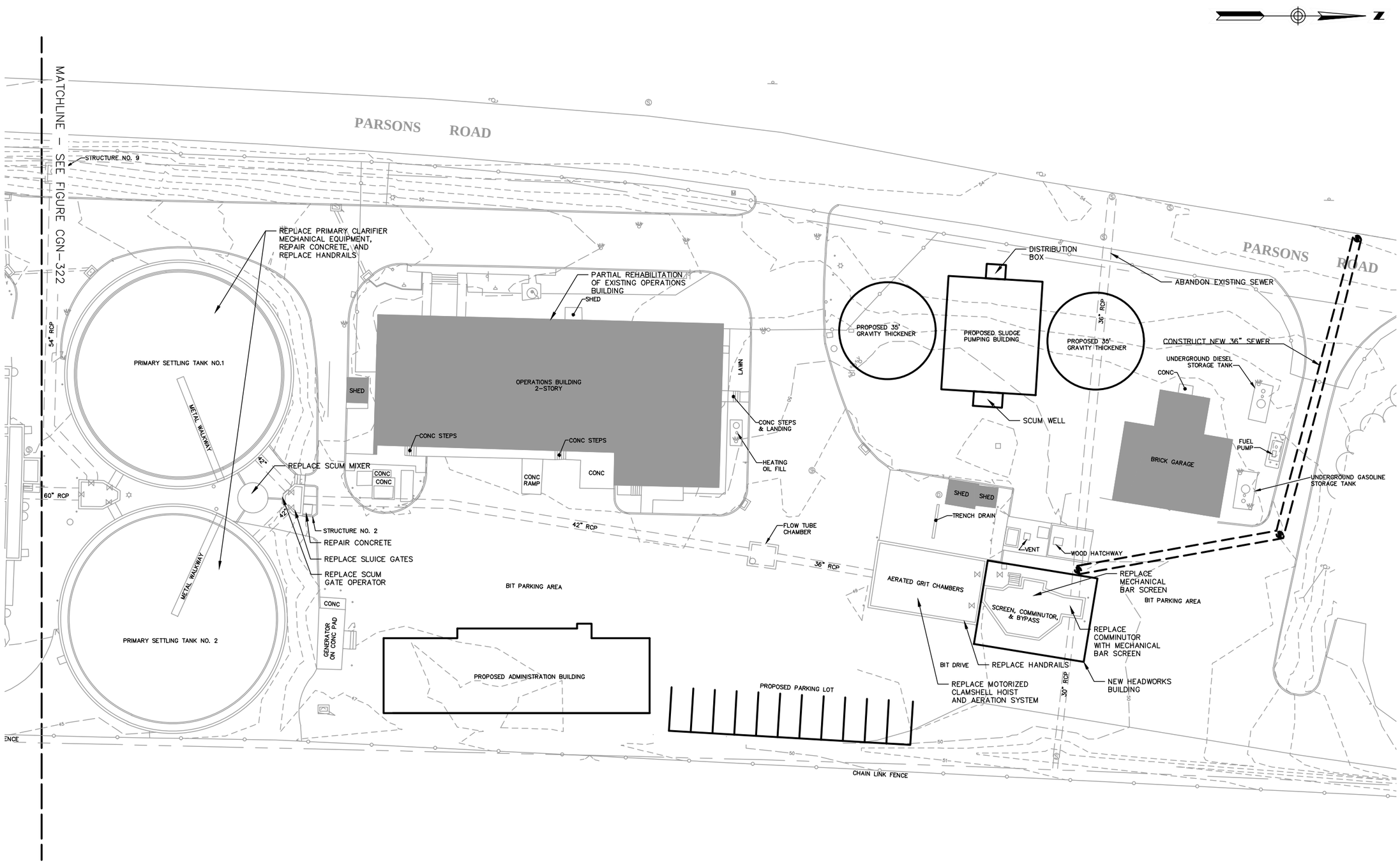
PARTIAL REHAB OB, NEW AB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-322



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ALTERNATIVE 3C – NORTH

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CHECKED BY:	MJB
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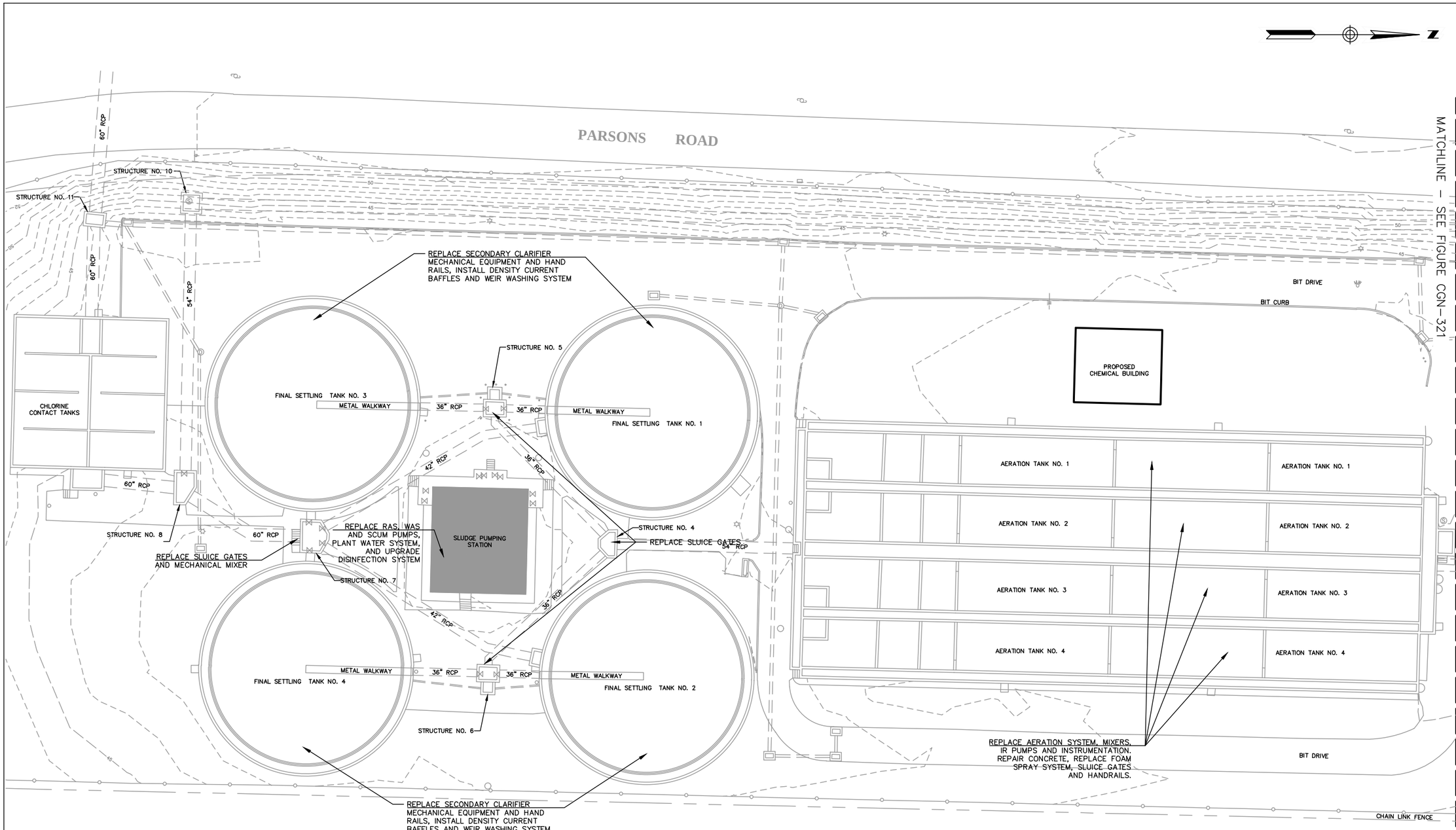
TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3C
PARTIAL REHAB OB, NEW AB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-323



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ALTERNATIVE 3C – SOUTH

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TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
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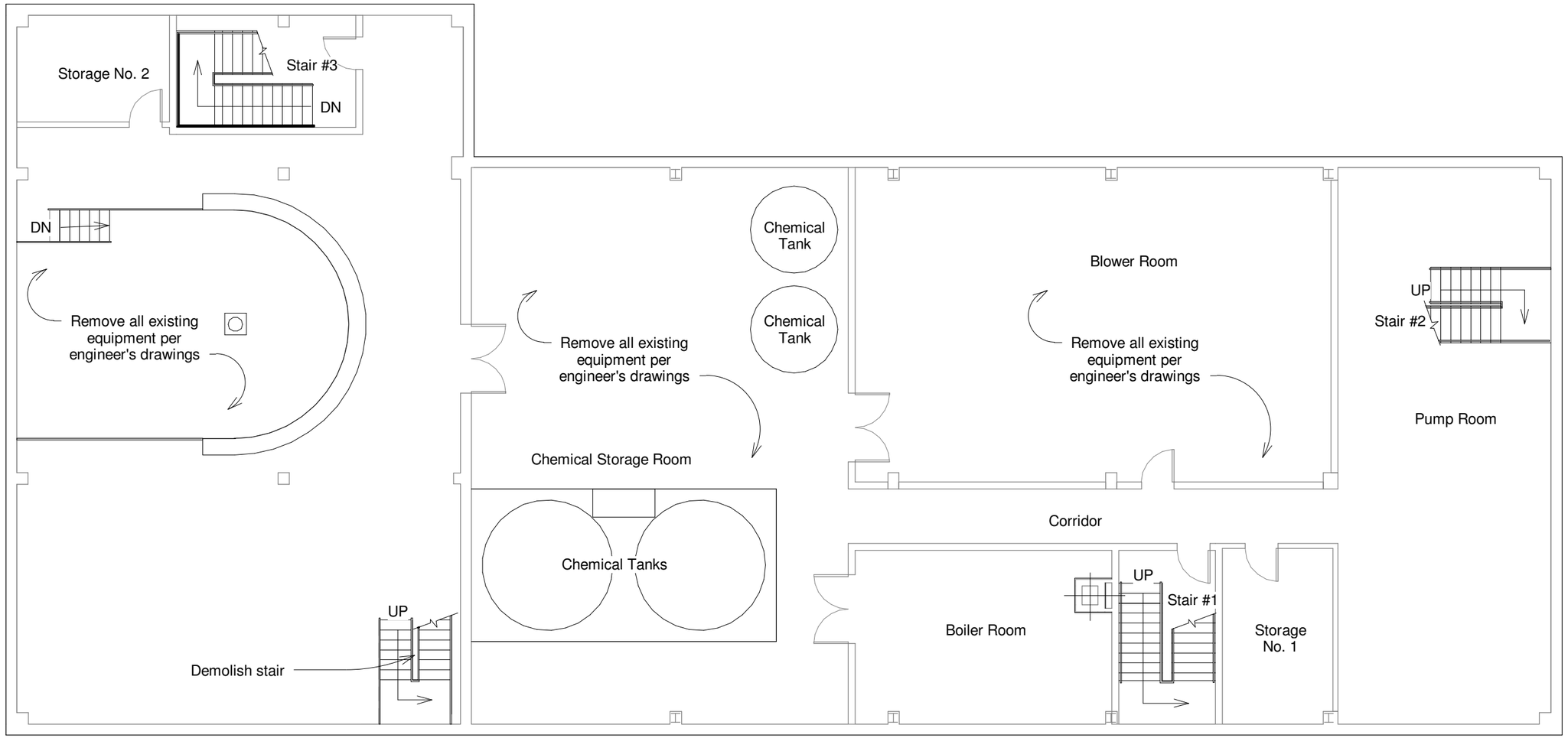
PARTIAL REHAB OP, NEW AB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 1" = 40'

CGN-324



1 Basement Plan
3/32" = 1'-0"

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Date | Issue

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Basement Demo

AD321

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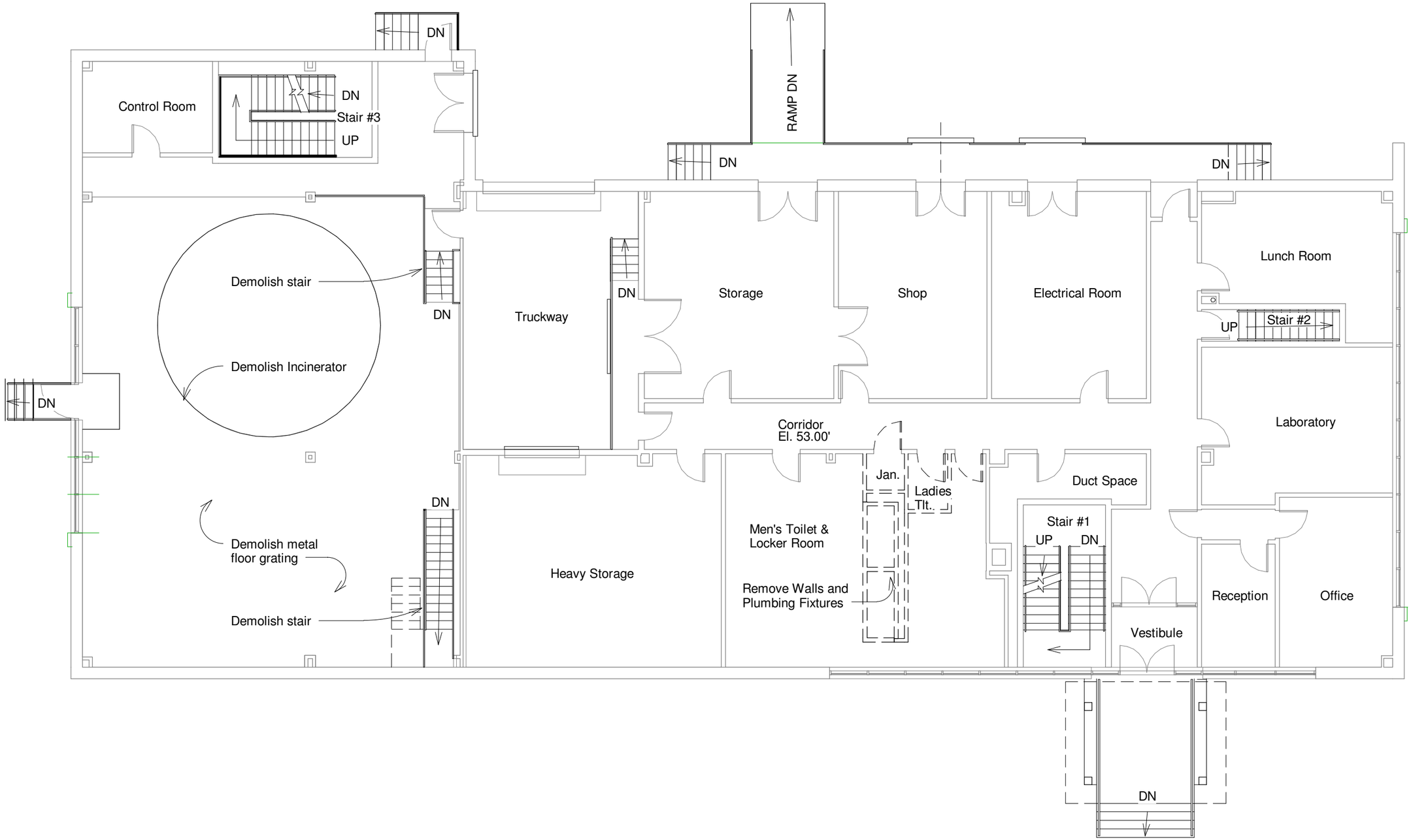

1 First Floor Demo Plan
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May 2015

Date | Issue

Title
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Renovated OB
First Floor Demo

AD322

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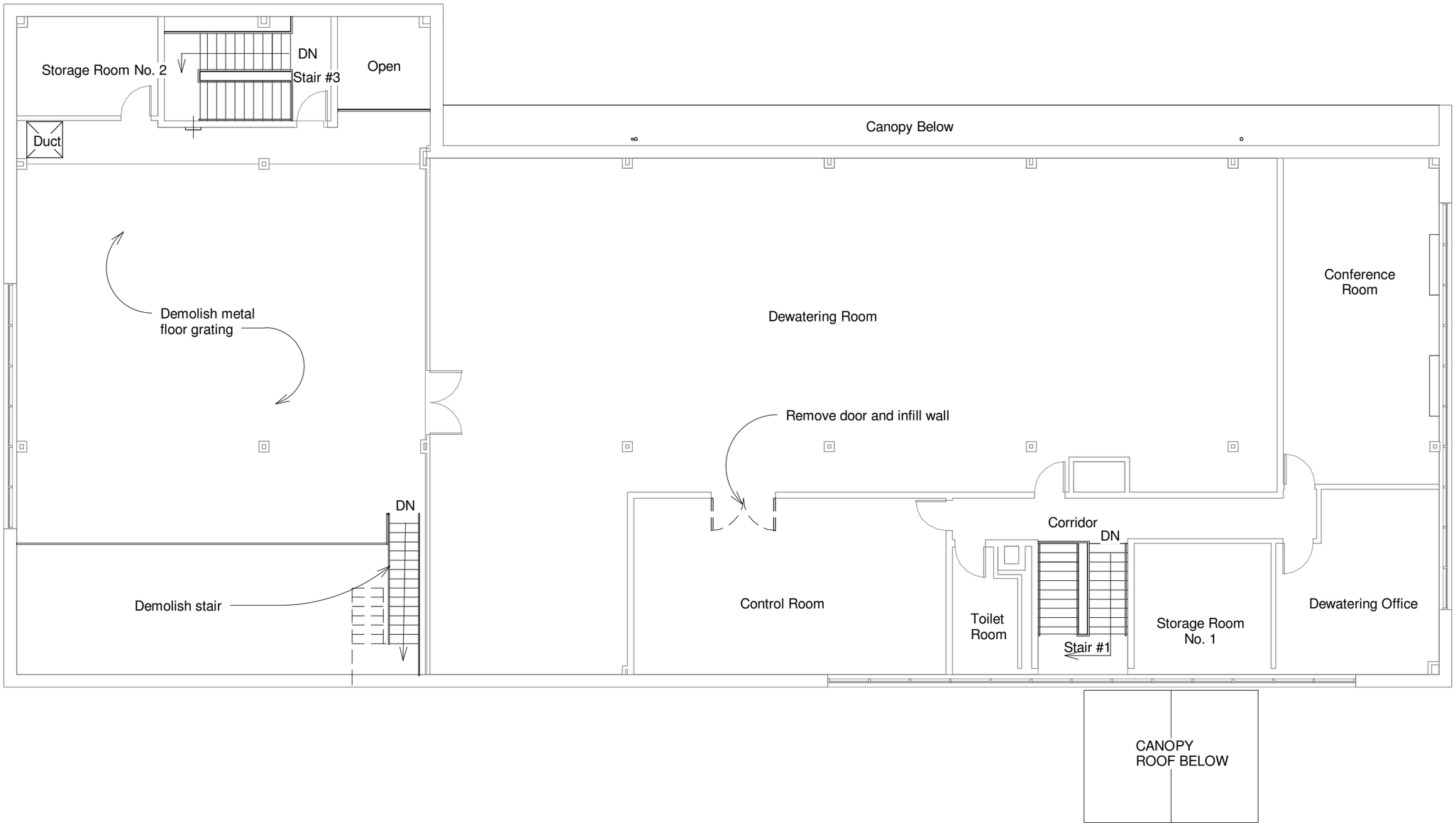

1 Second Floor Demo Plan
3/32" = 1'-0"

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Scale
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DATE
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Date | Issue

Title
ALTERNATE 3C
Renovated OB
Second Floor Demo

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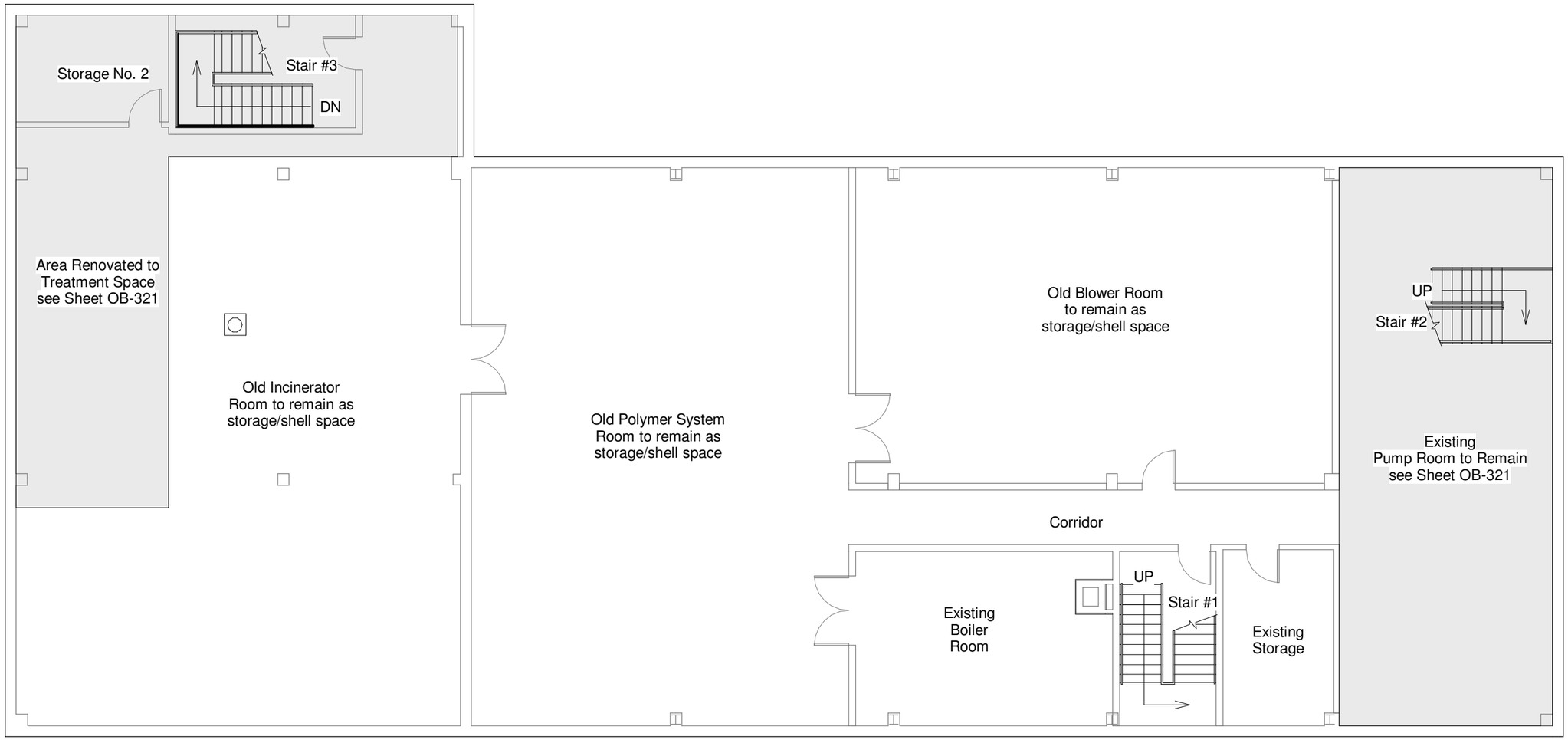
OB Renovation Summary - Basement

Light Renovation (Total 7,800 NSF)



1 OB Basement Revised Layout
3/32" = 1'-0"

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TOWN of ENFIELD

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DATE
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Title
ALTERNATE 3C Renovated OB Basement Layout

A321

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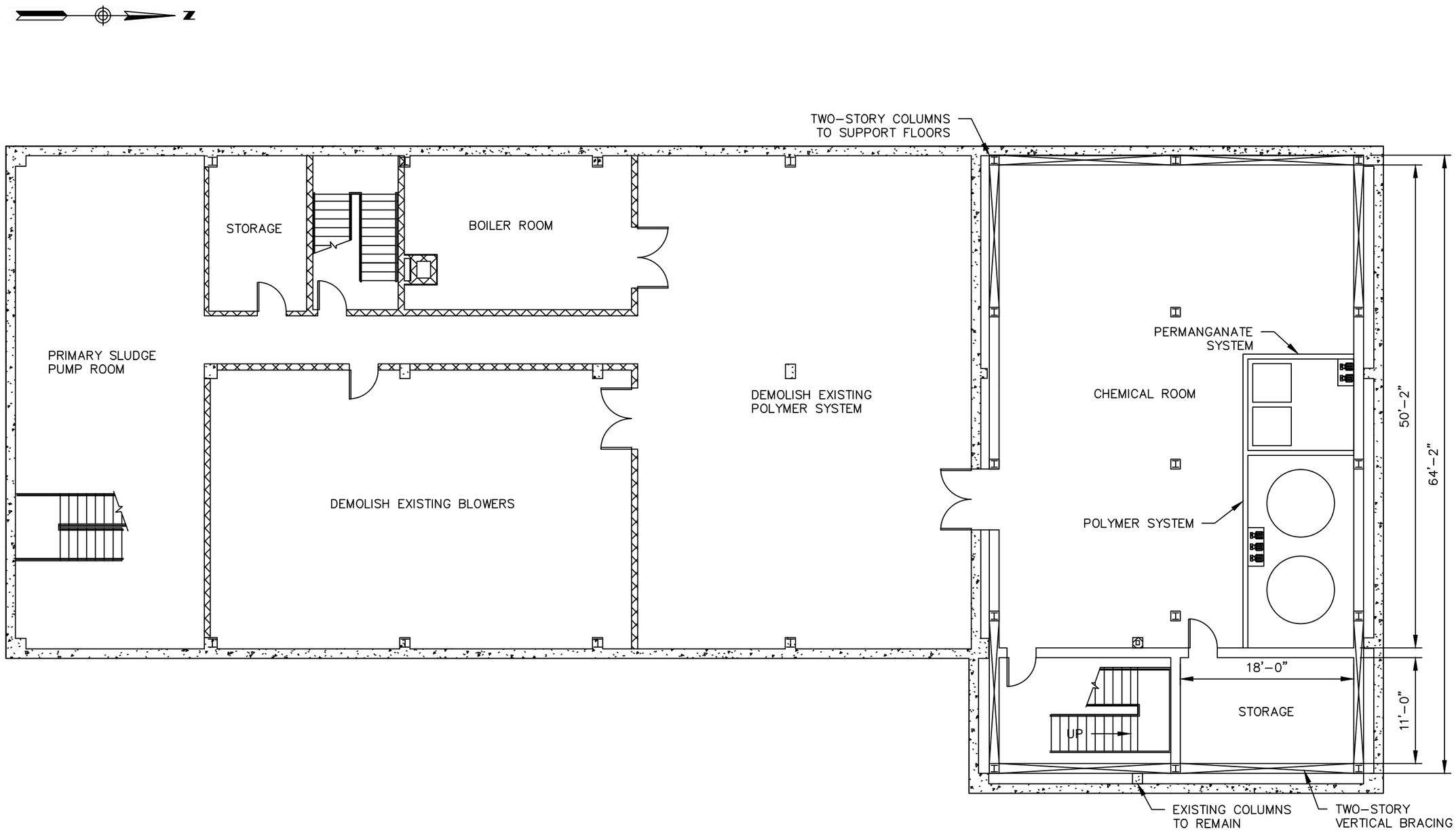

ALTERNATIVE 3C
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"

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OPERATIONS BUILDING
CONCEPTUAL LAYOUT
BASEMENT

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TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3C
PARTIAL REHAB OB, NEW AB & GT

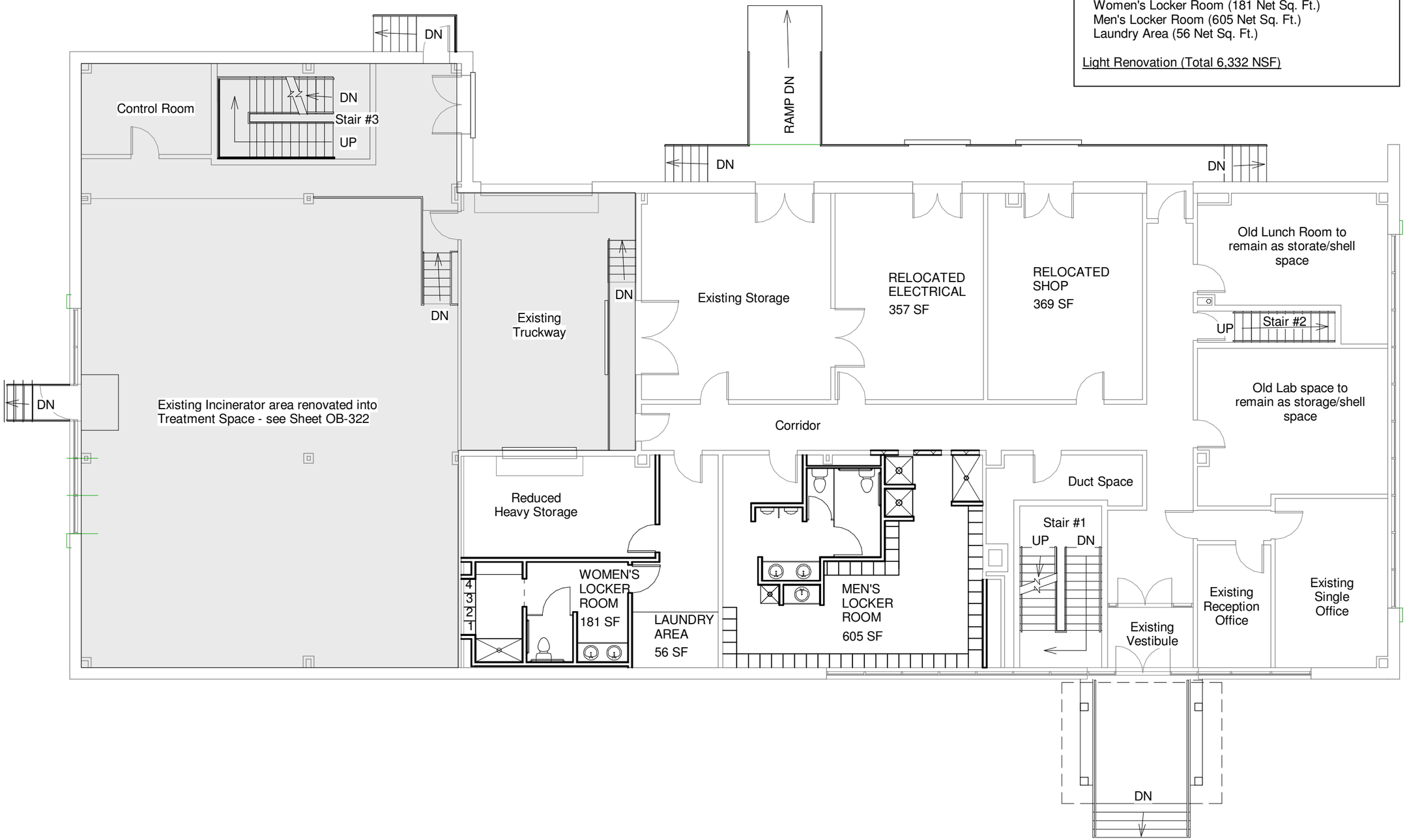
JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-321

OB Renovation - 1st Floor Summary

Heavy Renovation (Total 1,468 NSF):
- Relocated Shop (369 Net Sq. Ft.)
- Relocated Electrical (257 Net Sq. Ft.)
- Women's Locker Room (181 Net Sq. Ft.)
- Men's Locker Room (605 Net Sq. Ft.)
- Laundry Area (56 Net Sq. Ft.)

Light Renovation (Total 6,332 NSF)



1 OB First Floor Revised Layout
3/32" = 1'-0"

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TOWN of ENFIELD

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Project Number
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Scale
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Date | Issue

Title
ALTERNATE 3C Renovated OB First Floor Layout

A322

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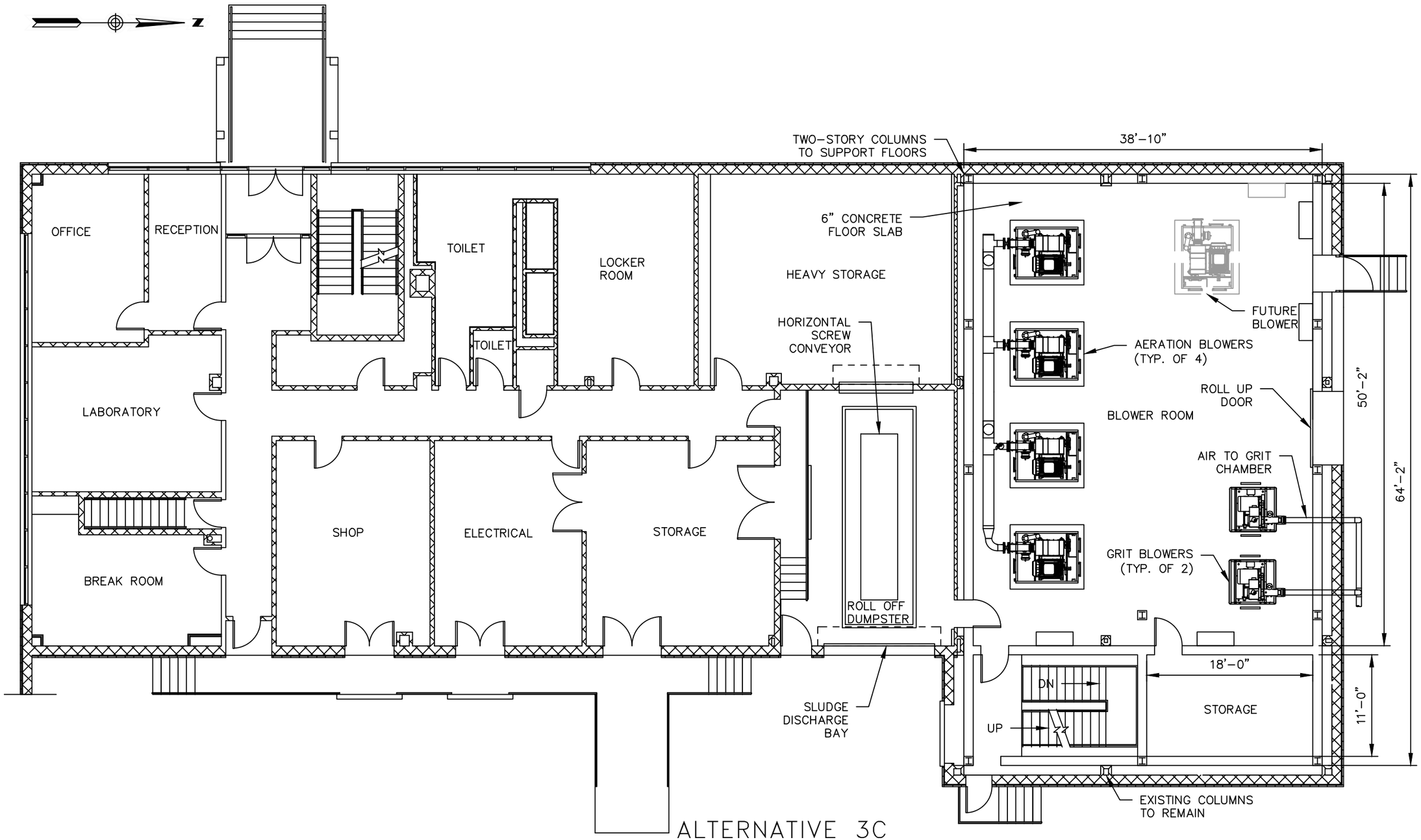

ALTERNATIVE 3C
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

SCALE: 3/32" = 1'-0"

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WOODARD & CURRAN

OPERATIONS BUILDING
CONCEPTUAL LAYOUT
FIRST FLOOR

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TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3C
PARTIAL REHAB OB, NEW AB & GT

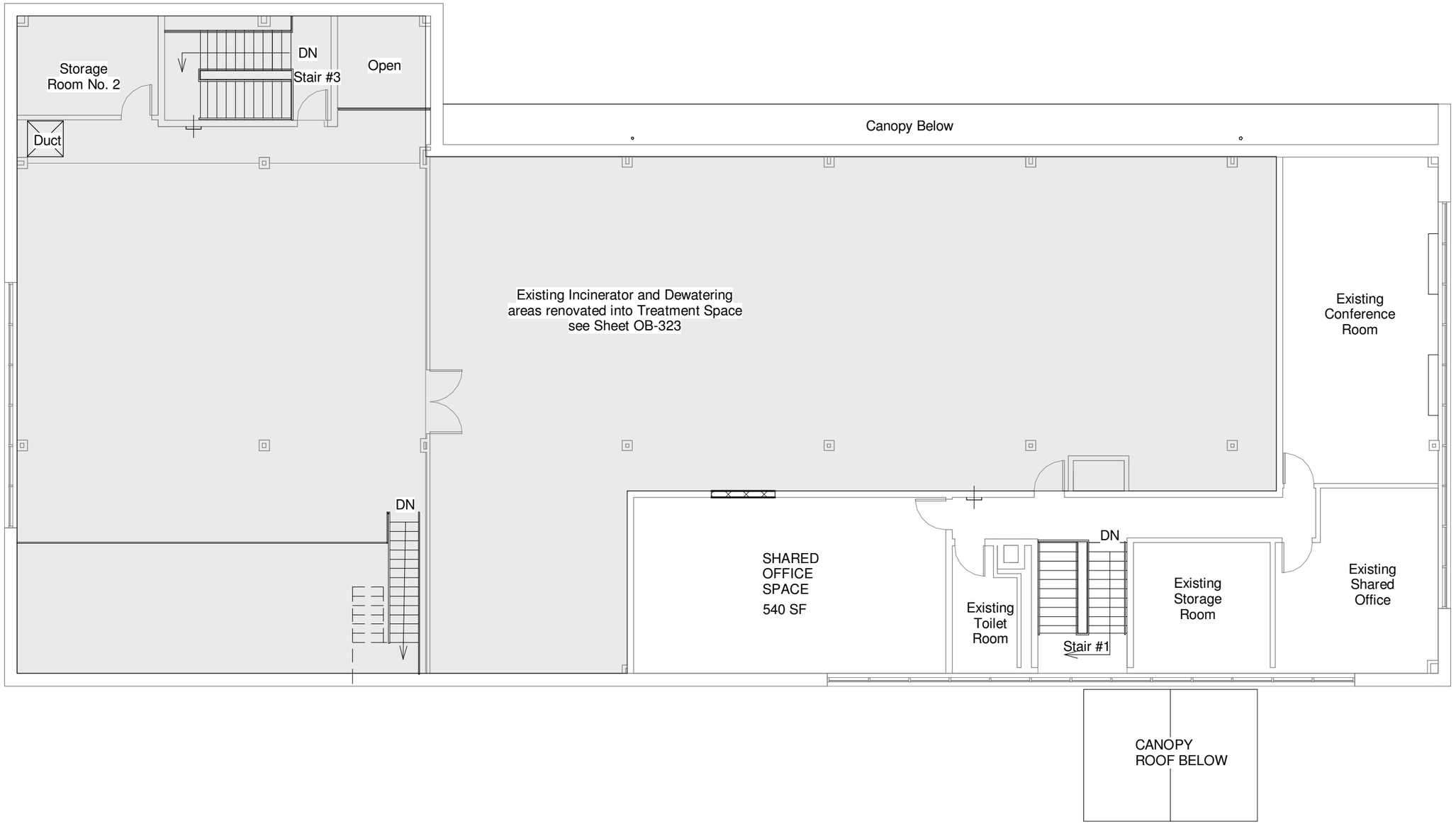
JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-322

OB Renovation - 2nd Floor Summary

Heavy Renovation (Total 540 NSF):
New Shared Offices (540 Net Sq. Ft.)

Light Renovation (Total 7,260 NSF)



1 OB Second Floor Revised Layout
3/32" = 1'-0"

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TOWN of ENFIELD

WPCF

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May 2015

Date | Issue

Title
ALTERNATE 3C
Renovated OB
Second Floor Layout

A323

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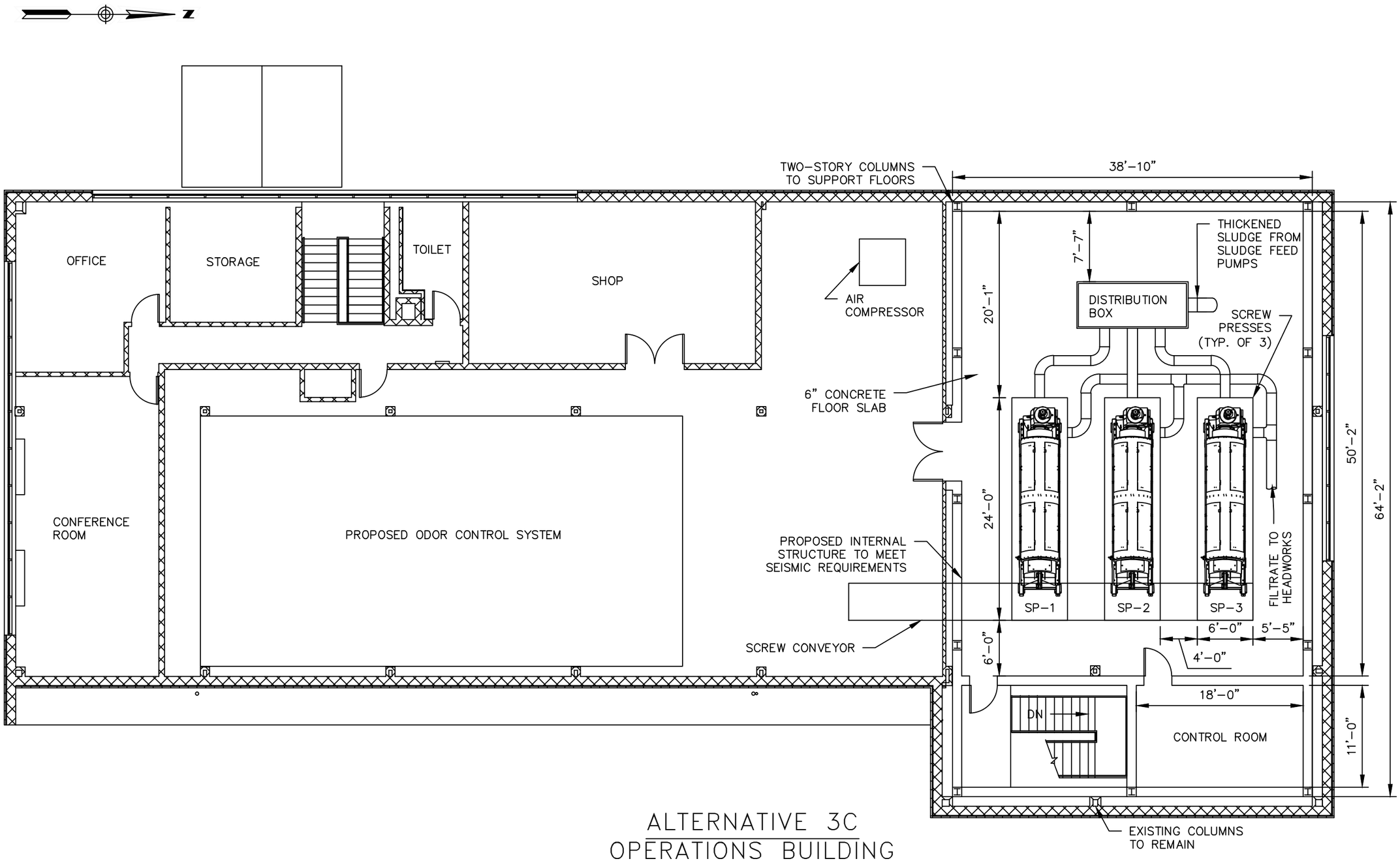

ALTERNATIVE 3C
OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR

SCALE: 3/32" = 1'-0"

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OPERATIONS BUILDING
CONCEPTUAL LAYOUT
SECOND FLOOR

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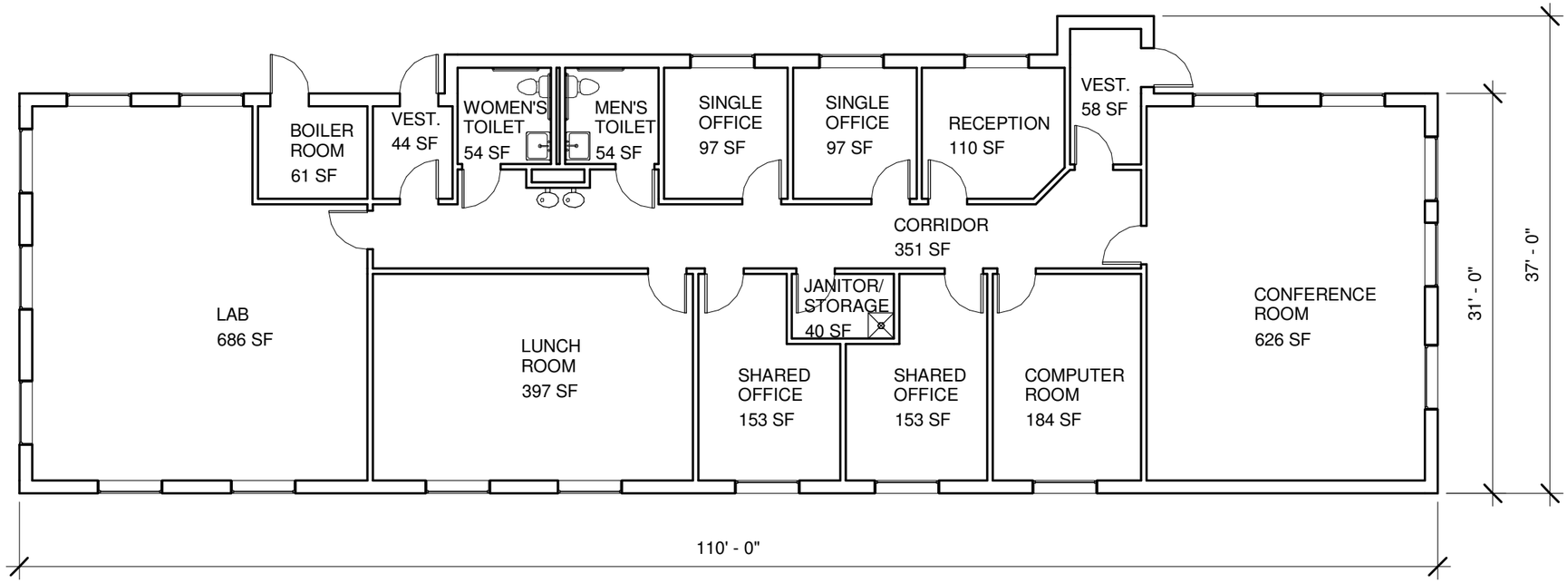
TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3C
PARTIAL REHAB OB, NEW AB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/32" = 1'-0"

OB-323

New Administration Building - 3,600 GSF



1 Admin Building Conceptual Layout
3/32" = 1'-0"

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TOWN of ENFIELD

WPCF

Project Number
2775-000
DATE
May 2015

Scale
3/32" = 1'-0"
N

Date | Issue

Title
ALTERNATE 3C
New Admin Building
First Floor Layout

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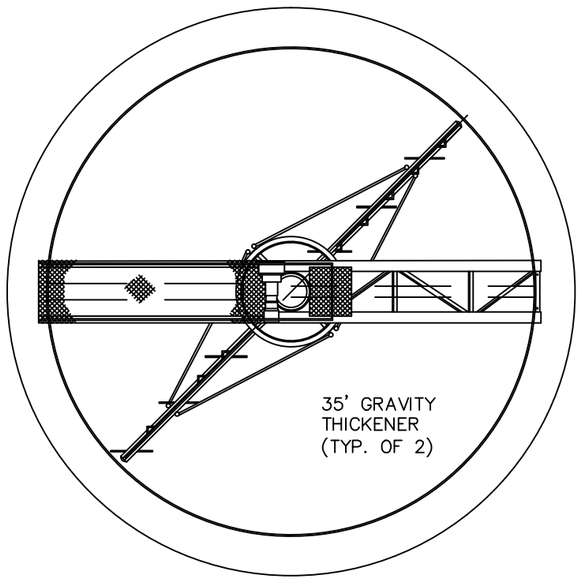

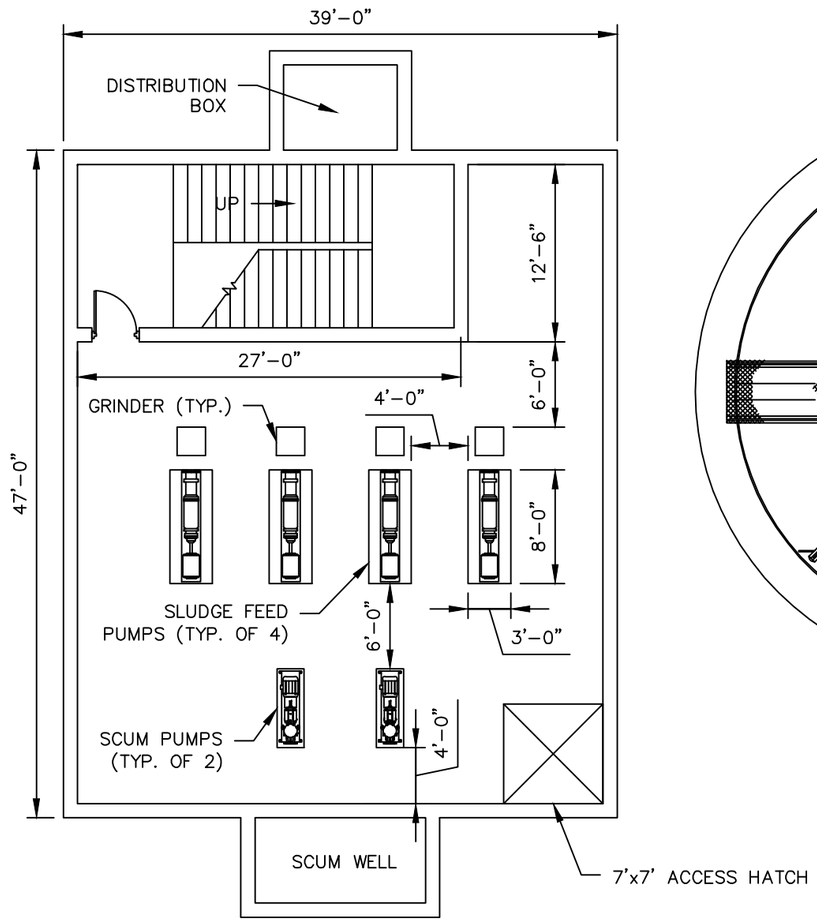

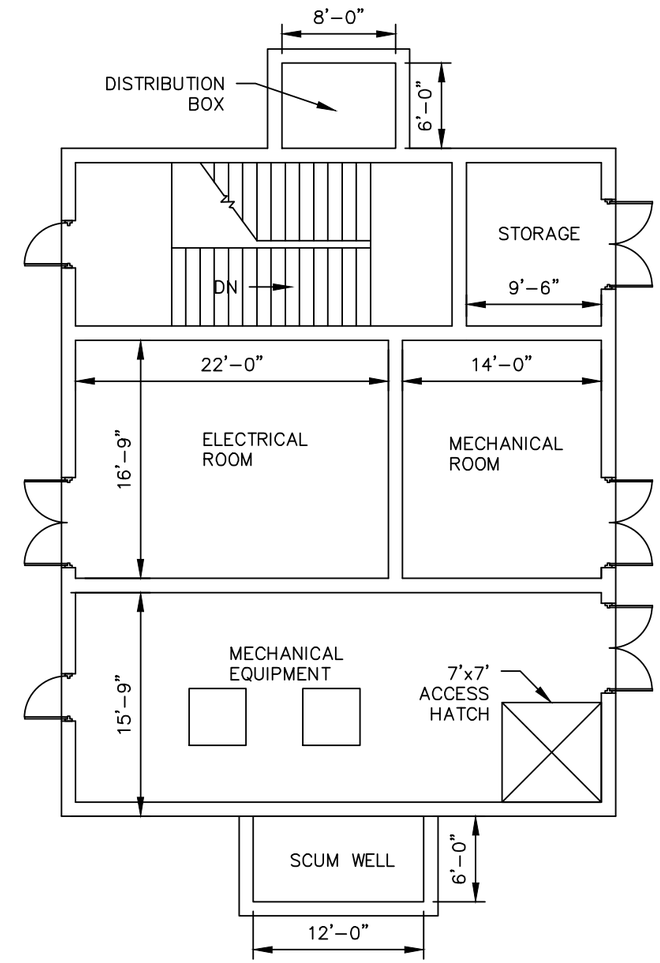

GRAVITY THICKENERS
CONCEPTUAL LAYOUT
BASEMENT

SCALE: 3/32" = 1'-0"

GRAVITY THICKENERS
CONCEPTUAL LAYOUT
GROUND FLOOR

SCALE: 3/32" = 1'-0"

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GRAVITY THICKENERS
CONCEPTUAL LAYOUT

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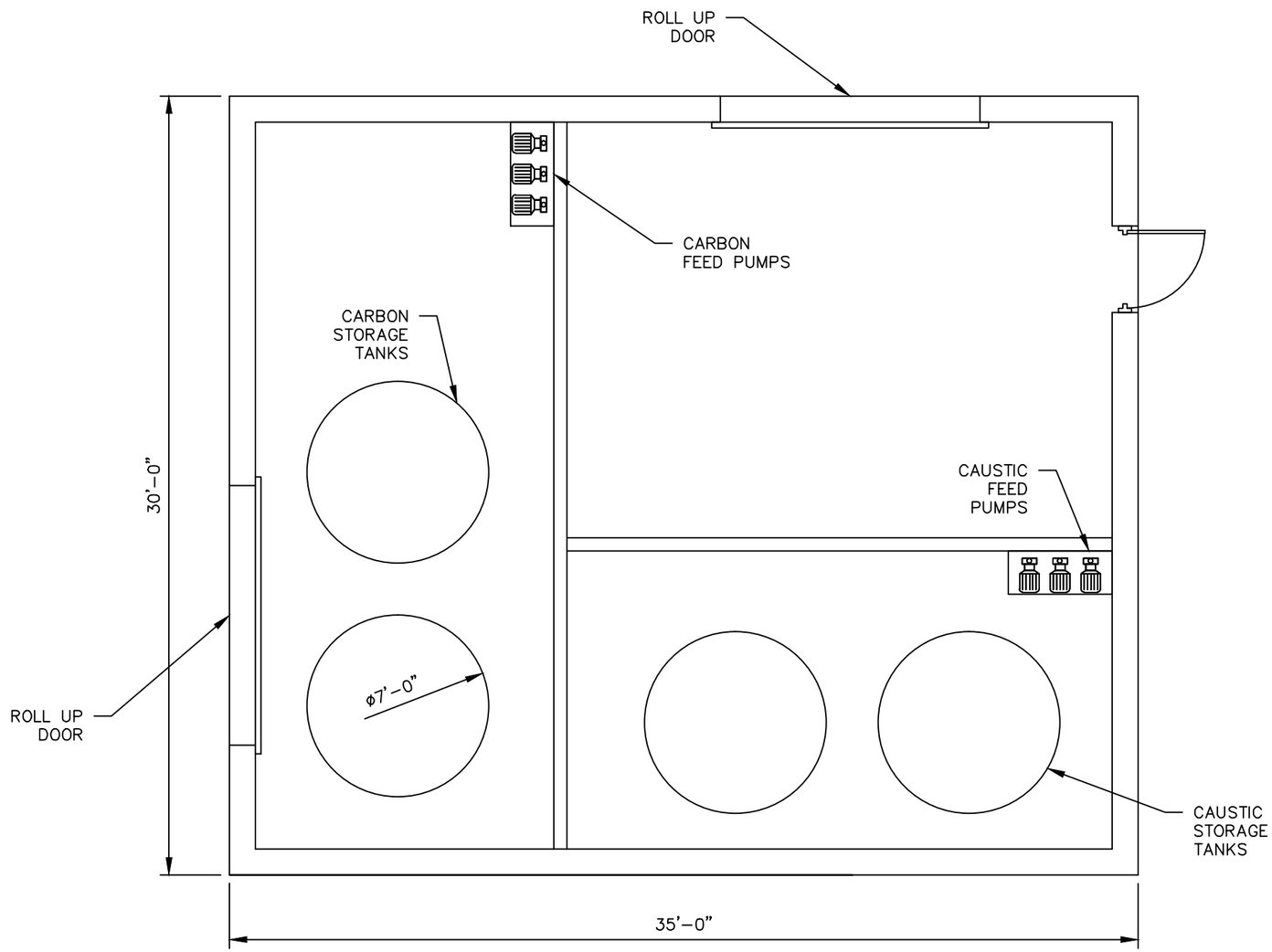
TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3B
PARTIAL REHAB OB, NEW AB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE:3/32" = 1'-0"

GT-321



ALTERNATIVE 3C
CHEMICAL BUILDING
CONCEPTUAL LAYOUT
SCALE: 3/16" = 1'-0"

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CHEMICAL BUILDING
CONCEPTUAL LAYOUT

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TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALTERNATIVE 3C
PARTIAL REHAB OB, NEW AB & GT

JOB NO: 227363
DATE: MARCH 2015
SCALE: 3/16" = 1'-0"

CB-321

22x34 SHEET
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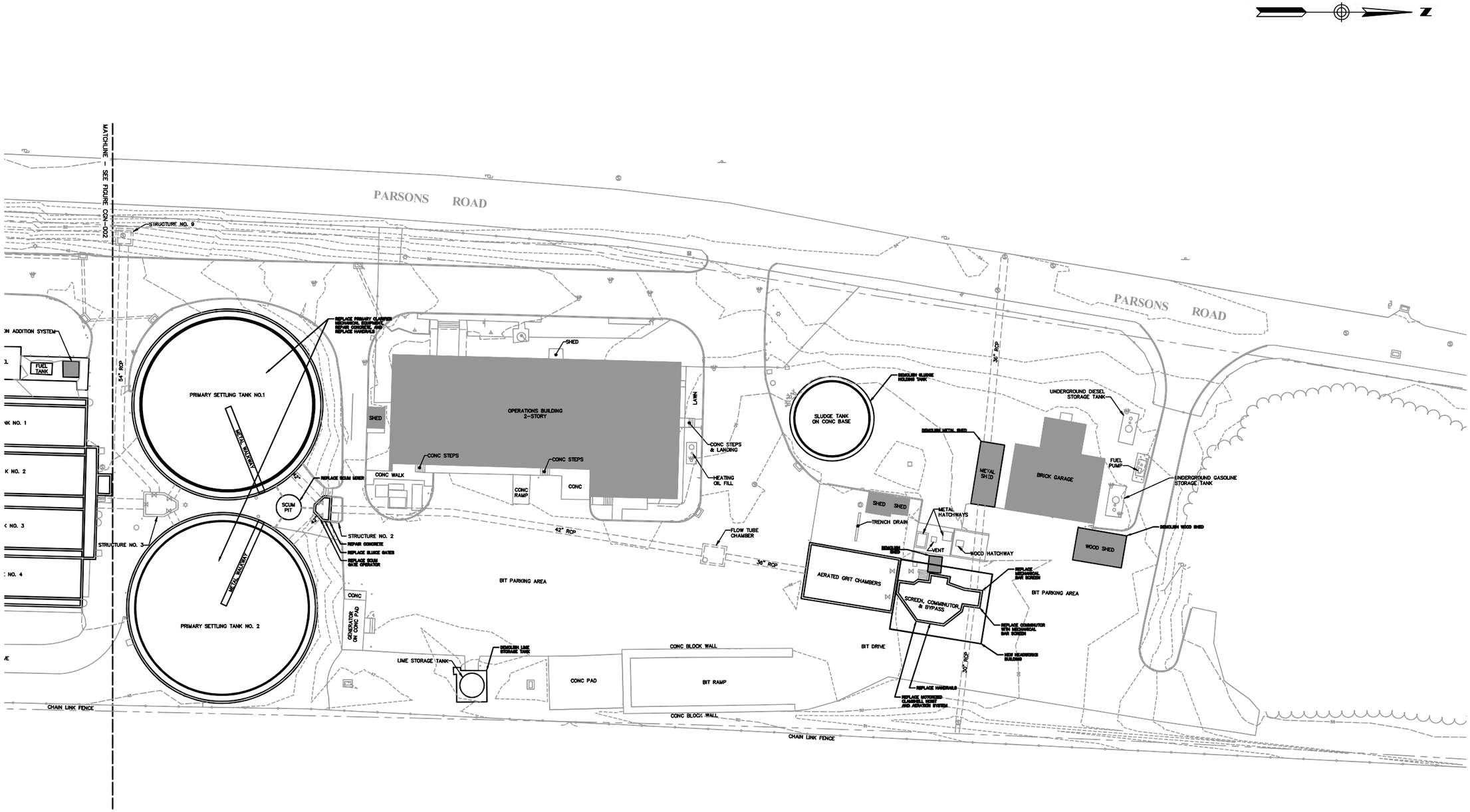

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WPCF SITE LAYOUT NORTH
COMMON ITEMS

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALL ALTERNATIVES

JOB NO.:227363
DATE:MAY 2015
SCALE:1" = 25'
SHEET: 2 OF 2

CGN-001

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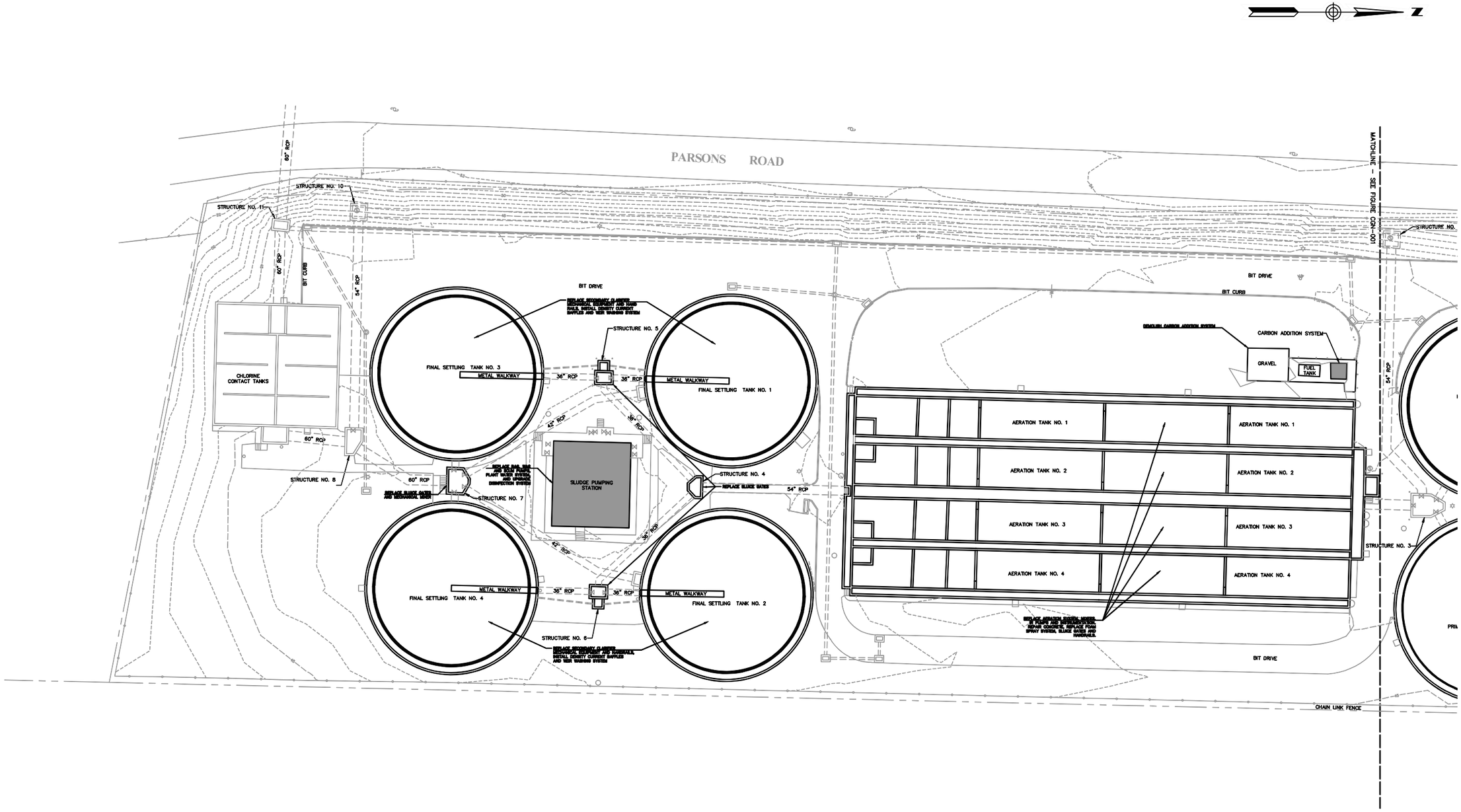

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WPCF SITE LAYOUT SOUTH
COMMON ITEMS

TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

FACILITIES PLAN
ALL ALTERNATIVES

JOB NO.: 227363
DATE: MAY 2015
SCALE: 1" = 25'
SHEET: 2 OF 2

CGN-002

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APPENDIX T: PUMP STATIONS ENERGY EVALUATION REPORT

Town of Enfield, Connecticut
Pump Station
Energy Evaluation

Prepared by:

JK Muir, LLC
21 New Britain Ave, Suite 204
Rocky Hill, CT 06067
860-249-0989

June 2015

TABLE OF CONTENTS

EXECUTIVE SUMMARY **3**

Summary of Energy Use and Proposed Measures **3**

Pump Station Energy Usage **3**

PUMP EFFICIENCY ANALYSIS **8**

PUMP STATION ANALYSIS **10**

Simon Road Pump Station **10**

South River Pump Station **13**

South Maple Pump Station **14**

Grape Brook Pump Station **20**

Pumping Optimization Program **22**

Pump Station Summary **24**

FUNDING FOR PUMP STATION ENERGY EFFICIENCY IMPROVEMENTS **25**

LIST OF TABLES

Table 1. Enfield Pump Station Energy Usage Summary – 2014 and 2015 3
Table 2. Annual Electrical Usage and Costs Summary – 2014 and 2015 4
Table 3. Projected Annual Cost and Savings Summary – Pump Stations 7
Table 4: Pump Efficiency 9
Table 5. Simon Road Pump Station Specifications 10
Table 6. Existing Run Hours 12
Table 7. Existing Operating Conditions 12
Table 8. Proposed Operating Conditions 12
Table 9. South River Pump Station Specifications 13
Table 10. Pump Specifications 14
Table 11. Existing Run Hours 15
Table 12. Base Case Operating Conditions 15
Table 13. Proposed Case Run Hours 17
Table 14. Proposed Case – Full Speed Operation 17
Table 15. Estimated Energy and Cost Savings – Pump Rebuild 17
Table 16. Estimated Cost Estimate – Pump Rebuild 18
Table 17. Simple Payback – Pump Rebuild 18
Table 18. Proposed Case - Reduced Speed Operation 18
Table 19. Calcuated Savings 19
Table 20. Project Cost Estimate 19
Table 21. Measure Savings & Payback 19
Table 22. Grape Brook Pump Station Specifications 20

Table 23. Energy Savings and Payback 24

LIST OF FIGURES

Figure 1. Simon Road Monthly Usage 4
Figure 2. South River Monthly Usage 5
Figure 3. South Maple Monthly Usage 5
Figure 4. Grape Brook Monthly Usage 6
Figure 5. Schematic and Elevations 10
Figure 6. System Curve 11
Figure 7. Pump Station Schematic 16
Figure 8. Variable Speed Analysis 16
Figure 9. Variable Speed Analysis 21
Figure 10. Grape Brook Schematic and Elevations 21
Figure 11. Energy Usage v Flowrate 22

LIST OF APPENDICES

APPENDIX A: EVERSOURCE TARIFF – RATE 30

APPENDIX B: PUMP CURVES

EXECUTIVE SUMMARY

This report provides a summary description of the facilities and energy demands for the four largest pump stations located in Enfield, Connecticut. The facility descriptions are based on site reconnaissance, staff input and available drawings. Billing data was utilized to summarize the pump station's current energy usage and costs.

The objectives of the report include the following:

- Provide a summary description of the evaluated Pump Stations;
- Summarize the energy usage and billing rates for the facilities, and demonstrate how electrical energy is being used;
- Identify specific operational and capital improvements at the facility, and estimate the energy savings and cost for each project.

The projects have been categorized as Energy Conservation Measures (ECMs), for projects that require a capital investment, and operational measures (OMs) for projects that can be done at a minimal cost. A site visit to the Pump Stations was conducted by JKMuir, LLC on March 19, 2015.

Summary of Energy Use and Proposed Measures

The energy usage summary shown below provides an overview of annual electrical (kWh), as well as costs based on billing information provided from April 2014 through March 2015. The data for this period is summarized below.

Table 1. Enfield Pump Station Energy Usage Summary – 2014 and 2015

Energy Source	Annual Energy Use (kWh)	Annual Cost	Unit Cost (per kWh)
Electrical Use	422,240	$65,795	$0.15

Pump Station Energy Usage

Currently, the Enfield Pump Stations receive electric supply through a multi-year contract with TransCanada and delivery service through Eversource. Each service is metered and billed separately by both TransCanada and Eversource. A summary of the annual electrical usage and costs for the facilities is summarized in Table 2 below, and is based on the 2014 and 2015 billing records. Please note that the unit cost per kWh is based on the utility bill value, which may have additional charges that fluctuate month to month resulting in a unit cost that is higher than the current Eversource supply rate.

Table 2. Annual Electrical Usage and Costs Summary – 2014 and 2015

Account	Rate	Average Monthly Usage (kWh)	Average Monthly Cost	Average kW Demand	Annual Energy Use (kWh)	Annual Cost	Unit Cost per kWh
Simon Road	030	4,947	$780	14	59,360	$9,363	$0.16
South River	030	7,293	$1,102	20	87,520	$13,218	$0.15
South Maple	030	9,160	$1,505	32	109,920	$18,063	$0.16
Grape Brook	030	13,787	$2,096	36	165,440	$25,151	$0.15
	Total				**422,240**	**$65,795**	

Each pump station's monthly electrical usage and demand are presented in the following figures.

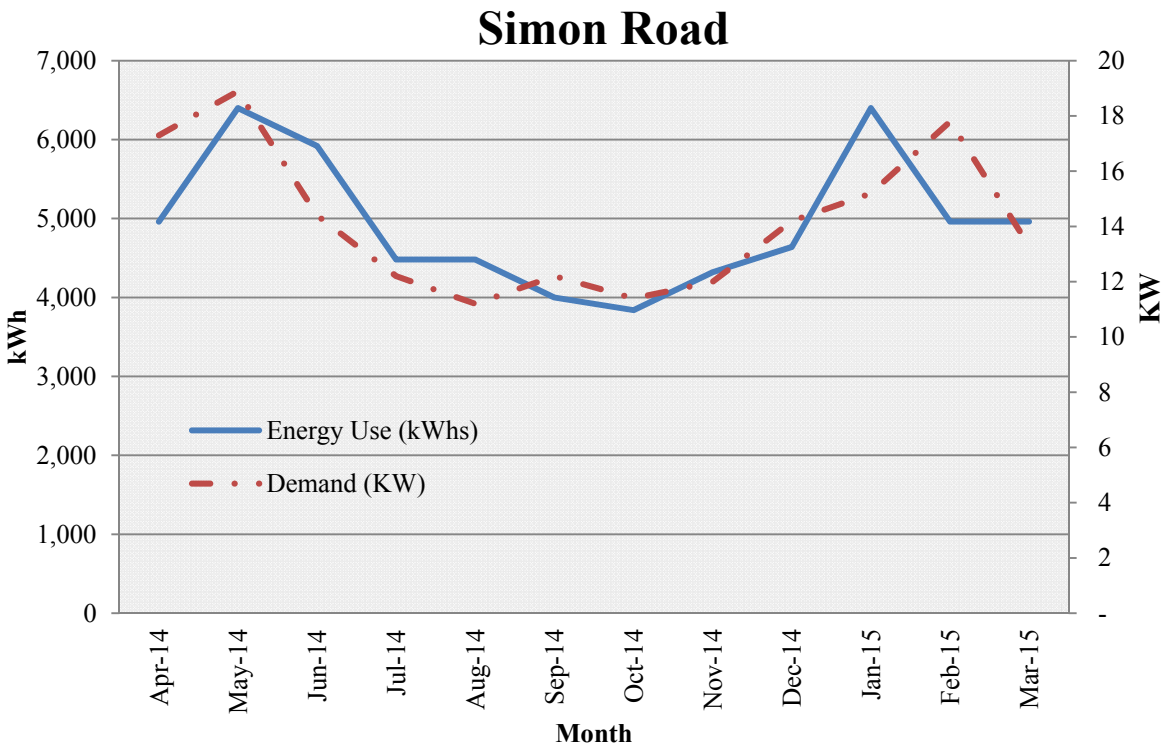


Figure 1. Simon Road Monthly Usage

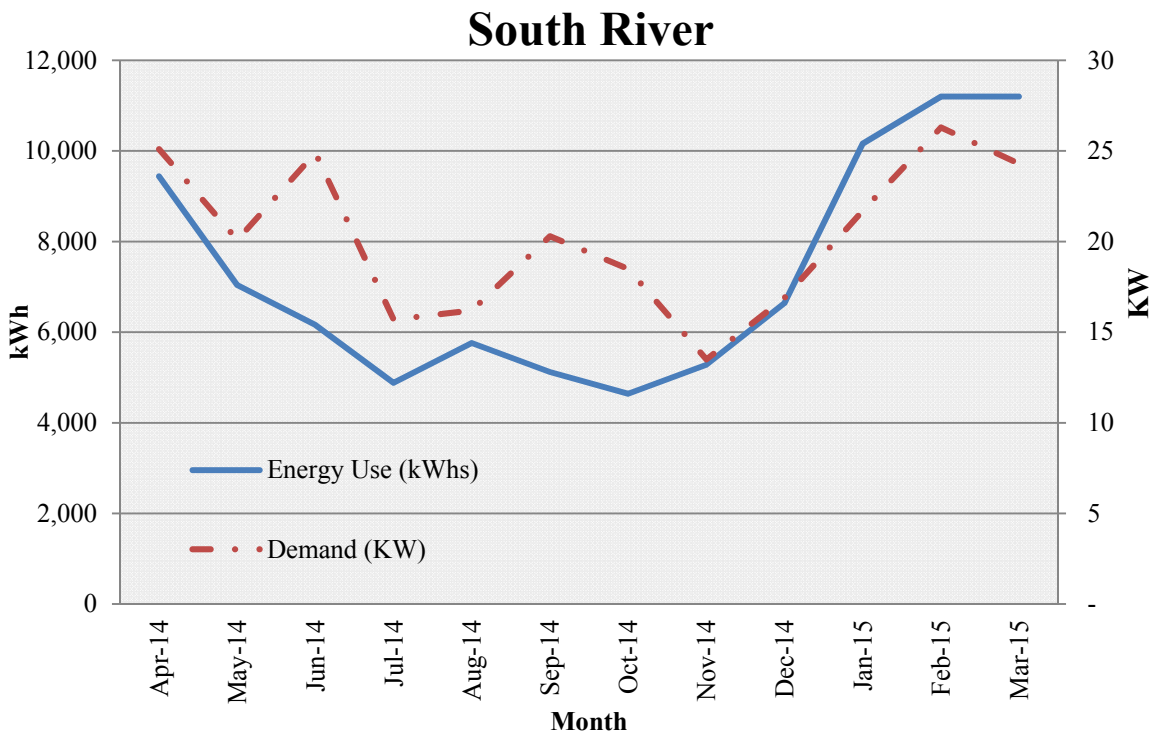


Figure 2. South River Monthly Usage

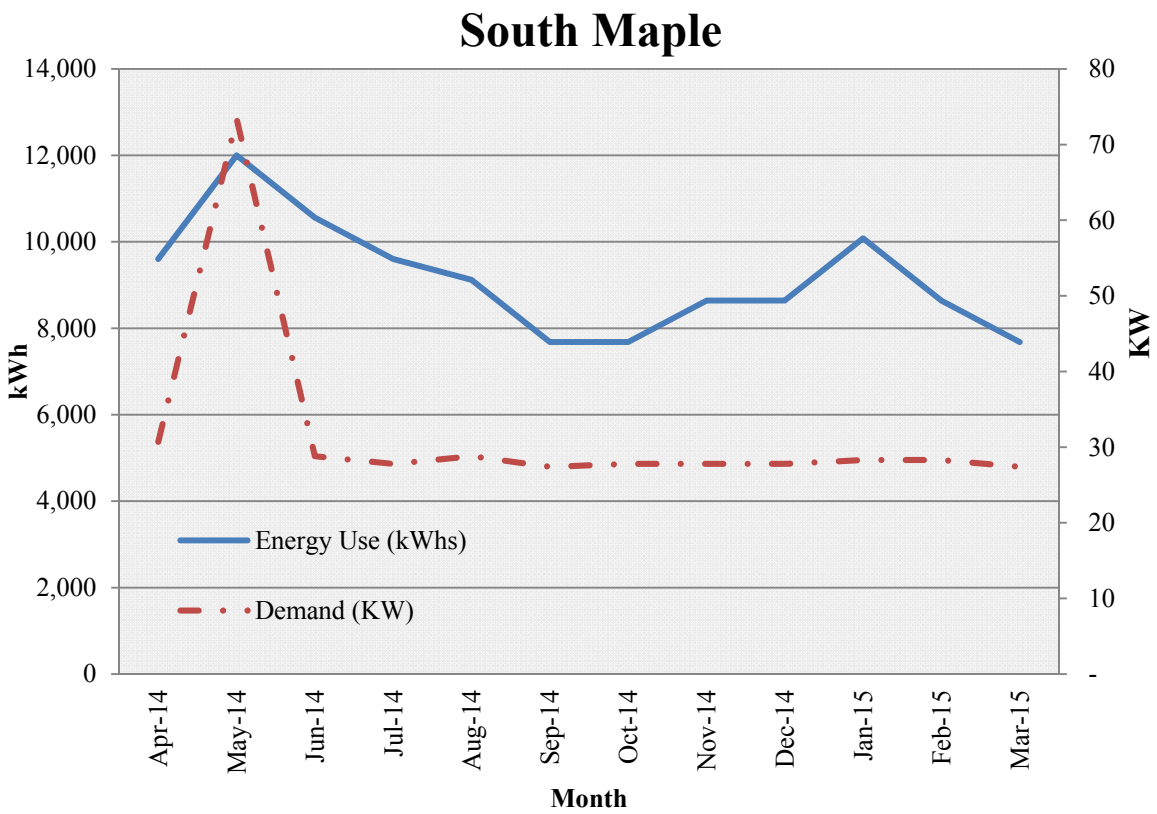


Figure 3. South Maple Monthly Usage

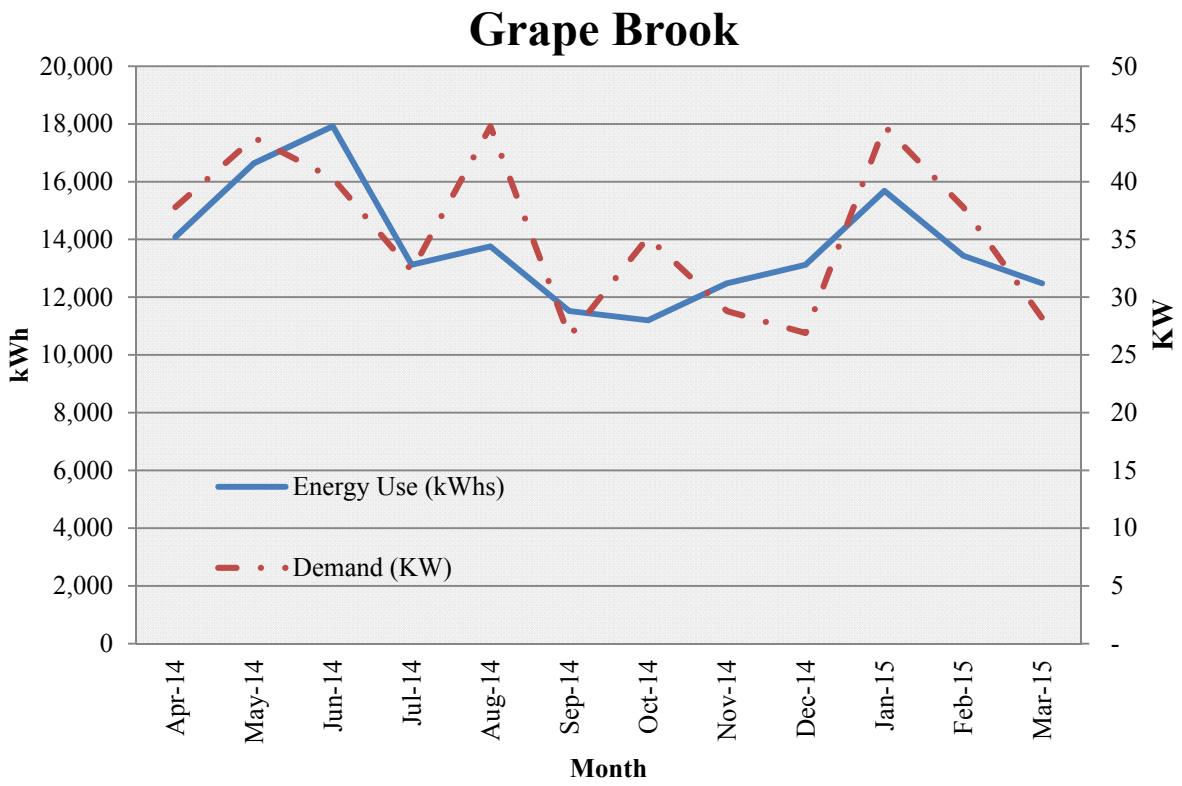


Figure 4. Grape Brook Monthly Usage

Under the TransCanada contract, generation/supply costs are based on the total kWh consumed by the station. Eversource is currently billing the four pump stations under the Small General Electric Service Rate 30. Rate 30 is for customers with a maximum annual demand less than 200 kW. There are two demand charges under this rate – distribution and transmission. The demand charge schedule is based on the greatest average 30 minute kW demand recorded during the billing month. This rate is based on a demand no less than 2 kW.

All electric customers have the option to negotiate their own rates with independent power supply companies or brokers. Customers who opt not to purchase generation power directly are automatically placed on either Eversource's Standard Service (maximum demand less than 500 kW) or Last Resort Service (maximum demand equal to or greater than 500 kW). Under this arrangement, Eversource negotiates a price for generation supply on behalf of aggregated customer blocks. The Enfield Pump Stations are currently purchasing power generation through TransCanada, a third party supplier. Under the current electrical supply contract, the facility pays a flat rate for power, and costs are not dependent on on/off peak pricing. In 2014, Enfield paid an average rate of $0.083 per kWh of electrical supply. At the end of the current contract, the facility should review electrical supply rates from other third party suppliers and Eversource. The current Eversource supply rate for Rate 30 is $0.121 per kWh. If electrical supply rates continue to decrease, the facility may wish to explore a "blend and extend" agreement with their current independent power supply company.

Table 3. Projected Annual Cost and Savings Summary – Pump Stations

Cost Saving Measures	Annual Energy Savings	First Year Annual Dollars	Initial Cost	Simple Payback (years)
South Maple – Pump Rebuild	7,858	$1,289	$15,000	11.6
South Maple – Pump Rebuild & Flow Reduction	11,692	$1,918	$15,000	7.8

NOTE: Calculations that did not demonstrate savings were not presented in the table.

PUMP EFFICIENCY ANALYSIS

During the site visit, field measurements were taken in an effort to determine the hydraulic efficiency of selected pumps. Spot readings of operating power, flow rate, and suction and discharge pressure were recorded where available for the operating pump(s) at each pump station. Where pumps were operated by variable speed devices, readings were obtained at multiple operating speeds when possible. Flow meters were not installed at two of the pump stations (South Maple and Simon Road) therefore, drawdown tests were performed to approximate the pumped flow. A refill test was also conducted to approximate the flow entering the pump station.

In order to determine existing pump hydraulic efficiency, the spot readings were applied to the pump equation, as defined below.

$$Pump\ eff.(\%) = \frac{Flow\ (GPM)\ \times\ Head\ (Feet)\ \times\ 0.746}{3{,}960\ \times\ kW\ \times Motor\ eff.\ \times Driver\ eff.}$$

Calculated pump efficiencies are provided in Table 3.

Table 4: Pump Efficiency

Pump Name	Speed	Leg	EMF	Current	Power	Power Factor	Flow	Motor Eff.	Suction	Discharge	TDH	Efficiency	Notes
	%		(VAC)	(Amp)	(kW)		(GPM)	(%)	(psi)	(psi)	(feet)		
Grape Brook PS Pump 2	82%	L1	282.3	26.9	4.7	0.62		95%	1.5	31		**79%**	
		L2	274.8	22.8	4.0	0.66		95%	1.5	31			
		L3	289.7	31.5	7.3	0.77		95%	1.5	31			
		AVG/ TOT		**27.1**	**16.1**	**0.7**	**927**	**95%**	1.5	**31**	**67.0**		
Grape Brook PS Pump 3	77%	L1	280.5	30.8	5.8	0.68		95%	1.5	32			No Efficiency calculated as flow and/or head conditions may be inaccurate.
		L2	275.0	27.3	5.2	0.70		95%	1.5	32			
		L3	288.7	21.4	4.9	0.77		95%	1.5	32			
		AVG/ TOT		**26.5**	**15.9**	**0.7**	**1065**	**95%**	1.5	**32**	**70.5**		
Simon Road PS Pump 1	100%	L1	491.1	38.7	5.7	0.27		94%	1.3	38		**67%**	
		L2	489.5	37.1	17.5	0.97		94%	1.3	38			
		L3	0.1	37.5	0.0	0.88		94%	1.3	38			
		AVG/ TOT	**490.3**	**37.8**	**23.2**	**0.7**	**918**	**94%**	1.3	**38**	**84.8**		
Simon Road PS Pump 2	100%	L1	490.5	37.9	3.1	0.16		94%	1.3	38		**72%**	
		L2	489.0	38.2	18.2	0.96		94%	1.3	38			
		L3	0.2	39.3	0.0	0.89		94%	1.3	38			
		AVG/ TOT	**489.8**	**38.5**	**21.3**	**0.7**	**901**	**94%**	1.3	**38**	**84.8**		
South Maple Pump 1	100%	L1	280.8	108.8	26.1	0.86		95%	2.4	62		**58%**	
		L2	282.1	111.0	27.3	0.90		95%	2.4	62			
		L3	281.4	107.3	25.7	0.86		95%	2.4	62			
		AVG/ TOT		**109.0**	**79.1**	**0.9**	**1623**	**95%**	**2.4**	**62**	**137.7**		
South Maple Pump 2	100%	L1	281.0	130.2	33.1	0.89		95%	2.4	64		**65%**	pump replaced in 2014.
		L2	280.7	126.4	31.2	0.87		95%	2.4	64			
		L3	281.8	128.6	31.9	0.89		95%	2.4	64			
		AVG/ TOT		**128.4**	**96.2**	**0.9**	**2151**	**95%**	**2.4**	**64**	**142.3**		
South River St Pump 1	73%	L1	242.7	25.4	3.99	0.65		92%	1.0	17		**85%**	
		L2	241.8	20.1	2.2	0.49		92%	1.0	17			
		L3	0.3	22.7	1.8	0.36		92%	1.0	17			
		AVG/ TOT	**242.3**	**22.7**	**8.0**	**0.5**	**894**	**92%**	1.0	**17**	**35.8**		

Conducting periodic equipment efficiency testing is an effective way of determining pump performance and can act as a helpful tool for determining if regular operation and maintenance measures are successful and time-worthy. Further, the data collected for pump efficiency testing can offer valuable insight regarding a facility's energy consumption and demand, as detailed in the Energy Conservation Measures.

PUMP STATION ANALYSIS

Simon Road Pump Station

Description

The Simon Pump Station was originally constructed in the 1970's, when more development was anticipated in the area. The station contains two VFD driven 40 hp centrifugal pumps with extended shaft motors. The pumps are located in the lowest level of the station, the motors are located on the level above this and the control panels for the pumps are on the level above this, which is the ground level. The pumps rotate operation every 24 hours to maintain equal operating hours. The pumps are automatically started based on wet well level and typically operate intermittently throughout the day. The VFD control is currently used to slowly ramp the speed to 100%; the speed of the pumps are not varied based on level. The station also contains two air compressors for previous controls system, service water and seal water system that are no longer in use. The air compressors are still used to control the exhaust fan in the station.

Table 5. Simon Road Pump Station Specifications

Parameter	Value
Pump #1 &2	
HP	40 hp
Control	VFD
Pump Manufacturer	Aurora Pump
Serial Number	79-697-1
TDH	77 feet
Flow	800 gpm

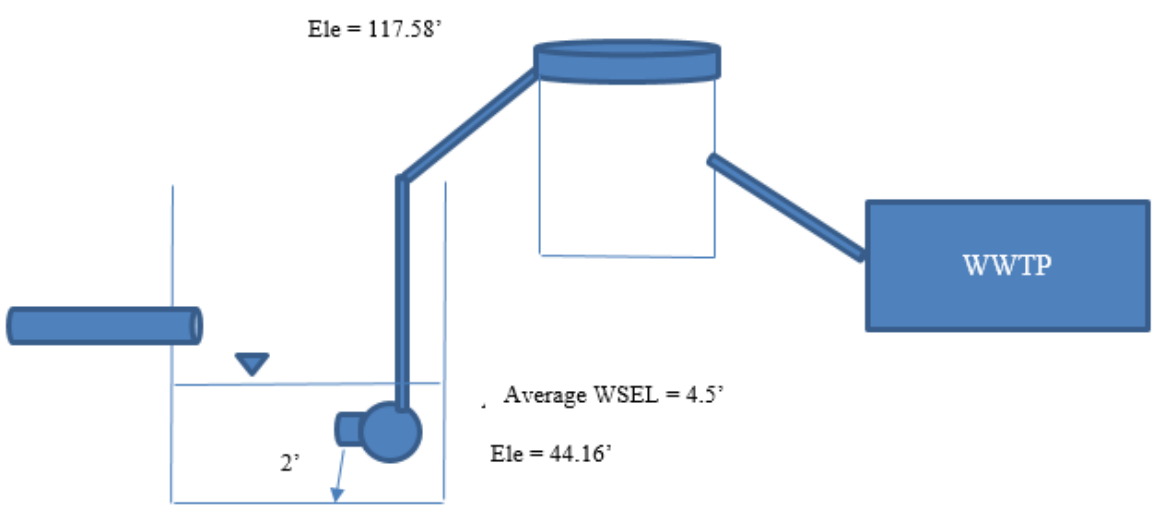


Figure 5. Schematic and Elevations

Drawdown tests were performed to determine the flow of each pump. The flows for each pump were calculated to be approximately 900 gpm. The TDH was also calculated to be approximately

85 feet using suction and discharge pressures of the pumps, using a portable, digital pressure gauge. The design point of these pumps is 800 gpm at a TDH of 77 feet, which is lower than the measured points. This may be a result of some inaccuracies inherent to estimating flow using drawdown tests. The flows were recorded at low wetwell levels therefore the calculated flow may be higher than actual conditions due to the sloped floor of the wetwell (reduced volumes at low wet well levels).

This station has VFDs installed on both pumps which function as soft starts. Because the pumps are currently operated on VFDs, varying flow rate and speed utilizing based on wet well level was considered as a potential energy conservation measure. Operating at a reduced speed, decreases the TDH and the kW draw of the pumps. However, reduced speeds also lower the hydraulic efficiency of the pump, and increase the operating hours. The evaluation of pump operation at reduced speed is presented below.

A pump curve was not available for this station therefore the proposed operating conditions were based on the system curve, developed using the measured operating points of the pumps, and the static head condition, as depicted in the figure above.

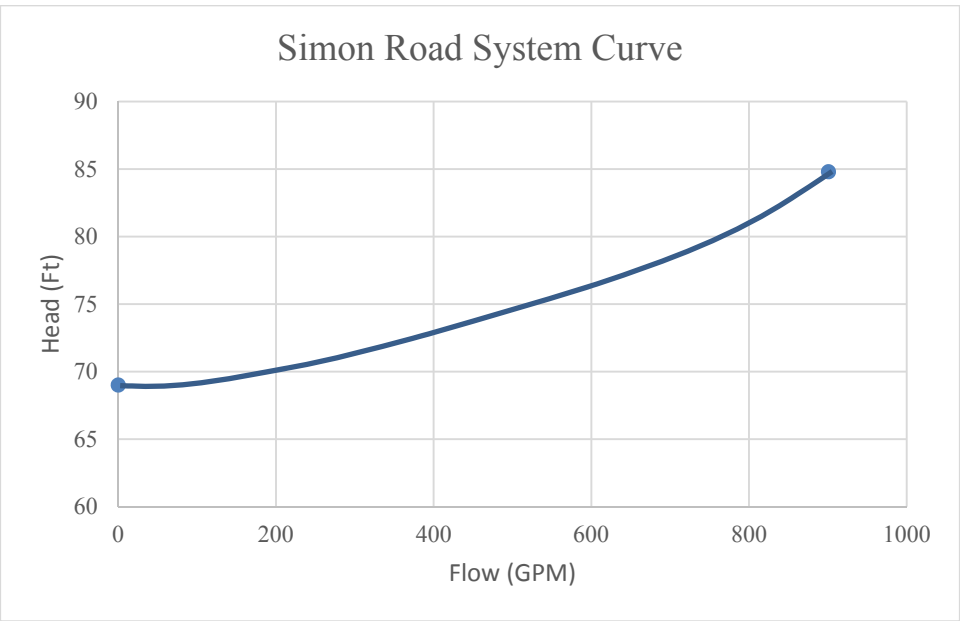


Figure 6. System Curve

Calculations

Based on spot readings conducted during the field visit each pump draws approximately 23 kW. Drawdown tests were used to calculate the total flowrate for each pump. Run times for each pump are not recorded at this station, therefore, the operating hours of the pumps were approximated based on the electrical data provided by the utility. It was assumed that 10% of the kWh usage at the station can be attributed to lighting and controls and the remaining 90% results from pumping operation (No electric heat is used at this facility.).

Table 6. Existing Run Hours

Existing Run Hours				
kWh From Billing Data	**10% For ancillary Equipment**	**Pumping kWh**	**Average Measured kW**	**Hours**
59,360.00	5,936	53,424	22.2	2,403

Notes:
Hours represent the total operating hours between two pumps.

Table 7. Existing Operating Conditions

Total Run Hours	Average Measured kW[1]	TDH[2]	Cost/ kWh	Annual kWh	Annual Cost
2,403	22.2	85	$ 0.16	53,424	$ 8,441

Notes:
1) kW measured in the field.
2) TDH measured in the field

Using the design point and existing conditions a system curve was developed to determine a reasonable proposed average operating point, under variable speed control. A flow of 600 gpm and a TDH of 75 feet was assumed to be the approximate operating point. Because the original pump curve was not available a pump efficiency of 60% was assumed for this measure.

Table 8. Proposed Operating Conditions

Total Run Hours[1]	kW[2]	Pump Efficiency[3]	Motor Efficiency	Flow (gpm)[4]	TDH (ft)[5]	Annual kWh	Annual Cost
3643	15.7	60%	94%	600	79	54,255	$ 9,030

Notes:
1) Run hours calculated using proposed flowrate.
2) kW calculated.
3) Pump efficiency based on assumed value.
4) Flow estimated using system curve.
5) THD estimated using system curve.

Due to the increased operating hours of the pumps along with the decreased pump efficiency operating the pumps at reduced speeds does not appear to provide savings.

South River Pump Station

Description

The South River Pump Station contains three VFD driven pumps with two larger 60 hp centrifugal pumps and one, smaller 25 hp pump. Typically, the smaller 25 hp pump is operated continuously while the larger pumps are called to operate during wet weather/high flow events. Due to potential flooding issues in the area, the wet well alarm level is shallow maintaining a constant and shallow level. When the large pumps are called utilized, typically only one pump is required.

Table 9. South River Pump Station Specifications

Parameter	Value
Pump #1*	
HP	25 hp
Control	VFD
Nominal Motor Efficiency	91.7 %
Pump Manufacturer	Chesterton
Pump Design	700 GPM @ 60ft of TDH
Pump Motor	Baldor Electric, 1175 RPM
Pump #2 & 3	
HP	60 hp
Control	VFD
Nominal Motor Efficiency	92.1 %
Pump Manufacturer	Fairbanks Morris
Identification Number	K3W1-071013-0

*Pump #1 did not have a pump nameplate

Based on the pump efficiency testing performed at the station, the pumps appear to be operating relatively efficiently, and there is not a need to rebuild or replace the pumps at this time. Under the current operation the pump speed is varied based on the wet well level, and the VFD operation is likely providing energy savings. In addition, the jockey pump allows for minimal operation of the larger hp pumps, which reduced demand and energy usage at this facility. The pump curves for this station were not available so the field data and typical flow and head conditions could not be compared to original design or efficiency.

South Maple Pump Station

Description

The South Maple Pump Station was originally installed in the early 1970's, when more development was anticipated in the area. The station consists of two VFD driven 125 hp centrifugal pumps. The pumps have Parco valves on the discharge side to hydraulically control the discharge pressure to prevent water hammer in addition to VFD control to slowly increase speed of the pumps. Under typical flow conditions, the pumps operate intermittently throughout the day based on wet well level, and lead pump operation is cycled every 24 hours. The pump and motor on Pump #2 were recently replaced in 2014, the replacement pump has experienced issues with ragging. In order to reduce the maintenance associated with pump ragging the Town is planning to install a channel grinder at the station.

Table 10. Pump Specifications

Parameter	Value
Pump #1	
HP	125 hp
Control	VFD
Pump Manufacturer	Aurora 75-76-2
TDH	156 feet
Flow	1,550 gpm
Pump Motor	Marathon Electric, 1775 RPM
Pump #2	
HP	125 hp
Control	VFD
Pump Manufacturer	Cornell Pumps
Serial Number	193791 1400 TB10567
Pump Motor	Marathon Electric, 1775 RPM

Calculations

Based on tests conducted during the field visit, the average energy draw of the pumps is 87kW. Drawdown tests were used to calculate the total flowrate for each pump. Run times for each pump are not recorded at this station, therefore, the operating hours of the pumps were approximated based on the electrical data provided by the utility. It was assumed that 10% of the kWh usage at the station can be attributed to lighting and controls and the remaining 90% is associated with pump operation.

Table 11. Existing Run Hours

Existing Run Hours				
kWh From Billing Data	**10% For ancillary Equipment**	**Pumping kWh**	**Average Measured kW**	**Total Hours**
109,920	10,992	98,928	87.7	1,129

Notes:
1) Hours based on billing data and represents the operating hours for both pumps.
Run times not recorded at facility.
2) kW based on field readings.

Based on the field testing Pump #2 (recently replaced) is operating relatively efficiently, as compared to the original design conditions (based on pump curve). However, Pump #1 is operating below its design efficiency, and could be considered for rebuild or replacement to improve the operating efficiency and reduce electrical costs at this facility.

Table 12. Base Case Operating Conditions

Condition	Run Hours per Pump	HP	Cost/ kWh	Annual kWh	kW	Average TDH	Annual Cost (pumping)
Existing	564	125	$ 0.16	49,464	79.1	140	$ 8,112

Notes:
Hours and cost based on only one pump (Pump #1).

Two options were considered for this station, rebuild the older pump and continue to operate it at full speed or rebuild the older pump and reduce the flow by utilizing the existing VFDs. Rebuilding the pump would allow the operating efficiency to be restored to like new conditions which would reduce the kW draw of the pump. Reducing the flow rate with the existing VFDs was also considered as reducing flow and head can further lower the energy demand of the pumping system. This would also increase the operating hours of the pumps. A variable speed analysis was performed to determine the approximate speed of the pumps under VFD operation.

In order to determine the system curve for this pump station the wet well and force main discharge elevations were evaluated to determine the static head of the system, and plotted along with the measured pressure at the station.

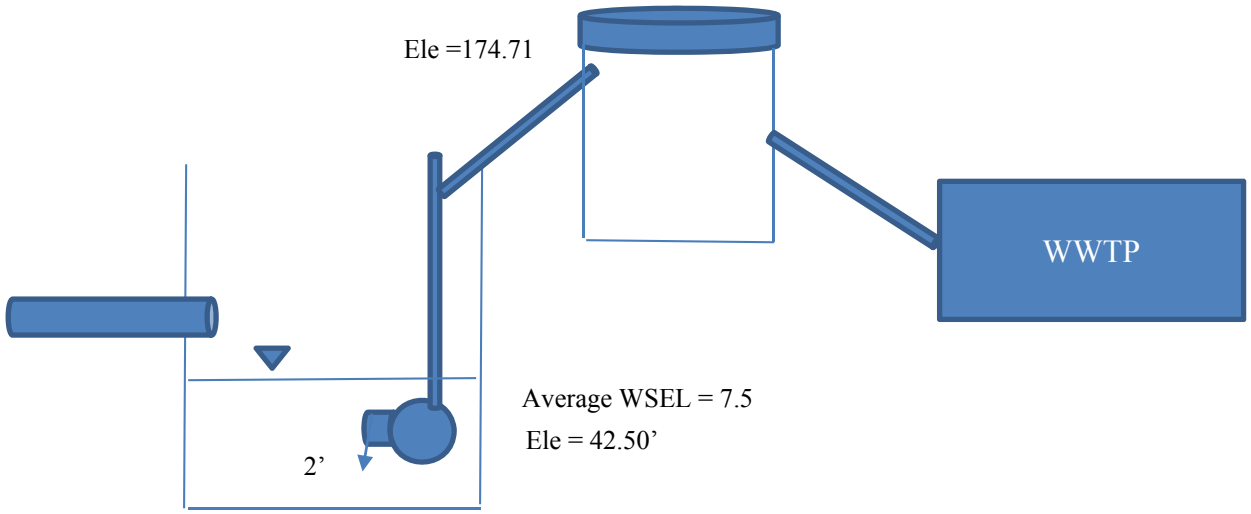


Figure 7. Pump Station Schematic

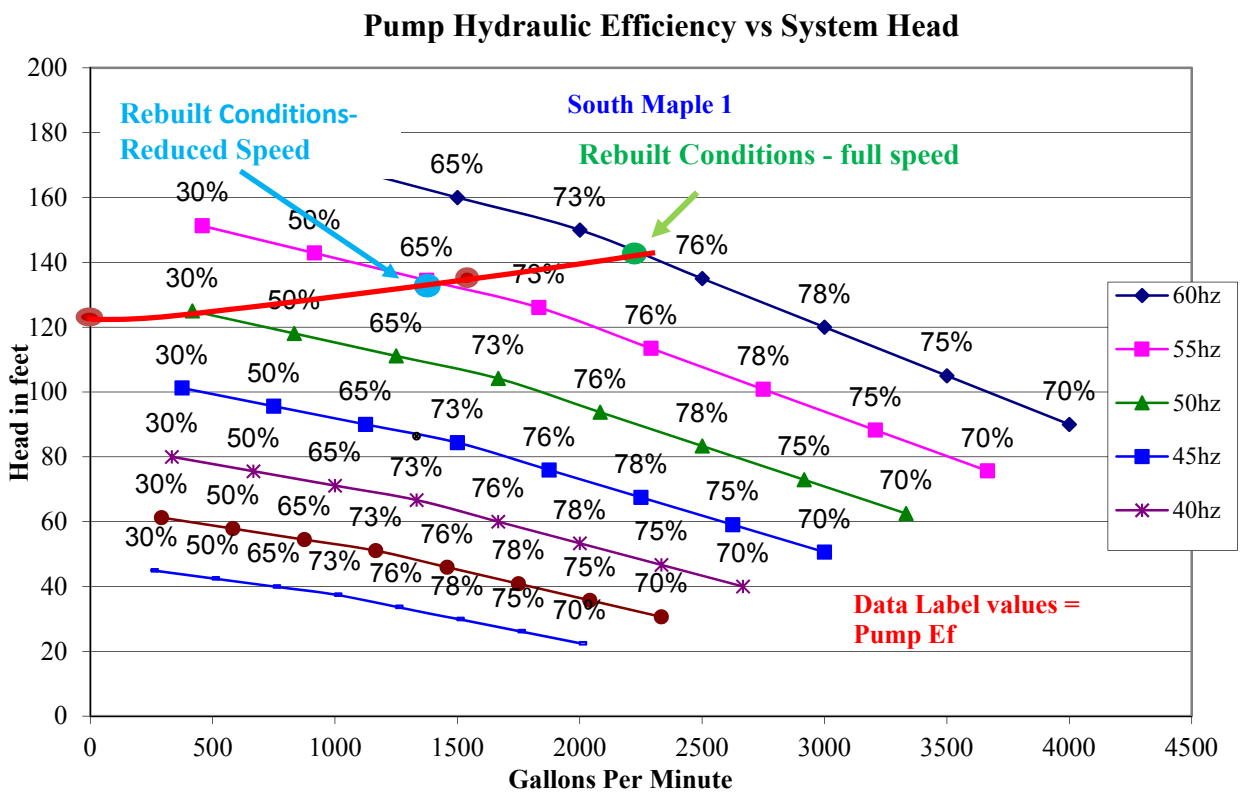


Figure 8. Variable Speed Analysis

Under rebuilt conditions at full speed, this pump could operate at a flow rate of 2,100 gpm and a total dynamic head (TDH) of 142 feet. Under these conditions the operating efficiency could be restored to approximately 74%.

The run hours for this station under rebuilt conditions were based on the total kWh billed in 2014 and a new flowrate of 2,100 gpm and a TDH of 142 feet under the rebuilt conditions.

Table 13. Proposed Case Run Hours

Run Hours				
Average Flow from two pumps at station (gpm)	**gph**	**gallons pumped based on base case hours**	**gpm with rebuilt flow rate**	**Proposed Run Hours**
1,887	113,239	127,809,107	60,861	507

Notes:

1) Rebuilt flow assumed to be approximately 2,100 gpm based on pump and system curves

Table 14. Proposed Case – Full Speed Operation

Condition	Run Hours	kW	Pump Efficiency	Motor Efficiency	VFD Efficiency	Flow (gpm)	TDH (ft)	Annual kWh	Annual Cost
Proposed-Full Speed	507	82	74%	95%	97%	2,100	142	41,606	$ 6,823

Notes:

1) Head based on system curve (measured pressure)
2) Pump efficiency based on rebuilt conditions.
3) Motor Efficiency and VFD efficiency based on assumed value.
4) kW calculated using the pump efficiency equation
5) Annual cost based on $0.16/kWh

Savings

The estimated energy and cost savings associated with this measure are presented in the following table.

Table 15. Estimated Energy and Cost Savings – Pump Rebuild

Condition	kWh/year	Cost/year
Existing	49,464	$ 8,112
Proposed – Full Speed Operation	41,606	$ 6,823
Savings	**7,858**	**$ 1,289**

Note: Cost is based on $0.16/kWh

Budgetary Cost Estimate

Table 16. Estimated Cost Estimate – Pump Rebuild

125 hp Rebuild	$ 10,000
Labor and Installation	$ 1,500
Subtotal	$ 11,500
30% Contingency	$ 3,400
Total	**$ 15,000**

Simple Payback

Table 17. Simple Payback – Pump Rebuild

Cost Savings	$ 1,289
Project Cost	$ 15,000
Simple Payback	**11.6**

Reduce Flowrate

Utilizing the VFD to varying the speed and flowrate of the pump based on wet well level may provide an opportunity for energy and cost savings. To approximate the savings associated with varying the speed of the pumps, an average operating conditions is estimated to evaluate the order of magnitude of the potential savings. An average annual flow condition of approximately 1,623 gpm and a TDH of 130 ft is assumed for this calculation (measured operating point). The efficiency of the rebuilt pump at this proposed operating point is estimated to be approximately 65% based on the original pump curve and variable speed analysis.

Calculations

Table 18. Proposed Case - Reduced Speed Operation

Condition	Run Hours	kW	Pump Efficiency	TDH	Motor Efficiency	Flow (gpm)	Annual kWh	Annual Cost
Proposed	564	66.9	68%	138	95%	1,623	37,772	$ 6,195

Notes:

1) Head based system curve
2) Pump efficiency based on rebuilt conditions.
3) Motor Efficiency and VFD efficiency based on assumed value.
4) kW calculated using the pump efficiency equation
5) Annual cost based on $0.16/kWh

Savings
The estimated energy and cost savings associated with rebuilding the pumps and varying the pump speed are presented in the following table.

Table 19. Calcuated Savings

Condition	kWh/year	Cost/year
Existing	49,464	$ 8,112
Proposed	37,772	$ 6,195
Savings	**11,692**	**$ 1,918**

Budgetary Cost Estimate

Table 20. Project Cost Estimate

125 hp Rebuild	$ 10,000
Labor and Installation	$ 1,500
Subtotal	$ 11,500
30% contingency	$ 3,450
Total	**$ 15,000**

Simple Payback

Table 21. Measure Savings & Payback

Cost Savings	$ 1,918
Project Cost	$ 15,000
Simple Payback	**7.8**

This payback is calculated prior to any available incentives or finance programs, which would reduce the project costs and payback period.

Grape Brook Pump Station

Description

The Grape Brook pump station was originally constructed in the 1960's and contains two smaller 60 hp VFD driven pumps and one larger constant speed 100 hp pump. Typical operation is for one 60 hp pump to continuously operate and automatically rotate the lead pump every 24 hours. The 100 hp pump is exercised on a daily basis for a short period of time and is only placed into operation during wet weather events. The large pump is also used if there is a power outage at the facility, as the smaller pumps will not automatically restart following an outage. The larger pump is original to the pump station and the smaller pumps were installed in 2004. The facility operates by maintaining a constant wet well level of approximately 5.5 feet by adjusting the speed of the small pump.

Table 22. Grape Brook Pump Station Specifications

Parameter	Value
Pump #1	
HP	100 hp
Control	Constant Speed
Pump Manufacturer	Morris Pump
Serial Number	M-5445
TDH	94 feet
Flow	2,200 gpm
Pump #2 & 3	
HP	60 hp
Control	VFD
Nominal Efficiency	94.5 %
Pump Manufacturer	Cornell 6NHTA-VC180B Vertical Centrifugal
Serial Number	135286 12 06 TB06048-F1Y
Design Point	1,800 @ 85 ft TD
Pump Motor	Reliance Electric 50 HP,1775 RPM

A variable speed analysis of the pumps is presented in Figure 9, showing the estimated system curve, based on the operating point and the static head condition.

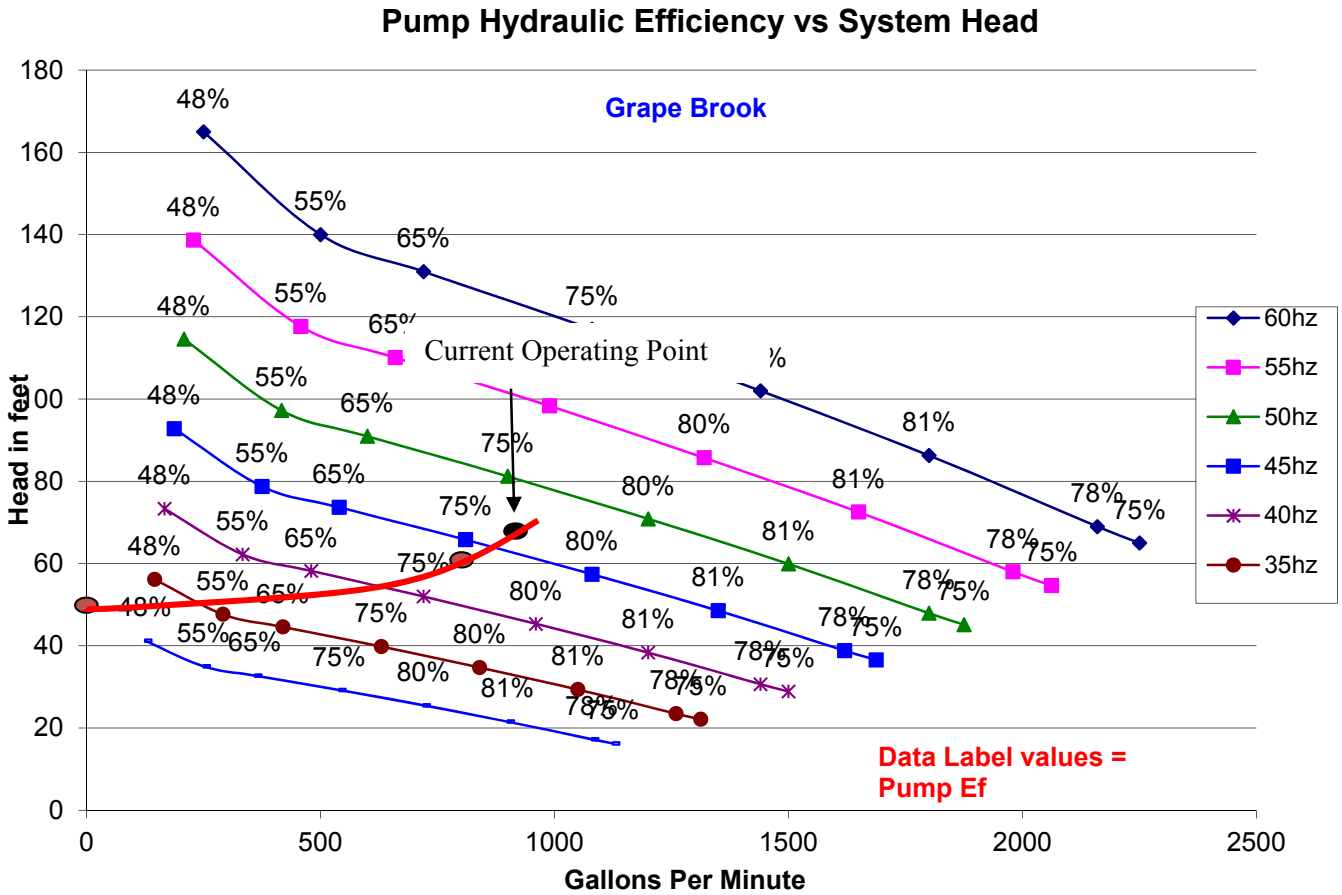


Figure 9. Variable Speed Analysis

During the site visit, the pumps were measured at approximately 80% speed. This point is represented on the variable speed curve and it suggests that both pumps are operating close to the original efficiency point. These pumps do not seem to be candidates for pump rebuilds at this time.

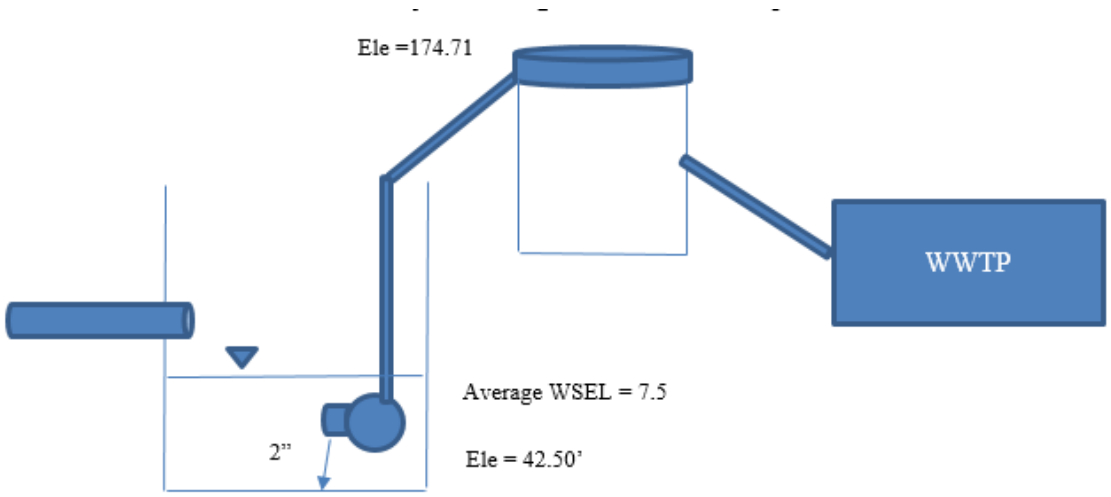


Figure 10. Grape Brook Schematic and Elevations

In order to determine the potential cost savings associated with reducing the flow and speed of the pump, the energy usage at various flow rates was determined using the system curve and pump curve. As shown in the figure below, the energy usage required to pump 1 million gallons decreases as flow and head are reduced at lower pump speeds. However, based on the variable speed analysis the pump curve and the pump efficiency also decreases as speed is reduced. The lower pump efficiencies reduce the savings associated with VFD operation. Around 700 GPM, the energy usage per million gallons begins to increase rather than decrease. From an energy perspective, the most efficient flow rate is approximately 700 gpm.

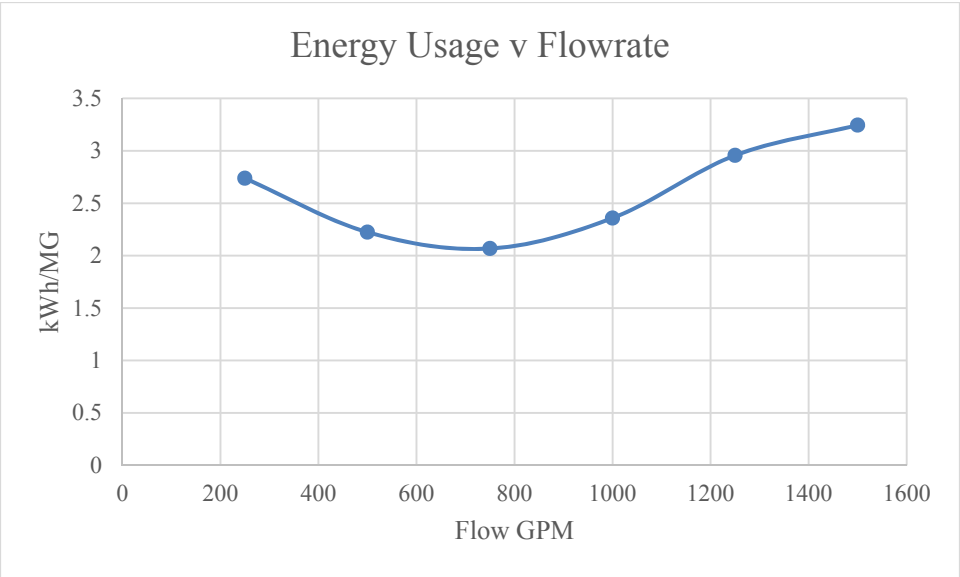


Figure 11. Energy Usage v Flowrate

Pumping Optimization Program

Pumping often represents a significant energy usage for most wastewater pump stations. The selection, sizing, maintenance, and operational control of these pumping systems determines the energy required at each pump station. As part of ongoing tracking of the facilities, the energy usage per million gallons pumped can be monitored. Where flows are not available pump run time can provide an indication of flows, as well as pump maintenance issues. High runs times, occurring outside wet weather months can be an indicator of ragging, pump wear, or other maintenance issues. The hydraulic efficiency of the pumps is critical to minimizing energy usage. The critical factors impacting pump efficiency are the pump selection (is the pump appropriately sized for the typical flow demand and operating point), and maintenance and wear (worn mechanical components can significantly reduce performance). In addition, pumping systems with variable speed operation can be adjusted to maintain pump operation at the most effective pump efficiency ranges, and to avoid unnecessary wear due to improper operating conditions (vibration and cavitation).

Pump efficiency testing and regular pump evaluations allow for on-going monitoring of pump performance and energy usage. By checking the suction and discharge pressures, pump flow rates, and power draw, the unit's efficiency can be determined and compared to the original design

parameters. The monitoring of a pump's efficiency on a regular basis is important, as a decrease in efficiency results in increased operating costs due to longer pump run times. By assessing the loss of pump efficiency and increased operating costs, staff can determine when a pump should be repaired or replaced.

Implementation of a Pump Efficiency Program can be incorporated into the existing operations of the facility without significant capital investment. This would include regular drawdown tests, weekly or monthly recording of pump run time, and monthly reconciliation of pump run time and/or flow to electrical bills. As part of this long term program the installation of flow meters at the pump stations, and/or purchase of a portable meter, may assist in the monitoring of pump performance.

In addition to considering the operating efficiency of each pump, and the continued assessment of the pumps as they age and wear, the demand at each pump station should be closely monitored. All of the pump stations are currently billed under Rate 30, which includes a demand charge of approximately $17 per kW (a 40% increase over 2014 rates). The demand is calculated on a monthly basis as the highest average 30 minute kW demand during the billed month. Due to the high cost per kW, it can be worthwhile to monitor demand at the stations. While pump operation is dictated by incoming flows, any operational adjustments to reduce multiple pump operation, or exercising pumps infrequently operated pumps for brief periods or while other pumps are not running, can provide demand savings.

Under the current Eversource incentive structure, pump rebuilds can obtain grant funding based on the projected savings associated with returning the pumps to "like-new" operating condition and efficiency. Any pump rebuild projects should be submitted for funding under these programs.

Coating of interior wear parts of pumps, as part of pump rebuilds, may also provide for improved pump efficiency. Recent studies and trials of pump coatings have suggested that the wear resistant material may also prolong the life of the pump, and extend the time between rebuilds, with the pumps maintaining a higher efficiency between repairs. Incorporating coatings into shop rebuilds of pumps can be implemented as part of the Energy Management Program. Eversource is currently funding trials of pump coatings and is considering offering grant funding for the application of pump coatings as part of efficiency incentive programs.

Pump Station Summary

The following table presents the calculated energy savings and payback for South Maple Pump Station. As presented in the preceding sections, there are no significant energy savings associated with changing the operation of the pumps at the South River or Grape Brook pump stations. In addition, the pump efficiencies measured from field readings determined that these pumps are operating at relatively good pump efficiencies. However, as the pump efficiency may change based on wear on the pump over time, it is recommended that the pumps at these other stations are monitored for efficiency.

Table 23. Energy Savings and Payback

Cost Saving Measures	Annual Energy Savings	First Year Annual Dollars	Initial Cost	Simple Payback (years)
South Maple – Pump Rebuild	7,858	$1,289	$15,000	11.6
South Maple – Pump Rebuild & Flow Reduction	11,692	$1,918	$15,000	7.8

NOTE: Calculations that did not demonstrate savings were not presented in the table.

FUNDING FOR PUMP STATION ENERGY EFFICIENCY IMPROVEMENTS

Eversource: The incentive programs offered by Eversource (Energize CT programs) can provide funding for any portions of pump station upgrades that can be shown to provide energy savings (i.e. VFDs, jockey pumps, updated controls, etc). Pump rebuilds are also eligible through these programs if the efficiency of the pump will be improved or returned to original design conditions. Any planned upgrades to the pump stations should be considered for this program.

CT DEEP – "Green Infrastructure Reserve": Treatment plant, pump station, and/or collection system improvement projects that incorporate cost-effective renewable energy components are eligible through this program (20% grant/80% loan). The CT DEEP has indicate that "green" and "renewable" could include energy efficiency projects, in addition to on-site renewable energy projects. This could be used for specific energy efficiency improvements at the wastewater pump stations, or capital improvement projects that will provide energy savings. (Pump rebuilds are not eligible for funding through the DEEP programs as they are considered maintenance projects by DEEP.)

CT DEEP – "Pump Station Rehabilitation Project Reserve": This program provides funding for the rehabilitation of pump stations and can be used for replacing aging infrastructure, reducing hydraulic overloading, incorporating energy efficient equipment and providing emergency power. (20% Grant/80% Loan) Because this is more open ended (not energy specific) this fund could be used for almost any upgrades to pump stations. Any upgrades or equipment replacement projects at the pump stations could utilize this reserve funding, including efficiency projects. This reserve fund may be eliminated when the next priority list is released.

APPENDIX A

Rate 30 Tariff

AVAILABLE for the entire electrical requirements at a single service location measured through one metering installation where the customer's maximum demand is less than 200 kW. Customers with maximum demands that are equal to or greater than 200 kW, but are less than 350 kW, must take service under Rate 27 or Rate 37, and are not eligible to return to Rate 30 or Rate 35 if their maximum demands drop below 200 kW, per DPUC decision in Docket No. 05-10-03. Where the Company deems it impractical to deliver electricity through one service, or where more than one meter has been installed for billing under a withdrawn rate, then the measurement of electricity may be by two or more meters.

Notwithstanding the applicability provisions of other rates, this rate is also available to full-requirements customers that (i) prior to March 1, 1992, had a maximum monthly 30-minute demand in excess of 350 kW; (ii) had a maximum monthly 30-minute demand in the twelve billing periods prior to March 1, 1992, that equaled or exceeded twice the average of the customer's maximum monthly 30-minute demands during the same billing periods; (iii) as of March 1, 1992, had established, and had a reasonable expectation of continuing, a seasonal pattern of electrical usage approximating that established during the twelve billing periods prior to March 1, 1992; and (iv) had not discontinued taking service under this rate or Rate 27 after March 1, 1992. The term of contract for customers eligible to take service under this paragraph shall be one year and shall continue thereafter until canceled by one month's written notice by the customer.

MONTHLY RATE:

DISTRIBUTION SERVICE RATE:

CUSTOMER CHARGE	$44.25
DEMAND CHARGE OVER 2 kW	$12.17 per kW
CHARGE PER kWh	
FIRST 300 kWh PER kW OF DEMAND	$0.00000
ALL OVER 300 kWh PER kW OF DEMAND	$0.00000

TRANSMISSION SERVICE RATE:

DEMAND CHARGE OVER 2 kW	$5.80 per kW

SYSTEMS BENEFITS CHARGE:

CHARGE PER kWh	$0.00053

COMPETITIVE TRANSITION ASSESSMENT:

DEMAND CHARGE OVER 2 kW	-$0.12 per kW
CHARGE PER kWh	
FIRST 300 kWh PER kW OF DEMAND	$0.00000
ALL OVER 300 kWh PER kW OF DEMAND	$0.00000

CONSERVATION CHARGE:

CHARGE PER kWh	$0.00300

CONSERVATION ADJUSTMENT MECHANISM:

CHARGE PER kWh	$0.00300

RENEWABLE ENERGY:

CHARGE PER kWh	$0.00100

FMCC DELIVERY CHARGE:
(as per FMCC tariff)

CHARGE PER kWh	$0.00386

SUPPLIER SERVICE OPTIONS:
(as per the Generation Services tariff)

GENERATION SERVICE PER kWh	$0.12109
THIRD-PARTY SERVICE	as per contract

FMCC GENERATION CHARGE:
(as per FMCC tariff – not applicable to customers taking THIRD-PARTY SERVICE above)

CHARGE PER kWh	$0.00030

COMBINED PUBLIC BENEFITS CHARGE: Pursuant to Conn. Agencies Regs. § 16-245-1(a)(2)(A) the Systems Benefits Charge, the Conservation Charge, the Conservation Adjustment Mechanism, and the Renewable Energy Charge are combined for billing purposes into the Combined Public Benefits Charge effective January 1, 2014.

RATE ADJUSTMENTS: This rate will be adjusted as provided in the Company's Energy and Transmission Adjustment Clauses.

COMPETITIVE TRANSITION ASSESSMENT COST ADJUSTMENT: Competitive Transition Assessment (CTA) charges and terms under this rate includes a CTA Cost Adjustment Charge set in accordance with the Company's CTA Cost Adjustment.

SYSTEMS BENEFITS COST ADJUSTMENT: Systems Benefits service charges for all customers taking service under this rate shall be set in accordance with the Company's Systems Benefits Cost Adjustment.

DETERMINATION OF DEMAND: The demand shall be the highest average 30-minute kilowatt demand recorded during the billing month, but not less than 2 kilowatts.

SPECIAL PROVISIONS:

1. Primary Metering: If the service is metered on the primary side of the transformers supplying the customer, 2% of the metered kilowatt-hours will be deducted in computing the bill.

2. Facilities Ownership: If the service is taken at the property line and the Company is relieved of owning and maintaining all electrical distribution equipment on private property, except the metering equipment, a credit shall be applied to the bill equal to $.20 per kW.

3. Transmission Voltage Delivery Allowance: Where service is supplied at transmission voltage, 69,000 volts and higher, and the Company is relieved of all investment on the customer's property, except the metering equipment, the Demand Charge under the Distribution Service Rate shall be waived, and all Energy Charges adjusted for the differential between line losses at transmission and primary distribution service. This Energy Charge shall be implemented by multiplying on-peak and off-peak charges by .9735 and .9787 respectively. Service supplied at transmission voltage is unregulated.

MINIMUM CHARGE: The minimum charge is the customer charge.

TERM OF CONTRACT: None, except as provided above.

APPENDIX B

PUMP CURVES

Pump Data Sheet - Cornell

Company: Blake Equipment
Name: Ray Bahr
Date: 1/29/2015

Grape Brook P.S. - small pump

Pump:

Size: 6NHTA

Type: Encl Solids Handling
Synch speed: 1800 rpm

Speed: 1770 rpm
Dia: 11.9375 in

Curve: 6NHTA18

Impeller:

Specific Speeds:

Ns: 2120
Nss: ---

Dimensions:

Suction: 6 in
Discharge: 6 in

Pump Limits:

Temperature: 250 °F
Pressure: 125 psi g
Sphere size: 3 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 1800 US gpm

Head: 85 ft

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 50 hp
Speed: 1800
Frame: 326T

Sizing criteria: Max Power on Design Curve

---- Data Point ----	
Flow:	1800 US gpm
Head:	86.3 ft
Eff:	81%
Power:	48.1 hp
NPSHr:	10.9 ft

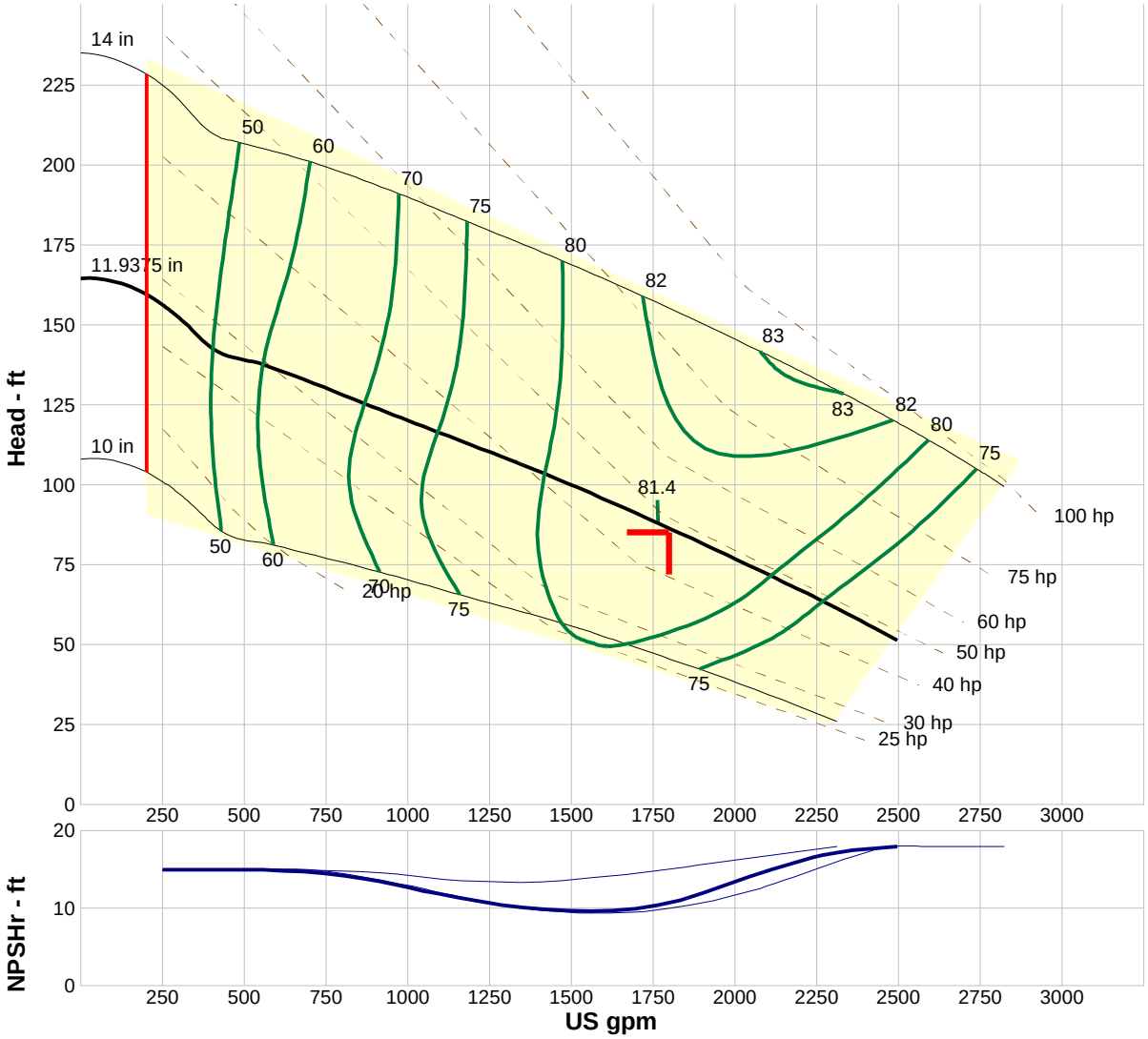
---- Design Curve ----	
Shutoff head:	165 ft
Shutoff dP:	71.2 psi
Min flow:	200 US gpm

BEP: 81% @ 1765 US gpm

NOL power:
48.6 hp @ 2268 US gpm

-- Max Curve --

Max power:
98.8 hp @ 2822 US gpm



Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
2160	1770	69	78	47.9	15.6
1800	1770	86.3	81	48.1	10.9
1440	1770	102	80	46.4	9.89
1080	1770	117	75	42.6	12
720	1770	131	65	35.9	14.4

Pump Data Sheet - Cornell

Company: Blake Equipment
Name: Ray BAhr, P.E.
Date: 3/17/2014

South Maple Pump Station - New Pump

Pump:

Size: 6NHM

Type: Delta
Synch speed: Adjustable

Speed: 1740 rpm
Dia: 14 in

Curve: 6NHMVAR

Impeller:

Specific Speeds:

Ns: 1880
Nss: ---

Dimensions:

Suction: 6 in
Discharge: 6 in

Pump Limits:

Temperature: 250 °F
Pressure: 125 psi g
Sphere size: 3 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 1400 US gpm

Head: 150 ft

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: ---
Enclosure: ---

Speed: ---
Frame: ---

Sizing criteria: Max Power on Design Curve

---- Data Point ----	
Flow:	1400 US gpm
Head:	151 ft
Eff:	59%
Power:	90.3 hp
NPSHr:	13.8 ft

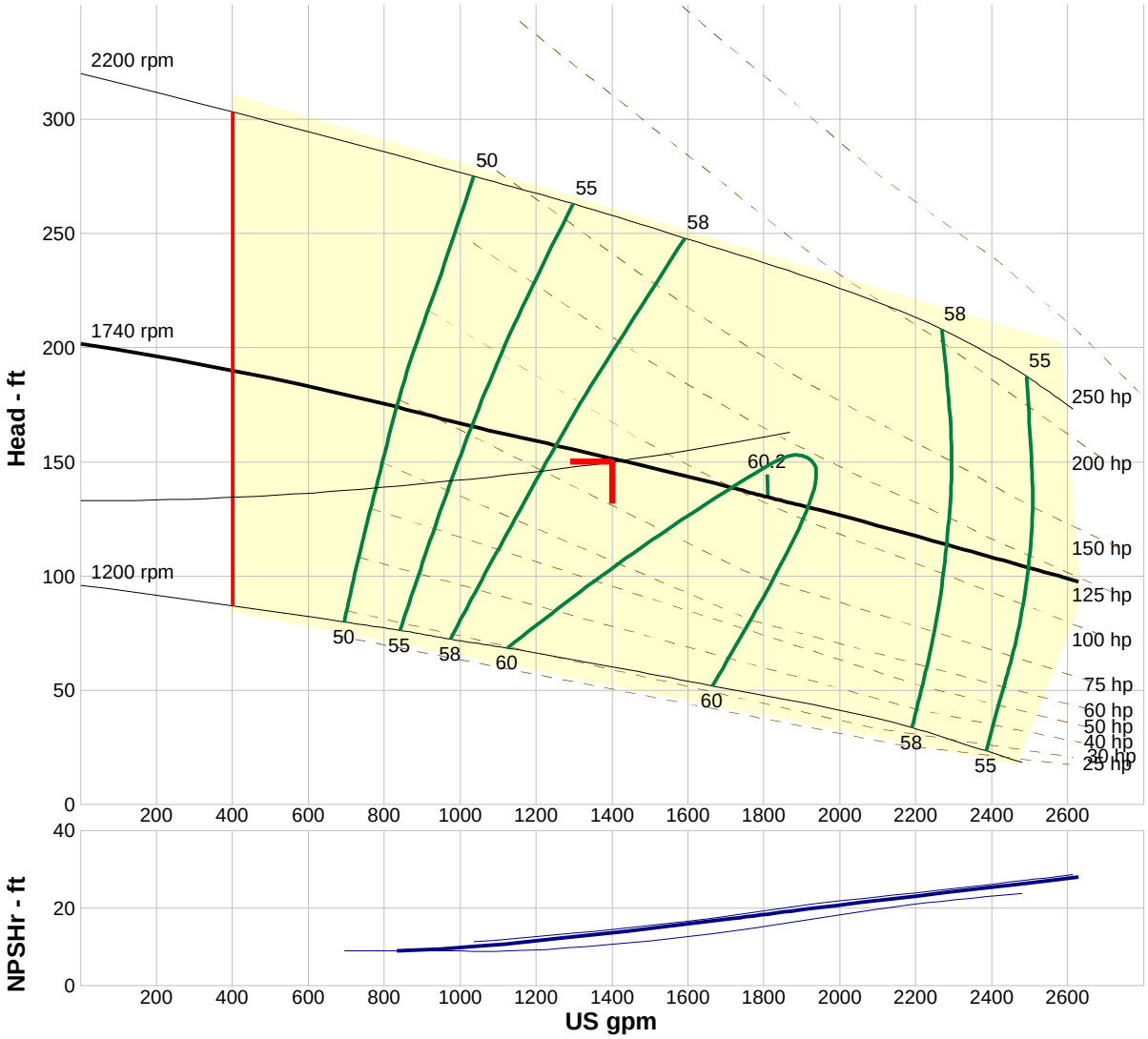
---- Design Curve ----	
Shutoff head:	202 ft
Shutoff dP:	87.3 psi
Min flow:	400 US gpm

BEP: 60% @ 1809 US gpm

NOL power:
123 hp @ 2628 US gpm

-- Max Curve --

Max power:
218 hp @ 2612 US gpm



Performance Evaluation:

Flow US gpm	Speed rpm	Head ft	Efficiency %	Power hp	NPSHr ft
1680	1740	140	60	99	17
1400	1740	151	59	90.3	13.8
1120	1740	162	56	81.3	11
840	1740	174	50	73.3	9.04
560	1740	183	43	66	7.46

FORM NO.

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA ILLINOIS · 60542

BS 1 14 75 JJ

ALL INQUIRIES AND CORRESPONDENCE SHOULD BE SENT TO NO. AURORA, ILL. WITH THIS NUMBER → ORDER NUMBER 8F5-76

INVOICE

SOLD TO
RAYMOND CONSTRUCTION COMPANY
100 AIRPORT ROAD
HARTFORD, CONNECTICUT

CUST ORDER NO
E3-B

South Maple Pump Station - Old Pump

SHIP TO
SEWAGE PUMP STATION
% RAYMOND CONSTRUCTION
ENFIELD, CT. 06033
(DUSTHOUSE RD & SO. MAPLE ST.)

TERMS-NET 30 DAYS UNLESS OTHERWISE MARKED 1% PER MONTH ADDED ON ALL INVOICES

MARK: ENFIELD PUMP STA/ SEWAGE PUMPS

MANUFACTURING POINT: XXX (N AURORA IL / AURORA / CITY OF INDUSTRY CALIF / CITY OF INDUSTRY)

COLLECT | PREPAID ALLOWED: XXX | PREPAID NOT ALLOWED | FRT

TERMS

ORDER NUMBER	DATE RECEIVED	CUSTOMER'S ORDER NO	VERT PTS	CURVES	BULTINS	INSTRUCTIONS	PARTS LISTS	SHIPMENT REQ'D
8F5-76	1 8 75	E3-B	X					05 26

AP A	CUST CODE	S TAX EXEMP NUMBER	S SOLD	DIST NO	S SHIP D	C SHIP D	SHIP VIA
	523110			199			MOTOR FREIGHT

SHIPMENT SCHEDULED

PROD CODE	QTY ORDERED	PRICE EACH	PART OR MODEL	DESCRIPTION	UNIT PRICE	QTY SHIPPED	TOTAL PR
610	2			6X8X15 MODEL 612 AI VERT SPHER-FLO PUMP ON POWER FRAME 5B NO 75-76-1+2 Mount in disch position #6 SPECIAL OPTIONS: BRONZE IMPELLER **SS CASE AND IMPELLER WEAR RING BRONZE GLAND WITH SS BOLTS AND BRONZE NUTS SPECIAL PAINT: INERTAL 621 PRIMER			9530.(
	2			820-0344-087 MOTOR RING BASE SHAFT AND FLANGES FURNISHED BY OTHERS			
	2			125 HP 3 60 480 VOLT 1750 RPM VERT ODP NEMA 'P' FLANGE FRAME 405 HP MOTORS SUITABLE FOR REDUCED VOLTAGE START NOTE: MOTOR MUST COMPLY TO NEMA STANDARDS AND HAVE DRILLED HOLES IN 'P' FACE			

IMPELLER PATT	DIA	CAPACITY	TOTAL HEAD	SPEED	EFFICIENCY	PUMPING TEMPERATURE	LIQUID
A097	15" @ 18°	1550 GPM	156 FT	1750 RPM	%	°F	

SPEC GRAV	VISCOSITY	BRAKE HORSE POWER	SUCTION PRESSURE	VAPOR PRESSURE	NPSH ABOVE VAPOR PRESSURE
	SSU		PSIG	PSIA	AVAIL / REQ'D

COMMISSION

	DIST'S ORDER NO	DISTRIBUTOR'S COST	COMMISSION
CARDINAL PUMP	2414	8664.00	866.00
		-FRT	

BASKET B/M | STANDARD B/M | AUX EQUIP SELLING PRICE

(2) A2227** 3 C0256*** H0048 ~~[illegible]~~ S0610

SPECIAL INSTRUCTIONS | ESTIMATED FREIGHT

CHECK CREDIT BEFORE SHIPPING *DRILL AND TAP IMPELLERS PER 178-0275-000 **IMPELLER MATERIAL TO BE 208 ***GLAND MATERIAL TO BE 208 CAPSCREWS 168-0500 TO BE 104 MATERIAL

JUL 30 REC'D

OFFICE COPY

FORM NO 300010

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA ILLINOIS · 60542

LH 4 15 75 JJ

-ALL INQUIRIES AND CORRESPONDENCE SHOULD BE SENT TO NO. AURORA, ILL. WITH THIS NUMBER →

ORDER NUMBER 8F5 76

INVOICE NO

SOLD TO
RAYMOND CONSTRUCTION CO
100 AIRPORT ROAD
HARTFORD, CONNECTICUT

CUST. ORDER NO: E3 B

INVOICE DATE

SHIP TO
SEWAGE PUMP STATION
C/O RAYMOND CONSTRUCTION
ENFIELD, CT. 06033
(DUSTHOUSE RD & SO. MAPLE ST.)

MARK: ENFIELD PUMP STA/
SEWAGE PUMPS

MANUFACTURING POINT: X

COLLECT | PREPAID ALLOWED: X | PREPAID NOT ALLOWED | FBT

TERMS-NET 30 DAYS UNLESS OTHERWISE MARKED 1% PER MONTH ADDED ON ALL PAST DUE INVOICES
TERMS

ORDER NUMBER	DATE RECEIVED	CUSTOMER'S ORDER NO	PER PTS	CURVES	BULLETINS	INSTRUCTIONS	PARTS LISTS	SHIPMENT REQUESTED
8F5 76	1 8 75	E3 B	X					5 26

AP CR	CUST CODE	S TAX EXEMP NUMBER	S SOLD	DIST NO	S SHIP D	C SHIP D	SHIP VIA	SHIPMENT SCHEDULED
	523110			199			MTR FRT	

PROD CODE	QTY ORDERED	PRICE EACH	PART OR MODEL	DESCRIPTION	UNIT PRICE	QTY SHIPPED	TOTAL PRICE
				COMPLETE MOTOR TESTS ON EACH MOTOR SHALL BE MADE PER AIEE TEST CODE AS SPECIFIED IN ANSI STD "C50" USING NEMA REPORT OF TEST FORMS"			
				IN 5 COPIES MTR TEST WILL BE SENT AS SOON AS POSSIBLE			

IMPELLER PATT	DIA	CAPACITY GPM	TOTAL HEAD FT	SPEED RPM	EFFICIENCY %	PUMPING TEMPERATURE °F	LIQUID S

STAGES	SPEC GRAV	VISCOSITY SSU	BRAKE HORSE POWER	SUCTION PRESSURE PSIG	VAPOR PRESSURE PSIA	NPSH ABOVE VAPOR PRESSURE AVAIL	REQ'D

DIST'S ORDER NO | DISTRIBUTOR'S COST

COMMISSION

COMMISSION

BLANKET B/M | STANDARD B/M | AUX EQUIP SELLING PR

SPECIAL INSTRUCTIONS | ESTIMATED FREIGHT

OFFICE COPY

BILL OF MATERIAL

AURORA PUMPS — AURORA PUMP, A UNIT OF GENERAL SIGNAL

ORDER NUMBER	CUSTOMER NAME	IMPELLER DIA.	ASSY. QTY.	ASSY. DATE
F5-00076	RAYMOND CONST	15	2	1/15/5

PATTERN NUMBER	DESCRIPTION	NEW PART NUMBER PART TYPE	NUMBER	MAT TYPE	UNIT QTY	QTY. REQ.	FLOOR STOCK	ORDER	SPECIAL INSTRUCTIONS
~~A2227~~									
~~116A064~~	~~BRACKET~~	~~116~~	~~0429~~	~~010~~		~~2~~			
	~~CAPSCREW~~	~~168~~	~~0562~~	~~080~~		~~12~~	~~FS~~		
	~~CAPSCREW~~	~~168~~	~~0634~~	~~080~~		~~32~~	~~FS~~		
~~180A140~~	~~CASING~~	~~180~~	~~1889~~	~~010~~		~~2~~			
~~260A016~~	~~COVER~~	~~260~~	~~0657~~	~~010~~		~~2~~			
	~~GASKET~~	~~364~~	~~1321~~	~~482~~		~~2~~			
	~~GASKET~~	~~364~~	~~1327~~	~~608~~		~~4~~			
	~~GASKET~~	~~364~~	~~2026~~	~~608~~		~~2~~			
	GASKET	364	2029	607		2			
444A097	IMPELLER	444	2078	208		2			
	IMP KEY	472	0391	087		2			
	NAMEPLATE	532	0045	114		2	FS		
	IMP NUT	544	0489	360		2			
	PIPE PLUG	600	0004	028		2	FS		
	PIPE PLUG	600	0022	028		4	FS		
676A082	WRG RING	676	1911	108		4			
	U DR SCREW	708	0013	365		4	FS		
	SCREW	708	0406	113		16			
	SEALER	716	0001	621		2		ORD	
	N C STUD	808	0404	080		2		ORD	
816A038	SUCT COVER	816	1146	010		2			
	IMP WASHER	908	0583	062		2			
	THREDSEAL	908	1280	999		2			
C0256									
008A013	ADAPTER	008	0544	010		2			
	CAPSCREW	168	0382	080		8	FS		
	CAPSCREW	168	0492	080		8	FS		
	CAPSCREW	168	0500	104		4		ORD	
	GLD CLAMPS	204	0121	360		4	FS		
	GASKET	364	0584	457		2			
	GASKET	364	2027	608		2			
372A029	GLAND	372	0321	208		4			
	KEY	472	0112	104		2	FS		
	LUBE FITT	508	0012	651		2	FS		
	PACKING	564	0183	730		10			
	TAPER PIN	592	0836	113		4			

CODE NO. FOR COMMON MAT'L. TYPE
010 - CAST IRON
100 - S.S. WROUGHT 303
131 - S.S. CAST 416
059 - CARBON STEEL C1020
104 - S.S WROUGHT 316
208 - BRONZE
062 - CARBON STEEL C1040
107 - S.S. WROUGHT 416
079 - STEEL
128 - S.S. CAST 316

BILL OF MATERIAL

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA ILLINOIS · 60542

ORDER NUMBER	CUSTOMER NAME	IMPELLER DIA.	ASSY. QTY.	ASSY. DATE
F5-00076				1/15/5

PATTERN NUMBER	DESCRIPTION	NEW PART NUMBER PART TYPE	NUMBER	MAT TYPE	UNIT QTY	QTY. REQ	FLOOR STOCK	ORDER	SPECIAL INSTRUCTIONS
	PIPE PLUG	600	0004	028		6	FS		
	HEX BUSH	600	0905	387		2			
	RING	676	0460	088		2			
	RING	676	0471	088		2			
676A055	LANT RING	676	1106	010		2			
756A006	SLEEVE	756	0084	108		2			
812A007	PKG INSERT	812	0309	010		2			
H0048									
060A012	BASE	060	0595	010		2			
	CAPSCREW	168	0562	080		8	FS		
	CAPSCREW	168	0636	080		16	FS		
	CAPSCREW	168	0640	080		16	FS		
260A024	COVER	260	0649	010		2			
	GASKET	364	0610	579		2			
	GASKET	364	1048	482		2			
	PIPE PLUG	600	0045	028		2	FS		
	PIPE PLUG	600	0096	087		2	FS		
816A072	SUCT ELBOW	816	1207	010		2			
S061C									
	OUTBRD BRG	068	0514	647		2			
	INBRD BRG	068	0541	647		2			
	GRS COVER	164	0091	503		2	FS		
164A016	BRG CAP	164	0524	010		2			
	CAPSCREW	168	0202	080		8			
	CAPSCREW	168	0564	080		8	FS		
356A010	PWR FRAME	356	0284	010		2			
	CPL KEY	472	0390	087		2			
	LUBE FITT	508	0015	651		4	FS		
	JAM NUT	544	0316	080		8	FS		
	PIPE PLUG	600	0095	087		4	FS		
	RING	676	0447	088		2			
	RING	676	0948	088		2			
	SEAL	712	0241	653		2			
	SEAL	712	0265	653		2			
	SEAL	712	0281	087		2			
	SHAFT	728	4981	063		2			
	SLINGER	764	0172	478		2			

CODE NO. FOR COMMON MAT'L. TYPE
010 - CAST IRON
100 - S.S. WROUGHT 303
131 - S.S. CAST 416
059 - CARBON STEEL C1020
104 - S.S WROUGHT 316
208 - BRONZE
062 - CARBON STEEL C1040
107 - S.S. WROUGHT 416
079 - STEEL
126 - S.S. CAST 316

BILL OF MATERIAL

AURORA PUMPS

AURORA PUMP
A UNIT OF GENERAL SIGNAL
808 AIRPORT ROAD NORTH AURORA, ILLINOIS 60542

ORDER NUMBER	CUSTOMER NAME	IMPELLER DIA.	ASSY. QTY.	ASSY. DATE
F5-00076				1/15/5

PATTERN NUMBER	DESCRIPTION	NEW PART NUMBER			UNIT QTY	QTY. REQ.	FLOOR STOCK	ORDER	SPECIAL INSTRUCTIONS
		PART TYPE	NUMBER	MAT. TYPE					
	SLINGER	764	0173	478		2			

CODE NO. FOR COMMON MAT'L. TYPE
010 - CAST IRON
100 - S.S. WROUGHT 303
131 - S.S. CAST 416
059 - CARBON STEEL C1020
104 - S.S. WROUGHT 316
208 - BRONZE
062 - CARBON STEEL C1040
107 - S.S. WROUGHT 416
079 - STEEL
128 - S.S. CAST 316

AURORA PUMP
A UNIT OF GENERAL SIGNAL
800 AIRPORT ROAD · NORTH AURORA, ILLINOIS · 60542

BS 1 7 75 JJ

ALL INQUIRIES AND CORRESPONDENCE SHOULD BE SENT TO NO. AURORA, ILL. WITH THIS NUMBER → ORDER NUMBER 675-76

INVOICE NO

SOLD TO
RAYFORD CONSTRUCTION COMPANY
100 AIRPORT ROAD
HARTFORD, CONNECTICUT

CUST ORDER NO: E3-6

INVOICE DATE

SHIP TO
~~RAYFORD CONSTRUCTION COMPANY~~
~~100 AIRPORT ROAD~~
~~HARTFORD, CONNECTICUT~~

See Change

MARK: ENFIELD PUMP STA/ SEWAGE PUMPS

MANUFACTURING POINT: XXX

TERMS: NET 30 DAYS UNLESS OTHERWISE MARKED 1% PER MONTH ADDED ON ALL PAST DUE INVOICES

ORDER NUMBER	DATE RECEIVED	CUSTOMER'S ORDER NO	COLLECT	PREPAID ALLOWED	PREPAID NOT ALLOWED	TERMS
675-76	1 8 75	E3-6		XXX		

AP TR	CUST CODE	S TAX EXEMP NUMBER	S SOLD	DIST NO	C SHIP	C SHIP D	SHIP VIA	CURVES	BULTNS	INSTRUCTIONS	PARTS LISTS	SHIPMENT REQUESTED
	583116			136			X MOTOR FREIGHT					RS 2 6 75

SHIPMENT SCHEDULED: Pump 7-28-75

PROD CODE	QTY ORDERED	PRICE EACH	PART OR MODEL	DESCRIPTION	UNIT PRICE	QTY SHIPPED	TOTAL PRICE
2010	2			6X5X15 MODEL E12 AT VERT SPINER-FLO PUMP ON POWER FRAME 5S NO 75-76-142	2-11		
				SPECIAL OPTIONS: BRONZE IMPELLER #SS CASE AND IMPELLER WEAR RING	See Change Order #6		
				BRONZE GLAND WITH SS BOLTS AND BRONZE NUTS			
				SPECIAL PAINT: INERTAL 621 PRIMER			
	2			620-0344-567 MOTOR RING BASE SHAFT AND FLANGES FURNISHED BY OTHERS			
	2			125 HP 3 60 480 VOLT 1750 RPM VERT ~~XX~~ ODP NEMA 'P' FLANGE FRAME 405 HP MOTORS SUITABLE FOR REDUCED VOLTAGE START. NOTE: MOTOR MUST COMPLY TO NEMA STANDARDS AND HAVE DRILLED HOLES IN 'P' ~~XX~~ FACE			

CREDIT OK

.3978 X57 = 2267.46 EA

7-10-75 Martinson 945370. $1390.80 9-10-75

IMPELLER PART	DIA	CAPACITY	TOTAL HEAD	SPEED	EFFICIENCY	PUMPING TEMPERATURE	LIQUID	SOLIDS
6AAAL57	15" & 13"	1500 GPM	150	1750 RPM		°F		

STAGES	SPEC GRAV	VISCOSITY	BRAKE HORSE POWER	SUCTION PRESSURE	VAPOR PRESSURE	NPSH ABOVE VAPOR PRESSURE
		SSU			PSIA	

2 Proposal forms

QUALITY CONTROL 1117

DIST'S ORDER NO | DISTRIBUTOR'S ORDER NO | 20 REQUIRED

REQD

COMMISSION

COMMISSION

199 CARDINAL PUMP

BLANKET B/M | STANDARD B/M: (2) A2227~~XX~~ 3 C0255~~XXX~~ M6046 ~~XXXXXX~~ S0610

ALL EQUIP SELLING PRICE

ESTIMATED FREIGHT

SPECIAL INSTRUCTIONS
CHECK CREDIT BEFORE SHIPPING ~~XX~~DRILL AND TAP IMPELLERS PER 176-0275-000
~~XX~~IMPELLER MATERIAL TO BE 20% ~~XXX~~GLAND MATERIAL TO BE 20% CAPSCREWS 160-0500 TO BE 104 MATERIAL

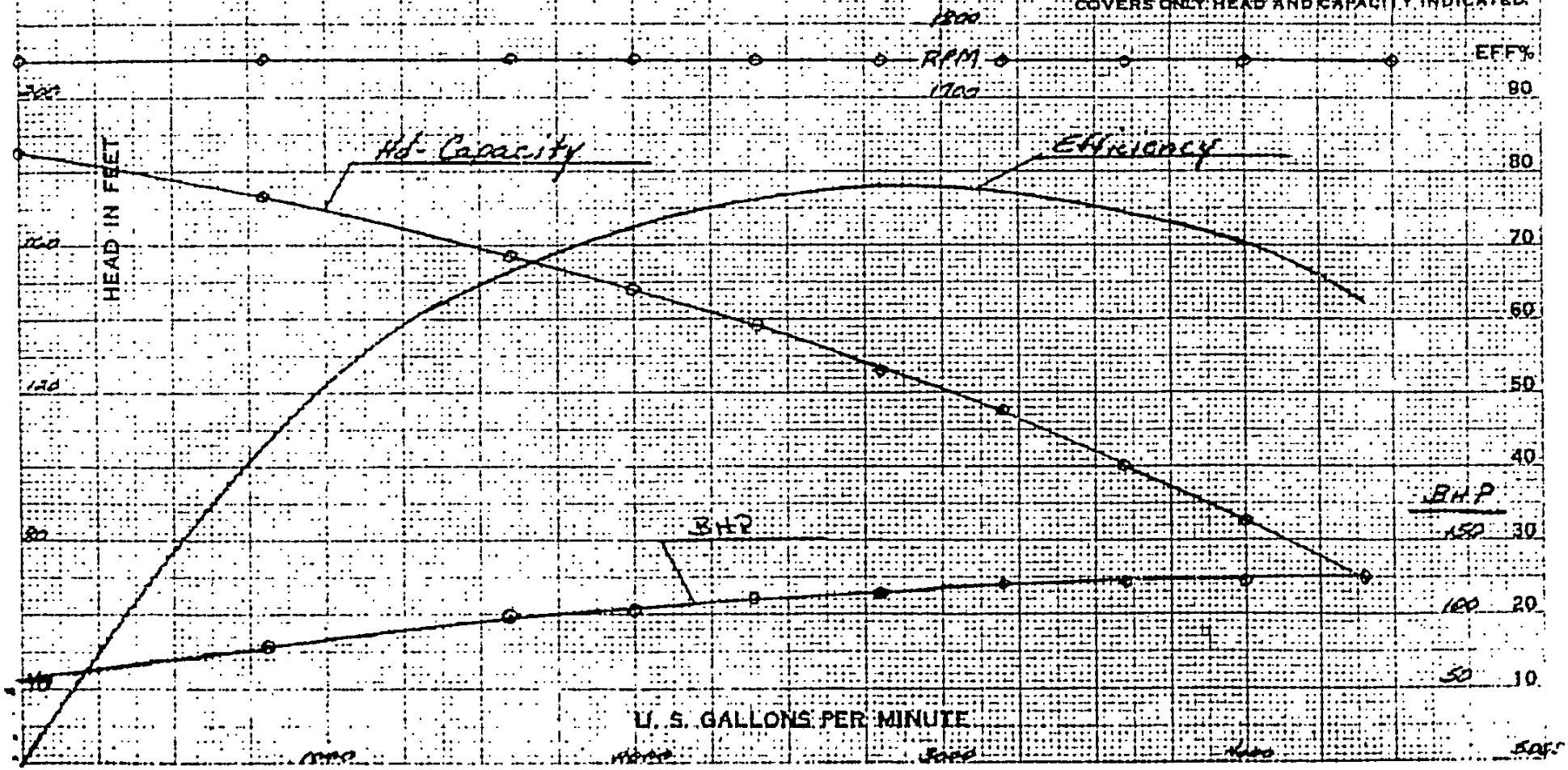
JAN 16 1975

PRODUCTION COPY

AURORA PUMP
A UNIT OF GENERAL SIGNAL CORPORATION
500 AURORA ROAD NORTH AURORA ILLINOIS 60542

PUMP NO. 45-76
SIZE 6x8x15 TYPE 6L2
R.P.M. AS DRAWN
IMPELLER NO. 44A077
IMPELLER DIA.
PLOTTED BY RRR
DATE 1-6-76
REF. CURVE NO. BPC 115575

THIS CURVE SHOWS THE GENERAL SHAPE OF PUMP CHARACTERISTIC, BUT GUARANTEE COVERS ONLY HEAD AND CAPACITY INDICATED.



A-40041 K&E 10 5154 11-71 2749

SHEET NO. 124743

APPENDIX U: WPCF ENERGY EVALUATION REPORT

Town of Enfield, Connecticut

Water Pollution Control Facility

Energy Evaluation

Prepared by:

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Rocky Hill, CT 06067
860-249-0989

July 2015

TABLE OF CONTENTS

EXECUTIVE SUMMARY **4**
- **Summary of Energy Use and Proposed Measures** **4**
- **Summary of Renewable Energy Technologies** **6**

FACILITY DESCRIPTION **7**
- **Electrical Usage per Process** **8**
- **Facility Energy Usage** **8**
- **Benchmarking** **11**

PUMP EFFICIENCY ANALYSIS **12**

ENERGY CONSERVATION MEASURES **15**
- **OM #1 – Bar Screen Control** **15**
- **ECM #1 – RAS Pump Rebuild** **17**
- **ECM #2 – Aeration Blower Replacement** **22**
- **ECM #3 – Plant Water System VFD Installation** **27**
- **ECM #4 – Internal Recycle Pump Control Adjustment** **30**
- **ECM #5 – Odor Control Fan VFD Installation** **32**
- **ECM #6 – Aeration Tank Mixing System – High Efficiency Mixer Upgrade** **35**
- **ECM #7 – HVAC Upgrades** **41**
- **ECM #8 – Lighting Upgrades** **42**

RENEWABLE ENERGY OPTIONS **43**
- **Wind** **43**
- **Hydroelectric Turbine** **46**
- **Solar Photovoltaic Array Evaluation** **50**
- **Installation & Ownership** **63**
- **Interconnection Requirements** **64**

LIST OF TABLES

Table 1. Enfield WPCF Energy Usage Summary – 2013 4
Table 2. Projected Annual Cost and Savings Summary – Upgrade ECMs 5
Table 3. Projected Annual Cost and Savings Summary – Short-Term ECMs 5
Table 4. Renewable Energy Alternative Summary 6
Table 5. Annual Electrical Usage and Costs Summary – 2013 9

Table 6. Pump Efficiency 13
Table 7. Equipment Data 14
Table 8. Energy Use 15
Table 9. Energy Savings & Cost 16
Table 10. Pump Specifications 17
Table 11. RAS Pump Efficiencies 17
Table 12. Existing Conditions 18
Table 13. Proposed Conditions 19
Table 14. Proposed Consumption 20
Table 15. Potential Savings 20
Table 16. Cost Estimate 20
Table 17. Simple Payback 21
Table 18. Blower Efficiency 24
Table 19. Estimated Power Draw of Blowers with VFDs 24
Table 20. Electrical Draw of New Blower 25
Table 21. Energy Usage 25
Table 22. Budgetary Cost Estimate 26
Table 23. Energy Savings & Payback 26
Table 24. PWS Operation Specifications 27
Table 25. Base Case: Plant Water System Energy Usage 28
Table 26. Plant Water Pump: Reduced Energy Usage 28
Table 27. Energy Cost & Savings 29
Table 28. Existing Energy Usage 30
Table 29. Proposed Energy Use 31
Table 30. Savings 31
Table 31. Exhaust Fan – Existing Conditions 32
Table 32. Exhaust Fan – Proposed Conditions 33
Table 33. Exhaust Fan – Energy Savings 33
Table 34. Exhaust Fan – Project Cost 33
Table 35. Exhaust Fan – Cost Savings and Payback 34
Table 36. Base Case Annual Energy Use of Aeration Mixers 35
Table 37. Base Case Energy Usage of Traditional Mixers 36
Table 38. Proposed Case Energy Usage of BioMix System 36
Table 39. BioMix System Energy and Cost Savings 37
Table 40. BioMix Proposed Project Cost Estimate 37
Table 41. Proposed AquaDDM Mixing System Energy Usage 38
Table 42. AquaDDM System Annual Energy and Cost Savings 38
Table 43. AquaDDM System Project Cost and Payback 38
Table 44. Invent Hyperbolic Mixer Estimated Energy Usage 39
Table 45. Energy Savings 39
Table 46. Invent Hyperbolic Mixer Estimated Energy Use 40
Table 47. Wind Turbine Manufacturer Ratings & Potential Energy Production 45
Table 48. TDH Determination 47
Table 49. Potential Energy Production 48
Table 50. Hydro Turbine Technologies 48
Table 51. Land Area Specifications 59

Table 52. Solar Location – Preliminary Evaluation 60
Table 53. Solar Energy Produced 61

LIST OF FIGURES

Figure 1. Electrical Usage Breakdown – 2013 8
Figure 2. Monthly Electrical Usage and Demand – 2013 9
Figure 3. Regional Wastewater Treatment Plant Performance 11
Figure 4. Original Pump Curve 19
Figure 5. Inlet Throttling Blower Curves 23
Figure 6. Aerial of Enfield WPCF 50
Figure 7. Annual Sun Path – Clockwise from top left, Site 1 51
Figure 8. Annual Sun Path – Clockwise from top left, Site 2 52
Figure 9. Annual Sun Path – Clockwise from top left, Site 3 52
Figure 10. Annual Sun Path – Clockwise from top left, Site 4 53
Figure 11. Obstruction Elevation – Clockwise from top left, Site 1 53
Figure 12. Obstruction Elevation – Clockwise from top left, Site 2 54
Figure 13. Obstruction Elevation – Clockwise from top left, Site 3 54
Figure 14. Obstruction Elevation – Clockwise from top left, Site 4 55
Figure 15. Monthly Solar Exposure – Clockwise from top left, Site 1 56
Figure 16. Monthly Solar Exposure – Clockwise from top left, Site 2 56
Figure 17. Monthly Solar Exposure – Clockwise from top left, Site 3 57
Figure 18. Monthly Solar Exposure – Clockwise from top left, Site 4 57

LIST OF APPENDICES

APPENDIX A: ELECTRICAL END USE AND RECONCILIATION

APPENDIX B: ELECTRICAL USE SUMMARY DATA

APPENDIX C: EVERSOURCE RATE TARIFF – RATE 30 AND RATE 37

APPENDIX D: FACILITY BENCHMARK DATA

APPENDIX E: FIELD DATA SUMMARY

APPENDIX F: PUMP & EQUIPMENT CURVES

- Existing RAS Pump Curve
- Proposed Aerzen Hybrid Blower
- Existing IR Pump Curve
- Anoxic Zone Mixer Proposals & Calculations

APPENDIX G: SOLAR REFERENCE & CALCULATIONS

- PVWATTS CALCULATIONS
- FAA NOTICE CRITERIA TOOL

APPENDIX H: HYDRAULIC PROFILE 1969 M&E

EXECUTIVE SUMMARY

This memo provides a summary description of the facilities and energy demands for the Town of Enfield Water Pollution Control Facility (WPCF) located at 90 Parsons Road in Enfield, Connecticut. The facility descriptions are based on site reconnaissance, staff input and available drawings. Billing data were utilized to summarize the facility's current energy demands.

The objectives of the report include the following:

- Provide a summary description of the evaluated WPCF;
- Summarize the energy usage and billing rates for the facility, and demonstrate how electrical energy is being used;
- Identify specific operational and capital improvements at the facility, and estimate the energy savings and cost for each project;
- Identify viable renewable energy projects that provide environmental, economic and social benefits to the community.

The projects have been categorized as Energy Conservation Measures (ECMs), for projects that require a capital investment, and operational measures (OMs) for projects that can be done at a minimal cost. The WPCF is currently undergoing a facilities plan by Woodard and Curran that will identify future upgrades at the facility. An initial site visit to the WPCF was conducted by JKMuir, LLC on June 20, 2014.

Summary of Energy Use and Proposed Measures

The energy usage summary shown below provides an overview of annual electrical (kWh), as well as costs based on billing information provided from January through December 2013. The data for the 2013 period is summarized below.

Table 1. Enfield WPCF Energy Usage Summary – 2013

Energy Source	Annual Energy Use (kWh)	Unit	Annual Cost	Unit Cost
Electrical Use	2,157,295	kWh	$267,707	$0.124

The Project Evaluation Economic Summary shown below provides an overview of our estimates for total project costs and annual savings. A more detailed summary of the qualified measures and their associated savings is presented in the summary table. The tables have been separated into two tables; the first table presents the ECMs associated with the facility upgrades and the second table shows the potential short-term options that could be incorporated prior to the facility upgrades.

Table 2. Projected Annual Cost and Savings Summary – Upgrade ECMs

	Cost Saving Measures	Annual Energy Savings (kWh)	First Year Annual Dollars ($)	Initial Cost ($)	Simple Payback (yrs)
ENERGY CONSERVATION MEASURES					
ECM 2	Aeration Blower Replacement	599,877	$74,385	$234,000	3.1
ECM 6A	AerationTank Mixing - Compressed Gas Mixing	743,987	$92,254	$695,800	7.5
ECM 7	HVAC Upgrades	----------			
ECM 8	Lighting Upgrades	----------			
Potential Energy Program Cost and Savings		**1,343,864**	**$166,639**	**$929,800**	**5.6**

NOTE: Potential energy program cost and savings do not include the potential Eversource Incentives.

Table 3. Projected Annual Cost and Savings Summary – Short-Term ECMs

	Cost Saving Measures	Annual Energy Savings	First Year Annual Dollars ($)	Initial Cost ($)	Simple Payback (yrs)
ENERGY CONSERVATION MEASURES					
OM 1	Bar Screen Control	16,201	$2,009	$0	Immediate
ECM 1	RAS Pump Rebuild[1]	81,988	$10,167	$42,900	4.2
ECM 3	PWS VFD Installation	41,880	$5,193	$50,500	9.7
ECM 4	Internal Recycle Pump Control	182,190	$22,592	$3,000	0.1
ECM 5	Odor Control Fan VFD Installation	15,470	$1,918	$15,000	7.8
Potential Energy Program Cost and Savings[2]		**337,729**	**$41,878**	**$111,400**	**2.7**

NOTE:

1) ECM paybacks are based first year savings.

2) Potential energy program cost and savings do not include the potential Eversource Incentives.

Summary of Renewable Energy Technologies

The following renewable energy alternatives were evaluated as a part of the energy evaluation.

1. **Wind Power** – small scale wind turbine on WPCF property
2. **Hydroelectric** – small scale hydro turbine from plant effluent flow
3. **Photovoltaic Array** – solar power on available land on WPCF property

The summary of the alternatives are presented in the following table. A more detailed evaluation is presented in the sections below.

Based on the evaluation, the Wind Mill alternative is not an economically feasible alternative for the Enfield WPCF.

Table 4. Renewable Energy Alternative Summary

Energy Alternative	Potential Energy Production (kWh/yr)	Potential Energy Production ($/year)	Percent of Annual Energy Production
Hydroelectric Turbine	40,413	$5,011	2%
Photovoltaic Array	274,307	34,015	12%

FACILITY DESCRIPTION

The Town of Enfield operates and maintains a Water Pollution Control Facility (WPCF), which provides wastewater treatment for over 40,000 Enfield residents. The WPCF processes include screenings removal, aerated grit removal, primary clarification, and BOD and nitrogen removal via activated sludge, secondary clarification, and chlorine disinfection. The facility was first constructed in 1938 as a primary treatment facility. A significant upgrade was made at the facility in 1969 which added the secondary treatment process. In 2004, the secondary treatment process was modified to include nitrification and denitrification. The WPCF is permitted to treat 10 million gallons per day (MGD) and the recorded average daily flow for 2013 was approximately 5.2 MGD.

Influent flow to the facility is split between two channels, with a portion of the flow entering through a pipe with a mechanical bar screen, which continuously operates, and the other portion through a pipe that has a comminutor. Wastewater from this headworks structure flows into one of two aerated grit chambers. There are two primary clarifiers, with one typically on-line. Waste sludge is co-settled in the primary clarification tanks and then pumped by four primary sludge pumps to the belt filter presses.

There are four trains of aeration tanks, and for approximately three months out of the year, only three trains are in operation. Each train includes both pre and post anoxic tanks (each with a submersible mixer), and internal recycle pumps. There are a total of 12 dissolved oxygen (DO) analyzers (one per aerated zone in each of the four trains) and a motorized butterfly valve for air flow control at each drop leg (one per aerated zone). Each aeration train also includes air flow metering. Air to the aeration tanks is supplied by four multistage centrifugal blowers with inlet valve control. Typically one blower is in operation, and is inlet throttled to control flow.

Secondary clarification occurs in four clarifiers, all of which are typically on-line. There are three Return Activated Sludge (RAS) pumps, with all units operating continuously. The pumps are on variable frequency drives (VFDs), but are typically operated at full speed. Waste activated sludge (WAS) is pumped continuously for co-settling in the primary settling tanks by a single unit that operates with a VFD. The speed of the pump is manually controlled.

Sodium hypochlorite is used to disinfect the treated effluent before it is discharged to the Connecticut River.

The solids handling system consists of four sludge pumps that transfer co-settled primary and secondary sludge and scum from the primary clarifiers to two belt-filter presses for dewatering. One of the sludge pumps is not operational. The belt filter presses are operated for two shifts on Monday and Tuesday, and for one shift on Wednesday, Thursday, and Friday. Both presses are operated simultaneously. There is currently a sludge storage tank, equipped with a pumped mixing system, which is off line due to odor issues.

A chemical scrubber was installed to address odors while dewatering. The fan associated with the scrubber system operates while the facility is dewatering but no water or chemical is added to scrubber.

There are two single speed plant water pumps, with one operating continuously. There is no automatic pressure control system. Plant water is used for tank wash down, carry water for chemicals and the belt filter press.

The facility is staffed for two shifts during weekdays, from 7 AM to 3:30 PM; and 2:30pm to 11pm. A morning walkthrough of the facility is performed on Saturdays and Sundays.

Electrical Usage per Process

A breakdown of the electrical energy use for the facility is shown in the figure below**.** A detailed electrical energy end use reconciliation is provided in Appendix A. As expected, the aeration system represents the highest energy consuming process at the facility.

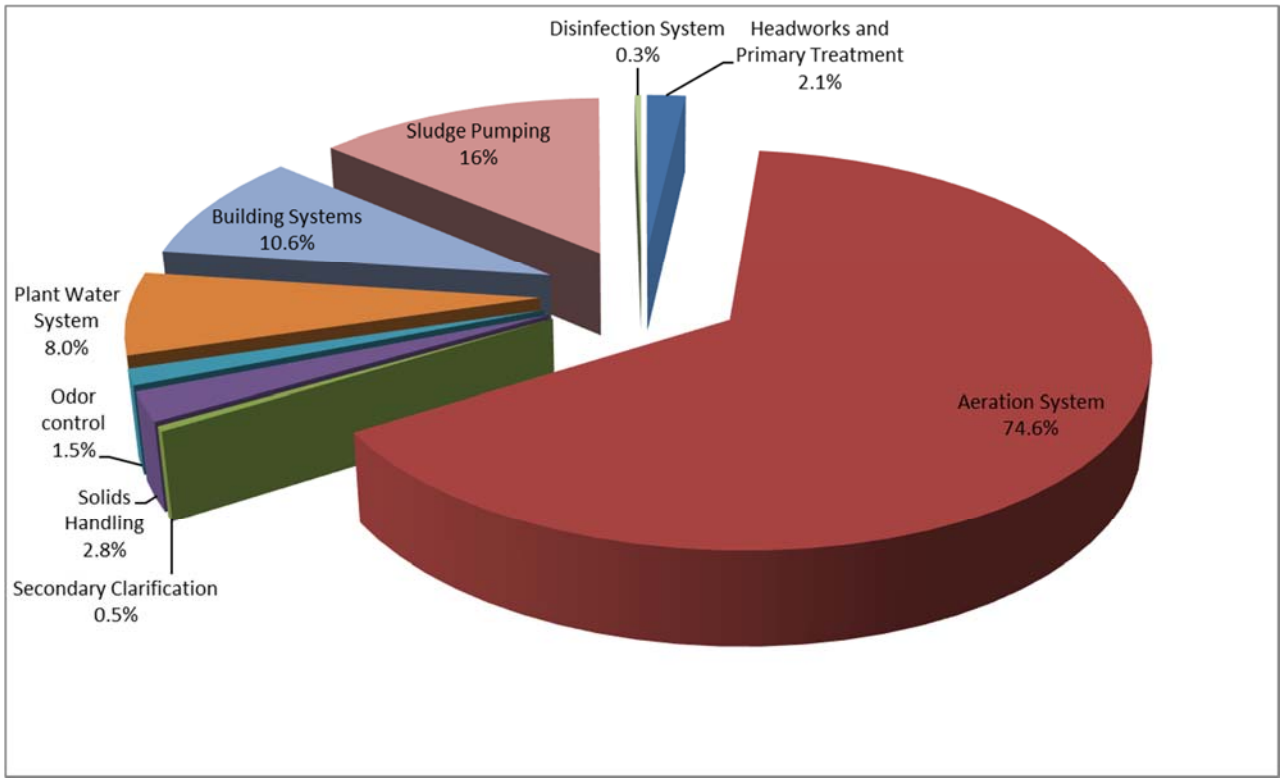


Figure 1. Electrical Usage Breakdown – 2013

Facility Energy Usage

Electricity is provided to the WPCF through two separate service entrances. One service covers the original WPCF electrical service which serves the headworks and second serves the rest of the major plant processes. Currently, the Enfield WPCF receives electric supply through a multi-year contract with TransCanada and delivery service through Eversource. Each service is metered and billed separately by both TransCanada and Eversource. A summary of the annual electrical usage and costs for the facility is summarized in the table below, and is based on the 2013 billing records.

A more detailed analysis of generation and supply costs for both services is provided in the appendix.

Table 5. Annual Electrical Usage and Costs Summary – 2013

Account	Rate	Average Monthly Usage (kWh)	Average Monthly Cost	Average kW Demand	Annual Energy Use (kWh)	Annual Cost	Unit Cost per kWh
WWTP (51270034010)	37	178,883	$22,158	321	2,146,598	$265,899	$0.124
Headworks (51881714026)	30	891	$151	3	10,696	$1,808	$0.169
	Total	179,775	$22,309	324	2,157,295	$267,707	$0.124

The facility's monthly electrical usage and demand are presented in the figure below.

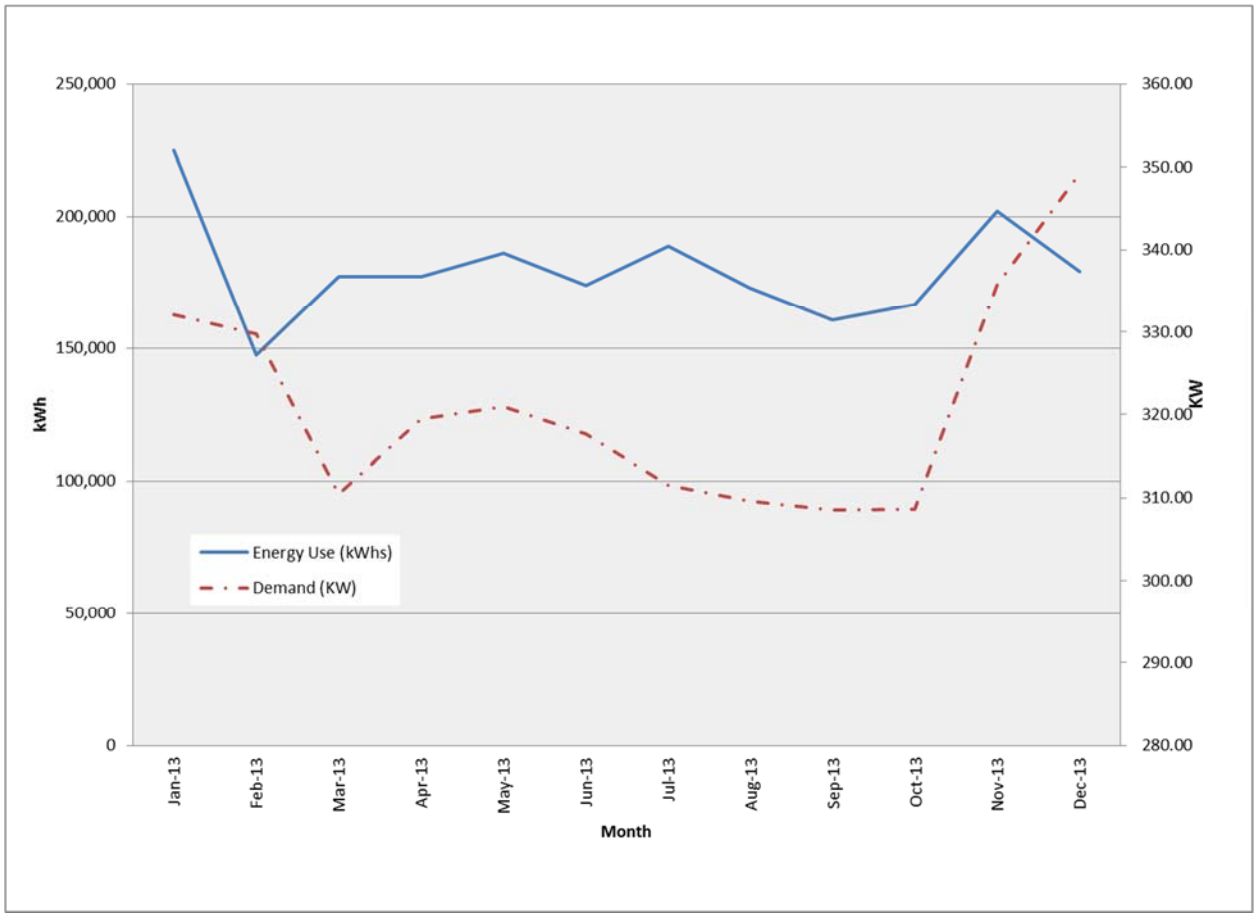


Figure 2. Monthly Electrical Usage and Demand – 2013

As shown in the figure above, the facility's electrical consumption was relatively stable, with an increase in usage and demand in the fall and winter months. This increase is likely due to heating buildings.

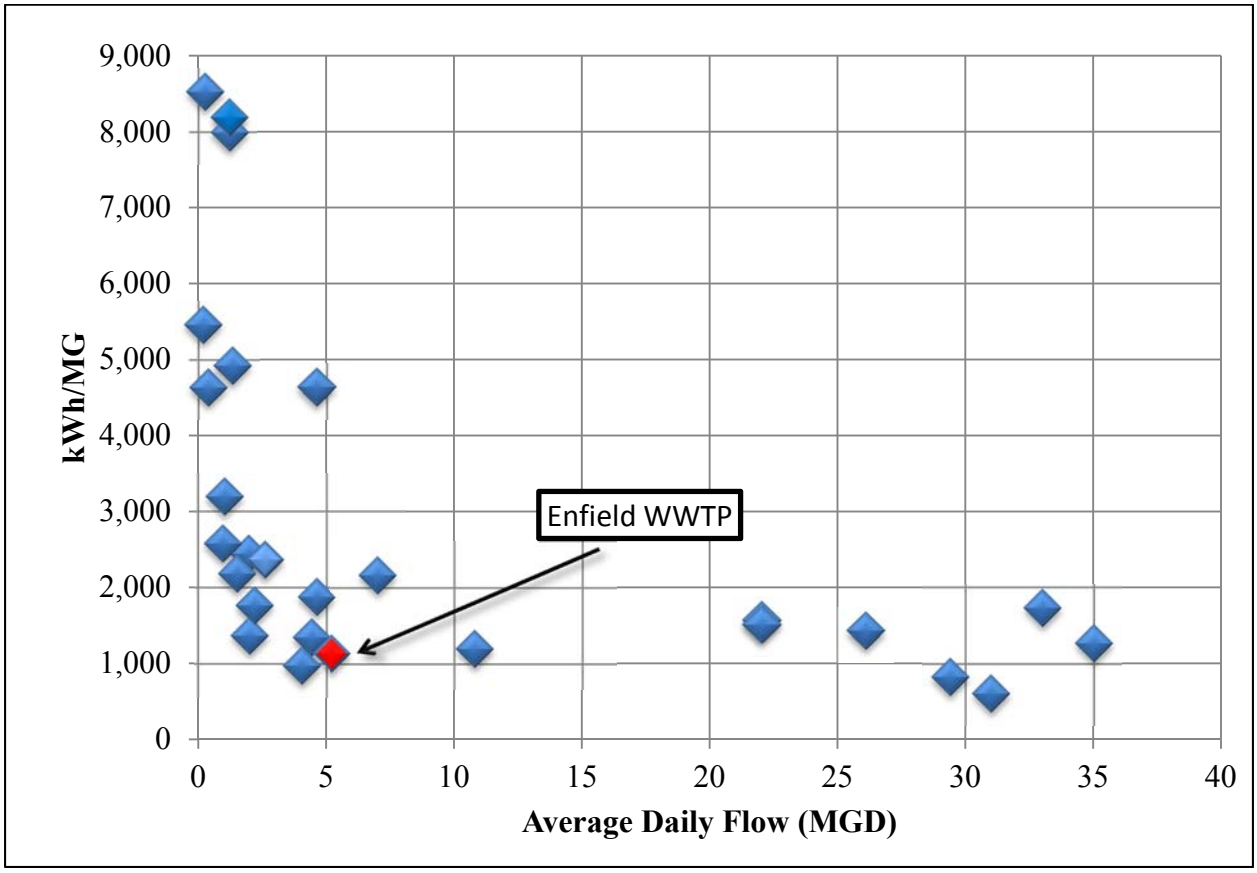
Under the TransCanada contract, generation/supply costs are based on the total kWh consumed by the facility. Eversource is currently billing the WPCF under the Small General Electric Service Rate 30 and Rate 37. Rate 30 is for customers with a maximum annual demand less than 200 kW. There are two demand charges under this rate – distribution and transmission. The demand charge schedule is based on the greatest average 30 minute kW demand recorded during the billing month. This rate is based on a demand no less than 2 kW. Time-of-day Rate 37 applies to customers with an annual maximum demand less than 350 kW, but greater than 200 kW. Under rate 37, the fees are based on a distribution demand charge, a production/transmission demand charge, a flat monthly distribution customer charge, and other fees associated with on- and off-peak kWh consumption. On-peak hours begin at 12:00 p.m. and end at 8:00 p.m. Eastern Standard Time (1:00 p.m. to 9:00 p.m. Daylight Savings Time) during the weekdays. Off-peak hours include all weekend hours and non on-peak weekday hours.

The Eversource production/transmission demand charge is based on the highest average 30 minute kW demand during the billed month. However, the distribution demand charge is based on the "highest average 30 minute kW demand in the current month or in the preceding eleven (11) months" per the tariff document. The distribution demand charge does not differentiate between on- and off-peak use, and is often referred to as the "ratchet". This distribution demand ratchet may be decreased through conservation measures and load management.

All electric customers have the option to negotiate their own rates with independent power supply companies or brokers. Customers who opt not to purchase generation power directly are automatically placed on either Eversource's Standard Service (maximum demand less than 500 kW) or Last Resort Service (maximum demand equal to or greater than 500 kW). Under this arrangement, Eversource negotiates a price for generation supply on behalf of aggregated customer blocks. The Enfield WPCF is currently purchasing power generation through TransCanada, a third party supplier. Under the current electrical supply contract, the facility pays a flat rate for power, and costs are not dependent on on/off peak pricing. In December 2013 and January 2014, the Enfield WPCF paid an average rate of $0.083 per kWh of electrical supply. At the end of the current contract, the facility should review electrical supply rates from other third party suppliers and Eversource. The current Eversource supply rates are 0.11934 per kWh for on-peak hours, and 0.08934 per kWh for off peak hours. If electrical supply rates continue to decrease, the facility may wish to explore a "blend and extend" agreement with their current independent power supply company.

Benchmarking

In 2013, the Enfield WPCF treated an average of 5.2 MGD Based on the electrical energy usage presented above, the treatment facility consumes approximately 1,137 kWh per million gallons treated. This energy usage is average when compared with the typical range for regional wastewater treatment facilities of similar size, as shown below.



Note: Data is based on a Massachusetts DEP Pilot Study as well as previously evaluated facilities.

Figure 3. Regional Wastewater Treatment Plant Performance

PUMP EFFICIENCY ANALYSIS

During the site visit, field measurements were taken in an effort to determine the hydraulic efficiency of selected process pumps. Spot readings of operating power, flow rate, and suction and discharge pressure were recorded where available for the operating pump(s) at each process or unit operation. Where pumps were operated by variable speed devices, readings were obtained at multiple operating speeds when possible.

In order to determine existing pump hydraulic efficiency, the spot readings were applied to the pump equation, as defined below.

$$Pump\ eff.(\%) = \frac{Flow\ (GPM)\ \times\ Head\ (Feet)\ \times\ 0.746}{3{,}960\ \times\ kW\ \times Motor\ eff.\ \times Driver\ eff.}$$

Efficiencies for variable speed devices are based on typical values for these devices as defined in the chart included in the appendix. Calculated pump efficiencies are provided in the table below.

Table 6. Pump Efficiency

Pump Name	Speed %	Leg	EMF (VAC)	Current (Amp)	Power (kW)	Power Factor	Flow (GPM)	Motor Eff. (%)	Suction (psi)	Discharge (psi)	TDH (feet)	Efficiency	Notes
Primary Sludge Pump 1		L1	277.0	2.0	0.5	0.60	75	90%	2.2	24	50.4		
		L2	276.0	2.0	0.5	0.3-0.6	75	90%	2.2	24	50.4		
		L3	276.0	2.0	0.1-0.8	0.5-0.6	75	90%	2.2	24	50.4		
		AVG/TOT	**478.1**	**2.0**	**1.0**	**0.6**	**75**	**90%**	**2.2**	**24**	**50.4**	**80%**	
Primary Sludge Pump 2		L1	276.5	2.0	0.1-0.5	0.40	55	90%	2.2	18	36.6		
		L2	275.0	2.0	0.1-0.4	0.42	55	90%	2.2	18	36.6		
		L3	276.0	2.0	0.1-0.6	0.47	55	90%	2.2	18	36.6		
		AVG/TOT	**477.2**	**2.0**	**1.0**	**0.4**	**55**	**90%**	**2.2**	**18**	**36.6**	**42%**	
RAS Pump 1	100%	L1	272.3	23.9	4.3	0.67	3015	91%	2.0	14	27.7		All three pumps running
		L2	274.0	24.6	4.5	0.67	3015	91%	2.0	14	27.7		
		L3	273.0	24.0	4.5	0.69	3015	91%	2.0	14	27.7		
		AVG/TOT	**472.5**	**24.2**	**13.3**	**0.7**	**3015**	**91%**	**2.0**	**14**	**27.7**	**NA**	
RAS Pump 2	100%	L1	272.5	18.0	4.9	0.97	3015	91%	2.0	14	27.7		All three pumps running
		L2	274.0	17.6	4.8	0.99	3015	91%	2.0	14	27.7		
		L3	272.9	17.8	2.6	0.64	3015	91%	2.0	14	27.7		
		AVG/TOT	**472.5**	**17.8**	**12.3**	**0.9**	**3015**	**91%**	**2.0**	**14**	**27.7**	**NA**	
RAS Pump 3	100%	L1	273.0	22.0	4.4	0.75	3015	89%	2.0				All three pumps running
		L2	274.0	22.0	4.5	0.75	3015	89%	2.0				
		L3	273.0	21.4	4.3	0.75	3015	89%	2.0				
		AVG/TOT	**472.9**	**21.8**	**13.2**	**0.8**	**3015**	**89%**	**2.0**			**NA**	
RAS Pump 2	100%	L1	274.0	21.9	5.8	0.96	1688	91%	2.0	8	13.9		Only this pump running
		L2	275.8	21.8	4.5	0.78	1688	91%	2.0	8	13.9		
		L3	275.0	22.3	6.0	0.98	1688	91%	2.0	8	13.9		
			475.6	**22.0**	**16.3**	**0.9**	**1688**	**91%**	**2.0**	**8**	**13.9**	**30%**	
RAS Pump 3	100%	L1	273.0	24.5	5.1	0.77	1830	89%	2.0				Only this pump running
		L2	275.0	24.0	5.1	0.77	1830	89%	2.0				
		L3	273.8	24.4	5.1	0.77	1830	89%	2.0				
		AVG/TOT	**473.9**	**24.3**	**15.3**	**0.8**	**1830**	**89%**	**2.0**			**NA**	
RAS Pump 1	100%	L1	273.0	26.5	5.3	0.71	1950	91%	2.0	10	18.5		Only this pump running
		L2	274.0	27.2	5.2	0.71	1950	91%	2.0	10	18.5		
		L3	273.0	26.6	5.3	0.72	1950	91%	2.0	10	18.5		
		AVG/TOT	**472.9**	**26.8**	**15.8**	**0.7**	**1950**	**91%**	**2.0**	**10**	**18.5**	**47%**	
WAS Pump	48%	L1	272.5	1.0	0.1	0.35	66	88%					
		L2	274.0	1.2	0.1	0.37	66	88%					
		L3	273.0	1.5	0.2	0.40	66	88%					
		AVG/TOT	**472.6**	**1.2**	**0.4**	**0.4**	**66**	**88%**	**NA**	**NA**	**NA**	**NA**	
Plant Water Pump 1		L1	272.9	32.0	7.2	0.83			0.5	79	181.3		
		L2	274.0	32.5	7.3	0.83			0.5	79	181.3		
		L3	273.0	31.7	7.1	0.83			0.5	79	181.3		
		AVG/TOT	**472.8**	**32.1**	**21.6**	**0.8**	**NA**	**NA**	**0.5**	**79**	**181.3**		
Plant Water Pump 2		L1	273.4	31.9	7.11	0.83			1.0	75	170.9		
		L2	274.2	32.9	7.4	0.82			1.0	75	170.9		
		L3	272.8	32.2	7.2	0.83			1.0	75	170.9		
		AVG/TOT	**473.1**	**32.3**	**21.6**	**0.8**	**NA**	**NA**	**1.0**	**75**	**170.9**	**NA**	

NOTE: RAS Pump readings with all three in oepration gave a total flow for all three pumps, which does not allow us to calculate the efficiency in that mode of operation.

Table 7. Equipment Data

Pump Name	Leg	Volts	Current (Amp)	Power (kW)	Power Factor	Motor Efficiency	RPM	HP	Flow (CFM)	Notes
Odor Control Exhaust Fan	L1	276.5	25.0	5.6	0.82	93.0	1770	30		
	L2	275.5	23.9	5.2	0.79	93.0	1770	30		
	L3	275.6	26.9	6.2	0.83	93.0	1770	30		
	AVG/TOT	**477.2**	**25.3**	**17.0**	**0.8**	**93.0**	**1770**	**30**		
Blower	L1	275.6	182.0	46.5	0.92	95.0	3560	200	2600	1 of 4 blowers operating
	L2	277.2	186.7	47.8	0.90	95.0	3560	200	2600	
	L3	276.3	181.9	46.8	0.91	95.0	3560	200	2600	
	AVG/TOT	**478.1**	**183.5**	**141.1**	**0.91**	**95.0**	**3560**	**200**	**2600**	
Mixer 2 & 3	L1	275.5	17.0	2.7	0.60			7.5		
	L2	277.0	17.0	2.7	0.60			7.5		
	L3	276.0	16.7	2.6	0.57			7.5		
	AVG/TOT	**477.8**	**16.9**	**8.0**	**0.59**			**7.5**		
Mixer 1 & 4	L1	275.4	17.7	2.8	0.60			7.5		
	L2	275.9	17.2	2.5	0.55			7.5		
	L3	276.7	17.9	2.8	0.56			7.5		
	AVG/TOT	**477.5**	**17.6**	**8.1**	**0.57**			**7.5**		

Conducting periodic equipment efficiency testing is an effective way of determining pump performance and can act as a helpful tool for determining if regular operation and maintenance measures are successful and time-worthy. Further, the data collected for pump efficiency testing can offer valuable insight regarding a facility's energy consumption and demand, as detailed in the Energy Conservation Measures below.

ENERGY CONSERVATION MEASURES

OM #1 – Bar Screen Control

The 3.5 hp mechanical bar screen currently operates continuously. The original controls included automatic control based on differential pressure or level. However, the intermittent operation of the screen resulted in flow surges through the influent flow meter. The internal recycle (IR) pumps were originally automated based on influent flow and nitrogen concentrations, the recorded flow surges resulted in significant fluctuations in the IR pump speed and flow. As a result, the screen is currently operated in hand. Reestablishing the automatic operation of the screen would provide for electrical energy savings, and would not currently impact the IR pump operation as these pumps are no longer automatically varied based on influent flow.

Calculations

The energy usage of the mechanical screen under continuous operation is calculated below, along with the energy usage of intermittent operation.

Table 8. Energy Use

Condition	HP	kW[1]	Hrs/yr	kWh/yr	Annual Reduction (kWh/yr)
Current Operation	3.5	2.22	8,760	19,442	--
Proposed Operation[2]	3.5	2.22	1,460	3,240	16,201

1. Assumes 85% motor loading
2. Intermittent use based on operating 10 minutes each hour

If the IR pump operation is modified to return a percentage of influent flow, as recommended in ECM 4, programming changes may allow for the IR flow and speed to be less susceptible to rapid fluctuations in influent flow caused by the intermittent screen operation. For example, the IR pumps could respond to an average influent flow calculated over a 10 to 20 minute period.

Summary of Cost and Savings

The energy reduction and savings from the existing conditions to reduced hours of operation are presented in the following table. There is assumed to be no cost associated with implementation of this measure, assuming the screens can be switched back to automatic operation.

Table 9. Energy Savings & Cost

Annual Reduction (kWh)	16,201
Billing Rate	$0.124
Annual Savings	**$2,009**
Project Cost	$0
Simple Payback	**Immediate**

ECM #1 – RAS Pump Rebuild

Currently, activated sludge is returned to the aeration basin via three 20 hp pumps that are operated on VFDs. Under the current operation all three pumps operate continuously at full speed.

Table 10. Pump Specifications

Parameter	RAS Pump
HP	20
No. of Units	3
Motor Efficiency	91%
RPM	885
GPM	1,800
TDH	20
Flow Control	VFD

Each of the RAS pumps was tested during the site visit, with all three pumps in operation, as well as individually, to determine the system conditions and the current operating efficiency of the pumps. The field testing data is included below.

Table 11. RAS Pump Efficiencies

Pump Name	Speed	Power	Power Factor	Flow	Motor Eff.	TDH	Efficiency	Notes
	%	(kW)		(GPM)	(%)	(feet)		
RAS Pump 1	100%	13.3	0.7	3015	91%	27.7	NA	All three pumps running
RAS Pump 2	100%	12.3	0.9	3015	91%	27.7	NA	All three pumps running
RAS Pump 3	100%	13.2	0.8	3015	89%		NA	All three pumps running
RAS Pump 2	100%	16.3	0.9	1688	91%	13.9	30%	one pump operation
RAS Pump 3	100%	15.3	0.8	1830	89%		NA	one pump operation
RAS Pump 1	100%	15.8	0.7	1950	91%	18.5	47%	one pump operation

Based on the spot readings of the pumps, they are currently operating significantly below the original design conditions. Rebuilding the pumps would provide an opportunity to reduce the energy consumption of this pumping system.

Given the average daily flow of 5.2 MGD and a RAS pumping rate of approximately 3,000 gpm the plant returns about 83% of the influent flow. If secondary treatment process could tolerate a lower RAS return rate, the energy usage of the RAS pump could be further reduced by lowering the speed of the pumps.

Calculations

Base Case

The baseline condition includes the operation of all three 20 hp pumps continuously at full speed. Electrical readings were taken during the site visit which were representative of actual typical operating conditions. At the time of the field test, a total kW of approximately 39 was obtained at a flow of approximately 3,000 gpm and a TDH of 28 feet. The annual energy consumption of the RAS pumps is shown in the table below. These pumps are operating at a higher TDH than the design point, which may indicate that the current pumps are undersized for the head requirements of the system.

Table 12. Existing Conditions

Total kW	Annual kWh	Annual Cost	TDH (ft)	Flow (gpm)
38.7	338,837	$42,016	27.7	3015

Notes:

1)kW based on measured values
2)Annual kWh based on continuous operation
3)Annual Cost based on $0.124/kWh

Proposed Case

The original pump curve was obtained from the manufacturer and is represented in the figure below. Using the original pump curve the efficiency was estimated to be approximately 60% under rebuilt conditions. Under rebuilt conditions three pumps would be required to meet the 3,000 gpm flow requirement, with each of the pumps contributing approximately 1,000 gpm.

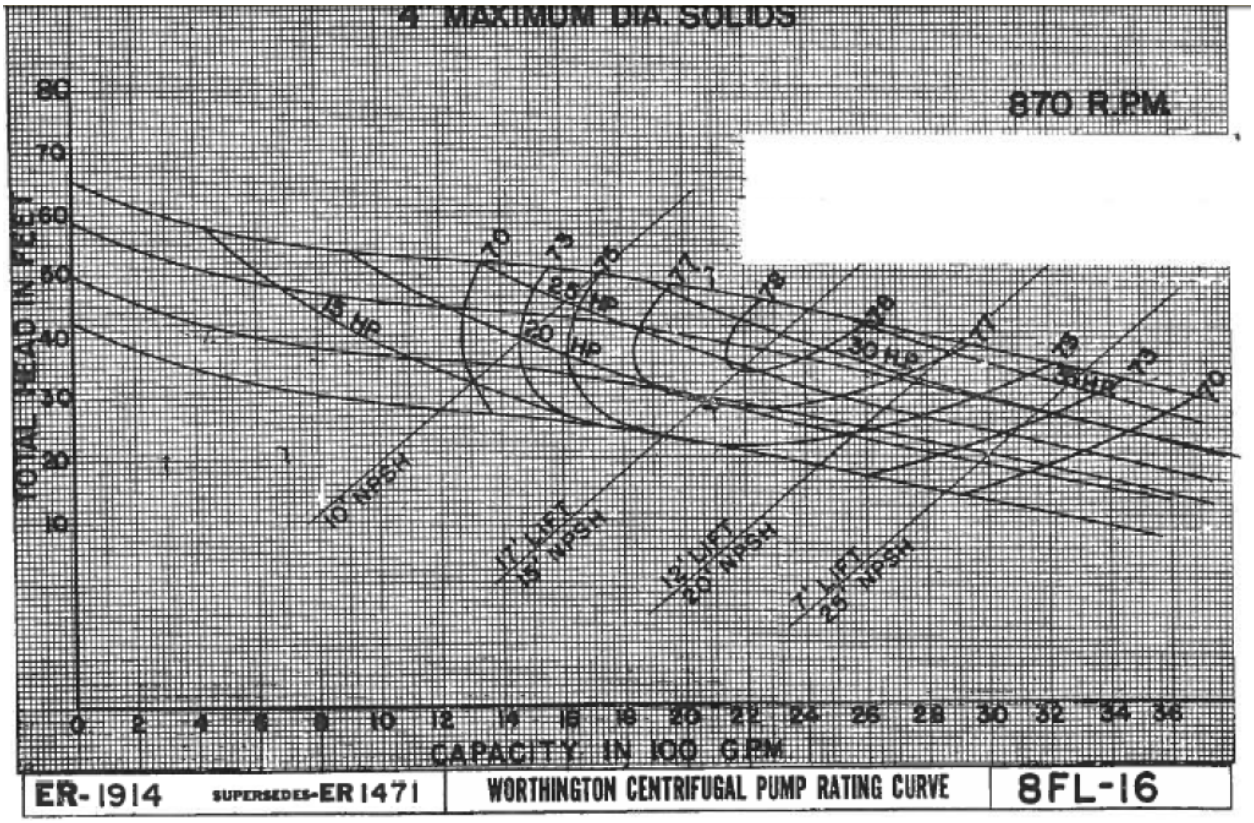


Figure 4. Original Pump Curve

The pump equation below was used to determine the new kW power draw based on the rebuilt conditions.

$$Pump\ eff.(\%) = \frac{Flow\ (GPM)\ \times\ Head\ (Feet)\ \times\ 0.746}{3{,}960\ \times\ kW\ \times Motor\ eff.\ \times Driver\ eff.}$$

Table 13. Proposed Conditions

Flow (gpm)	TDH	Motor Efficiency	Pump Efficiency	VFD Efficiency	kW
1,000	27.7	91%	60%	97%	9.7

Notes:

1) Flow based on assumed rebuilt operating point
2) TDH as measured in the field
3) Motor Efficiency based on manufacturer information
4) Pump Efficiency based on curve
5) VFD Efficiency based on typical values
6) kW calculated based on one pump in operation.

Table 14. Proposed Consumption

Total kW	Annual kWh	Annual Cost
29.3	256,849	$ 31,849

Notes:
1) Total kW based on three pumps in operation
2) Annual kWh based on continuous operation
3)Annual cost based on $0.124/kWh

Savings
The estimated electrical and cost savings are presented below.

Table 15. Potential Savings

Condition	Annual kWh	Annual Cost
Existing Conditions	338,837	$ 42,016
Proposed Conditions	256,849	$ 31,849
Savings	**81,988**	**$ 10,167**

Budgetary Cost Estimate
Implementation of the measure would involve rebuilding the existing pumps. A pump rebuild often includes pump disassembly, blast and clean; replacement of bearings and packing as required; replacement of the mechanical seal; new painting and coatings; and reassembly and re-installation. The pump rebuild process will restore impeller clearances and pump efficiency to original manufacture tolerances and levels, respectively. The approximate cost to rebuild three 20 hp pump is shown in the table below.

Table 16. Cost Estimate

Three 20 hp Rebuild	$	30,000
Labor 10%	$	3,000
Sub total	$	33,000
Contingency 30%	$	9,900
Total	**$**	**42,900**

Summary of Cost and Savings
The savings associated with this measure and the simple payback are presented below. It is important to note that pump efficiencies will decline over time due to wear and tear of the pump. Therefore, the savings presented below are an estimate of the first year savings associated with this measure as they reflect the optimum pump efficiency. The annual savings will decline as the efficiency of the units drops due to their operation and wear and tear. It is recommended that the pump efficiency be checked frequently to assess the condition of the pumps as they are placed into service. This will help staff determine the maintenance required to maintain the hydraulic

efficiencies of the units at their optimum, ensuring that the energy savings are materialized on an annual basis.

Table 17. Simple Payback

Project Cost	$ 42,900
Annual savings	$ 10,167
Payback	**4.2**

Note: Payback is based on the first year savings

Incentive

Pump rebuilds are currently eligible for incentives through Eversource's Custom Measure program. The payback period presented above is calculated prior to any available incentives through Eversource, and these incentives would be expected to reduce the payback period.

ECM #2 – Aeration Blower Replacement

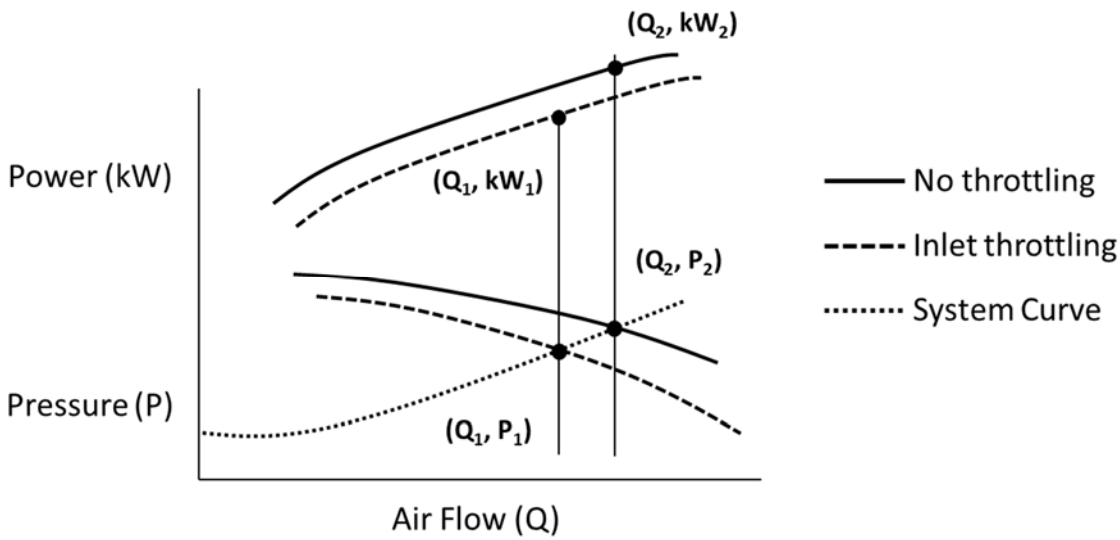
Aeration is provided to the fine bubble membrane diffusers in the aeration tanks (four trains) by four, single speed 200 hp multistage centrifugal blowers. The air flow is controlled by an inlet throttling valve, which is currently manually varied based on DO levels in the aerated zones. The Biochem control system for the secondary treatment system included automatic control of the blowers based on header pressure. There are flow control valves at the drop leg for each tank, which are controlled by air flow meters and the control system which monitors DO and ammonia levels. Typically, one blower is operated at a time, and operation is cycled between the blowers. The blowers are oversized, and limited by the turn capability of throttling, so blow-off valves were added to allow for 100 cfm of air to be released at Tanks 1 and 4.

Calculations

The baseline condition includes the operation of one 200 hp multi-stage centrifugal blower, controlled by the inlet throttling valve. Electrical readings were taken during the site visit and at the time of the field measurement the operating blower was drawing 141 kW at an air flow of approximately 2600 scfm, and discharge pressure of approximately 6.8 psi. The inlet valve was ~50% open, which represents the minimum condition. Due to varying air temperature conditions, as well as fluctuating flows and loads, the airflow required to maintain adequate DO in the aeration tanks varies diurnally and seasonally. No trending or data logging of blower airflow, or discharge pressure was available to determine typical trending. However, the operations staff indicated that the blower is typically operated at the 50% open condition, except during high air demand periods (during the summer months) when the valve may be opened to 75%.

When an inlet valve is throttled to control the air flow through a blower, the unit no longer operates on its original design curve due to the headloss associated with the inlet valve. Instead, the blower operates on a new curve that incorporates the headloss associated with the percent opening of the inlet valve. Each specific valve position, therefore, corresponds to a new blower curve, providing the relationship between air flow and pressure (see Figure below). Infinite blower curves are generated depending on the valve position as well as new horsepower curves. The change in air density due to the pressure drop across the inlet valve and reduction in the blower inlet pressure, results in lower power requirements at lower air flows.

Inlet throttling curves are typically not provided by blower manufacturers. As noted in the figure, operation of a blower at lower air flows with inlet throttling will result in lower power consumption due to the lower mass of air handled by the blower. The blower, however, does have to compensate for the higher head loss associates with the closure of the inlet valve.



Source: Modified from Liptak, Bela G. Instrument Engineer's Handbook Process Control and Optimization Third Edition. 1999.

Figure 5. Inlet Throttling Blower Curves

Adiabatic principles show that the power consumption at each flow condition is a function of the air mass, inlet and discharge pressures, and blower efficiency as explained in the following formulas.

$$bhp = 0.01542 \times \frac{Q \times pi \times X}{n}$$

Where:

bhp = brake horsepower
Q = blower inlet cubic feet per minute (ICFM)
pi = blower inlet pressure (psia)
n = blower efficiency
X = blower adiabatic factor defined as:

$$X = \left(\frac{pd}{pi}\right)\text{^}0.283 - 1$$

Where:

pd = discharge pressure (psia)

The efficiency of the blower under the design condition, as well as the measured condition, using the adiabatic formula, are presented below.

Table 18. Blower Efficiency

Parameter	Values	
Air flow (SCFM)	4,500	2,600
Pressure (psig)	7.1	6.8
kW[1]	149.2	141.0
Calculated BHP	190.0	179.6
Blower Mechanical Efficiency (%)	64%	38%

NOTE: kW under the design condition is based on the 200 hp motor sizing.

The blower, under the existing conditions, appears to be operating relatively inefficiently, and the electrical readings suggest only a small incremental reduction in the energy usage at the lower flow (throttled) condition.

To conservatively reflect the current annual energy usage of the blowers, it is assumed that the measured value of 141 kW represents the annual average condition. The estimated energy consumption of the blowers is calculated below.

Average kW	Hrs/yr	kWh/yr
141.0	8,760	1,235,160

If the blowers could be operated on VFDs to control airflow, as opposed to inlet throttling, it is assumed that the blower efficiency could be maintained at a higher efficiency over a broader range of air flows.

To estimate the power draw of the blowers utilizing VFDs the current estimated average airflow and pressure conditions are used, and a conservative assumption of the blower efficiency at reduced speed.

Table 19. Estimated Power Draw of Blowers with VFDs

Parameter	Values
Air flow (SCFM)	2,600
Pressure (psig)	6.8
Blower Mechanical Efficiency (%)	50%
BHP	136
kW	107

Notes: Blower efficiency estimated

While installing a VFD may provide some savings as compared to the existing inlet throttled control, it will not increase the turndown of the blowers, and allow for greater control of system

performance. Improved process control as well as reduced energy usage could be achieved by installing a new blower or replacing an existing blower with a more efficiency technology. This may allow the same airflows to be provided more efficiently, but may also allow for a smaller blower to be installed that would operate without blow off air, and then could respond to actual air requirements in the tanks via the automated control system.

Woodard & Curran has evaluated several blower technologies that would meet the flow and pressure requirements of the system. High speed turbo blowers, positive displacement blowers as well as hybrid rotary lobe compressors, were considered for replacement of the existing multistage centrifugal blowers. The proposed blower curves for each option are included as an appendix. Based on the efficiency and energy usage of the options considered, the hybrid units meet the design requirements at the lowest energy usage.

A more detailed evaluation of the available blower technologies, as well as final selection and sizing of the blower will be developed as part of the upgrade design.

It is assumed that a replacement blower could operate more efficiently, and would operate continuously. Based on preliminary equipment information received, a new hybrid unit could be expected to operate at 70% efficiency (conservative estimate based on manufacturer provided data). The kW draw of the new blower is calculated below for several conditions including the current estimated average airflow of ~2,600 cfm and a lower airflow of 2,400 cfm. The low airflow condition reflects elimination of the air currently being blown off (~200 cfm), and potential improvements to process control that would allow for automated control that could minimize over aeration.

Table 20. Electrical Draw of New Blower

Parameter	Values	
Air flow (SCFM)	2,600	2,400
Pressure (psig)	6.8	6.8
Blower Mechanical Efficiency (%)	70%	70%
BHP	97	90
kW	78.6	72.5

Notes: kW includes 95% motor efficiency and 97% VFD efficiency

The estimated annual energy usage of the new, smaller blower and reduced airflow is estimated below.

Table 21. Energy Usage

Condition	kW	Hrs/yr	kWh/yr
New Blower	72.5	8,760	635,283

Budgetary Cost Estimate
Budgetary costs for the blower improvements are estimated below.

Table 22. Budgetary Cost Estimate

Item	Estimated Cost
New Blower	$100,000
Installation, Piping, Ductwork (25%)	$25,000
Programming and Systems Integration (15%)	$19,000
Engineering (25%)	$36,000
Contingency (30%)	$54,000
Project Cost	**$234,000**

Summary of Costs & Savings

Table 23. Energy Savings & Payback

	New Blower
Annual Reduction (kWh)	599,877
Billing Rate	$0.124
Annual Savings	$74,385
Project Cost	$234,000
Simple Payback	**3.1**

Incentive

It is anticipated that this project would be eligible for incentive through Eversource's Custom Measure program. The payback period presented above is calculated prior to any available incentives through Eversource, and these incentives would be expected to reduce the payback period. The incentive would be based on the current program cap of up to $0.30 per annual kWh saved or up to 40% of the project cost (the lesser of).

ECM #3 – Plant Water System VFD Installation

Plant effluent water is recirculated via two, single speed 40 hp pumps. Typically, one pump is operated continuously, with pressure varying based on the system demand. The pumps circulate treated plant effluent water to various locations around the plant buildings, as well as process equipment that require non-potable water. These include hose bibs throughout the plant, the dewatering equipment, aeration tank foam spray water, and chemical addition systems. By minimizing the operating pressure of the system to a point where adequate plant water flow and pressure is still available, the overall energy usage of the plant water system will decrease.

Base Case

At the time of the site visit, one pump was operating at full speed, at a pressure of 79 psi. There was not a flow meter installed on the plant water system so the flow rate is unknown. Electrical measurements were taken of both pumps, and the average kW draw at approximately 79 psi was 23 kW. The pressure and flow rate of the system vary based on the plant water demands, and fluctuate throughout the day and seasonally with changes in operation (chemical systems offline etc). In order to determine the estimate flow rate of the pump at the time of the site visit the pump equation was used, given the measured pressure and kW, and an assumed pump efficiency. Pump 1 was recently rebuilt so its efficiency is assumed to be comparable to a new pump of this type and size.

Table 24. PWS Operation Specifications

Measured kW	Measured Pressure (psi)	Assumed Pump Efficiency[1]	Assumed Motor Efficiency[2]	Calculated Flow Rate (gpm)
21.6	78	0.65	0.93	385

1. Pump 1 has recently been rebuilt
2. Efficiency not indicated on motor nameplate

An analysis was performed to determine the annual energy usage of the system, using estimated annual hours of operation at various flow rates.

Table 25. Base Case: Plant Water System Energy Usage

System Flow (GPM)[1]	System Pressure (PSI)[2]	Motor Eff.[3]	Pump Eff. (%)[4]	Estimated Power (kW)	Annual Operation (hrs)[5]	Annual Energy Use (kWh)
385	78	93%	65%	21.7	4,380	95,039
275	95	93%	60%	20.4	3,066	62,623
150	102	93%	50%	14.3	1,314	18,765
Total						**176,427**

Notes:
1) System flowrate estimated
2) System Pressure based on similar pump curves
3) Motor efficiency assumed
4) Pump efficiency estimated from similar pumps
5) Annual hours estimated based on estimated usage.

Proposed Case

It may be feasible to reduce the system pressure while maintaining an adequate non-potable water supply. The pump curve is not available, so estimated pump efficiencies were used to determine energy usage at the lower pressure control set point.

Shown below is the estimated energy usage of the plant water system operating at a reduced pressure.

Table 26. Plant Water Pump: Reduced Energy Usage

System Flow (GPM)[1]	System Pressure (PSI)[2]	Motor Eff.[3]	Pump Eff. (%)[6]	VFD Eff. (%)[4]	Estimated Power (kW)	Annual Operation (hrs)[5]	Annual Energy Use (kWh)
385	65	93%	65%	97%	18.6	4,380	81,346
275	65	93%	63%	97%	13.7	3,066	41,964
150	65	93%	55%	97%	8.6	1,314	11,237
Total							**134,547**

Notes:
1) System flowrate estimated
2) System Pressure based on constant pressure controls
3) Motor efficiency assumed
4) VFD Efficiency based on typical values.
5) Annual hours estimated based on estimated usage.
6) Pump efficiency estimated from similar pumps

Project Cost and Savings

Shown below is the estimated energy and cost savings associated with the implementation of this energy conservation measure.

Table 27. Energy Cost & Savings

Condition	kWh	Cost
Base Case	176,427	$21,877
Proposed Case	134,547	$16,684
Savings	**41,880**	**$5,193**

The replacement of the plant water system (pumps and controls) is proposed as part of the facility upgrade. On a short term basis, the savings associated with variable speed operation of the pumps could be obtained by adding VFDs to the existing pumps and implementing a temporary pressure control system.

Annual Reduction (kWh)	41,880
Billing Rate	$0.124
Annual Savings	$5,193
Project Cost	$50,500
Simple Payback	**9.7**

Incentive

It is anticipated that this project would be eligible for incentive through Eversource's Custom Measure program. The payback period presented above is calculated prior to any available incentives through Eversource, and these incentives would be expected to reduce the payback period. The incentive would be based on the current program cap of up to $0.30 per annual kWh saved or up to 40% of the project cost (the lesser of).

ECM #4 – Internal Recycle Pump Control Adjustment

The secondary treatment process includes four trains of anoxic/aeration tanks. One, 10 hp, variable speed submersible internal recycle (IR) pump is installed in the third aerated zone of each train and return flow to the pre-anoxic tanks. The control system originally included automated control of the IR pumps based on influent flow and ammonia/nitrate levels. Under current operation, the IR pumps are operated in hand at full speed.

It may be feasible to reduce the energy usage of this pumping system by reducing the speed of the pumps or reprogramming the control system to allow for automatic flow pacing.

Calculations

Based on the pump curve and a design point of 6,338 gpm at 2 feet TDH, the rated power of the pumps is 7.5 kW. The annual energy usage of the IR pumps under full speed operation is estimated in the following table. The pump curve for the existing IR pumps is included as an appendix.

Table 28. Existing Energy Usage

Conditions	Speed	No. of Pumps	Rated Power (kW)	VFD Eff. (%)	Estimated Power (kW)	Annual Operation (hrs)	Annual Energy Use (kWh)
IR Pumps (3 trains)	100%	3	7.5	97%	7.7	8,760	203,196
IR Pumps (1 train)[1]	100%	1	7.5	97%	7.7	6,744	52,144
Total							**255,340**

Notes:
1) One train offline for several months
2) Estimated power is based on the rated power divided by the VFD efficiency.

Based on the curve, at full speed operation, each pump is operating at 6,338 gpm, for a total flow of 25,352 gpm (36.5 MGD). This represents 700% of average influent flow (5.3 MGD). Under the proposed operation, the internal recycle pump speed would be reduced either through manual speed adjustment or by automating the pump speed with influent flow. A typical IR pump flow rate is between 200% and 400% of influent flow. Assuming 400% of influent is required, the total IR pump flow is estimated to be 20.8 MGD (14,444 gpm), or 3,611 gpm per pump. Based on the existing pump curve, and a head of approximately 1.2 ft at the reduced flow rate, the pumps would operate at approximately 40 Hz. The energy usage of the pumps under the proposed conditions is calculated below.

Table 29. Proposed Energy Use

Conditions	Speed	No. of Pumps	Rated Power (kW)[2]	VFD Eff. (%)	Estimated Power (kW)	Annual Operation (hrs)	Annual Energy Use (kWh)
IR Pumps (3 trains)	67%	3	2.7	97%	2.8	8,760	73,151
IR Pumps (1 train)[1]	67%	1	2.7	97%	2.8	6,744	18,772
Total							**91,922**

Notes:
1) One train offline for several months
2) Based on the pump curve
3) Estimated power is based on the rated power divided by the VFD efficiency.

Summary of Costs & Savings

Because some modifications to the controls, and potential additional monitoring of the secondary treatment process may be required, to allow for IR pump turndown and automated flow pacing. A cost estimate of $3,000 is assumed for systems integration and other control modifications. The savings are presented in the following table.

Table 30. Savings

Annual Reduction (kWh)	182,190
Billing Rate	$0.124
Annual Savings	$22,592
Project Cost	$3,000
Simple Payback	**0.1**

Incentive

It is anticipated that this project would be eligible for incentive through Eversource's Custom Measure program. The payback period presented above is calculated prior to any available incentives through Eversource, and these incentives would be expected to reduce the payback period. However, because the project has such a low payback period, it may be appropriate to pursue funding for this measure in conjunction with other measures with longer payback periods. By evaluating the projects on a comprehensive basis the incentive available through the utility programs can be optimized.

ECM #5 – Odor Control Fan VFD Installation

The Odor Control System (OCS) consists of a packed tower with chemical addition and serves the sludge processing and grit removal areas. The exhaust fan associated with the odor control system consists of a 30 hp, single speed exhaust fan, which operates while solids processing is being conducted.

It may be feasible to install a VFD to reduce the speed of the 30 hp odor control fan on a continuous basis because it is sized for a much larger area than it currently serves. By installing a VFD on the fan, the speed can be reduced to minimize energy usage. This energy conservation measure includes operating the units on a VFD versus full speed operation.

Calculations

Under the base case, the fan operates at a constant speed year round (while dewatering). During the field visit, electrical readings of the 30 hp fan were taken. Shown below is the estimated annual energy usage of the odor control fan.

Table 31. Exhaust Fan – Existing Conditions

Condition	Design CFM	HP	kW	Hrs/yr	kWh/yr
Odor Control Fan	14,000	30	17.0	2,080	35,360

Note:
1) kW reading based on field measurements.

For the proposed case, the speed of the odor control fan would be controlled through a VFD.

To estimate the electrical savings associated with this measure, the following assumptions were made:

- Reduced speed fan operation to 75% when the fan is in operation;
- The reduced power consumption using a VFD was calculated using the affinity fan laws. The calculation was based on the squared (instead of the cubed law) to adopt a conservative approach. A VFD efficiency of 97% was used.

The proposed energy usage is summarized in the following table.

Table 32. Exhaust Fan – Proposed Conditions

Condition	CFM	VFD Eff.	kW	Hrs/yr	kWh/yr
Existing	14,000	-	17.0	2,080	35,360
Proposed - Reduce speed to 75%	10,500	97%	9.6	2,080	19,890
Annual Total					55,250

Notes:
1) Proposed summer based on field readings and includes VFD efficiency.
2) Winter kW calculated based on affinity laws to the 2nd power
(Power 2 = Power1 * (CFM2/CFM1)2 / VFD Efficiency).

The estimated electrical and cost savings are presented below.

Table 33. Exhaust Fan – Energy Savings

Condition	Energy Use (kWh)	Energy Cost ($)
Existing	35,360	$4,385
Proposed	19,890	$2,466
Savings	**15,470**	**$1,918**

Note: Costs based on a blended rate of $0.124/kWh.

Budgetary Cost Estimate

The costs included below are a budgetary estimate of the potential costs associated with this measure, and are based on typical costs for VFDs. This project would also require programming, and potentially additional instrumentation to implement this measure.

Table 34. Exhaust Fan – Project Cost

Item	Estimated Cost
1 - 30 HP VFD	$7,500
Instrumentation, Electrical Installation, Programming, SCADA/Systems Integration	$5,000
Contingency (20%)	$2,500
Project Cost	**$15,000**

NOTE: VFD cost is based on $250 per HP

Summary of Cost and Savings

Table 35. Exhaust Fan – Cost Savings and Payback

Item	Cost
Annual Reduction (kWh)	15,470
Billing Rate	$0.124
Annual Savings	$1,918
Project Cost	$15,000
Simple Payback	**7.8**

The proposed installation of a VFD on the existing exhaust fan, which was originally designed for a larger area than it currently serves, would reduce energy usage, resulting in annual savings of almost $2,000 per year. It should also be noted, that the reduced speed to 75% was used as a conservative estimate for the purposes of this evaluation. In addition to reducing energy usage, it may also reduce the load during peak operations. As discussed above, the plant is subject to a demand charge, the demand charge may potentially be reduced if equipment load is reduced during peak hours of operation, such as when the plant is conducting solids processing during first shift. Additional investigation into the current peak load during daytime operating hours could assist the WPCF in determining what areas have the greatest impact on the demand charges.

Incentive

As part of the facility upgrades the odor control system will be upgraded to a biofilter system, which will include a new 25hp fan. The new system is proposed to operate continuously to provide ventilation and odor control. If a VFD is installed on the fan to allow for seasonal turndown of the system, in accordance with NFPA 820 regulations, the cost associated with the VFD could be eligible for incentives through Eversource.

It is anticipated that this project would be eligible for incentive through Eversource's Custom Measure program. The incentive would be based on the current program cap of $0.30 per annual kWh saved or up to 40% of the project cost (the lesser of).

ECM #6 – Aeration Tank Mixing System – High Efficiency Mixer Upgrade

The aeration system at the Enfield WPCF consists of five (5) separate zones – a primary anoxic zone, three (3) aerobic zones, and one (1) secondary anoxic zone. In the primary and secondary anoxic zones, submersible propeller mixers have been installed to maintain adequate mixing while the wastewater is not being aerated. There are a total of four (4) primary-anoxic zones, and four (4) secondary-anoxic zones. As part of the preliminary facilities plan, the Enfield WPCF is investigating the installation of mixers in one of the aerobic "swing" zones to allow additional functionality of the secondary treatment process.

The Enfield WPCF is currently working with Woodard & Curran to develop a facilities plan, which will identify which plant systems and process will be upgraded, repaired, or replaced as part of a comprehensive upgrade. One of the proposed upgrades will include the aeration mixing system, as noted in the previous ECM. The aeration tanks currently includes a primary anoxic zone, three aerobic zones, and a secondary anoxic zone. Woodard & Curran has recommended that one of the three aerobic zones be used as a "swing" zone, to allow operational flexibility in the secondary treatment process. This means that the zone can be treated as either an aerobic zone, or an anoxic (mixed) zone, and will require the installation of additional mixing systems. Woodard & Curran has explored a number of options including compressed gas mixing systems, floating propeller mixers, and hyperbolic vertical shaft mixers.

Currently, there is one (1) submersible propeller mixer installed in each of the four primary-anoxic and secondary-anoxic zones. The primary-anoxic mixers are rated at 7.5 hp each, and the secondary-anoxic mixers are rated at 4 hp each. The mixers run continuously throughout the year while the aeration tanks are online. Typically, all four aeration trains will operate, with the only exception being a 3-month period in the winter during which one train is shut down. To account for this, a mean value of 8,256 annual hours will be used in all calculations. Shown below is the estimated energy usage of the standard submersible propeller mixers under the current configuration.

Table 36. Base Case Annual Energy Use of Aeration Mixers

Zone	Mixer Quantity	Size (HP)	Est. Motor Loading	Est. Line Power (kW)	Annual Operation (hrs)	Annual Energy Usage (kWh)
Primary Anoxic	4	7.5	-	4.0	8,256	**132,096**
Secondary Anoxic	4	4	80%	2.4	8,256	**78,835**
Total						**210,931**

Note:
1) Primary Anoxic Power values based on field readings
2) Secondary Anoxic Power Values based on motor loading estimates
3) Annual operating hours reduced from 8760 to reflect a 3-month period where one aeration train is offline

Base Case

The purpose of this ECM is to explore the energy savings of the proposed high-efficiency mixing options, compared to the installation of traditional submersible propeller mixers. The base case is calculated using standard, induction motor, submersible mixers. It is assumed that since the swing zone is the same size as the primary anoxic zone, the same quantity of mixers will be installed. Shown below is the estimated annual energy usage associated with the installation of traditional submersible propeller mixers, which will be used as the Base Case comparison for the other mixing alternatives.

Table 37. Base Case Energy Usage of Traditional Mixers

Zone	Qty.	Rated Mixing Power (kW)	Motor Efficiency	Input Power (kW)	Annual Operation (hrs)	Annual Energy Usage (kWh)
Primary Anoxic	8	3.5	76%	4.6	8,256	304,168
Secondary Anoxic	8	3.1	83%	3.7	8,256	246,483
Swing/Aerobic	8	3.5	76%	4.6	8,256	304,168
					Total	854,820

Note:
1) Input power referenced from manufacturer's cut sheet.
2) Motor efficiency referenced from manufacturer's cut sheet.

Proposed Case 6A – Compressed Gas Mixing System

One of the energy-efficient mixing options being considered by the Enfield WPCF is the BioMix Compressed Gas Mixing System. This system consists of a single air compressor, which runs continuously to provide air to pipe headers located at the bottom of each zone. Each pipe header contains nozzles that modulate automatically to deliver small bursts of compressed air bubbles to provide mixing in the zone. These nozzles do not require any electricity to operate, so the only power demand of the mixing system is from the one compressor. The Enfield WPCF was provided with a proposal from EnviroMix, which stated a 20-horsepower compressor would be required to provide mixing to the four aeration tanks. Shown below is the proposed electrical energy usage of the BioMix system. A total of 1.2 HP is added to the compressor size to include fans and controls. Information provided by the Manufacturer is included in the appendix.

Table 38. Proposed Case Energy Usage of BioMix System

Zone	**Qty.**	**Size (HP)**	**Motor Loading**	**Estimated Line Power (kW)**	**Annual Hours**	**Annual Energy Usage (kWh)**
All Mixing Zones	1 Compressor	21.2	80%	12.65	8760	**110,833**
					Total	**110,833**

Note:
1) Compressor sizing provided by manufacturer.
2) Motor loading estimated based on typical data.

Shown below is the estimated energy and cost savings associated with the installation of the BioMix system in lieu of a traditional submersible propeller mixing system.

Table 39. BioMix System Energy and Cost Savings

Condition	Annual Energy Usage (kWh)	Annual Energy Cost ($)
Base Case	854,820	$105,998
Proposed Case	110,833	$13,743
Savings	**743,987**	**$92,254**

Note:
1) Enfield WPCF is billed $0.124 per kWh

Shown below is the estimated project cost, provided by EnviroMix, and the simple payback of the project. Since the BioMix system requires a large quantity of piping, valves, and controls, a conservative installation cost of 40% is used to calculate a budgetary project cost.

Table 40. BioMix Proposed Project Cost Estimate

Item	Cost
Compressor, Piping, and Nozzles	$497,000
Installation (40%)	$198,800
Total	**$695,800**
Annual Cost Savings	**$92,254**
Simple Pay Back (yrs)	**7.5**

Proposed Technology 6B – AquaAerobic AquaDDM Surface Mixing

Another potential energy-efficient mixing option is the AquaAerobic Direct Drive Mixing (DDM) System. This system utilizes a series of fixed, floating surface mixers, which are mechanically similar to submersible propeller mixers. The floating design allows for vertical, top-to-bottom mixing, which creates higher mixing energy than standard horizontal submersible propeller mixers of the same size. This increased mixing energy would allow for smaller mixers to be installed in each of the mixed zones at the Enfield WPCF.

AquaAerobic provided a proposal for the design and installation of an AquaDDM system at Enfield. Base on their calculations, two (2) – 2 HP mixers would be installed in each of the 12 mixed zones, for a total of twenty-four (24) 2 HP mixers. Shown below is the estimated annual energy usage of the proposed AquaDDM system. All information provided by the manufacturer is included in the appendix.

Table 41. Proposed AquaDDM Mixing System Energy Usage

Zone	Qty.	Size (HP)	Motor Loading	Est. Line Power (kW)	Annual Hours	Annual Energy Usage (kWh)
Primary Anoxic	8	2	80%	1.19	8256	**78,835**
Secondary Anoxic	8	2	80%	1.19	8256	**78,835**
Swing Aerobic Zone	8	2	80%	1.19	8256	**78,835**
					Total	**236,505**

Note:
1) Motor size provided by manufacturer.
2) Motor loading estimated based on typical data.

Shown below is the estimated energy and cost savings associated with the installation of the Aqua DDMsystem in lieu of traditional submersible propeller mixers.

Table 42. AquaDDM System Annual Energy and Cost Savings

Condition	Annual Energy Usage (kWh)	Annual Energy Usage ($)
Base Case	854,820	$105,998
Proposed Case	236,505	$29,327
Savings	**618,316**	**$76,671**

Note:
1) Enfield WPCF is billed $0.124 per kWh.

Shown below is the estimated project cost and simple payback of the AquaDDM System. Costs have been estimated based on information provided by AquaAerobic and a crane, which would be required to lift the mixers out of the basins for maintenance.

Table 43. AquaDDM System Project Cost and Payback

Item	Cost
(24) - 2HP DDM Mixers	$240,000
Crane for Mixers	$40,000
Installation (40%)	$112,000
Total	**$392,000**
Annual Cost Savings	$76,671
Simple Payback (yrs)	**5.1**

Proposed Case 6C – Invent Hyperbolic Vertical Shaft Mixers

Woodard & Curran is also exploring the potential installation of vertical shaft hyperbolic mixers. The Invent Hyperclassic vertical mixer is becoming a very common alternative to submersible mixers in activated sludge aeration systems. The mixer motor sits on a bridge suspended above the aeration tank, and rotates the mixer body via a long hollow shaft that extends to the bottom of the tank. The design of the mixer body allows for a hyperbolic mixing profile throughout the tank, which creates a more even dispersion of solids in the zone. This allows the capability to reduce the motor size as compared to a submersible propeller mixer in the same application. Additionally, submersible motors are mechanically less efficient than standard electric motors. Since the motor is not submerged in an Invent Hyperclassic system, the use of NEMA Premium Efficiency Motors further reduces the energy usage of the system.

Based on the Invent proposal attached in Appendix F, one (1) – 3 hp mixer would be installed in each of 12 mixing zones for a total of twelve (12) – 3 hp mixers. Shown below is the estimated annual energy usage of a proposed Invent Hyperbolic Mixing System at the Enfield WPCF.

Table 44. Invent Hyperbolic Mixer Estimated Energy Usage

Mixer	Qty	Motor Size (hp)	Power Consumption (kW)[2]	Annual Hours	Annual Energy
3 HP	12	3	2.7	8256	**267,494**
				Total	**267,494**

NOTE:
1) Design is based on manufacturer recommendations for this application.
2) Power consumption is based on manufacturer provided data, it is assumed this includes the motor efficiency.

Shown below is the annual energy and cost savings associated with the installation of Invent Hyperbolic mixers.

Table 45. Energy Savings

Condition	Annual Energy Usage (kWh)	Annual Energy Cost ($)
Base Case	854,820	$105,998
Proposed Case	267,494	$33,169
Savings	**587,326**	**$72,828**

Note:
1) Enfield WPCF is billed $0.124 per kWh

While the Invent Hyperclassic mixers provide adequate mixing at a reduced energy demand, the mixers require the installation of structural support for the motor and drive, as well as a suspended

walkway for maintenance. The Enfield WPCF does not currently have mixer bridges installed, and the cost of fabricating and installing a total of twelve bridges will increase the total project cost significantly. Shown below is a budgetary estimate of the project cost, with installation as well as the simple payback of the project.

Table 46. Invent Hyperbolic Mixer Estimated Energy Use

Item	Cost
(12) 3 HP Invent Mixers	$290,000
(12) Steel Mixer Bridges and Supports	$240,000
Installation (40%)	$212,000
Total Cost	**$742,000**
Annual Cost Savings	**$72,828**
Simple Payback (yrs)	**10.2**

Incentive

This project may qualify for incentive funding under Eversource Energy's Custom Measure program. As of 2015, incentive funding is based on the lesser of $0.30 per annual kWh saved, or up to 75% of the incremental project cost.

Summary

The three mixing alternatives are presented in the following table.

Mixing Alternative	Annual Energy Savings (kWh)	Annual Savings	Project Cost	Simple Payback
BioMix Compressed Air	743,987	$92,254	$695,800	7.5
Aqua DDM	618,316	$76,671	$392,000	5.1
Invent Hyperbolic Mixers	587,326	$72,828	$742,000	10.2

Based on the evaluation of the three mixing alternatives, it appears that the Aqua DDM alternative provides the shortest payback based on energy savings and estimated project cost. Considering that the payback periods of all alternatives are shorter than the expected useful life of the equipment, the long term energy savings could also be taken into consideration. Based on the potential energy savings, the Biomix compressed gas system provides the most savings which could be achieved over a longer period of time. In addition, this system has less mechanical moving parts, which will experience wear over time.

ECM #7 – HVAC Upgrades

Based on the HVAC evaluation conducted at the WPCF, there are several electric unit heaters controlled with manual thermostats throughout the plant. Installing a programmable thermostat would allow these unit heaters to be automatically set to reduce temperature during after work hours and on the weekends, when no or limited plant staff is at the facility. Additional, as part of the design of the facility upgrades, the most recent energy code and Eversource required efficiencies should be incorporated in order to maximize incentive funding. HVAC equipment is eligible for incentives through the Prescriptive programs, and equipment must meet the minimum efficiency standards as established by the utility for each calendar year.

ECM #8 – Lighting Upgrades

The plant is currently working towards converting all of their lighting fixtures to more efficient models. The Administration building currently has motion sensors on most of the lights in that building. The remainder of the facility is typically temporarily manned for brief periods throughout the day and may also benefit from having motion sensors placed in them to prevent lighting from remaining on for extended periods of time. Ideal locations for light sensors would be the bathrooms and conference rooms, because they have varying occupancy throughout the day.

The facility may also benefit from installing LED lights on exterior lights throughout the facility, they may also want to consider installing motion sensors on lights that do not require continuous use at night. A select number of safety lights may remain in operation throughout the night, if desired. LED lighting is incentivized through Eversource's efficiency programs. Prescriptive applications can be completed for specific fixtures to be upgraded, and options are available for on-bill financing, in addition to the incentives. In order to qualify for incentives the lighting fixtures should be on the pre-approved list and should meet minimum operating hour requirements. Other facilities in CT have obtained incentives through these programs for lighting.

The reduction in operating hours of plant wide lighting can provide for significant energy savings, and the addition of automated control systems is proposed as part of the facility upgrades.

RENEWABLE ENERGY OPTIONS

Sustainability will be a central focus of the design of the upgrades to the facility, including viable alternative energy opportunities and utilizing energy conscious and sustainable design and building practices. As part of the energy evaluation of Enfield's WPCF, a preliminary assessment of renewable energy alternatives was conducted in addition to the energy efficiency study detailed herein. The purpose of this conceptual evaluation was to identify viable renewable energy projects that provide environmental, economic and social benefits to the community.

The following alternatives are discussed in more detail in the following sections.

4. **Wind Power** – small scale wind turbine on WPCF property
5. **Hydroelectric** – small scale hydro turbine from plant effluent flow
6. **Photovoltaic Array** – solar power on available land on WPCF property

Following the analysis for each renewable energy alternative, the interconnection options and requirements are discussed followed by funding, incentive and grant opportunities for these technologies.

Wind

The number of wind turbine installations in the U.S. has been increasing, particularly over the past several years due to both improvements in the technology and the range of wind speeds that can be effectively utilized. There are several sizes of horizontal wind turbines currently available, ranging in height from 30 to 140 feet with an average height of 80 feet, and capacity from 2 kW to over 1,000 kW. In a typical application, a facility is served simultaneously by the wind turbine and a local utility. If the wind speeds are below the cut-in speed (~ 2-3 meters per second, m/s), the minimum speed to spin the blades, then very little power will be generated. As wind speeds increase, turbine output increases and the amount of power purchased from the utility is proportionately decreased.

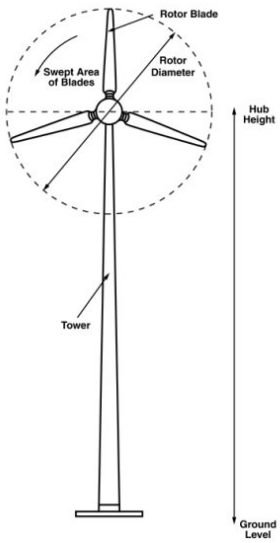
<u>Wind Turbine Assessment</u>

For an installation at the Enfield WPCF, an evaluation of turbines in the smaller range of these options is most appropriate. Location is critical for the viability of wind power as the wind speed determines the potential power production. Large scale wind turbines require wind speeds of 7 m/s or greater, while lower capacity units can produce power with as little as 5 m/s. To determine the true average wind speed and direction, meteorological monitoring is required and must be carried out at the specific location being considered. However, wind speeds can be approximated from available wind maps. These maps indicate wind speeds for the Enfield area, averaging approximately 4.0 to 5.0 m/s. Typical wind speed of at least 12 miles per hour (5 m/s) are recommended for a small wind turbine installation. Historically, these winds speeds may not produce enough power for a viable wind energy project.

$$P(kW) = \frac{\xi \rho A v^3}{2(1{,}000)}$$

Where:

ξ = efficiency
ρ = density of air (kg/m^3)
A = Impeller area, perpendicular to the wind (m^2)
v = wind velocity (m/s)
NOTE: The 1,000 value converts watts into kilowatts.



The efficiency of the windmill will vary depending on manufacturer, however, a windmill which is considered very efficient would have 50% efficiency, and therefore, a conservative value of 30% efficiency was used for these calculations. The density of air changes significantly with temperature and altitude. For the purposes of this evaluation, a standard air temperature of 20°C was used for a density of 1.205 kg/m^3. Based on historical data, the average wind speed in this area is approximately 4-5 m/s, a conservative value of 4.0 m/s will be used for the evaluation.

The impeller area in the equation is the sweep area of the blades, as shown in the figure. This area is based on the diameter of the impeller on the windmill. A larger impeller is going to produce more electricity than a smaller impeller, based on this area. For this evaluation, several different impeller diameters were evaluated to determine the potential energy that may be produced. Typical diameters for small scale wind turbines start at around 10 meters (~33 ft) for a 20 kW turbine.

Please note that the various wind turbine manufacturers have ratings for the "cut-in wind speed", which is the required wind speed for the wind turbine to begin turning. The "rated wind speed" is the value where the turbine will reach maximum power output, it will not be able to produce additional output power over this value. The required wind speed for the various manufacturers analyzed are included in the table below.

Table 47. Wind Turbine Manufacturer Ratings & Potential Energy Production

US Manufacturers	Model	Wind Cut-in Speed (m/s)	Rated Wind Speed (m/s)	Turbine Diameter (meters)	Area (square meters)	kW	kWhrs/yr
Bergey	Excel 6	2.5	11	6.2	30	0.3	3,058
Polaris	20 kW	2.7	10	10	79	0.9	7,955
	25 kW	2.7	10	12	113	1.3	11,455
	39.9 kW	2.7	9.5	15.2	181	2.1	18,379
Endurance	E 3120	<2	10	19.2	289	3.3	29,325
Northern Power Systems	NPS 100C-24	3	12	24.4	467	5.4	47,360
	NPS 60-24	3	11	24.4	467	5.4	47,360

NOTE: Energy production included in the table are calculated values and are not manufacturer provided values.

As demonstrated in the table, the larger the wind turbine diameter, the more power is generated. Based on this information, the power generation from a wind turbine could be as high as almost 50,000 kWh per year, which is approximately 2% of the annual energy usage. Please note that this is only for the largest wind turbine installation with a 24.4 meter diameter (80 feet). An installation of this size may not be practical for the WPCF.

The wind velocity used for these calculations, as previously noted was 4 m/s, the lower end of the average wind speed in the Enfield area. Notice that the 20 kW Polaris wind turbine produces less than 1 kW, corresponding to just over 3,000 kWh per year. The wind velocity has significant impact on the energy production and should be further investigated for accurate payback values.

Because local wind speeds can vary significantly, Enfield may want to consider further site specific wind speeds through meteorological monitoring. Generally, this requires the temporary installation of a weather/atmospheric condition monitoring station or system. The data obtained from these systems can be used to perform site-specific analysis of wind energy generation potential.

Federal Aviation Administration

Based on a preliminary evaluation using the Federal Aviation Administration (FAA) Notice Criteria Tool, a proposed structure in the vicinity of the Enfield WPCF (Lat. 41.93°, Long. 72.68°) is in the proximity to a navigation facility and may impact navigation signal reception. Please find the Notice Criteria Tool attached in the appendices. Because the plant is in relatively close proximity to Bradley International Airport (BDL), the FAA requests that a potential construction project be filed under the Code of Federal Regulations (CFR) Title 14 Part 77.9 Safe, Efficient use and Preservation of the Navigable Airspace, Construction of Alteration Requiring Notice. The attached Notice Criteria Tool used an elevation of 40 feet as the proposed elevation, which is the approximate ground level at the WPCF. This notice requires an FAA evaluation to be done in this area because a tall structure could impact the navigation signals, which may require additional permitting and costs associated with implementation.

Based on the low energy output, limited space for installation and limited wind speeds in the Enfield area, this location may not be suitable for a wind turbine installation.

Hydroelectric Turbine

Small hydropower applications can be found at water pollution control facilities where significant head is available to drive a turbine and produce a relatively small amount of electrical power. The amount of power than can be produced is dependent on the vertical distance of the hydraulic elevation change and the volume of flow that can be captured through the turbine.

The hydropower evaluation focused on the potential application use of low-head turbines at the facility. When installed within a pipeline these devices utilize hydraulic head to generate power, and often mimic the functionality of a pressure reducing valve (PRV). Power generating devices commonly used in these applications operate as a "pump-in-reverse", and may utilize either a reaction or impulse turbine. Some turbines allow for pressure to remain on the downstream side of the turbine, whereas others require free discharge to atmosphere (i.e. to the top of a tank, or above the water pool) and allow for the regulation of flow. The turbine is then connected to a generator that turns the rotational power from the turbine shaft into electrical power.

Hydro Turbine Design Parameters

The following evaluation for a hydro turbine is based on the total dynamic head (TDH) provided at the Connecticut River and the flow provided from the WPCF at the effluent of the chlorine contact chamber. This location provides TDH from the chlorine contact chamber down to the river elevation. In addition, the wastewater characteristics at this point in the process would have lower concentrations of solids and corrosive material to prevent fouling of the turbine.

The following evaluation assumes that the total effluent flow would be harnessed in the effluent of the plant. This could be achieved through installing an additional effluent pipe at the same elevation as the effluent channel, housing the turbine to achieve the peak energy production with the total flow. The pipe would be isolated so the flow could divert through it or the existing effluent channel, this would allow diversion from either the channel or the pipe if maintenance is required on the hydro turbine. The location of the effluent sample line should be considered for this installation method. Other technology alternatives are available and include the installation of a vertical turbine in the channel, which turns the based on the flow that passes the individual turbine in a vertical position and axial channel turbines, which can operate in a variety of submerged levels. These alternatives do not necessarily capture the entire effluent flow. For the purposes of this study, the entire effluent flow form the plant is considered for energy production through a hydro turbine.

The average daily flow (ADF) at the Enfield WPCF is 5.5 million gallons per day (MGD), based on historical data. The ADF for 2013 was approximately 5.2 MGD. Based on this information, various flow rates were evaluated for the hydro turbine system. These values vary from 5.0 million gallons per day (MGD) to 10 MGD.

The Hydraulic Profile attached in the appendices, from the 1969 Metcalf & Eddy plans (Sheet C-6) was utilized to assess the existing head from the chlorine contact chamber to the Connecticut River outfall. According to the plans, the Chlorine Contact weir crest is at an elevation of 40.00

and the median water elevation of the Connecticut River is 28.45. This equates into 11.55 feet of available head between the chlorine contact chamber weir to the Connecticut River.

The following table presents several different available TDHs based on the flow rate going through the plant and the elevation in the Connecticut River. Please note that the current river elevation and elevations at different flows through the plant should be verified based on current conditions, these values are most likely out of date since they were developed in 1969.

Table 48. TDH Determination

Chlorine Contact Chamber	Flow (MGD)	Elevation (feet)	TDH at Median	TDH at Mean
Future Peak Flow	30.0	41.21	12.8	15.4
Design Average Flow	10.0	34.15	5.7	8.4
Initial Minimum Flow	1.0	33.35	4.9	7.6
Linear Average	5.0	33.75	**5.3**	8.0

Notes: 1. The chlorine contact weir crest is at an elevation of 40.00 ft
2. Flows & elevations taken from the Hydraulic Profile
3. Median elevation is 28.45 ft
4. Mean elevation is 25.80 ft

The linear average of 5.3 feet, presented above is assumed to be the average elevation at approximately 5.0 MGD and was calculated based on the average between the elevations of 10.0 MGD and 1.0 MGD. For the purposes of this evaluation, a conservative TDH of 5.0 feet was used for the remaining calculations. Please note that this TDH should be verified and will limit the feasible alternatives for hydro turbine installation.

Potential Energy Production

The following equation can be used for estimating potential power production based on the flow and head available at the outfall of the WPCF to the Connecticut River.

$$P(kW) = \frac{\eta \rho_w Q g TDH}{1{,}000}$$

Where:

P = Power in kW
η = efficiency (unitless)
ρ_w = density of water (1,000 kg/m^2)
Q = Flow (m^3/s)
g = gravity (9.81 m/s^2)
Note: The 1,000 value converts watts to kilowatts.

Table 49. Potential Energy Production

Flow (MGD)	Energy Produced (kW)	Energy Produced (kWh)	Energy Produced 85% Operation
5.0	4.9	43,223	36,739
5.2	5.1	44,952	38,209
5.5	5.4	47,545	**40,413**
10.0	9.9	86,446	73,479

NOTES:
1. Calculations are based on the equation listed above.
2. Efficiency used is 70%
3. TDH used is 5.0 ft

Assuming hydro turbine operation with an average daily flow (ADF) of 5.5 MGD for approximately 85% of the time, and a water-to-wire efficiency of 70%, a hydro turbine system could theoretically generate approximately 40,000 kWh per year around the ADF. This is based on generation rate of approximately 5 kW. That is approximately 2% of the total annual energy use at the WPCF.

Technologies & Manufacturers

There are a variety of different hydro turbine technologies and manufacturers that require different flow and head requirements for their technology to effectively operate. The technologies presented incorporate different styles of hydro turbines including in stream and in pipe styles. In addition, some of these technologies have various installation methods, for instance, the in pipe designs can be configured as a siphon drawn directly from the chlorine contact basin as opposed to a parallel pipe on the discharge.

Several companies offering low head technologies were contacted to determine the require flow and TDH required for their respective technology.

Table 50. Hydro Turbine Technologies

Technology	Manufacturer	TDH (feet)	Required Flow (MGD)
Axial Flow Propeller Turbine	Energy Systems & Design LH 1000	10 (max)	0.7 (min)-1.4 (typical range)
In Stream Propeller Turbine	Power Pal MHG 1000LH	5 (min)	3.2 (min)
Submerged Channel Turbine	VLH Turbine 121-1	4.6 – 10.5 (required range)	228 – 616 (limiting range)
In Pipe or Channel Propeller Turbine	Voith StreamDiver	6.6 – 20 (typ)	45 – 273 (limiting range)

NOTE: Data presented in table is based on preliminary investigation.

Each manufacturer suggests minimum flow and head requirements in order to cost effectively generate electricity from the water system. These baseline requirements include pressure differentials or TDH of at least 4 feet and varying flow rates from 700,000 gallons per day (gpd) to over 616 MGD, and represent the minimums required for reasonable return on investment (ROI) in most applications. Some of these technologies are far outside of the TDH and flows at the WPCF are not considered viable alternatives for this application.

Further investigation should be conducted to determine if the technologies above and manufacturers are feasible for installation at the WPCF. The elevations at the discharge end of the plant should also be verified in addition to the average and maximum elevations at the Connecticut River outfall. The ability of the WPCF to install a hydro turbine at the outfall should also be evaluated based on easements and property ownership, if applicable. The hydro turbine will also require an electrical connection, this should be evaluated based on the location of the potential installation of the hydro turbine.

Solar Photovoltaic Array Evaluation

Solar photovoltaic (PV) systems can be a reliable, renewable energy source. There has been an increase in installation of PV technology in the northeast in recent years as public and private agencies and businesses look for opportunities to reduce their environmental impact and reduce electrical costs. Solar cells, or photovoltaic (PV), convert sunlight directly into electricity that are typically combined into modules that are mounted in PV ***arrays*** that can be mounted at a fixed angle facing due south, or can be mounted on a tracking device that follows the sun, allowing them to capture the most sunlight over the course of a day.

According to the National Renewable Energy Laboratory, the available solar energy in Massachusetts is between 4.0 and 5.0 kWh/day/m2 based on solar data collected from 1998 to 2009. The available energy may be reduced based on specific site and location conditions such as shading and obstructions and mounting method of PV such as ground or roof mount.

Several location were evaluated at the Enfield WPCF for installation of PV arrays included open land and roof tops. There is minimal unused area at the plant currently and several small locations were identified as potential PV installation locations.

Figure 6. Aerial of Enfield WPCF

The available area, as indicated on the map, is approximately 1,370 square meters (m^2). Site #3 & 4 are angled at approximately 20 degrees, going west to east (due East). Sites #1 & 2 are also angled approximately 20 degrees going south to north (due North). A preliminary investigation was performed at these sites including a sun path analysis while on site and an energy production analysis based on the available space and location.

Solar Calculations – Sun Path Analysis

The sun path, or available sun exposure, for this site is evaluated in the following figures. The sun path was evaluated using a hand held Solmetric SunEye, which produced the following figures. The Sun Eye contains a global positioning system (GPS) to determine the amount of sun based on location and how the radiation intensity changes throughout the year. The device then assigns an appropriate percentage to the location based on the amount of sun exposure. The device graphs the obstructions at that location (including elevation) to determine if this will affect the sun exposure throughout the day from obstruction shading. Please note, this evaluates sun exposure throughout the day and year, due to changes in position of the earth with respect to the sun. In addition, there is a "tilt" input in the device for the anticipated tilt of the panel itself, for a flat ground mount system, this is typically assumed to be approximately 20 degrees from level. Based on the existing ground tilt being approximately 20 degrees, it is anticipated that the panels would either tilt with the existing ground or be tilted in a different direction for optimum sun exposure. Please note that this evaluation presents the potential sun radiation achievable.

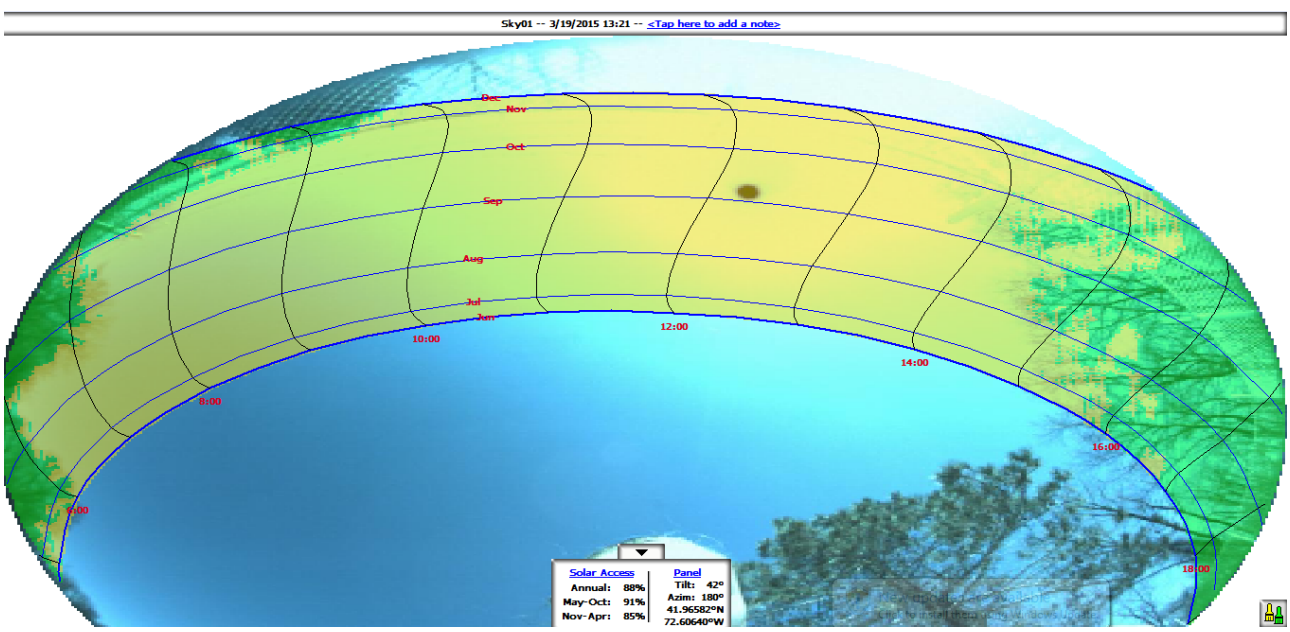


Figure 7. Annual Sun Path – Clockwise from top left, Site 1

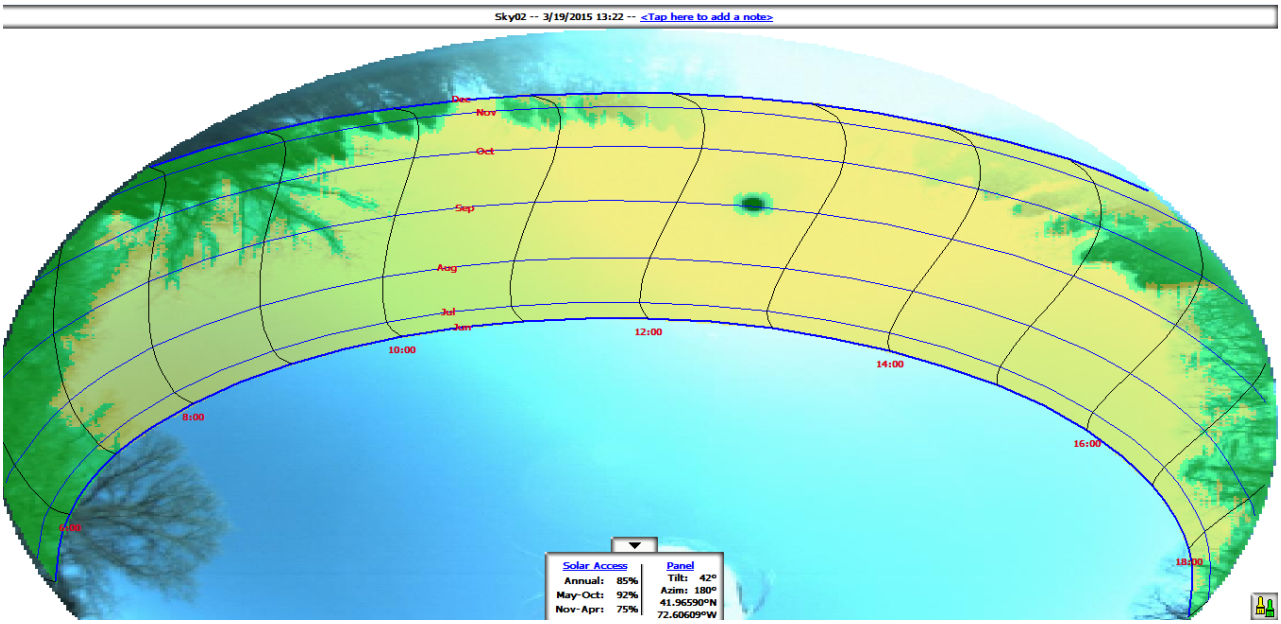


Figure 8. Annual Sun Path – Clockwise from top left, Site 2

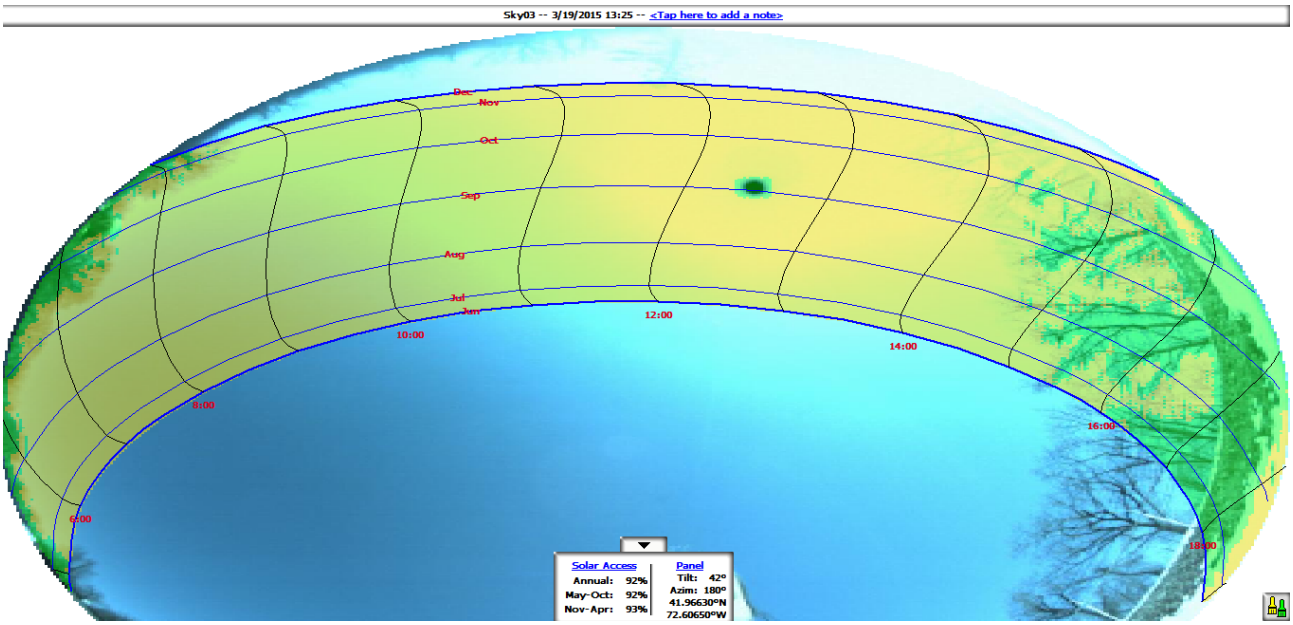


Figure 9. Annual Sun Path – Clockwise from top left, Site 3

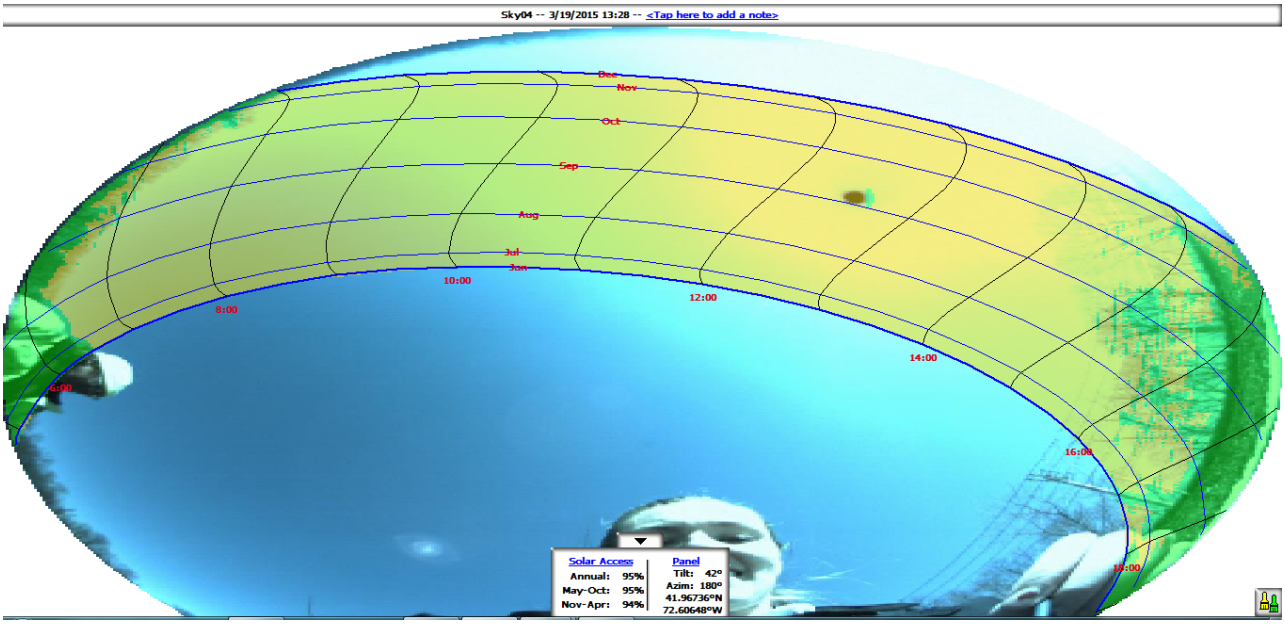


Figure 10. Annual Sun Path – Clockwise from top left, Site 4

The annual sun path figures above, displays the general path of the sun during day light hours with corresponding times of day and year. The black dot on the figure represents the suns location at the time the data was collected. The vertical sun path lines represent morning hours starting on the left and evening on the right hand side of the figure. The horizontal lines represent months of the year with December at the top and ending with June at the bottom. This figure was collected as a picture through a wide angle lens to capture 180 degrees of the sky. As can be seen in the figures, depending on the location, the trees in the area will cause minimal obstructions in the morning and evening hours.

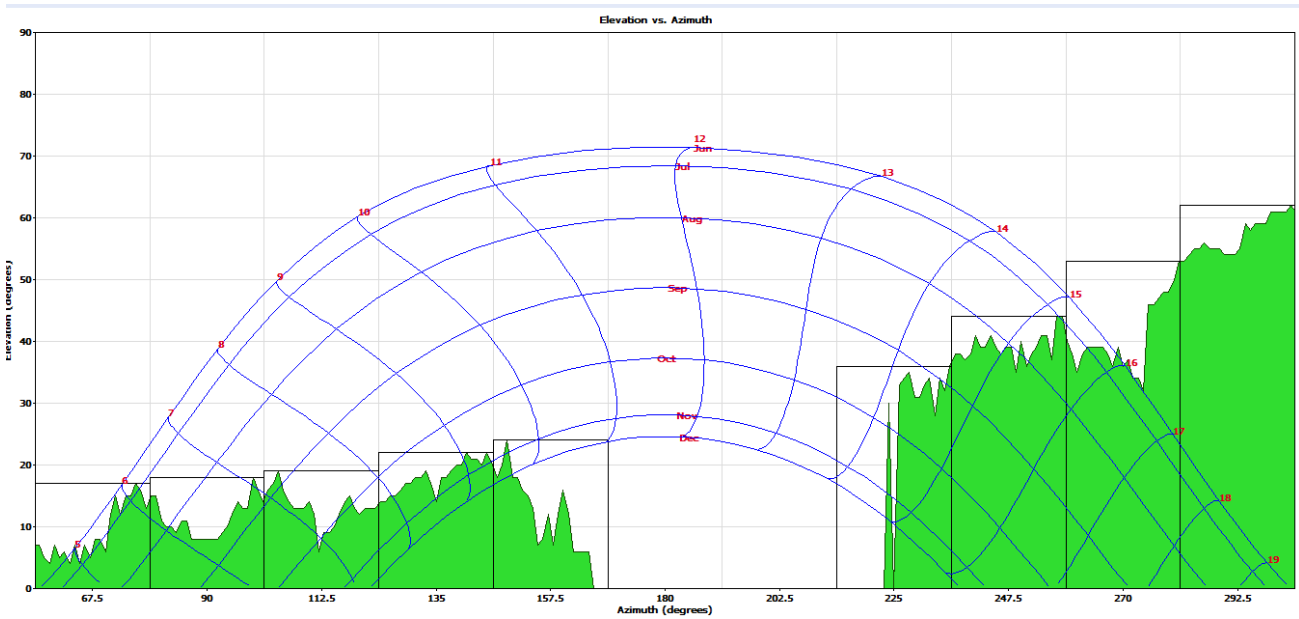


Figure 11. Obstruction Elevation – Clockwise from top left, Site 1

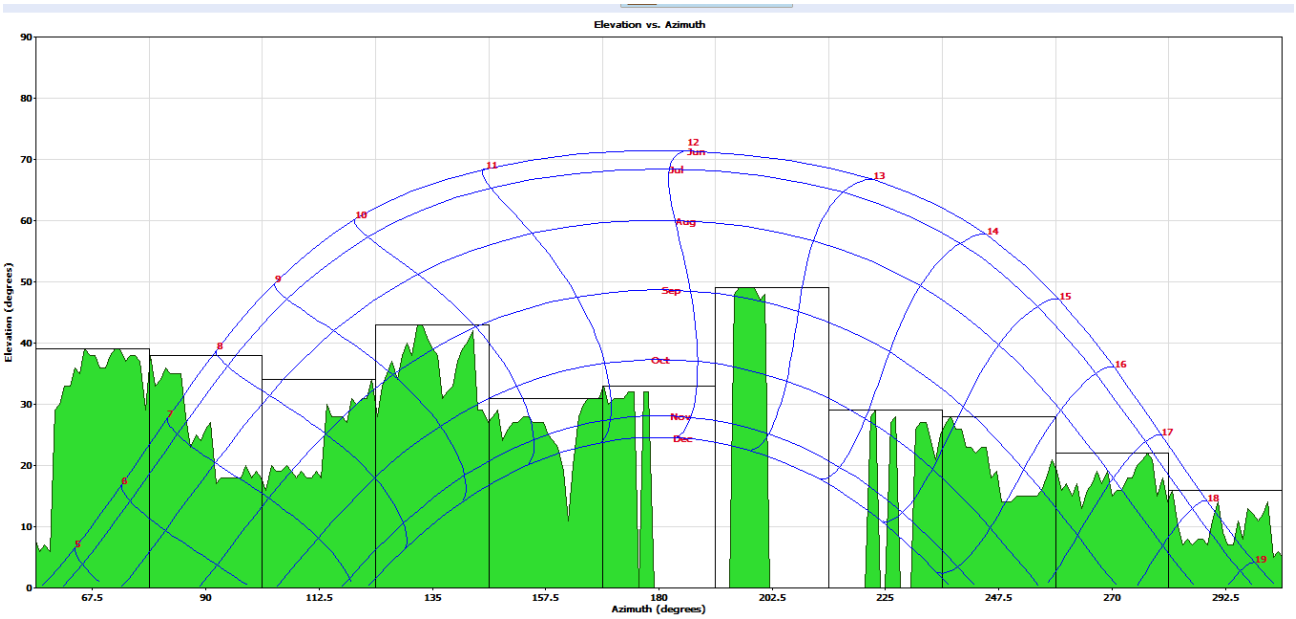


Figure 12. Obstruction Elevation – Clockwise from top left, Site 2

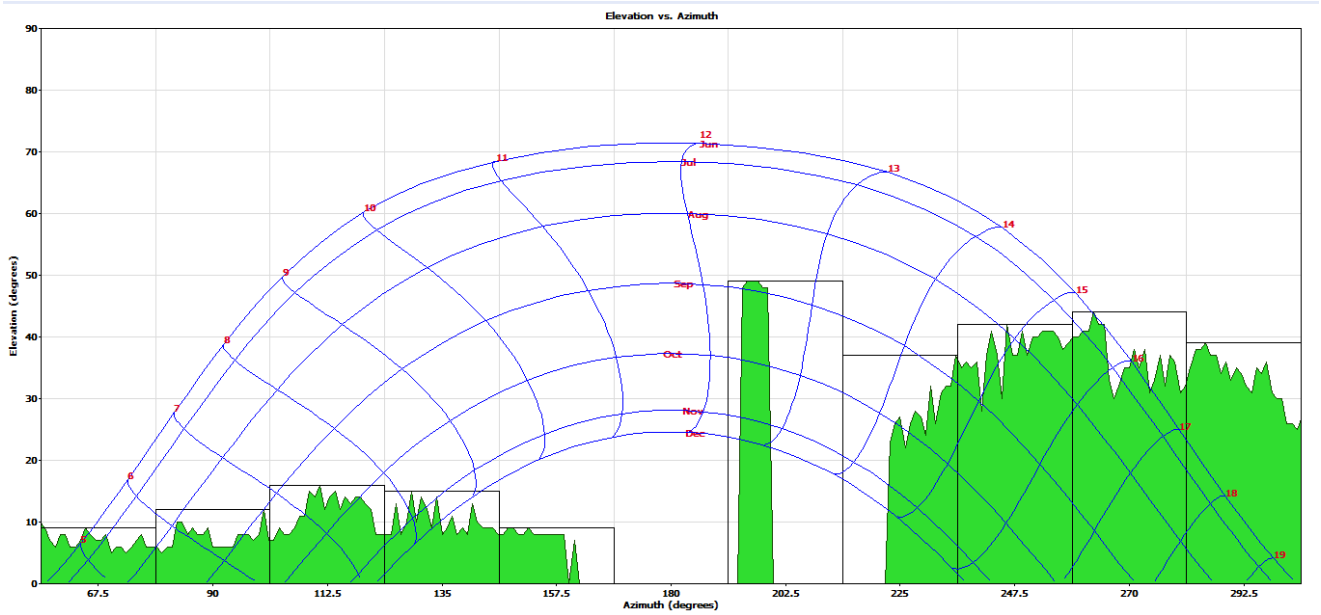


Figure 13. Obstruction Elevation – Clockwise from top left, Site 3

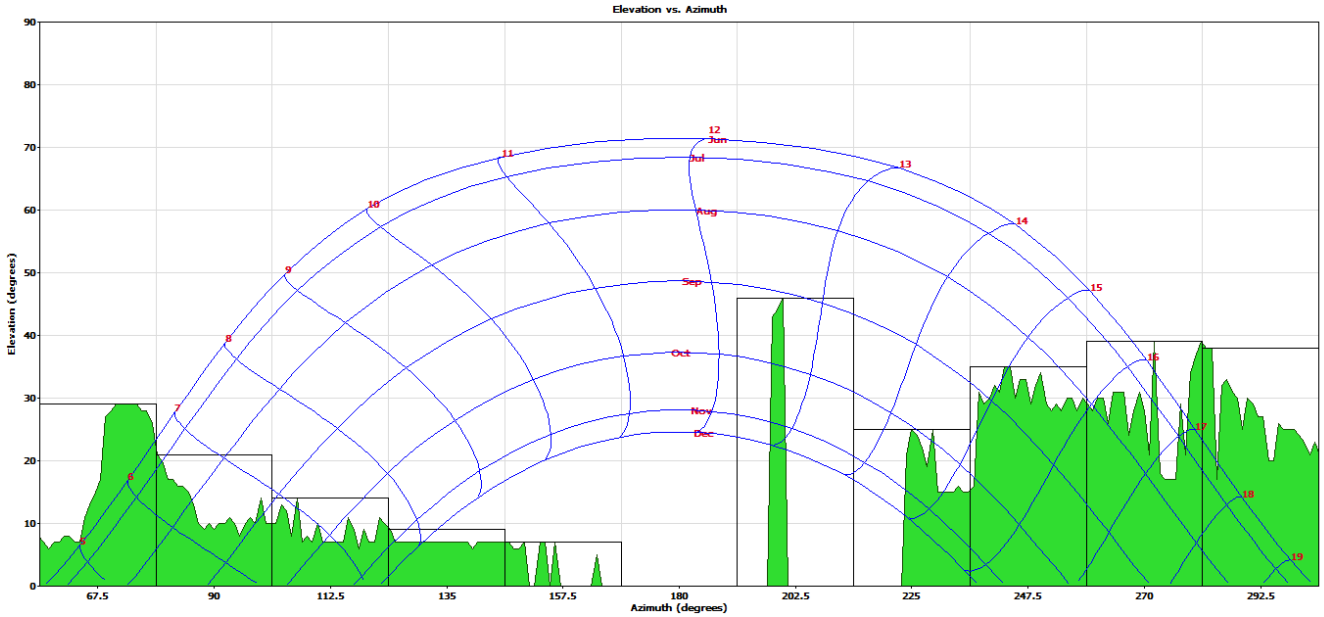


Figure 14. Obstruction Elevation – Clockwise from top left, Site 4

The curved wide angle photo is then digitally displayed as presented in the obstruction graphs above. This maps out the path of the sun and how the obstructions effect the sun exposure. The azimuth is the starting location of where the photo was taken, for this analysis, the azimuth was due south, the photo was taken while facing south (180°).

As can be seen in the preceding figures, there are minimal obstructions during daylight hours, throughout the year. Early morning and late afternoon show some obstructions, which are most likely vegetation and trees surrounding the location. These obstructions are expected when the sun is low on the horizon. Fortunately, the obstructions have minor impact throughout the day and year.

Following the graphical display of the sun path and obstructions, the SunEye translates the amount of sun exposure in a percentage form. The percentage is calculated for each month and displayed in a bar graph, as can be seen in the following figures.

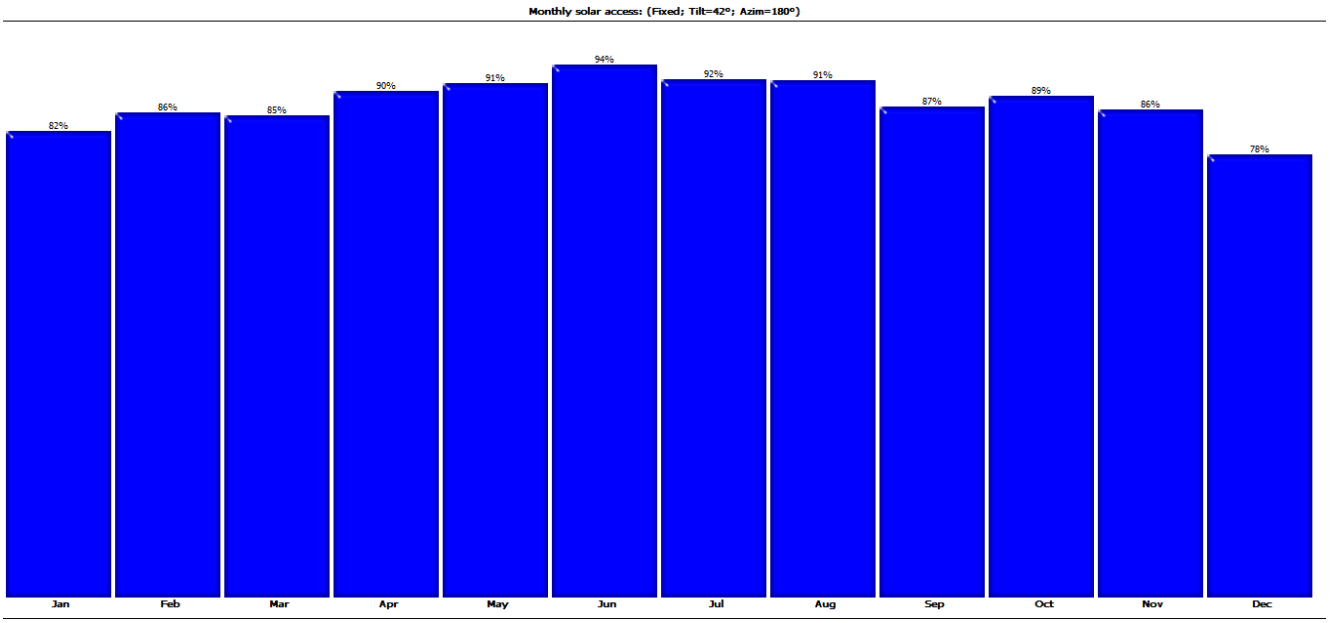


Figure 15. Monthly Solar Exposure – Clockwise from top left, Site 1

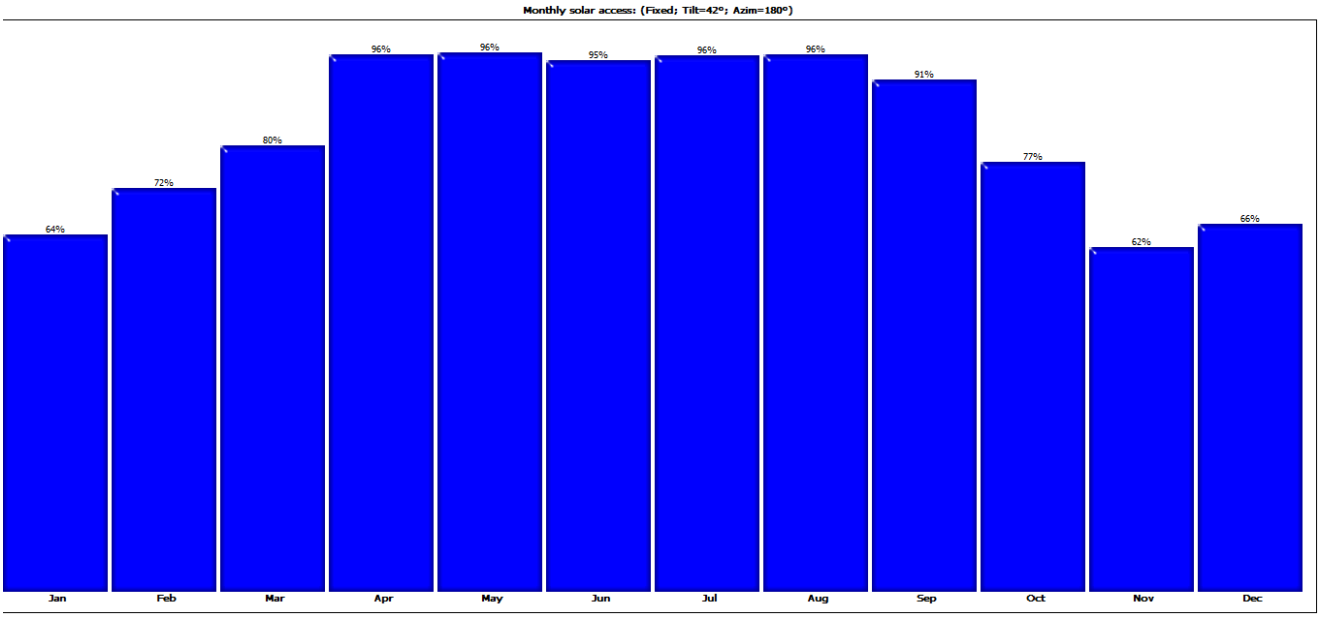


Figure 16. Monthly Solar Exposure – Clockwise from top left, Site 2

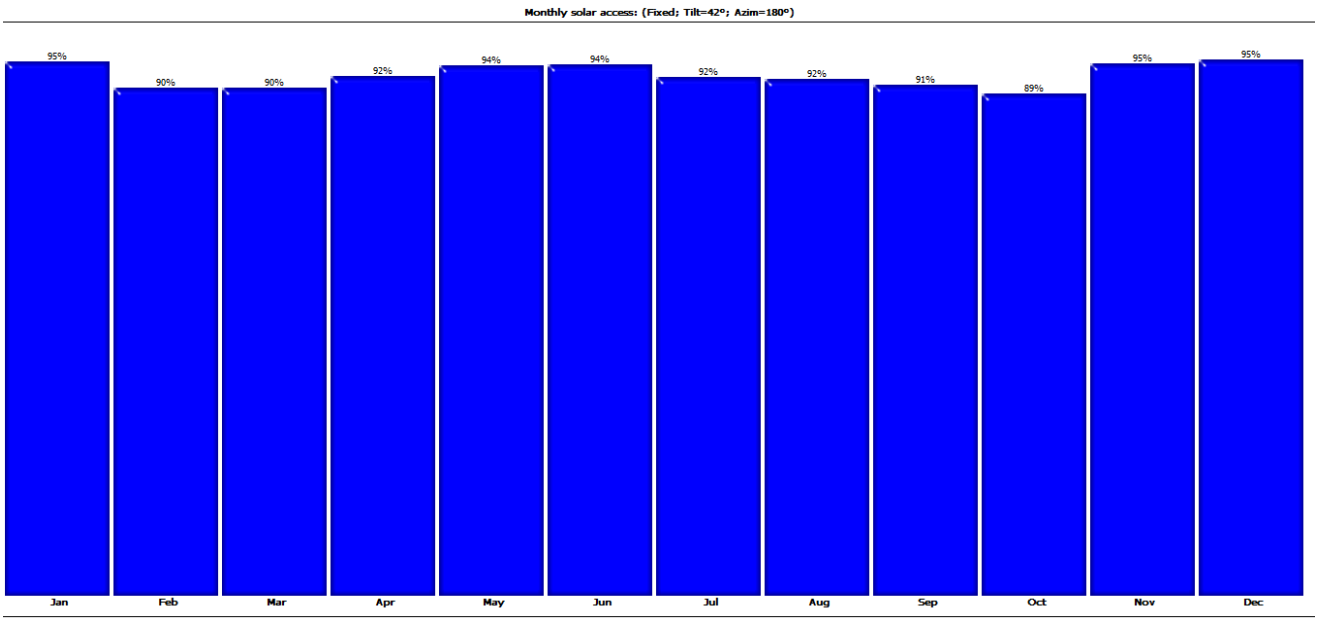


Figure 17. Monthly Solar Exposure – Clockwise from top left, Site 3

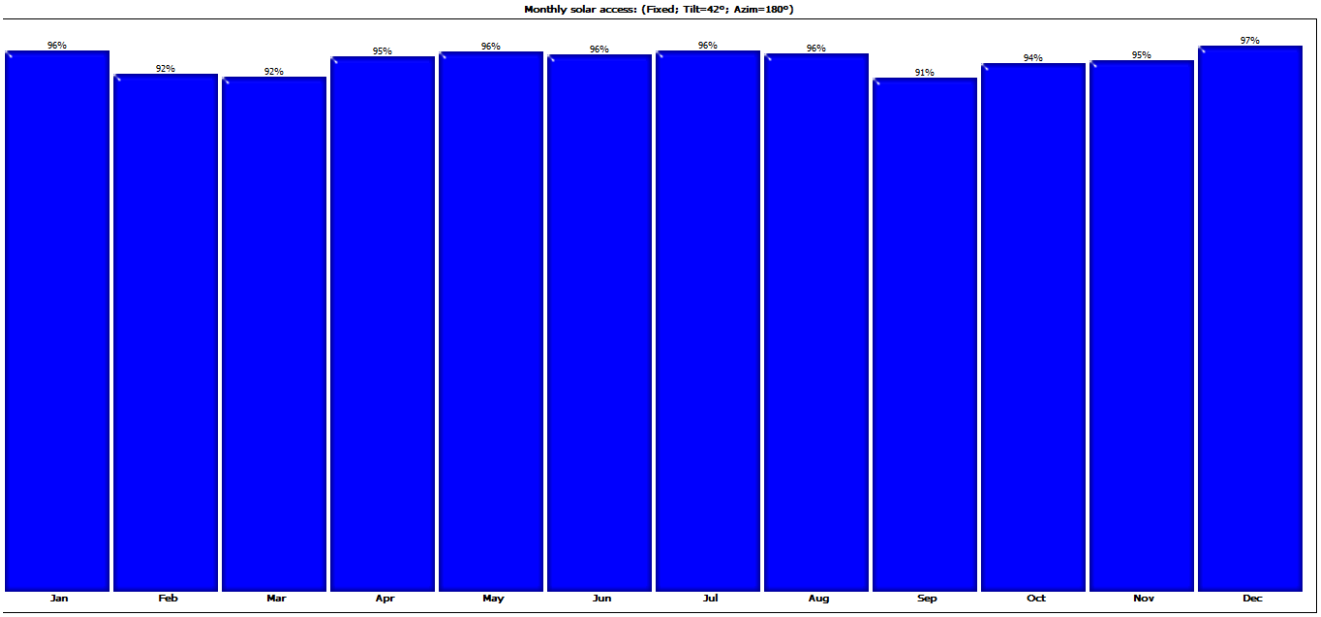


Figure 18. Monthly Solar Exposure – Clockwise from top left, Site 4

As may be seen in the Monthly Solar Exposure graph above, the peak solar exposure is 96% and is experienced during May through August, as expected. In contrast, during the colder weather months, the solar exposure drops to approximately 90%, which is the lowest percentage throughout the year. The average exposure throughout the year at Sites 1 & 2 is approximately 85%, Sites 3 & 4, however, have a higher exposure at approximately 94%, which is suitable exposure for a PV array installation. Typically, it is not recommended to install PV panels when the exposure is less than 90%, therefore, Sites 1 & 2 may not be suitable locations for installation of PV panels.

An additional concern is the angle of the panel. Typically, the best exposure for the sun is due south, this is because solar noon, when the sun is at its height, in the northern hemisphere is due

south. This should be considered for the angle of the solar panels on the available area at the plant. Sites #1 & 2 are angled due North, this may require installed PV panels to be lifted and angles in the opposite direction. Sites #3 & 4 are angled due east, these panels would require being angled south to achieve the greatest sun exposure.

Solar Calculations – Potential Power Generation

As previously mentioned, the location and exposure to the sun effect the amount of energy that can be produced from the sun. The National Renewable Energy Laboratory (NREL), a division of the Department of Energy (DOE) provides a Photovoltaic calculator called PVWatts™, which estimates energy production and cost of energy for grid connected PV arrays throughout the world. This calculator was utilized to evaluate Sites 1 through 4 at the Enfield WPCF.

Table 51. Land Area Specifications

Parameter	Specification
Site Quality	~94% sun Exposure - excellent
Land Area Sites 1 & 2	344 square meters
Land Area Sites 3 & 4	1,026 square meters
Total Land Area	1,370 square meters
Obstructions	Vegetation & swales
Land Condition	Grass, shrubs and stumps located on existing ground. These would have to be removed and conditioned for PV placement.

NOTES:

- Site quality is based on the average 95% sun exposure throughout the year calculated by the sun path, above.
- Total land area was calculated using Google Earth & PVWatts™.
- Obstructions determined through visual inspection.

The DC rating presented below was automatically generated by PVWatts™ based on the available land area. The size can also be calculated with the following equation.

$$DC\ Rating\ (kW) = Array\ Area\ (m^2) * 1\ \frac{1\ kW}{m^2} * PV\ Module\ Efficiency$$

Based on the existing conditions, the following parameters were established for evaluation through the calculator.

Table 52. Solar Location – Preliminary Evaluation

Location Identification	
Location:	90 Parsons Road, Enfield CT
Weather Data Source:	Hartford, CT (TMY2)
Latitude:	41.9 ° N
Longitude:	72.7 ° W
PV System Specifications	
Sites #1 & 2 DC Rating:	58.4 kW
Sites #3 & 4 DC Rating:	179.2 kW
Total DC Rating:	**238 kW**
System Losses:	20.03%
DC to AC Derate Factor:	0.9
Array Type:	1-Axis Tracking/Fixed (Open Rack)
Array Tilt:	20 °
Array Azimuth:	180 °
Energy Specifications	
Cost of Electricity:	12.4 ¢/kWh

NOTES:

- Weather Data source is the closest weather station utilized by the DOE
- The Lat & Long are for the Weather Data Source
- Land area was calculated using PV Watts
- The DC rating is the amount of energy that can be produced for the available area
- System losses are based on soiling, shading, snow and wiring losses.
- The DC/AC Derate Factor is a size ratio between the inverter and arrays respective rated size. The larger the factor the more output is produced. A conservative 0.9 was selected.
- The array type is based on a fixed ground mount design.
- Array tilt is based on a typical ground mount tilt of 20°.
- Array Azimuth is based on true south.
- Cost of electricity is based on previously calculated generation and delivery costs combined.

The calculator uses historical meteorological data recorded for a specific site and determines the solar radiation available. The kWh per month generated by the program are calculated based on the solar radiation and the solar system's specifications.

Table 53. Solar Energy Produced

Results - Enfield						
Month	Solar Radiation	#1 - AC Energy	#2 - AC Energy	#3 & 4 - AC Energy	Total - AC Energy	Energy Value
	(kWh/m^2 /day)	(kWh)	(kWh)	(kWh)	(kWh)	($)
January	2.67	1,432	2,512	12,103	16,047	$1,990
February	3.53	1,692	2,968	14,299	18,959	$2,351
March	4.20	2,191	3,845	18,524	24,560	$3,045
April	5.13	2,458	4,313	20,779	27,550	$3,416
May	5.40	2,580	4,526	21,806	28,912	$3,585
June	5.98	2,686	4,712	22,703	30,101	$3,733
July	5.77	2,649	4,648	22,396	29,693	$3,682
August	5.39	2,492	4,372	21,066	27,930	$3,463
September	4.61	2,135	3,745	18,043	23,923	$2,966
October	3.54	1,752	3,073	14,805	19,630	$2,434
November	2.47	1,223	2,145	10,335	13,703	$1,699
December	2.18	1,514	2,026	9,759	13,299	$1,649
Annual Value	**4.24**	24,804	42,885	206,618	**274,307**	**$34,015**

NOTE: Radiation and Energy values were calculated using PVWatts.

The installation of solar panels on all of the available area as outlined above, could produce approximately 274,000 kWh per year. This represents approximately 12% of the total energy use of the facility. Please note that majority of energy production in the above analysis is for Sites 3&4 at over 200,000 kWh.

Based on this preliminary analysis, installation of a solar PV system may be viable for the Enfield WPCF. However, prior to incorporating a solar PV installation at the facility, a more thorough analysis of the costs, electrical energy production potential, payback period, and interconnection options of PV installations should be completed. As discussed in more detail below, the ability for the solar installation to be interconnected into the existing grid will need to be evaluated to determine the project cost. A thorough cost analysis of the installation and potential construction costs should be performed to determine the payback period for such an installation.

Solar Conclusion

Based on the above analysis, further investigation should be conducted to determine the ability for the Enfield WPCF to interconnect a solar PV system into the grid. Eversource requires an

application and this evaluation to determine if the existing infrastructure and its components require modifications and upgrades prior to an interconnection. Based on the shading analysis, Sites 3 & 4 are suitable candidates considering shading and sun exposure. PV installation on Sites 3 & 4 would require to be tilted in the direction of due south, currently the angle of the swale is due east. This area would also require excavation for PV array installation and should be factored into the overall project cost. The nearest building to the Site 3 & 4 is the Administration building. An evaluation of the electrical panels should be conducted to determine the suitability for the PV installation.

Installation & Ownership

Financing of the onsite generation system can be accomplished through the following options:

- Municipal ownership
- Power Purchase Agreement

Municipal Ownership

Under municipal ownership, the municipality would be responsible for acquiring the capital funding (i.e. issuance of bonds) necessary to purchase and install the proposed renewable energy systems. The municipality would own the wind/hydro/solar system and the associated Zero Emission Renewable Energy Credits (ZRECs) acquired through the generation of kW-hrs through the Energize Connecticut programs. Under this scenario, the municipality would be responsible for maintaining and operating the system and for acquiring the necessary permits to build and operate it.

By owning the system, the municipality would see a direct offset in electrical consumption and an energy savings associated with the on-site generation of power. The system would be owned in perpetuity and would continue to provide power once the costs associated with the installation have been paid. However, a significant disadvantage involves the acquisition of funding for the project. In addition, the municipality would be responsible for operating and maintaining the system and for administering the sale of any acquired ZRECs, as further discussed below.

Power Purchase Agreement / Third Party Ownership

A Power Purchase Agreement (PPA) is an alternative to municipal ownership in which the municipality becomes the host and the installer is the owner of the power system. In a PPA, the installing company owns the equipment and sells the electricity generated by the system to the municipality at a negotiated contract price. The installer is responsible for financing the project and for designing, installing, monitoring, operating and maintaining the system. The installer is also responsible for paying any property taxes associated with the system. Since installers are eligible to receive federal tax credit (30% for renewable energy projects), they can benefit from an additional incentive that is not accessible by municipalities. In addition, any associated ZRECs acquired through the operation of the system would be owned by the installer and not the host/municipality.

PPAs offer a number of advantages. The municipality would avoid acquiring any of the upfront costs necessary for the installation of the system. With the operation and maintenance of the system being the responsibility of the installer, the municipality would also avoid any of those costs. The municipality would see a savings based on the lower cost of electricity negotiated with the installer. At the end of the contract period, the host/installer would have the option to buy the system at a negotiated price.

Interconnection Requirements

Electricity for the Enfield WPCF is supplied through Eversource. Connection to the existing power grid requires an Interconnection Agreement between the generator (owner of the power system) and the energy distribution company (EDC). Certified inverter based generators larger than 10 kW qualify for the Fast Track Interconnection Process. Prior to submitting an Interconnection Application and prior to the purchase of any equipment associated with the generating system, it is recommended that the generator contact the EDC facilitator for an initial scoping meeting to discuss the proposed project and interconnection approach.

The application process involves a number of screening steps to determine the project's feasibility, safety, reliance and overall compliance with the EDC's interconnection design and legal requirements. In addition, there are fees associated with an interconnection application, which vary based on the energy generation size of the proposed system (less than 10 kW & up to 2 MW).

Key requirements of the Interconnection Application process include the following.

- The design of the proposed power generating system must comply with the EDC's technical requirements for the interconnection into the existing power system (per Eversource Exhibit B Generator Interconnection Technical Requirements);
- The generator must provide proof of site control (i.e. ownership of site, leasehold interest in, or developing rights for the purpose of building a generating facility);
- Site and/or Facility plans must be provided identifying the location of site structures, transformers, Eversource electrical metering and vicinity to the AC disconnect switch;
- One line electrical schematics with PE stamp must be provided including the utility voltage at the main panel, fuse symbol at the main panel, number and location of inverters with manufacturer name, model number and rating; circuit connectivity from the main switch including sub mains, metering and the main switch and rating of breakers; location of isolation device; generator electrical information; typical customer loads and operating voltages and additional formatting requirements. There are sample diagrams on the Eversource website for reference.
- Operating and/or Instruction Manual for the required relaying or inverter protection functions;
- Functional description of the proposed generation system including normal and abnormal functionality;
- Inverter based systems ranging in size between 0 kW to 10 kW must maintain general liability insurance of $300,000 and have an application fee of $100;
- Fast Track systems ranging in size between 0 kW and 2 MW must maintain general liability insurance of $500,000 to $2,000,000 and have an application fee of $500;

- Complicated systems requiring additional studies up to 2 MW must maintain general liability insurance of $2,000,000 to $5,000,000 and have an application fee of $1,000, which excludes the cost of the study;
- The generator must pay for any necessary upgrades to the existing power grid resulting from the proposed interconnection as identified by the EDC;
- The EDC may require an Interconnection Study that assesses the feasibility of the project and the impact of the proposed power system to the existing power system;
- The generator must provide municipal approval of the proposed system;
- Commissioning of the system must be witnessed by the EDC;
- Upon the successful completion of the commissioning tests, the EDC will issue the final approval for the interconnection.
- Incentives for Renewable Energy

Several funding options are available for wind turbine, solar array, and hydro turbine installations through state and federal funding agencies. The two funding options discussed here are considered the most viable for this type of installation in the state.

1. CT DEEP Clean Water State Revolving Fund (SRF) – Reserve for Green Infrastructure
2. Eversource LREC/ZREC Program

Reserve for Green Infrastructure

The CT DEEP Reserve for Low Impact and Green Infrastructure provides funding at 20% of the project cost and 80% loan for improvement projects that incorporate cost-effective renewable energy components at waste water treatment plants and pump stations. The Connecticut Department of Energy & Environmental Protection (CT DEEPs) Clean Water Fund Priority List dated March, 2014 states that projects that qualify for the Green Infrastructure reserve fund are intended for a "Treatment plant, pump station, and/or collection system improvement projects that incorporate cost effective renewable energy components (20% grant/80% loan); and Community demonstration projects of green infrastructure technologies to promote infiltration of storm water into the ground in combined sewer overflow areas (50% grant/50% loan)."

Eversource LREC/ZREC Program

The Low and Zero Emission REC (LREC/ZREC) program became the primary incentive funding source for Class I energy technologies, which includes solar arrays, wind turbines and hydro turbines as defined in the Connecticut General Statutes (CGS) Section 16-1 (a)(26)(x). The LREC/ZREC program is managed by the electric distribution companies (EDCs) such as Eversource and United Illuminating (UI), and by the DEEP's Public Utility Regulatory Authority (PURA). Under these regulations, the EDCs are required to allocate funding for the purchase of LREC/ZRECs from customers generating renewable energy. The customers, once deemed to be qualified bidders, will be able to sell their LREC/ZRECs to the EDCs for a fifteen (15) year

contract period. Each year, the EDCs will allocate $12M in these LEC/ZREC contracts. Overall, the program focuses on a market driven approach whereby generators enter a competitive, bidding process for the sale of the RECs they produce to the EDCs.

The power generating system program categories include the following:

- Small (1 to 100 kW);
- Medium (>100 kW and < 250 kW);
- Large (≥250 kW and ≤1,000 kW).

Generating systems are capped at 1,000 kW of ZRECs and at 2,000 kW for LRECs.

Systems that qualify must be in the proposal phase or if installed, must be behind electric meters and in operation after July 1, 2011. Projects which are in the proposal phase must be completed, permitted and in operation within one year after the contract award date.

Based on the Year 1 2012 request for proposals, the winning bids resulted in the following LREC/ZREC prices:

2012	**Price/REC (CL&P)**
LREC	$65.94
Large ZREC	$101.36
Medium ZREC	$149.29

The Year 2 RFP was issued on April 25, with bids due on June 13, 2013. On October, 2013 PURA approved 90 contracts. The winning bids resulted in the following LREC/ZREC prices:

2013	**Price/REC (CL&P)**
LREC	$57.03
Large ZREC	$76.67
Medium ZREC	$93.65
Small ZREC	$103.01

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Based on the Year 3 RFP, the winning bids resulted in the following LREC/ZREC prices filed on December 30, 2014:

2014	**Price/REC (CL&P)**
Medium ZREC	$73.61
Small ZREC	$80.97

The LREC/ZREC program is based on a 15 year contract for the purchase of the number of RECs that the renewable energy project is expected to generate. If excess RECs are generated above the LREC/ZREC contract, the generator would have the ability to sell the excess RECs to the Wholesale Electric Market.

APPENDIX A

ENERGY BALANCE

Facility:	Enfield WWTP						
	Electric Energy Balance						
				Measured or	Annual		
			Estimated	Estimated	Estimated		
Equipment Description		**HP**	**Load**	**kW**	**hours**	**kWhs**	**Notes**
Headworks and Primary Treatment							
Primary Scum Pit Mixer		10	0.8	5.97	52	310	One day per week, 1 hour per day (1 hr/wk)
Primary Tank Drive 1		0.75	0.8	0.45	4380	1,960	One tank runs continuously
Primary Tank Drive 2		0.75	0.8	0.45	4380	1,960	
Comminutor		3	0.8	1.79	8760	15,684	
Influent Screen		5	0.8	2.98	8760	26,140	
Grit Chamber Hoist (closing motor)		5	0.8	2.98	364	1,086	
Grit Chamber Hoist (trolley motor)		1	0.8	0.60	364	217	
Grit Chamber Hoist (holding motor)		5	0.8	2.98	364	1,086	
				18		**48,445**	
Aeration System							3 of 4 trains (3months/yr)
Blower 1		200	NA	141	2190	308,790	One runs continuously
Blower 2		200	NA	141	2190	308,790	kW based on field readings
Blower 3		200	NA	141	2190	308,790	
Blower 4		200	NA	141	2190	308,790	
Internal Recirculation Pump 1		10	0.8	5.97	8760	52,280	
Internal Recirculation Pump 2		10	0.8	5.97	8760	52,280	
Internal Recirculation Pump 3		10	0.8	5.97	8760	52,280	
Internal Recirculation Pump 4		10	0.8	5.97	6744	40,248	
Primary Anoxic Mixer 1		7.5	0.8	4.48	8760	39,210	
Primary Anoxic Mixer 2		7.5	0.8	4.48	8760	39,210	
Primary Anoxic Mixer 3		7.5	0.8	4.48	8760	39,210	
Primary Anoxic Mixer 4		7.5	0.8	4.48	6744	30,186	
Secondary Anoxic Mixer 1		4	0.8	2.39	8760	20,912	
Secondary Anoxic Mixer 2		4	0.8	2.39	8760	20,912	
Secondary Anoxic Mixer 3		4	0.8	2.39	8760	20,912	
Secondary Anoxic Mixer 4		4	0.8	2.39	6744	16,099	
Auto Air Valves (12 @ 1 hp)		12	0.8	7.16	8760	62,736	
Carbon Feed Pump		0.5	0.8	0.30	4380	1,307	Estimate based on operating half the year
				200		**1,722,940**	
Secondary Clarification							
Secondary Settling Clarifier Drive 1		0.5	0.8	0.30	8760	2,614	
Secondary Settling Clarifier Drive 2		0.5	0.8	0.30	8760	2,614	
Secondary Settling Clarifier Drive 3		0.5	0.8	0.30	8760	2,614	
Secondary Settling Clarifier Drive 4		0.5	0.8	0.30	8760	2,614	
Secondary Scum Well Mixer 1		10	0.8	5.97	52	310	One hour per week
Secondary Scum Well Mixer 2		10	0.8	5.97	52	310	
				13		**11,077**	
Disinfection System							
Chlorine Feed Pump 1		1.0	0.80	0.60	**2190**	1,307	
Chlorine Feed Pump 2		1.0	0.80	0.60	**2190**	1,307	
Flash Mixer		2.0	0.80	1.19	**4380**	5,228	
				2		**7,842**	
Sludge Pumping							
RAS Pump 1	VFD	20	NA	13.50	8760	118,260	Three RAS pumps run in continuous operation
RAS Pump 2	VFD	20	NA	13.50	8760	118,260	kW based on field readings
RAS Pump 3	VFD	20	NA	13.50	8760	118,260	
WAS Pump	VFD	5	0.0	0.40	8760	3,504	KW based on field readings
Secondary Scum Pump		5	0.80	2.98	52	155	
				43.9		**358,439**	

Solids Handling							
Primary Sludge Pump 1	VFD	10	0.8	5.97	1040	6,207	Two units operating 40 hours per week
Primary Sludge Pump 2	VFD	5	0.8	2.98	1040	3,103	
Primary Sludge Pump 3	VFD	5	0.8	2.98	1040	3,103	
Primary Sludge Pump 4	VFD	5	0.8	2.98	1040	3,103	
Primary Sludge Grinder		3	0.8	1.79	1040	1,862	
Dewatering Pump		10	0.8	5.97		0	Removed.
Sludge Mixing Pump 1		15	0.8	8.95	0	0	Currently not online
Sludge Mixing Pump 2		15	0.8	8.95	0	0	
Polymer Transfer Pump 1		5.0	0.8	2.98	1040	3,103	
Polymer Transfer Pump 2		5.0	0.8	2.98	1040	3,103	
Polymer Mixer 1		1.5	0.8	0.90	1040	931	
Polymer Mixer 2		1.5	0.8	0.90	1040	931	
Polymer Feed Pump 1		3	0.8	1.79	2080	3,724	2 duty, 1 spare
Polymer Feed Pump 2		3	0.8	1.79	2080	3,724	
Polymer Feed Pump 3		3	0.8	1.79	0	0	
Belt Filter Press (2 @ 3 hp)		6	0.8	3.58	2080	7,448	
Wash Water for BFP (2 @ 5 hp)		10	0.8	5.97	2080	12,413	
Belt Conveyor		3	0.8	1.79	2080	3,724	
Shuttle Belt Conveyor		3	0.8	1.79	2080	3,724	
Shutte Drive		3	0.8	1.79	2080	3,724	
Septage Receiving Pump		3	0.8	1.79		0	
				45		**63,929**	
Odor control							
Odor Control Fan		30	NA	17.00	2080	35,360	Runs while dewatering,kW based on field readings
Scrubber 1 Pump		7.5	0.8	4.48	0	0	Currently not online
Sodium Permanganate Pumps (2 @ 0.25 hp)		0.50	0.8	0.30	2080	621	
				21.5		**35,360**	
Plant Water System							
Plant Water Pump 1		40	NA	21.00	4380	91,980	One runs continuously, kw based on field readings
Plant Water Pump 2		40	NA	21.00	4380	91,980	
Foam Spray Water Pump 1		7.5	0.8	4.48	0	0	Currently not online.
Foam Spray Water Pump 2		7.5	0.8	4.48	0	0	
Carrier Water 1		0.5	0.8	0.30	0	0	
Carrier Water 2		0.5	0.8	0.30	0	0	
Jockey Pump 1		2	0.8	1.19	0	0	
Carrier Water Pumps (2 @ .5 hp)		1	0.8	0.60	0	0	
				30.5		**183,960**	
Building Systems							
Air Handeling Unit		10	0.8	5.97	1700	10,146	
Hot Water Circulation Pump		1.5	0.8	0.90	4368	3,910	
Exhaust Fan-1	VFD	30	0.8	17.90	1700	30,437	
Exhaust Fan-2		5	0.8	2.98	1700	5,073	
Exhaust Fan-3		1.5	0.8	0.90	1700	1,522	
Exhaust Fan-4		5	0.8	2.98	1700	5,073	
Exhaust Fan-5		0.5	0.8	0.30	1700	507	
Exhaust Fan-6		1.5	0.8	0.90	1700	1,522	
Exhaust Fan-7		0.75	0.8	0.45	1700	761	
P-PF1	VFD	3	0.8	1.79	1700	3,044	
P-PF2	VFD	3	0.8	1.79	1700	3,044	
Air Handeling Unit-CR		0.5	0.8	0.30	2000	597	
MAU-1		7.5	0.8	4.48	0	0	
MAU-2		7.5	0.8	4.48	0	0	
Sump Pump 1		0.75	0.8	0.45	12	5	Used based on 1 hour per month
Sump Pump 2		0.5	0.8	0.30	12	4	
Sump Pump 3		0.5	0.8	0.30	12	4	
Sump Pump 4		1	0.8	0.60	12	7	
Sump Pump 5		0.5	0.8	0.30	12	4	
Sump Pump 6		2	0.8	1.19	12	14	
Sump Pump 7		2	0.8	1.19	12	14	
Electric Unit Heaters (7 @ 1 hp)		7	0.8	29.24	2000	58,486	7 unit heaters at 1 HP each
Air Compressors (2 @ 10 hp)		20	0.8	83.55	364	30,413	Estimate based on 2 hrs/day for half the year
Indoor and Outdoor Lighting				15.00	4380	65,700	
Misc				25.00	1000	25,000	
				196		**245,286**	

		Baseline					
		Annual	**% of**	**Average**			
Plant System		**kWh**	**Total**	**kW**			
Headworks and Primary Treatment		48,445	2.10%	18			
Aeration System		1,722,940	74.55%	200			
Secondary Clarification		11,077	0.48%	13			
Solids Handling		63,929	2.77%	45			
Odor control		35,360	1.53%	21			
Plant Water System		183,960	7.96%	21			
Building Systems		245,286	10.61%	13			
Sludge Pumping		358,439	15.51%	44			
Disinfection System		7,842	0.34%	2			
				378			
Annual Total		**2,310,996**					
Annual Electric Use 2013		**2,157,295**	**107%**	**321**			

APPENDIX B

ELECTRICAL USE SUMMARY DATA

TransCanada Supply / Generation Charges

Date	Total kWh	Total Cost	Contract Cost/kWh	Calculated Cost/kWh
Dec-13	200,880	$ 17,119.66	$ 0.083	$ 0.085
Jan-14	196,560	$ 15,809.12	$ 0.082	$ 0.080
Average				$ 0.083

Note: Calculated cost/kWh incorporates passthrough charges and adjustments.

Acct 51270034010	kWh	T&D Costs	$/kWh	Gen Costs	Total Costs	Total $/kWh
1/1/2013	223065.3	$8,580.23	$0.038	$18,514.42	$27,094.65	$0.121
2/1/2013	145440	$5,907.51	$0.041	$12,071.52	$17,979.03	$0.124
3/1/2013	175680	$7,248.72	$0.041	$14,581.44	$21,830.16	$0.124
4/1/2013	176400	$7,260.74	$0.041	$14,641.20	$21,901.94	$0.124
5/1/2013	185760	$7,432.59	$0.040	$15,418.08	$22,850.67	$0.123
6/1/2013	173520	$6,903.12	$0.040	$14,402.16	$21,305.28	$0.123
7/1/2013	188640	$7,517.75	$0.040	$15,657.12	$23,174.87	$0.123
8/1/2013	172800	$7,256.19	$0.042	$14,342.40	$21,598.59	$0.125
9/1/2013	160560	$6,992.18	$0.044	$13,326.48	$20,318.66	$0.127
10/1/2013	166320	$7,100.37	$0.043	$13,804.56	$20,904.93	$0.126
11/1/2013	200880	$7,886.70	$0.039	$16,673.04	$24,559.74	$0.122
12/1/2013	177532.9	$7,645.48	$0.043	$14,735.23	$22,380.71	$0.126
					$265,899.23	
Acct 51881714026	**kWh**	**T&D Costs**	**$/kWh**		**Total Costs**	**Total $/kWh**
1/1/2013	1974.6	$320.33	$0.16		$320.33	$0.162
2/1/2013	2023	$306.06	$0.15		$306.06	$0.151
3/1/2013	1400	$212.99	$0.15		$212.99	$0.152
4/1/2013	700	$122.66	$0.18		$122.66	$0.175
5/1/2013	278	$68.97	$0.25		$68.97	$0.248
6/1/2013	235	$63.78	$0.27		$63.78	$0.271
7/1/2013	250	$65.38	$0.26		$65.38	$0.262
8/1/2013	243	$64.63	$0.27		$64.63	$0.266
9/1/2013	232	$63.45	$0.27		$63.45	$0.273
10/1/2013	457	$95.56	$0.21		$95.56	$0.209
11/1/2013	1316	$195.87	$0.15		$195.87	$0.149
12/1/2013	1587.8	$227.87	$0.14		$227.87	$0.144
					$1,807.55	

APPENDIX C

CONNECTICUT LIGHT AND POWER TARIFF – RATE 30 AND 37

CL&P Standard Service Total Generation
(July through December 2014)

Rate/Description	Standard Service (¢/kWh) GSC Rate (A)	FMCC-Generation Rate (B)	Total Generation Supply Rate C = A + B
Rate 1	9.920	0.070	**9.990**
Rate 5	9.920	0.070	**9.990**
Rate 7			
On-Peak	12.490	0.070	**12.560**
Off-Peak	8.990	0.070	**9.060**
Rate 18	9.847	0.070	**9.917**
Rate 27			
On-Peak	11.864	0.070	**11.934**
Off-Peak	8.864	0.070	**8.934**
Rate 29	9.847	0.070	**9.917**
Rate 30	9.847	0.070	**9.917**
Rate 35	9.847	0.070	**9.917**
Rate 37			
On-Peak	11.864	0.070	**11.934**
Off-Peak	8.864	0.070	**8.934**
Rate 40	9.847	0.070	**9.917**
Rate 41 (less than 500 kW)			
On-Peak	11.961	0.070	**12.031**
Off-Peak	8.961	0.070	**9.031**
Rate 55 (less than 500 kW)			
On-Peak	11.961	0.070	**12.031**
Off-Peak	8.961	0.070	**9.031**
Rate 56 (less than 500 kW)			
On-Peak	11.961	0.070	**12.031**
Off-Peak	8.961	0.070	**9.031**
Rate 115	9.847	0.070	**9.917**
Rate 116	9.942	0.070	**10.012**
Rate 117	9.942	0.070	**10.012**
Rate 119	9.825	0.070	**9.895**

CL&P Last Resort Service Total Generation
(July through September 2014)

Rate/Description	Last Resort Service (¢/kWh) GSC Rate (A)	FMCC-Generation Rate (B)	Total Generation Supply Rate C = A + B
Rate 39			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Rate 41 (greater than or equal to 500 kW)			
On-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Off-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Rate 55 (greater than or equal to 500 kW)			
On-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Off-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Rate 56 (greater than or equal to 500 kW)			
On-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Off-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Rate 57			
On-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Off-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Rate 58			
On-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**
Off-peak			
July	9.358	0.070	**9.428**
August	8.896	0.070	**8.966**
September	7.963	0.070	**8.033**

AVAILABLE for the entire electrical requirements at a single service location measured through one metering installation where the customer's maximum demand is less than 200 kW. Where the Company deems it impractical to deliver electricity through one service, or where more than one meter has been installed for billing under a withdrawn rate, then the measurement of electricity may be by two or more meters.

Notwithstanding the applicability provisions of other rates, this rate is also available to full-requirements customers that (i) prior to March 1, 1992, had a maximum monthly 30-minute demand in excess of 350 kW; (ii) had a maximum monthly 30-minute demand in the twelve billing periods prior to March 1, 1992, that equaled or exceeded twice the average of the customer's maximum monthly 30-minute demands during the same billing periods; (iii) as of March 1, 1992, had established, and had a reasonable expectation of continuing, a seasonal pattern of electrical usage approximating that established during the twelve billing periods prior to March 1, 1992; and (iv) had not discontinued taking service under this rate or Rate 27 after March 1, 1992. The term of contract for customers eligible to take service under this paragraph shall be one year and shall continue thereafter until canceled by one month's written notice by the customer.

MONTHLY RATE:

DISTRIBUTION SERVICE RATE:

CUSTOMER CHARGE	$38.50
DEMAND CHARGE OVER 2 kW	$6.06 per kW
CHARGE PER kWh	
FIRST 300 kWh PER kW OF DEMAND	$0.01780
ALL OVER 300 kWh PER kW OF DEMAND	$0.01780

TRANSMISSION SERVICE RATE:

DEMAND CHARGE OVER 2 kW	$5.80 per kW

SYSTEMS BENEFITS CHARGE:

CHARGE PER kWh	$0.00132

COMPETITIVE TRANSITION ASSESSMENT:

DEMAND CHARGE OVER 2 kW	$0.10 per kW
CHARGE PER kWh	
FIRST 300 kWh PER kW OF DEMAND	$0.00000
ALL OVER 300 kWh PER kW OF DEMAND	$0.00000

CONSERVATION CHARGE:

CHARGE PER kWh	$0.00300

CONSERVATION ADJUSTMENT MECHANISM:

CHARGE PER kWh	$0.00300

RENEWABLE ENERGY:

CHARGE PER kWh	$0.00100

FMCC DELIVERY CHARGE:
(as per FMCC tariff)

CHARGE PER kWh	$0.00611

SUPPLIER SERVICE OPTIONS:
(as per the Generation Services tariff)

GENERATION SERVICE PER kWh	$0.09847
THIRD-PARTY SERVICE	as per contract

FMCC GENERATION CHARGE:
(as per FMCC tariff – not applicable to customers taking THIRD-PARTY SERVICE above)

CHARGE PER kWh	$0.00070

COMBINED PUBLIC BENEFITS CHARGE: Pursuant to Conn. Agencies Regs. § 16-245-1(a)(2)(A) the Systems Benefits Charge, the Conservation Charge, the Conservation Adjustment Mechanism, and the Renewable Energy Charge are combined for billing purposes into the Combined Public Benefits Charge effective January 1, 2014.

RATE ADJUSTMENTS: This rate will be adjusted as provided in the Company's Energy and Transmission Adjustment Clauses.

COMPETITIVE TRANSITION ASSESSMENT COST ADJUSTMENT: Competitive Transition Assessment (CTA) charges and terms under this rate includes a CTA Cost Adjustment Charge set in accordance with the Company's CTA Cost Adjustment.

SYSTEMS BENEFITS COST ADJUSTMENT: Systems Benefits service charges for all customers taking service under this rate shall be set in accordance with the Company's Systems Benefits Cost Adjustment.

DETERMINATION OF DEMAND: The demand shall be the highest average 30-minute kilowatt demand recorded during the billing month, but not less than 2 kilowatts.

SPECIAL PROVISIONS:

1. Primary Metering: If the service is metered on the primary side of the transformers supplying the customer, 2% of the metered kilowatt-hours will be deducted in computing the bill.

2. Facilities Ownership: If the service is taken at the property line and the Company is relieved of owning and maintaining all electrical distribution equipment on private property, except the metering equipment, a credit shall be applied to the bill equal to $.20 per kW.

3. Transmission Voltage Delivery Allowance: Where service is supplied at transmission voltage, 69,000 volts and higher, and the Company is relieved of all investment on the customer's property, except the metering equipment, the Demand Charge under the Distribution Service Rate shall be waived, and all Energy Charges adjusted for the differential between line losses at transmission and primary distribution service. This Energy Charge shall be implemented by multiplying on-peak and off-peak charges by .9735 and .9787 respectively. Service supplied at transmission voltage is unregulated.

MINIMUM CHARGE: The minimum charge is the customer charge.

TERM OF CONTRACT: None, except as provided above.

AVAILABLE for the electrical requirements where the customer's maximum demand is equaled or exceeded in the last twelve months, or shall equal or exceed in the next twelve months, 200 kW but less than 350 kW and delivered at one point and at one standard voltage through one installation of transformers supplied by the Company. Service will be metered at one point by one installation of meters. The meter location will be determined by the Company. Where the Company deems it impractical to deliver electricity through one service, or where more than one meter has been installed for billing under a withdrawn rate, then the measurement of electricity may be by two or more meters.

MONTHLY RATE:

ON-PEAK (Weekdays 12 Noon - 8 p.m. during Eastern Standard Time)
(Weekdays 1 p.m. – 9 p.m. during Daylight Savings Time)

OFF-PEAK (All other hours)

DISTRIBUTION SERVICE RATE:

CUSTOMER CHARGE	$350.00
DIST. DEMAND CHARGE	$6.34 per kW

TRANSMISSION SERVICE RATE:

PROD./TRAN. DEMAND CHARGE	$3.24 per kW
CHARGE PER KWH ON-PEAK	$0.01964
CHARGE PER KWH OFF-PEAK	$0.00450

SYSTEMS BENEFITS CHARGE:

CHARGE PER KWH	$0.00060

COMPETITIVE TRANSITION ASSESSMENT:

PROD./TRAN. DEMAND CHARGE	$0.12 per kW
CHARGE PER KWH ON-PEAK	$0.00000
CHARGE PER KWH OFF-PEAK	$0.00000

CONSERVATION CHARGE:

CHARGE PER KWH	$0.00300

CONSERVATION ADJUSTMENT MECHANISM:

CHARGE PER kWh	$0.00300

RENEWABLE ENERGY:

CHARGE PER KWH	$0.00100

FMCC DELIVERY CHARGE:
(as per FMCC tariff)

CHARGE PER KWH ON-PEAK	$0.01241
CHARGE PER KWH OFF-PEAK	$0.00278

SUPPLIER SERVICE OPTIONS:
(as per the Generation Services tariff)

GENERATION SERVICE: STANDARD SERVICE
(MAX DEMAND LESS THAN 500 KW)

CHARGE PER KWH ON-PEAK	$0.11864
CHARGE PER KWH OFF-PEAK	$0.08864
THIRD-PARTY SERVICE	as per contract

FMCC GENERATION CHARGE:
(as per FMCC tariff – not applicable to customers taking THIRD-PARTY SERVICE above)

CHARGE PER KWH	$0.00070

POWER FACTOR:

If a customer is found to have a power factor of less than 90% lagging, the Company may require correction to at least 90% lagging as a condition of service. If the customer does not correct the power factor to at least 90% lagging and the Company corrects the condition, the customer will reimburse the Company for all costs which it incurs. The Company shall have the right to conduct periodic tests at reasonable intervals to determine the customer's power factor.

COMBINED PUBLIC BENEFITS CHARGE: Pursuant to Conn. Agencies Regs. §16-245-1(a)(2)(A) the Systems Benefits Charge, the Conservation Charge, the Conservation Adjustment Mechanism, and the Renewable Energy Charge are combined for billing purposes into the Combined Public Benefits Charge effective January 1, 2014.

RATE ADJUSTMENTS: This rate will be adjusted as provided in the Company's Energy and Transmission Adjustment Clauses.

COMPETITIVE TRANSITION ASSESSMENT COST ADJUSTMENT: Competitive Transition Assessment (CTA) charges and terms under this rate includes a CTA Cost Adjustment Charge set in accordance with the Company's CTA Cost Adjustment.

SYSTEMS BENEFITS COST ADJUSTMENT: Systems Benefits service charges for all customers taking service under this rate shall be set in accordance with the Company's Systems Benefits Cost Adjustment.

DETERMINATION OF PRODUCTION/TRANSMISSION DEMAND: The production/transmission demand shall be the highest average 30-minute kilowatt demand recorded during the billing month in the on-peak hours as defined above.

DETERMINATION OF DISTRIBUTION DEMAND: The distribution demand shall be the highest average 30-minute kilowatt demand in the current month or the preceding eleven (11) months.

The customer may, upon not less than three (3) months' prior written notice to the Company, decrease the Distribution Demand solely to reflect lower load levels from demonstrable conservation and load management.

SPECIAL PROVISIONS:

1. Primary Metering: If the service is metered on the primary side of the transformers supplying the customer, 2% of the metered kilowatthours will be deducted in computing the bill.

2. Facilities Ownership: If the service is taken at the property line and the Company is relieved of owning and maintaining all electrical distribution equipment on private property, except the metering equipment, a credit shall be applied to the bill equal to $.20 per kW of the Distribution Demand billed.

3. Transmission Voltage Delivery Allowance: Where service is supplied at transmission voltage, 69,000 volts and higher, and the Company is relieved of all investment on the customer's property, except the metering equipment, the Distribution Demand Charge under the Distribution Service Rate shall be waived, and all Energy Charges adjusted for the differential between line losses at transmission and primary distribution service. This Energy Charge shall be implemented by multiplying on-peak and off-peak charges by .9735 and .9787 respectively. Service supplied at transmission voltage is unregulated.

MINIMUM CHARGE: The minimum charge is the customer charge plus the distribution demand charges in any rate category.

TELEMETERING REQUIREMENT: The customer agrees that it is necessary to install telemetering equipment for the Company to read the meter(s). The location of such facilities shall be at the sole discretion of the Company. The customer will choose to either provide a dedicated direct dial analog phone line or elect for the Company to connect to their existing

phone line. The provision of a suitable dedicated direct dial analog telephone line in the reasonable proximity of the electric meter as determined by the Company's specifications is the sole responsibility of the customer. The customer shall be the owner of all telephone lines and shall maintain them in operable condition at all times. The Company will be responsible for the installation and maintenance of the connection between the telemetering equipment and the customer's telephone line.

TERM OF CONTRACT: One year and thereafter unless canceled by one month's written notice.

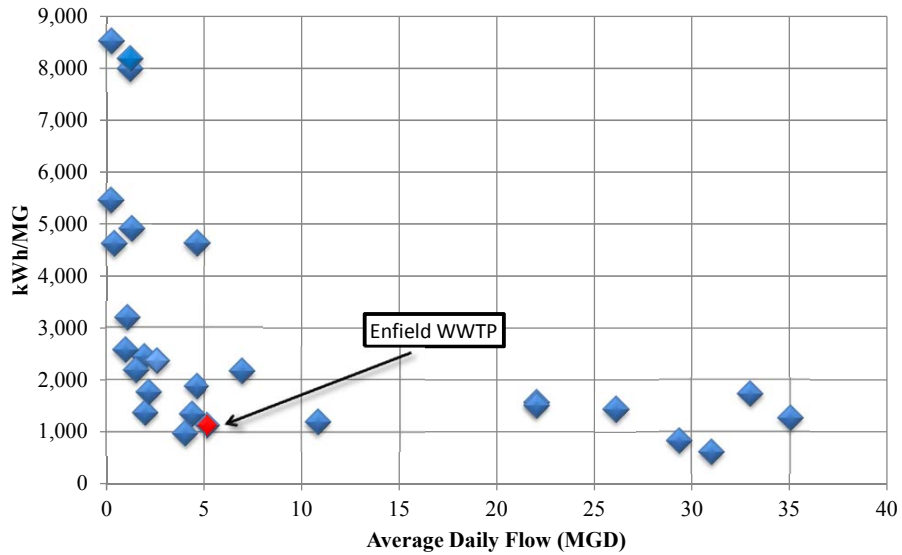
APPENDIX D

FACILITY BENCHMARK DATA

Wastewater Facility Benchmarking Data

Data is based on the Massachusetts DEP Pilot Study & previously evaluated facilities

Facility	MGD	kWh	mg/yr	kWh/MG
A	1.97			2,443
B	4.6			1,878
C	33			1,731
D	31			613
E	10.8			1,201
F	1.03			3,193
G	2.01			1,369
H	35			1,270
I	0.25			8,524
J	1.2			7,997
K	4.6	643,800	139	4,642
L	1.5	1,196,400	548	2,183
M	0.95	893,400	347	2,576
N	2.19	1,413,300	800	1,767
O	4.4	2,162,700	1,606	1,347
P	0.38	643,800	139	4,642
Q	0.18	358,600	66	5,458
R	1.30	2,336,914	475	4,925
S	22	12,612,879	8,030	1,571
T	26.1	13,703,200	9,527	1,438
U	29.4	8,909,600	10,731	830
V	4.04	2,881,200	2,952	976
W	22.00	12,154,800	8,030	1,514
X	7	5,531,400	2,555	2,165
Y	1.20	3,586,320	438	8,188
Z	2.6	2,240,400	949	2,361
AA	5.20	2,157,295	1,898	1,137



APPENDIX E

FIELD DATA SUMMARY

Pump Name	Leg	Volts	Current (Amp)	Power (kW)	Power Factor	Motor Efficiency	RPM	HP	Flow (CFM)	Notes	
Odor Control Exhaust Fan	L1	276.5	25.0	5.6	0.82	93.0	1770	30			
	L2	275.5	23.9	5.2	0.79	93.0	1770	30			
	L3	275.6	26.9	6.2	0.83	93.0	1770	30			
	AVG/TOT	**477.2**	**25.3**	**17.0**	**0.8**	**93.0**	**1770**	**30**			
Blower	L1	275.6	182.0	46.5	0.92	95.0	3560	200	2600	1 of 4 blowers operating	
	L2	277.2	186.7	47.8	0.90	95.0	3560	200	2600		
	L3	276.3	181.9	46.8	0.91	95.0	3560	200	2600		
	AVG/TOT	**478.1**	**183.5**	**141.1**	**0.91**	**95.0**	**3560**	**200**	**2600**		
Mixer 2 & 3	L1	275.5	17.0	2.7	0.60			10			
	L2	277.0	17.0	2.7	0.60			10			
	L3	276.0	16.7	2.6	0.57			10			
	AVG/TOT	**477.8**	**16.9**	**8.0**	**0.59**			**10**			
Mixer 1 & 4	L1	275.4	17.7	2.8	0.60			10			
	L2	275.9	17.2	2.5	0.55			10			
	L3	276.7	17.9	2.8	0.56			10			
	AVG/TOT	**477.5**	**17.6**	**8.1**	**0.57**			**10**			

Pump Test Log

Pump Name	Speed %	Leg	EMF (VAC)	Current (Amp)	Power (kW)	Power Factor	Flow (GPM)	Motor Eff. (%)	Suction (psi)	Discharge (psi)	TDH (feet)	Efficiency	Notes
Primary Sludge Pump 1		L1	277.0	2.0	0.5	0.60	75	90%	2.2	24	50.4		
		L2	276.0	2.0	0.5	0.3-0.6	75	90%	2.2	24	50.4		
		L3	276.0	2.0	0.1-0.8	0.5-0.6	75	90%	2.2	24	50.4		
		AVG/TOT	**478.1**	**2.0**	**1.0**	**0.6**	**75**	**90%**	**2.2**	**24**	**50.4**	**80%**	
Primary Sludge Pump 2		L1	276.5	2.0	0.1-0.5	0.40	55	90%	2.2	18	36.6		
		L2	275.0	2.0	0.1-0.4	0.42	55	90%	2.2	18	36.6		
		L3	276.0	2.0	0.1-0.6	0.47	55	90%	2.2	18	36.6		
		AVG/TOT	**477.2**	**2.0**	**1.0**	**0.4**	**55**	**90%**	**2.2**	**18**	**36.6**	**42%**	
RAS Pump 1	100%	L1	272.3	23.9	4.3	0.67	3015	91%	2.0	14	27.7		All three pumps running
		L2	274.0	24.6	4.5	0.67	3015	91%	2.0	14	27.7		
		L3	273.0	24.0	4.5	0.69	3015	91%	2.0	14	27.7		
		AVG/TOT	**472.5**	**24.2**	**13.3**	**0.7**	**3015**	**91%**	**2.0**	**14**	**27.7**	**NA**	
RAS Pump 2	100%	L1	272.5	18.0	4.9	0.97	3015	91%	2.0	14	27.7		All three pumps running
		L2	274.0	17.6	4.8	0.99	3015	91%	2.0	14	27.7		
		L3	272.9	17.8	2.6	0.64	3015	91%	2.0	14	27.7		
		AVG/TOT	**472.5**	**17.8**	**12.3**	**0.9**	**3015**	**91%**	**2.0**	**14**	**27.7**	**NA**	
RAS Pump 3	100%	L1	273.0	22.0	4.4	0.75	3015	89%	2.0				All three pumps running
		L2	274.0	22.0	4.5	0.75	3015	89%	2.0				
		L3	273.0	21.4	4.3	0.75	3015	89%	2.0				
		AVG/TOT	**472.9**	**21.8**	**13.2**	**0.8**	**3015**	**89%**	**2.0**			**NA**	
RAS Pump 2	100%	L1	274.0	21.9	5.8	0.96	1688	91%	2.0	8	13.9		Only this pump running
		L2	275.8	21.8	4.5	0.78	1688	91%	2.0	8	13.9		
		L3	275.0	22.3	6.0	0.98	1688	91%	2.0	8	13.9		
			475.6	**22.0**	**16.3**	**0.9**	**1688**	**91%**	**2.0**	**8**	**13.9**	**30%**	
RAS Pump 3	100%	L1	273.0	24.5	5.1	0.77	1830	89%	2.0				Only this pump running
		L2	275.0	24.0	5.1	0.77	1830	89%	2.0				
		L3	273.8	24.4	5.1	0.77	1830	89%	2.0				
		AVG/TOT	**473.9**	**24.3**	**15.3**	**0.8**	**1830**	**89%**	**2.0**			**NA**	
RAS Pump 1	100%	L1	273.0	26.5	5.3	0.71	1950	91%	2.0	10	18.5		Only this pump running
		L2	274.0	27.2	5.2	0.71	1950	91%	2.0	10	18.5		
		L3	273.0	26.6	5.3	0.72	1950	91%	2.0	10	18.5		
		AVG/TOT	**472.9**	**26.8**	**15.8**	**0.7**	**1950**	**91%**	**2.0**	**10**	**18.5**	**47%**	
WAS Pump	48%	L1	272.5	1.0	0.1	0.35	66	88%					
		L2	274.0	1.2	0.1	0.37	66	88%					
		L3	273.0	1.5	0.2	0.40	66	88%					
		AVG/TOT	**472.6**	**1.2**	**0.4**	**0.4**	**66**	**88%**	**NA**	**NA**	**NA**	**NA**	
Plant Water Pump 1		L1	272.9	32.0	7.2	0.83			0.5	79	181.3		
		L2	274.0	32.5	7.3	0.83			0.5	79	181.3		
		L3	273.0	31.7	7.1	0.83			0.5	79	181.3		
		AVG/TOT	**472.8**	**32.1**	**21.6**	**0.8**	**NA**	**NA**	**0.5**	**79**	**181.3**		
Plant Water Pump 2		L1	273.4	31.9	7.11	0.83			1.0	75	170.9		
		L2	274.2	32.9	7.4	0.82			1.0	75	170.9		
		L3	272.8	32.2	7.2	0.83			1.0	75	170.9		
		AVG/TOT	**473.1**	**32.3**	**21.6**	**0.8**	**NA**	**NA**	**1.0**	**75**	**170.9**	**NA**	

Note: Flow is represen

NOTE: RAS Pump readings with all three in oepration gave a total flow for all three pumps, which does not allow us to calculate the efficiency in that mod of operation.

APPENDIX F

PUMP CURVES & EQUIPMENT DATA

- *Existing RAS Pump Curve*
- *Proposed Aerzen Hybrid Blower Curve*
- *Existing IR Pump Curve*
- *Anoxic Mixer Proposals & Calculations*

EQUIPMENT DATA SHEET

EQUIPMENT Return Sludge Pump #1 REFERENCE Section 303

LOCATION Basement of the Sludge Pump Station MANUFACTURER Worthington Corp. 401 Worthington Avenue, Harrison, New Jersey 07029

SALES AND SERVICE Hart Pump Inc., 150 Willard Avenue, Newington, Connecticut

MOTOR DATA

Serial no. GP1029298 Frame 5H-286U-50 Type VEHLTVGH Model

Volts 480 Hertz 60 Phase 3 Amps 22.5 Horsepower 15 Motor rpm 1800

Rating Cont. Insulation class Max. amb. 55°C Service factor Max. temp. rise

Code letter H NEMA design B Shaft end bearing no. - Front bearing no. -

Motor manufacturer U. S. Electric Motors, Milford, Connecticut (Varidrive)

MOTOR CONTROL INFORMATION

MCC no. 4 Breaker or switch frame trip Starter size 2 Heater size T-49 Megger reading

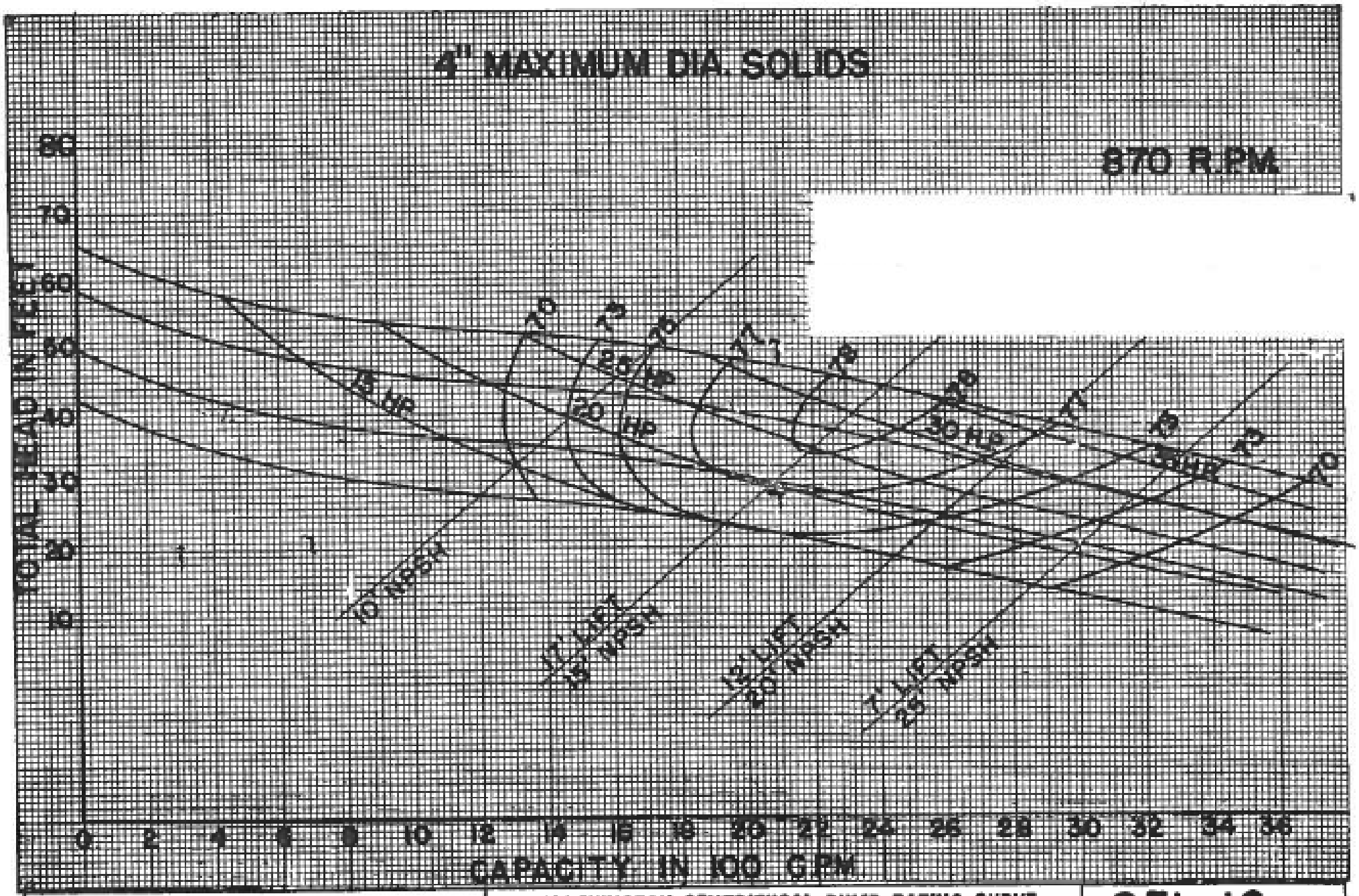
PUMP DATA

Serial no. Y486442 Model 3FN16 Size 8" rpm 860 gpm 1800 TDH, ft. 20

Impeller diam., in. Material Bronze Lubrication Grease Packing gland 1/2" packing Seal Grease

NOTES Gear Ratio 2.29
Min. rpm 450
Max. rpm 900

Electric Remote Speed Indicator
Type ERS1



ER-1914 SUPERSEDES-ER1471 | WORTHINGTON CENTRIFUGAL PUMP RATING CURVE | 8FL-16

Friday, May 01, 2015 4:06:51 PM - 8FN-FL16.pdf - Adobe Acrobat

AERZEN USA
Corporation
108 Independence Way
Coatesville, PA 19320

www.aerzenusa.com

Ph: (610) 656-1683 email: tmccurdy@aerzenusa.com

14-Apr-15

To: Amine Hanafi
Woodard & Curran
c/o: Chris Shea of Aqua Solutions (617) 923-3900
Re: Enfield, CT WWTP

From: Tom McCurdy
Aerzen Ref: E02-24191

		Hybrid Option 3 Duty/1 Standby D 98S		3-Lobe PD Option 3 Duty/1 Standby GM 90S.	
Performance Data:		Design	Min Flow	Design	Min Flow
flow at intake conditions	icfm	2,669	905	2,669	820
flow at standard conditions	scfm	2,394	812	2,394	736
intake pressure (absolute)	psia	14.63	14.63	14.63	14.63
differential pressure	psi	8.6	8.6	8.6	8.6
relative humidity	%	80	80	80	80
intake temperature	°F	100	100	100	100
discharge temperature	°F	208	219	205	234
blower speed	rpm	5,262	2,200	2,062	800
motor speed	rpm	3,570	1,493	1,780	691
power required at blower shaft	bHp	109.7	41.2	126.2	45.1
total power required to customer VFD*	kW	90.5	34.4	103.3	37.7
*assumes 97% efficient VFD operation					
motor rating	Hp	125		150	
Tolerance on flow & power	± 5 %				
Sound pressure level w/ enclosure measured in free field at 3ft. distance from the outline of the unit (tol. ± 2 dB(A)).	dB(A)	80	75	79	75

Weights & Dimensions:

Inlet connection	ANSI	12"	10"
Discharge connection	ANSI	10"	10"
Blower pkg weight	lbs.	6,725	7,070
Envelope dim.*	LxWxH in.	87x75x93	87x75x93
Cooling fan	kW	0.38	shaft driven
AERtronic	kW	0.2	0.2

* non binding dimensions includes, inlet filter silencer, relief valve, check valve, and flex connector

Aerzen Blower Package consists of the following components, assembled in our factory.

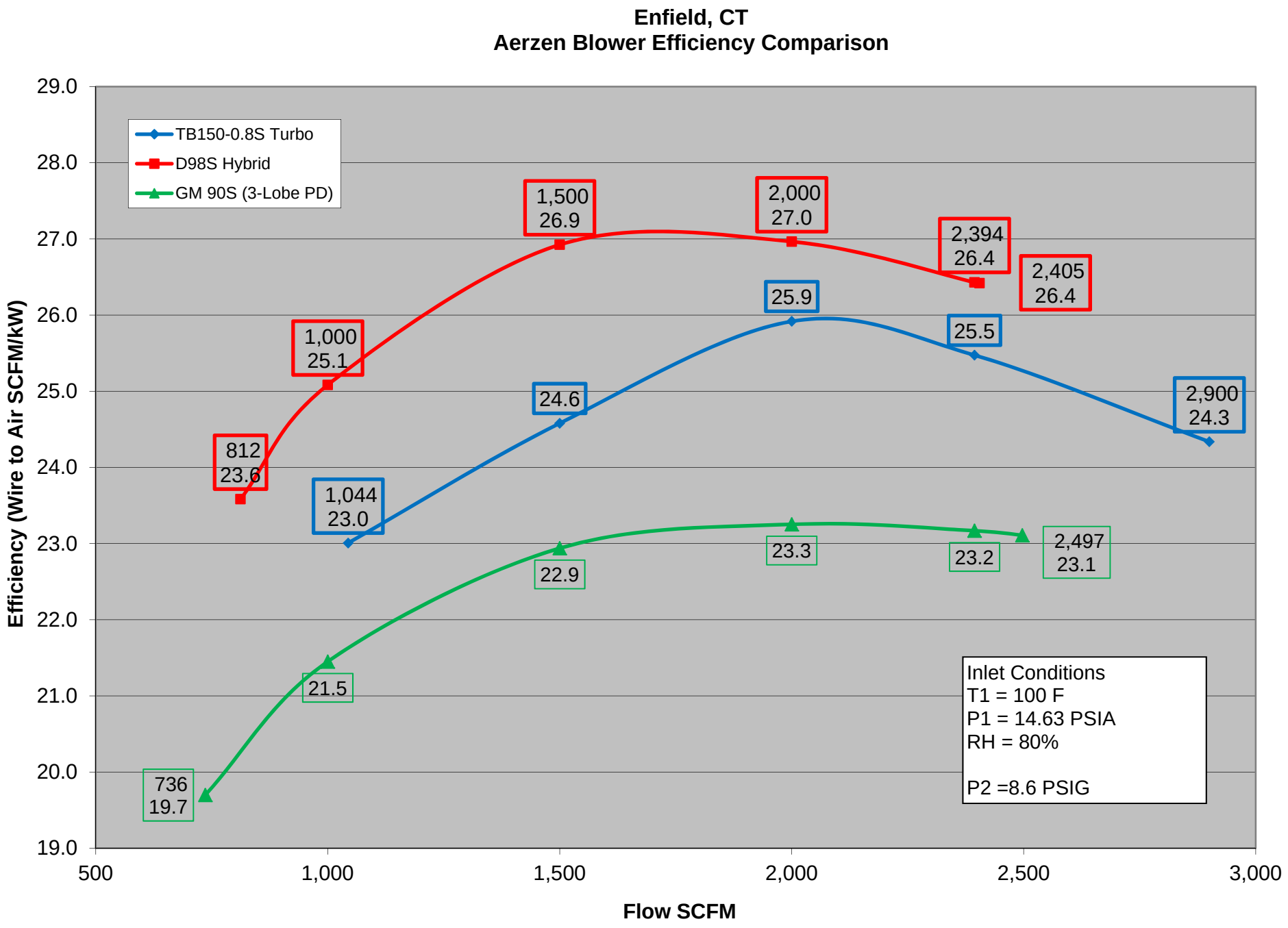
1 Aerzen Rotary Lobe Blower GM Series or Rotary Lobe Compressor D Series
1 base frame with integrated reactive type silencer
1 hinged motor support as automatic belt tensioning device
1 set of vibration isolating mounts
1 intake filter-silencer
1 narrow V-belt drive with guard
1 spring loaded pressure relief valve
1 discharge manifold with externally accessible integrated check valve
1 flexible connector with clamps for schedule 40 pipe, intake
1 flexible connector with clamps for schedule 40 pipe, discharge,

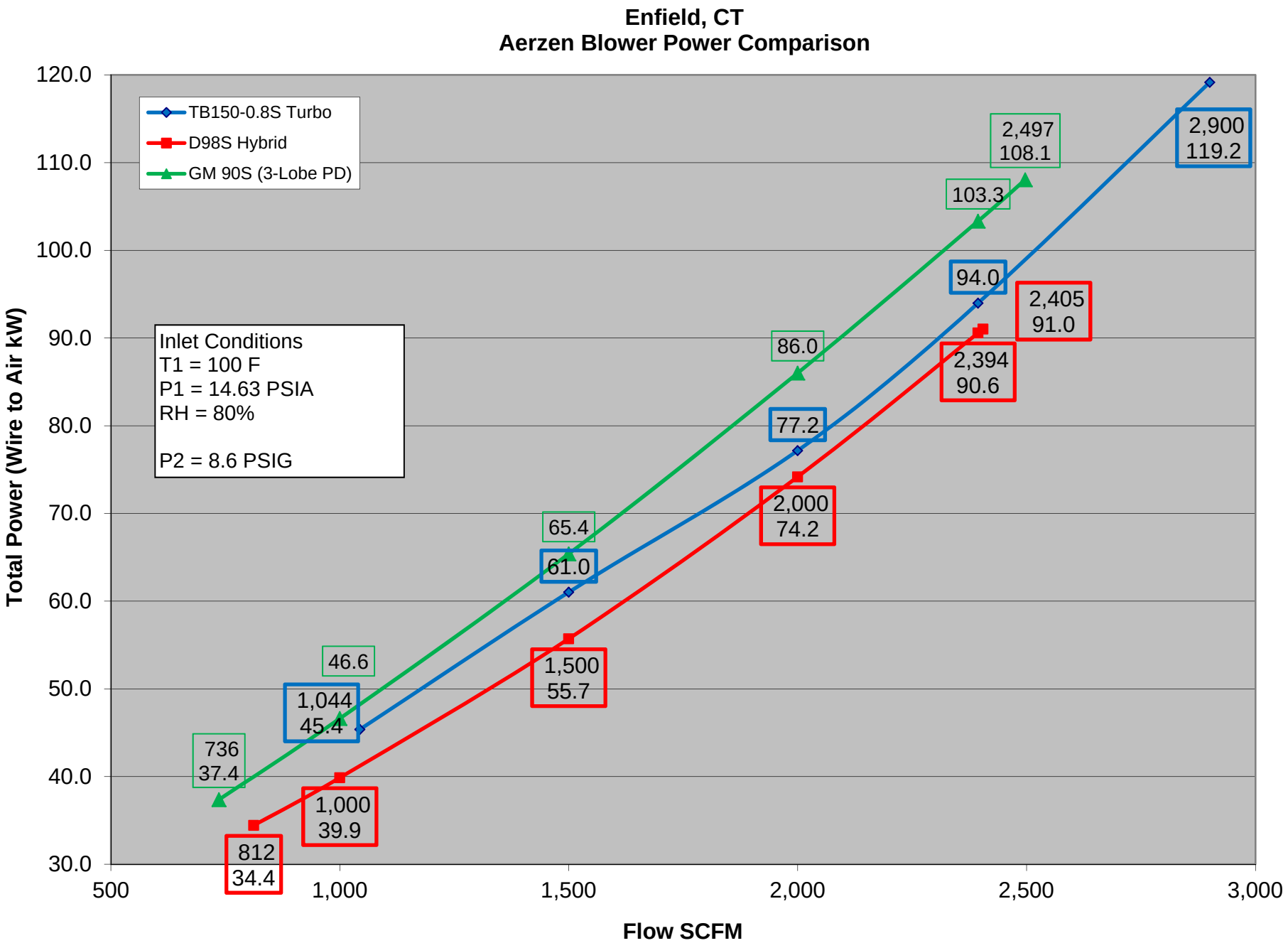
Scope of Supply

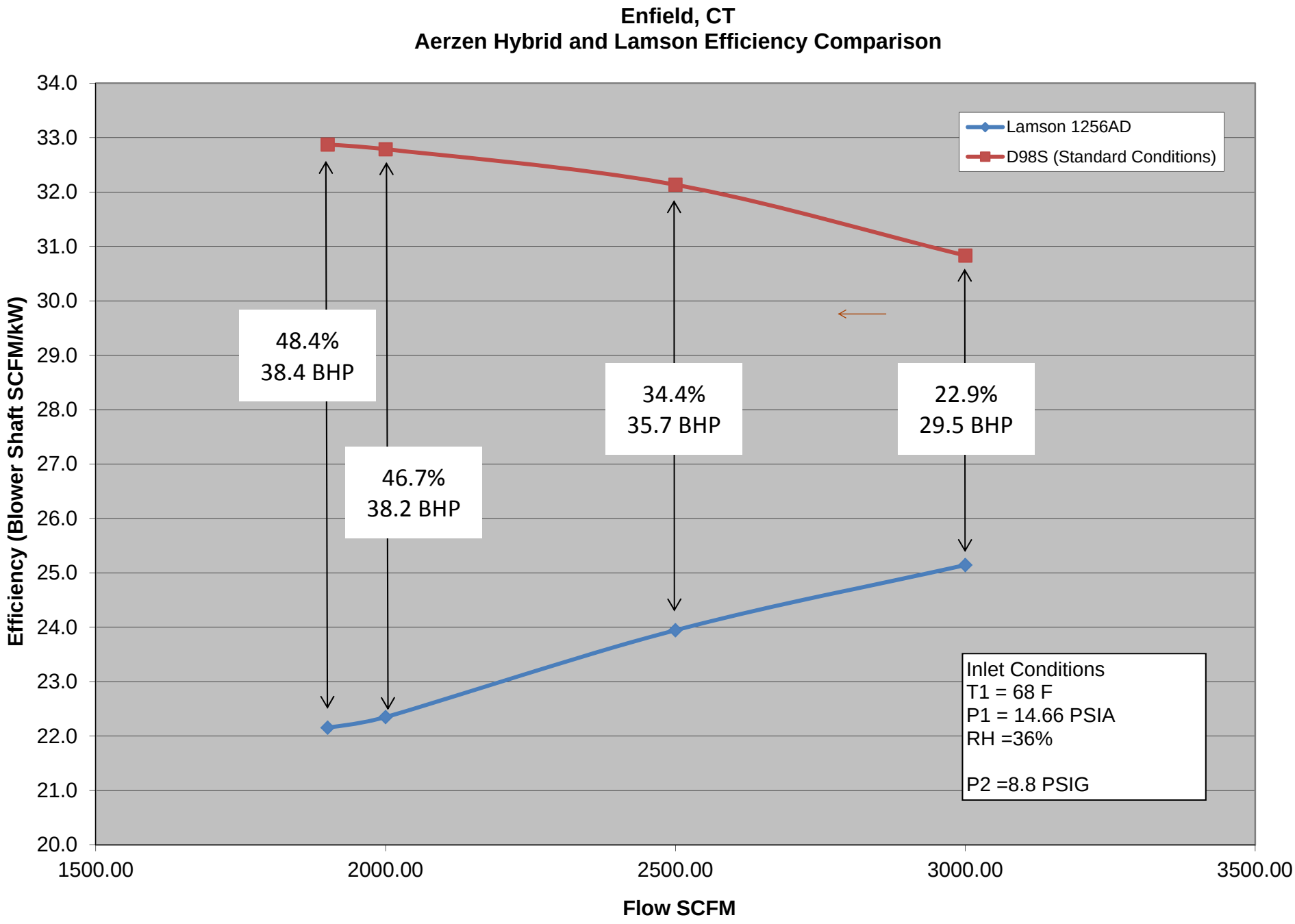
4 or 4 compact blower package as listed above
4 or 4 electric motor per NEMA, TEFC, 460v / 60Hz, premium efficiency
4 or 4 acoustic hood with integral cooling fan
4 set of instrumentation (4" gauges: P1, P2, T2 with High Temp Switch) **GM 90S**
4 set of sensors (P1, P2, T2 & Oil Temp) w/AERtronic Control **D98S**
4 or 4 set of spare belts & filter
4 or 4 domestic packaging
1 freight to jobsite
5 day of mfg onsite services (addl days $1,800/day)

TOTAL for 4 or 4 unit(s) **c/o: Chris Shea of Aqua Solutions (617) 923-3900**

Pricing: DAP Jobsite
Terms: This offer is subject to Aerzen Standard Terms and Conditions (A2-001-USA January 2009)
Submittals: 3 weeks after receipt of Purchase Order
Delivery: presently approx. 4 months upon technical release by customer
Payment: 20% upon receipt of approved submittal, 75% upon shipment Net 30 and 5% retention not to exceed 180 days from shipment.
Warranty: 24 months after start up or 30 months after delivery, which ever comes first*
*Maintenance must be performed per the Instruction Manual using Aerzen spare parts.
*Equipment not manufactured by Aerzen will carry the manufacturer's standard warranty.


Enfield, CT
Aerzen Blower Efficiency Comparison
TB150-0.8S Turbo
D98S Hybrid
GM 90S (3-Lobe PD)
Efficiency (Wire to Air SCFM/kW)
Flow SCFM
29.0
28.0
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
19.0
500
1,000
1,500
2,000
2,500
3,000
812
23.6
1,000
25.1
1,500
26.9
2,000
27.0
2,394
26.4
2,405
26.4
1,044
23.0
24.6
25.9
25.5
2,900
24.3
736
19.7
21.5
22.9
23.3
23.2
2,497
23.1
Inlet Conditions
T1 = 100 F
P1 = 14.63 PSIA
RH = 80%
P2 =8.6 PSIG


Enfield, CT
Aerzen Blower Power Comparison
TB150-0.8S Turbo
D98S Hybrid
GM 90S (3-Lobe PD)
Inlet Conditions
T1 = 100 F
P1 = 14.63 PSIA
RH = 80%
P2 = 8.6 PSIG
736
37.4
46.6
1,044
45.4
65.4
61.0
86.0
77.2
103.3
94.0
2,497
108.1
2,900
119.2
812
34.4
1,000
39.9
1,500
55.7
2,000
74.2
2,394
90.6
2,405
91.0
Total Power (Wire to Air kW)
Flow SCFM
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
500
1,000
1,500
2,000
2,500
3,000

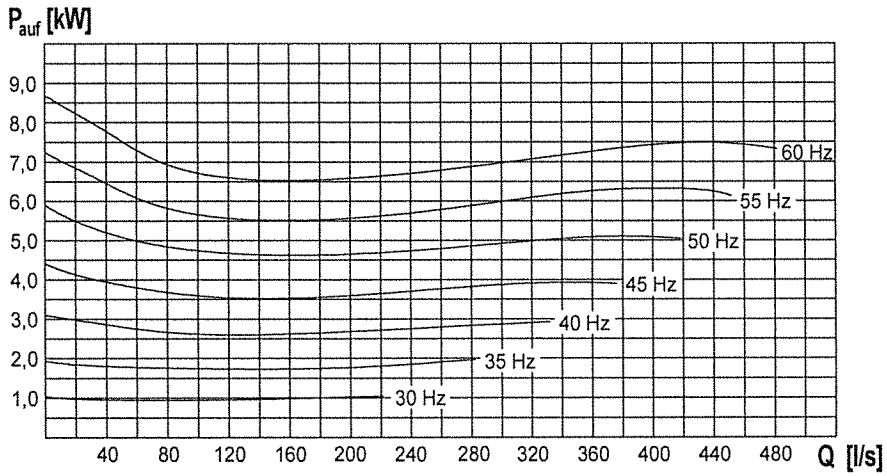

Enfield, CT
Aerzen Hybrid and Lamson Efficiency Comparison
Efficiency (Blower Shaft SCFM/kW)
34.0
33.0
32.0
31.0
30.0
29.0
28.0
27.0
26.0
25.0
24.0
23.0
22.0
21.0
20.0
1500.00
2000.00
2500.00
3000.00
3500.00
Flow SCFM
Lamson 1256AD
D98S (Standard Conditions)
48.4%
38.4 BHP
46.7%
38.2 BHP
34.4%
35.7 BHP
22.9%
29.5 BHP
Inlet Conditions
T1 = 68 F
P1 = 14.66 PSIA
RH =36%
P2 =8.8 PSIG

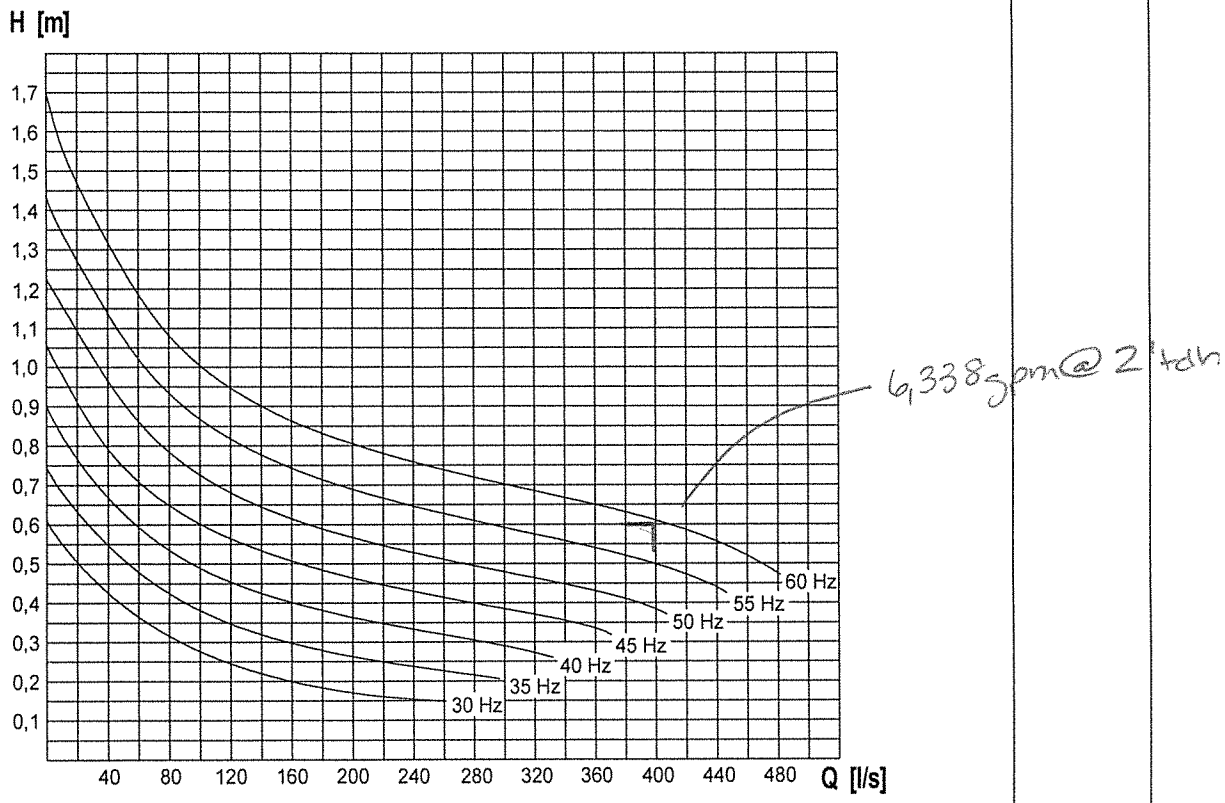
EMU
Unterwasserpumpen GmbH

Recirculation pump RZP 50-2.58-4/16 K6

Curves

Propeller type	PUR	Motor type:	T175 - 4/16
Number of blades	three	Rated output [kW]	7,5
Diameter [mm]	465	Power input [kW]	9,5
Free ball passage [mm]	120	Rated speed [rpm]	1740
Frequency [Hz]	60	Rated current [A]	14,0
Voltage [V]	460	Maximum starts [/h]	15





Technical modifications reserved

± 10% Toleranz

20.7.1999

April 30, 2015

Amine Hanafi
Woodard & Curran
1699 King Street, Suite 406
Enfield, CT 06082

RE: Budgetary Proposal— BioMix™ System – Anoxic and Swing Zones
Enfield, CT WPCF
Proposal # OM-14-123972

Amine,

Please find attached our proposal for a BioMix™ Compressed Gas Mixing System for the Anoxic and Swing Zones at the Enfield, CT WPCF.

The Enfield, CT WPCF is the type of facility that, when utilizing BioMix™ system in lieu of a mechanical mixing will attain reduced maintenance expense and reduced energy cost savings while providing improved mixed conditions.

The primary advantages of BioMix™ compressed gas mixing, versus other mixing technologies are:

- Reduced energy consumption – up to 60%+ savings versus traditional mixing.
- Reduced maintenance – BioMix™ maintenance is minimized and localized:
    - No moving parts in the basin.
    - Replace 20+ mixers with a single compressor.
    - Adaptable to any basin geometry with power input specific to the application.
    - No expensive bridges or platforms required.
    - EnviroMix will guarantee homogeneous mixing through a Field Performance Test demonstrating Coefficient of Variation of <10%.

Municipalities today are making decisions reflective of long-term cost of ownership as well as environmental stewardship. This 304SS system provides both: The 20-year ownership costs are significantly lower and address not only the initial capital and installation costs, but also equipment replacement, maintenance and energy consumption. BioMix offers significant advantage for this application and we look forward to the opportunity of discussing further with you.

We hope that you will find this proposal responsive to your needs. Please contact me with any questions.

Best Regards,

Tyler Kunz, P.E.
Vice President of Sales

BUDGETARY PROPOSAL

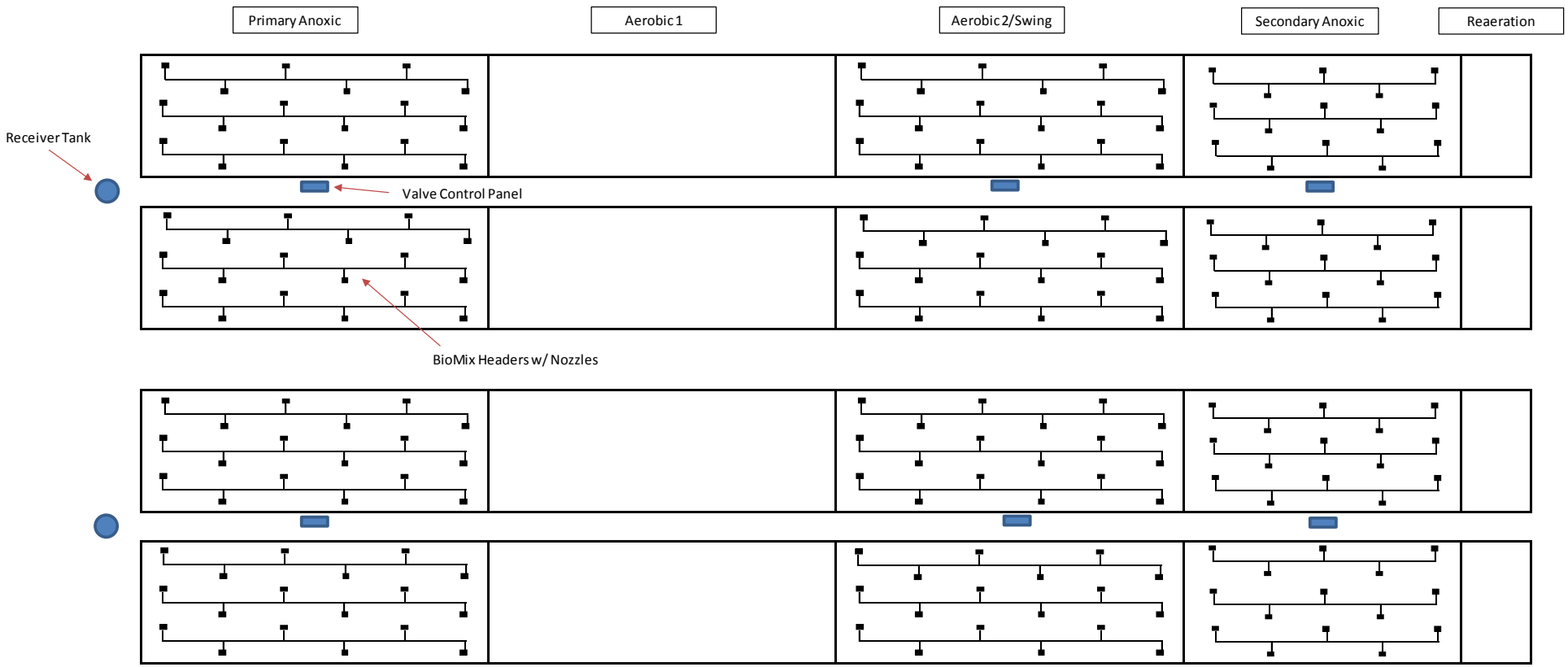
PROJECT DEFINITION

Current Process – Submersible Mixers. Zones to be reconfigured.

Future Process – A BioMix™ Compressed Gas Mixing System is proposed to provide complete mix conditions of the Anoxic and Swing Zones.

Primary Anoxic Zone:	61.2-ft x 24-ft x 16.1-ft SWD
Aerobic Zone2/Swing:	61.2-ft x 24-ft x 16.1-ft SWD
Secondary Anoxic Zone:	49.2-ft x 24-ft x 16.1-ft SWD

See next page for proposed BioMix configuration.



BioMix™ Configuration			
Zone	Primary Anoxic	Aerobic 2	Secondary Anoxic
Size of Pipe (Ø)	2-Inch		
Length of Header	±52'	±52'	±40'
Nozzles / Header	6	6	5
Headers / Basin	3	3	3
Total Number of Nozzles / Basin	18	18	15
Total Nozzles	204		

DESCRIPTION OF SYSTEM PROPOSED

BioMix™ systems provide mixing in liquids by firing short bursts of compressed air through engineered nozzles affixed to the floor of a tank. This compressed air is intermittently fired in fractional second durations to mix the tank. The relatively small surface area of the large gas volumes and their rapid upward velocity enable BioMix™ to transfer an insignificant amount of oxygen to the wastewater, providing efficient anaerobic/anoxic mixing. Valve Panels (VP) with 304SS enclosure, mounted at the tank wall, will control the firing of the compressed air through Sch 5 304SS press-technology tank piping and the 304SS BioMix™ nozzles. An operator interface in the VP allows user input to optimally control the firing pressure, sequence, frequency and duration for each tank. Electrical power requirements are limited to the power to operate the compressed air source and the 120V VP.

All BioMix™ installations share the following key benefits:

- Significantly reduced power consumption compared to mechanical mixing
- Reduced numbers of operating equipment to be maintained
- No mechanical or electrical components in the wastewater
- Non-clogging, self-cleaning in-tank components
- Minimal scheduled maintenance of other components (compressor, air control valves) in controlled environments

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SCOPE OF SUPPLY SUMMARY

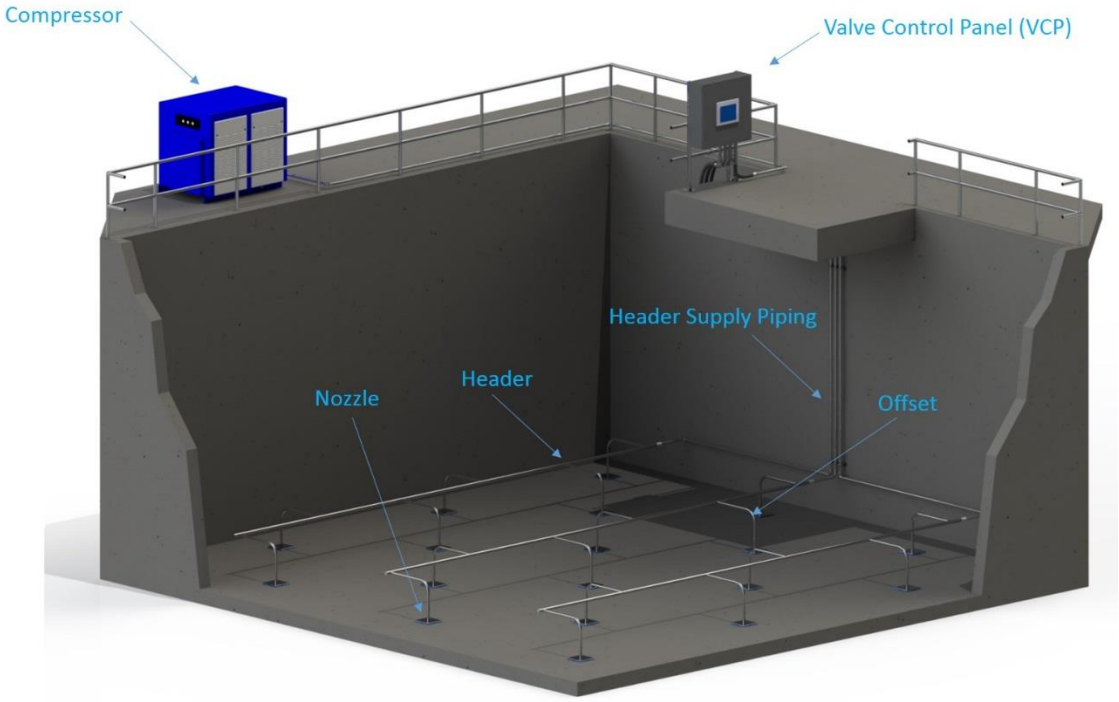
EnviroMix proposes the following BioMix™ System:

- (6) – 304SS Valve Panel with EnviroMix HMI controller, six (6) electrically-actuated poppet valves and corresponding valve manifold.
- (204)— 304SS BioMix™ 90-degree nozzles affixed to straight headers (see above configuration detail)
- 304SS Sch5 press-technology in-tank air piping to tank headers and nozzles, 200 psig industrial hose from VPs to in-tank air piping, respective fittings and 304SS wall/pipe supports and anchors
- (1)—20 HP Quincy QGS rotary-screw air compressor with integrated filter and receiver tank.

  (Expected 21.2-HP total operating requirement—includes motor and fan)
- (2) – days of on-site time for a qualified representative are included for equipment installation, testing, startup, and operations and maintenance training
- Submittals and Operations & Maintenance manuals
- Assumptions:
  - Electrical connection to compressor (460/3/60) and VP/receiver drain valves (120/1/60) by others
  - Interconnecting compressed air piping to VP from compressor receiver by others
  - Control wiring (if required) to VP and compressor by others
  - Excludes installation

PICTURE FROM SIMILAR INSTALLATION

The following illustrations show a typical BioMix™ layout and picture from a similar installation:



PROPOSED PRICING

It is our intent that this budgetary proposal for the Anoxic and Swing Zones mixing system serves as the basis for a more detailed proposal. **Pricing for the above Scope of Supply is $475,000.**

Tyler Kunz, P.E.
Vice President of Sales
180 East Bay Street, Suite 200, Charleston SC 29401
tkunz@enviro-mix.com C 262 720 0316; T 843 573 7510

AQUA-AEROBIC SYSTEMS, INC.

AquaDDM®

DIRECT-DRIVE MIXER

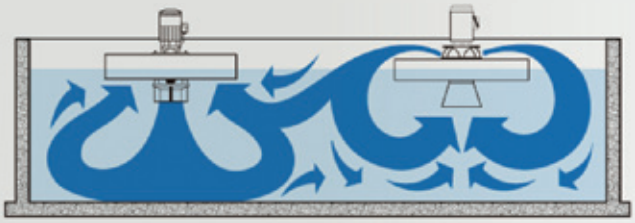
AquaDDM®

DIRECT-DRIVE MIXER

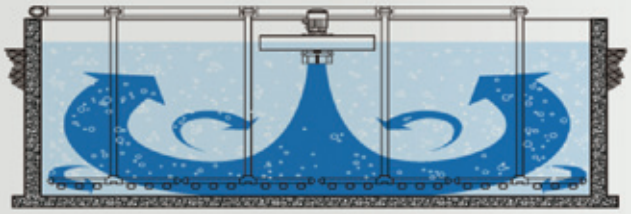
Since 1973, Aqua-Aerobic Systems has installed more than 10,000 AquaDDM® Direct-Drive Mixer units in a variety of municipal and industrial applications. The mixer has also been incorporated into several Aqua-Aerobic processes including the AquaSBR® Sequencing Batch Reactor, Aqua-Aerobic® MBR Membrane Bioreactor, and AquaMB Process® Multiple Barrier Membrane System. The AquaDDM mixer is designed to provide maximum mixing efficiency. When mixing requirements are the controlling factor, the mixer can reduce power costs, while delivering 3-4 times the mixing of any aerator of the same size.

System Features and Advantages

- Available in FSS and SS models ranging from 1-75 HP
- Suitable for most basin configurations
- Floating mixer operates in varying liquid depths
- Anti-fouling impeller
- High volume, downflow mixing pattern and near surface intake eliminates short circuiting
- Eliminates or greatly reduces surface splashing and foaming
- Submerged intake volute eliminates air entrainment
- Lower initial cost, and less expensive to install and maintain than gear reduced (slow speed) units
- More reliable service than submerged directional mixers
- High efficiency mixing reduces power consumption
- One-piece stainless steel shaft; no couplings or submerged bearings
- High Efficiency and Endura® Series motor options are available
- Directional flow assembly, and anti-erosion plate options available



AquaDDM® mixer with mechanical aeration.



AquaDDM® mixer with diffused aeration.

Aqua MixAir® System

The AquaDDM mixer, in combination with mechanical aeration or diffused aeration, composes the Aqua MixAir system. The combined use of downflow AquaDDM mixers and upflow Aqua-Jet® surface aerators creates complementary flow patterns, and results in better suspension of solids and better distribution of oxygen and substrate. This improved process efficiency can result in energy savings of 30-40% in many applications.

When combined with diffused aeration, the AquaDDM mixer provides a full range of aeration control without compromising mixing. This combination enables the operator to operate the diffused air systems only when oxygen is required. Full scale tests and operation in various installations have demonstrated that the addition of AquaDDM mixers to diffused aeration systems improves aeration efficiency by up to 30%.

Anoxic Basins

The AquaDDM mixer is ideal for use in anoxic basins for denitrification and phosphorus reduction. The mixer provides unrivaled mixing and uniform top-to-bottom blending of the basin. Unlike horizontal, side-entering, and submersible mixers, the AquaDDM provides efficient intermixing of the basin contents resulting in increased nutrient reduction.

AquaDDM® Unit Sizes and Dimensions

FSS Series (US units)

FSS Model	HP	RPM	Approx. Ship Wt. (lbs)	Dimensions (inches)					Shaft Dia. (inches)	Mooring Cable Dia. (inches)
				A	B	C	D	E		
5700131	1	1200	462	44.375	14.812	4	11	64	1.5	0.1875
5700231	2	1200	472	44.375	14.812	4	11	64	1.5	
5700331	3	1200	577	51.187	18.563	7	12.25	71	2	
5700531	5	1200	691	51.187	18.563	7	12.25	71	2	
5700731	7.5	1200	722	56.125	18.563	7	12.25	71	2	
5701031	10	900	857	60	19.75	6	12.25	84	2.25	
5701531	15	900	887	60	19.75	6	12.25	84	2.25	
5702031	20	900	1227	65.938	22.563	7	12.75	94.5	2.75	
5702531	25	900	1267	65.938	22.563	7	12.75	94.5	2.75	
5703031	30	900	1676	74.312	27.812	7	13.25	114.5	2.75	0.25
5704031	40	900	1780	74.312	27.812	7	13.25	114.5	2.75	

FSS Series (50 hz Metric Units)

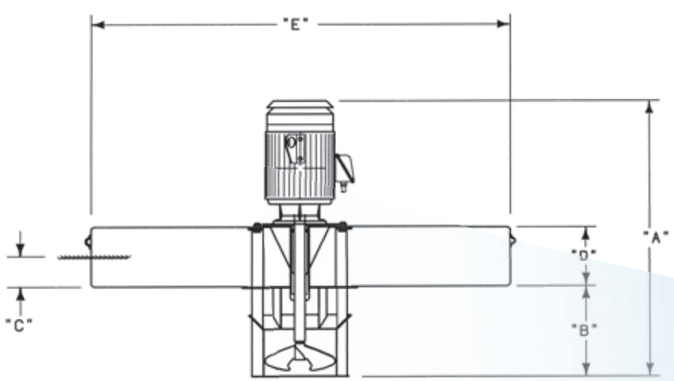
FSS Model	KW	RPM	Approx. Ship Wt. (kg)	Dimensions (mm)					Shaft Dia. (mm)	Mooring Cable Dia. (mm)
				A	B	C	D	E		
5100131	.75	1500	210	1127	376.2	101.6	279.4	1625.6	38.1	4.8
5100231	1.5	1500	214	1127	376.2	101.6	279.4	1625.6	38.1	
5100331	2.2	1500	262	1300.2	471.5	177.8	311.2	1803.4	50.8	
5100531	3.7	1500	313	1300.2	471.5	177.8	311.2	1803.4	50.8	
5100731	5.6	1500	327	1425.6	471.5	177.8	311.2	1803.4	50.8	
5101031	7.5	1000	389	1524	501.7	152.4	311.2	2133.6	57.2	
5101531	11.2	1000	402	1524	501.7	152.4	311.2	2133.6	57.2	
5102031	14.9	1000	557	1674.8	573.1	177.8	323.9	2400.3	69.9	
5102531	18.6	1000	575	1674.8	573.1	177.8	323.9	2400.3	69.9	
5103031	22.4	1000	760	1887.5	706.4	177.8	336.6	2908.3	69.9	6.35
5104031	29.8	1000	807	1887.5	706.4	177.8	336.6	2908.3	69.9	

Stainless Steel Series (US Units)

SS Model	HP	RPM	Approx. Ship Wt. (lbs)	Dimensions (inches)					Shaft Dia. (inches)	Mooring Cable Dia. (inches)
				A	B	C	D	E		
5900131	1	1200	518	44.375	15.062	5	11.188	59.5	1.5	0.1875
5900231	2	1200	528	44.375	15.062	5	11.188	59.5	1.5	
5900331	3	1200	647	51.312	18.938	7	12	70	2	
5900531	5	1200	762	51.312	18.938	7	12	70	2	
5900731	7.5	1200	792	56.125	18.938	7	12	70	2	
5901031	10	900	952	59.625	19.75	6	12	83	2.25	
5901531	15	900	982	59.625	19.75	6	12	83	2.25	
5902031	20	900	1319	65.812	22.563	7	12.625	91	2.75	
5902531	25	900	1359	65.812	22.563	7	12.625	91	2.75	
5903031	30	900	1806	74.063	27.812	7	13	114.625	2.75	
5904031	40	900	1910	74.063	27.812	7	13	114.625	2.75	
5905031	50	900	2641	83	31.25	8	16	114.625	3.5	
5906031	60	900	2711	83	31.25	8	16	114.625	3.5	0.25
5907031	75	900	2801	88.625	31.25	8	16	114.625	3.875	

Stainless Steel Series (50 hz Metric Units)

SS Model	KW	RPM	Approx. Ship Wt. (kg)	Dimensions (mm)					Shaft Dia. (mm)	Mooring Cable Dia. (mm)
				A	B	C	D	E		
5000131	.75	1500	236	1127	382.6	127	284.2	1511.3	38.1	4.8
5000231	1.5	1500	240	1127	382.6	127	284.2	1511.3	38.1	
5000331	2.2	1500	293	1303.3	481.0	177.8	304.8	1778.0	50.8	
5000531	3.7	1500	346	1303.3	481.0	177.8	304.8	1778.0	50.8	
5000731	5.6	1500	359	1425.6	481.0	177.8	304.8	1778.0	50.8	
5001031	7.5	1000	432	1514.5	501.7	152.4	304.8	2108.2	57.2	
5001531	11.2	1000	445	1514.5	501.7	152.4	304.8	2108.2	57.2	
5002031	14.9	1000	598	1671.6	573.1	177.8	320.7	2311.4	69.9	
5002531	18.6	1000	616	1671.6	573.1	177.8	320.7	2311.4	69.9	
5003031	22.4	1000	819	1881.2	706.4	177.8	330.2	2911.5	69.9	
5004031	29.8	1000	866	1881.2	706.4	177.8	330.2	2911.5	69.9	
5005031	37.3	1000	1198	2108.2	790.6	203.2	406.4	2911.5	88.9	
5006031	44.7	1000	1230	2108.2	790.6	203.2	406.4	2911.5	88.9	6.35
5007031	55.9	1000	1271	2251.1	790.6	203.2	406.4	2911.5	98.4	



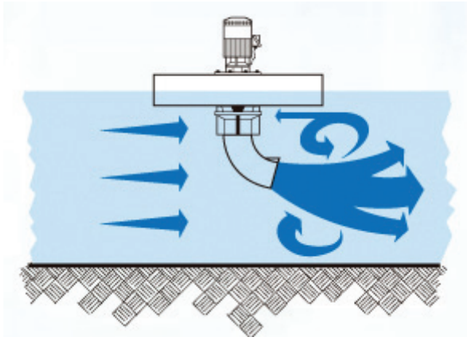
AquaDDM® Component Parts

Component	SS*	FSS*	Component	SS*	FSS*
Impeller	316 S.S.	316 S.S.	Flotation Assembly	304 S.S.	Fiberglass
Impeller Shaft	17-4 PH S.S.	17-4 PH S.S.	All Chassis Fasteners	18-8 S.S.	18-8 S.S.
Motor Base Assembly	304 S.S.	304 S.S.	Float Center Structure	304 S.S.	304 S.S.
Intake Volute Assembly	304 S.S.	304 S.S.	Float Filler	Closed Cell Polyurethane	

AquaDDM® Accessory Options

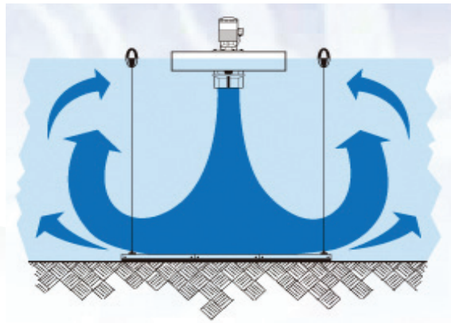
Directional Flow Assembly

The AquaDDM is available with an optional directional discharge assembly which converts the downward vertical flow to a horizontal flow. The AquaDDM with a directional flow assembly is ideally suited for use in long narrow tanks and oxidation ditches where directional flow may be necessary or desirable. In such applications, the AquaDDM with a directional flow assembly greatly reduces or eliminates short circuiting of the basin, eliminates deadspots and provides exceptional mixing of the basin contents.



Anti-Erosion Plate

Aqua-Aerobic Systems has designed an anti-erosion plate for use in those applications where the AquaDDM is installed in earthen basins.



AquaDDM®
Typical Applications

The AquaDDM mixer can be utilized in a number of applications: anoxic systems, back mixing, equalization, disinfection, neutralization, denitrification, directional mixing, blending combined streams, and sequencing batch reactors (SBRs).

Anoxic Mixing

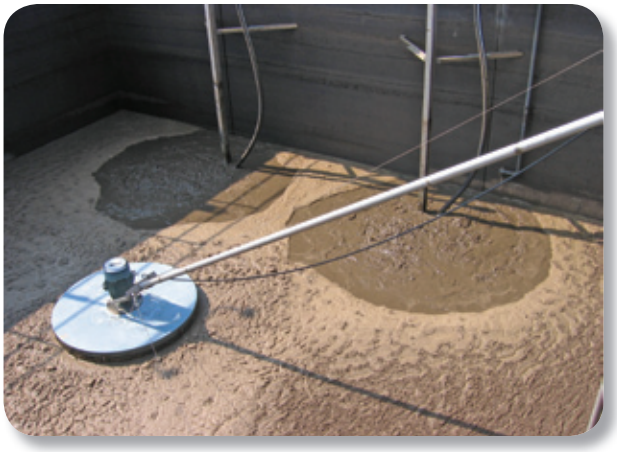
- This plant installed (54) 7.5 HP AquaDDM mixers in its (18) anoxic mixing basins to meet new permit requirements for denitrification and phosphorus prior to tertiary filtration in order to provide 25 MGD of reclaimed water

Denitrification

- (20) 7.5 HP AquaDDM mixers are divided among five anoxic basins to provide a completely mixed environment for successful denitrification, without aeration, in this 65 MGD wastewater treatment facility

Sequencing Batch Reactors

- AquaDDM mixers are utilized in this dual-basin AquaSBR system to meet the plant's strict permit effluent levels (mg/l) of 8.0 BOD, 30 TSS, 1.5 Total Kjeldahl Nitrogen, 1.0 Ammonia Nitrogen, and 0.75 Total Phosphorus



Aerobic Digesters

- This plant replaced (16) submersible mixers with four (4) AquaDDM mixers in its two anoxic basins and one (1) Aqua MixAir system in its two aerobic digesters (consisting of an AquaDDM mixer combined with diffused aeration)

Providing TOTAL Water Management Solutions

Visit our website at www.aqua-aerobic.com to learn more about the AquaDDM® Direct-Drive Mixer and our complete line of products and services:

Aeration & Mixing

Biological Processes

Filtration

Membrane Systems

Controls & Monitoring Systems

Aftermarket Products and Services

AQUA-AEROBIC SYSTEMS, INC.

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p 815.654.2501 f 815.654.2508
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solutions@aqua-aerobic.com

The information contained herein relative to data, dimensions and recommendations as to size, power and assembly are for purpose of estimation only. These values should not be assumed to be universally applicable to specific design problems. Particular designs, installations and plants may call for specific requirements. Consult Aqua-Aerobic Systems, Inc. for exact recommendations or specific needs. Patents Apply.

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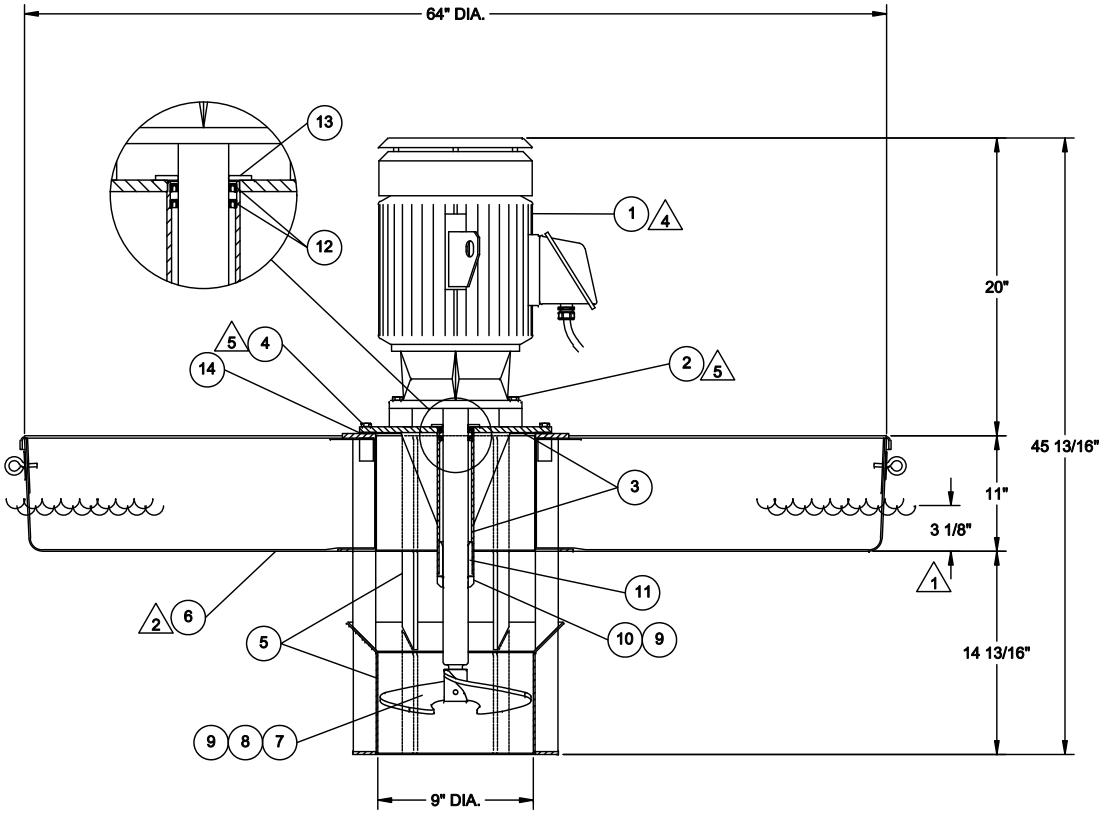
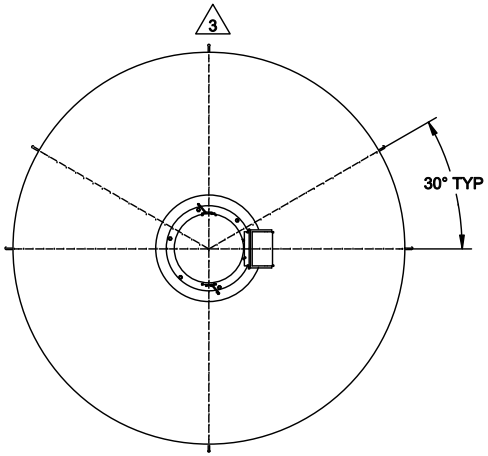
Bulletin #702F 9/12





TOP VIEW

NOTES:

1. APPROXIMATE OPERATING WATER LEVEL.
2. THE FLOAT WILL BE FILLED WITH TWO COMPONENT, CLOSED CELL, POLYURETHANE FOAM (APPROX. 2 LBS. PER CUBIC FOOT DENSITY).
3. THE FLOAT MOORING ANCHOR POINTS WILL BE 316 STAINLESS STEEL WITH A QUANTITY OF SIX (6) EYES APPLICABLE FOR A THREE (3) OR FOUR (4) POINT MOORING SYSTEM.
4. MOTOR SPECIFICATIONS: TEFC, 1.15 SERVICE FACTOR, CLASS-F INSULATION, CONTINUOUS DUTY, NEMA DESIGN LETTER-B, NON-HYGROSCOPIC WINDINGS, CORROSION-RESISTANT PAINT, ONE-PIECE 17-4 PH STN. STL. SHAFT.
5. THESE FASTENERS ARE TO BE SAFETY WIRED IN PLACE.
6. POWER SECTION INCLUDES ITEMS: 1,2,3,7,8,9,10,11,12.
7. BALANCING: THE ENTIRE ROTATING ASSEMBLY INCLUDING THE MOTOR ROTOR, SHAFT AND IMPELLER SHALL BE DYNAMICALLY BALANCED TO WITHIN 2.0 MILS PEAK-TO-PEAK HORIZONTAL DISPLACEMENT MEASURED AT THE UPPER AND LOWER MOTOR BEARINGS. MEASUREMENTS SHALL BE TAKEN AT FREQUENCY EQUIVALENT TO THE MOTOR RPM WITH THE MOTOR IN A VERTICAL, SHAFT DOWN POSITION AND WITH THE MOTOR OR ENTIRE POWER SECTION MOUNTED ON RESILIENT PADS.
8. THE NOMINAL UNIT WEIGHT IS 422 POUNDS.
9. THE CALCULATED RESERVE BUOYANCY IS 820 POUNDS BASED ON WEIGHTS OF STANDARD UNIT SPECIFICATIONS.
10. COMPRESSION FITTING WILL BE SUPPLIED IF THE UNIT IS PROVIDED WITH FACTORY-ATTACHED ELECTRICAL CABLE.

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	DWG
10 15	1		COMPRESSION FITTING (OPTIONAL)	ZINC PLATED	
14	1		MOTOR BASE GASKET	NEOPRENE	
13	1		SEAL PLATE	DELRIN	
12	2		LIP SEAL	NITRILE	
11	1		ANTI-DEFLECTION INSERT	DELRIN	
10	1		LOWER SLINGER	DELRIN	
9	4		SET SCREW	316 STN. STL.	
8	1		PROPELLER PIN	17-4 STN. STL.	
7	1		PROPELLER	STN. STL.	
6	1		FLOAT ASSEMBLY	FIBERGLASS	
5	1		INTAKE VOLUTE	304 STN. STL.	
4	6		BOLT, MOTOR BASE	316 STN. STL.	
3	1		MOTOR BASE ASSEMBLY	304 STN. STL.	
2	4		BOLT, MOTOR	316 STN. STL.	
1	1		MOTOR		

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

JOB NAME:
JOB LOCATION:

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE: MIXER
DRAWN BY: JAK DATE:
CHECKED BY: DATE:
WEIGHT: LBS SHEET: 1 OF 1

DRAWING NAME: MIXER ASSEMBLY, FSS, 2 HP
DRAWING NUMBER: 2802099
SCALE: N.T.S. SIZE: C

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Enfield WFP
Enfield , CT
Woodard & Curran

Objective: Recommend quantity and size of AquaDDM mixers in 4) Primary Anoxic Zones, 4) Aerobic Zones #2 and 4) Secondary Anoxic Zones.

Design Data:

▪ **Primary Anoxic Zones**				
▪ **Aerobic Zones #2**			▪ **Secondary Anoxic Zones**	
TSS	=	2 %		
Length	=	61.2 ft	Length	= 49.2 ft
Width	=	24 ft	Width	= 24 ft
Water Depth	=	16.1 ft	Water Depth	= 16.1 ft
Volume	=	0.18 MG	Volume	= 0.14 MG
Material	=	concrete		

Scope: Recommend quantity and size of AquaDDM mixers

Calculations:

Power Requirement

A mixing level of 20 HP/MG is recommended to provide complete mix conditions.

Power	=	20 HP/MG x 0.18 MG	= 20 HP/MG x 0.14 MG
	=	4 HP	= 3 HP

Recommendation:

The length to width ratio requires the uses of (2) DDM mixers in each mixing zone. The recommendation is to install (2) two - 2 HP DDM mixers in each of the twelve zones to be mixed.

JFF

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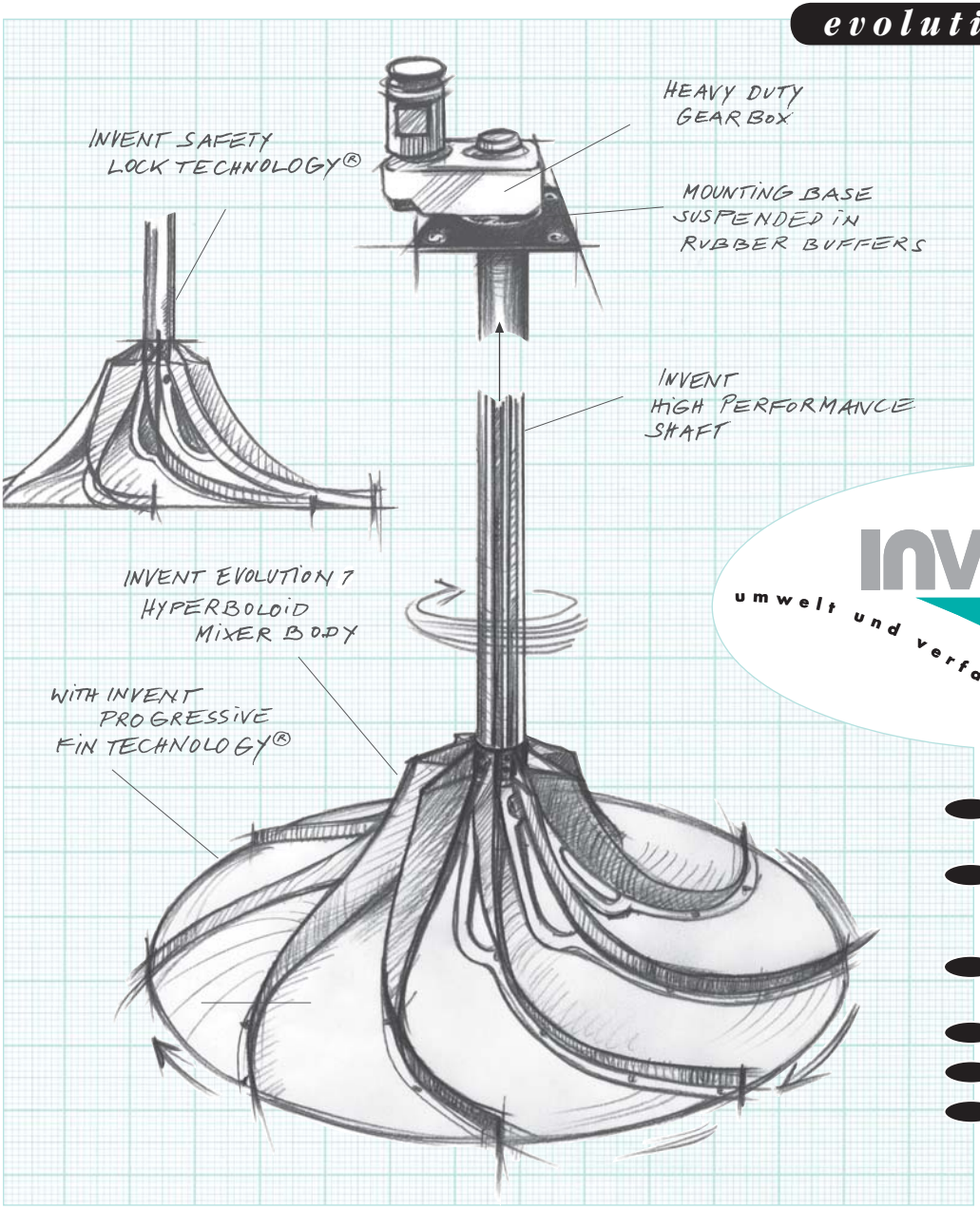
HYPERCLASSIC®- Mixer

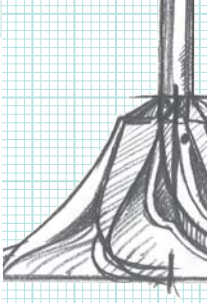
evolution 7

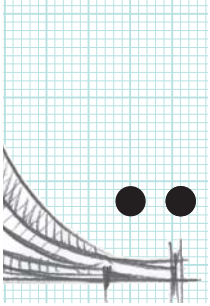
mixing technology



invent®
umwelt und verfahrenstechnik

- Fluid mechanically optimized
- Excellent suspension and homogenizing characteristics
- Low energy consumption
- Robust construction
- Low maintenance
- Low operational costs



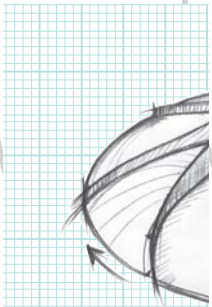


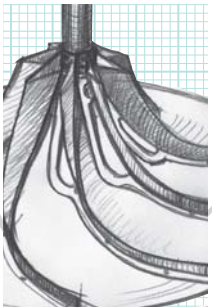
innovation for nature

The growing pollution of our environment is a problem which concerns all of us. For years water pollution, in particular, has continued to grow in threatening proportions. Water is turning into a more and more limited resource. As a consequence, forward-looking technologies are desperately needed for water and wastewater treatment. With great commitment **INVENT** *is dedicated to the development and implementation of such technologies, thus creating powerful products which contribute greatly to the preservation of the water quality of our groundwater, rivers and lakes.*

The protection, the preservation and, where necessary, the restoration of our environment will remain one of the most important tasks of our society in the future.

INVENT *takes on responsibility in this field, with innovative environmental and process engineering.*





HyperClassic®

The Benchmark

The Benchmark-
for more than 20 years

INVENT develops, produces and globally markets innovative machines and plants for the treatment of water and wastewater.

Water and wastewater treatment plants are usually created as a made-to-measure design and lay-out for a particular project.
Depending on the original situation and the intended treatment, various process engineering steps are combined so that the aim of the process engineering is safely within reach. While doing so, the engineer draws from a range of known unit processes. The most important processes from this range are stirring and mixing processes. They play a decisive role in nearly all water and wastewater treatment plants.

Below you will find some examples for important applications of mixing technology in water and wastewater treatment plants.

The table shown to the right is impressive proof of the importance of mixing processes for the water and wastewater treatment.

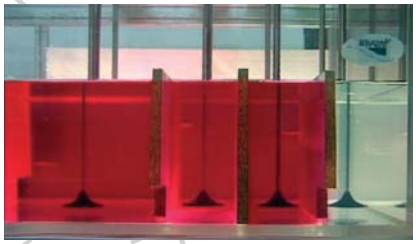
4 **INVENT HYPERCLASSIC®** *-Mixers combined with* **iDISC®** *Membrane Aeration System*

Application	Mixing task
Mixing and equalization tank	Suspension and Homogenization
Neutralization	Flash-Mixing
Pre-Mixing of Precipitants	Flash-Mixing
Precipitation	Suspension and Homogenization
Coagulation	Suspension and Homogenization
Biological phosphate elimination	Suspension and Homogenization
Denitrification	Suspension and Homogenization
BOD or COD removal	Homogenization and Dispersion
Disinfection	Flash-Mixing
Sludge treatment	Suspension and Homogenization
Storage of chemicals/chemical solution	Suspension

An Overview

INVENT made a significant contribution to the efficiency and cost-effectiveness of such plants by introducing the hyperboloid mixing technology to the market for water and wastewater treatment over 20 years ago. Since then, the hyperboloid mixing technology has been continuously developed and improved. Thousands of successful installations in municipal and industrial water and wastewater treatment plants world-wide impressively demonstrate that the hyperboloid mixing technology has already become the industrial standard in this field of application. With the current version **HYPERCLASSIC®** ***evolution 7***, the seventh, completely revised and revolutionary improved version of the classic hyperboloid mixer is now available.

The **INVENT HYPERCLASSIC®**-Mixer is a vertical mixer with a hyperboloid-shaped mixer-body, installed close to the bottom, and a drive mounted in dry position above the water level. Contrary to other products, it was developed and optimized especially for applications in the area of water and wastewater treatment.



Optimal design presents short circuit flows and guarantees optimal reactor behaviour.

The Task

As the above table shows, mixers for applications in water and wastewater treatment are mainly used for suspension and homogenization tasks as well as for intensive mixing and flash-mixing. These tasks should be implemented in a reliable, secure and energy-saving way and with the lowest possible maintenance requirement.

With regard to process engineering the following demands must be met:

- The settling of particles, such as activated sludge flakes, should be reliably avoided (suspension).
- Particles, such as activated sludge flocks, should be distributed evenly throughout the wastewater in order, for example, to efficiently reduce the nitrogen and phosphate percentage (homogenization).
- In the anaerobic and anoxic part of the activated sludge tank, turbulences on the water surface should be reduced to a minimum, in order to prevent the transfer of oxygen from the air into the wastewater.
- The energy input should be executed with as little shear force as possible, in order to avoid the destruction of the activated sludge flakes.
- Short circuit currents should be avoided.
- The reactor behaviour, upon which the process technological lay-out is based e.g. plug flow or completely stirred, together with the mixer design, should be implemented in a realistic way.

As a consequence of the above mentioned considerations it is important, from a fluid mechanics perspective, to take into account the following points when developing a mixer:

- The mixer- body should be positioned close to the bottom, so that the energy input takes place where the sedimentation of particles should be avoided.
- The mixer should be positioned as centrally as possible in the tank, should run slowly and have a large diameter, so that

the energy input takes place in a homogeneous way and the particles can be distributed evenly. A design like this is energy-efficient and low in shear force.

- In order to avoid short circuit currents and the correct implementation of the desired reactor behaviour, it is necessary to manufacture the mixer in various diameters and directions of rotation. These are then chosen according to the tank geometry and the position of the supply and discharge pipes.

Finally, when designing the perfect mixer, all mechanical factors must be considered also:

- The mixer should run smoothly in order to take the strain off the drive and shaft as well as the bridges. This is achieved by a high number of blades. Two-bladed constructions are the most disadvantageous.
- Reaction forces in the vertical direction at the shaft, drive and bridge are to be avoided. They result in a large increase in wear.

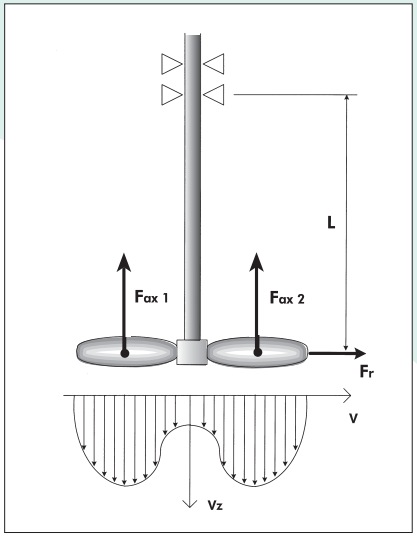


Figure 1: Conventional mixer – high reaction forces on drive and bridge (upwards)

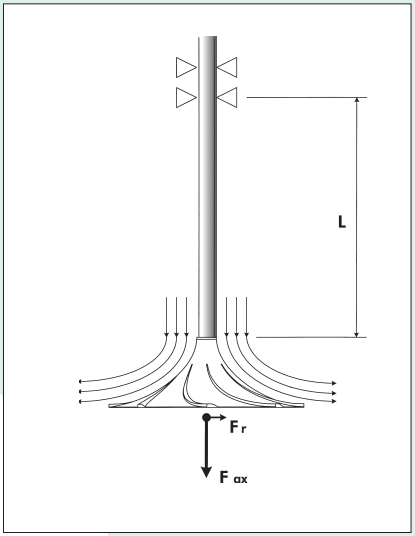


Figure 2: **HYPERCLASSIC®***-Mixer – low forces on drive and bridge (downwards)*

- It must be possible to adjust the mixer to a perfect position on the bridge. The mixer should be galvanically separated from the bridge.
- The drive design should be robust and rather on the large side. It should possess a high efficiency factor and its bearings should have a calculated minimum life expectancy of 100.000 hours. Depending on the installation location, further specific demands must be taken into consideration.

- All parts submerged in water should be non-corrosive and maintenance-free during their life.
- The mixer body should be completely free of tenon joints.
- The gear unit should possess the highest-possible energy efficiency factor.

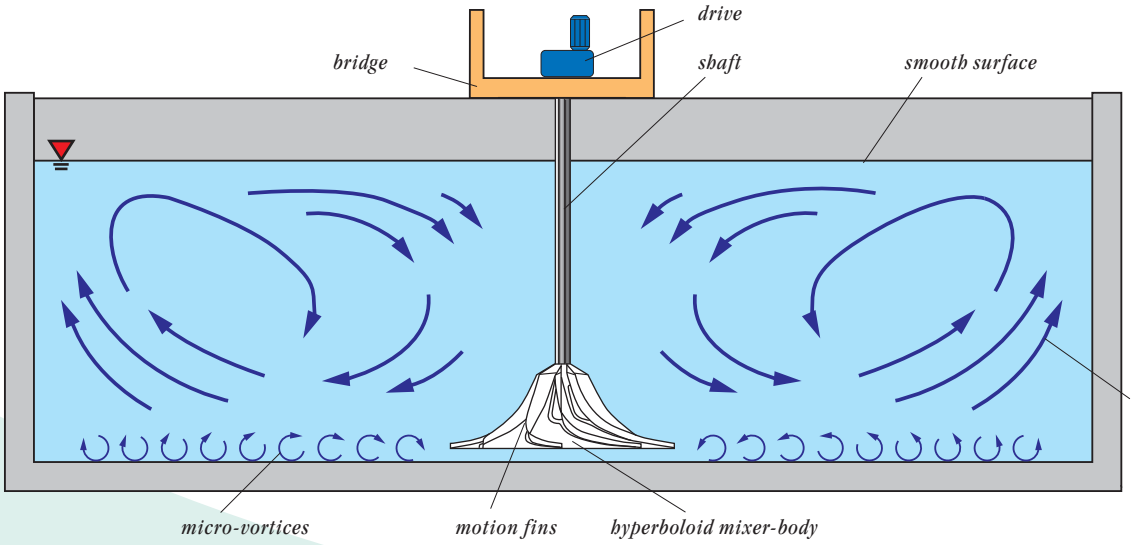
The Solution

The **INVENT HYPERCLASSIC**®-Mixer is a vertical shaft mixer with a hyperboloid-shaped mixer-body installed close to the bottom and a dry-mounted drive. In contrast to other products, it was developed and optimized especially for applications in the area of water and wastewater treatment.
The way the hyperboloid mixer functions can be seen in the opposite illustration. The mixer is pictured with its three main components, the drive, the shaft and the hyperboloid mixer-body in a typical aeration tank, which, depending on the type of treatment plant, can be rectangular or round.

Naturally, other shapes of tank are also possible.
The hyperboloid mixer rotates close to the bottom and its 8 integrated and specially optimized motion fins thus produce a bottom flow which is directed radially outwards. Particularly at the bottom, this flow is turbulent and thus effectively which whirls up depositions. Along the walls the flow rises upwards and transports all particles until they are just below the water surface. On the water surface the speed has been reduced to such an extent that no further surface turbulences can be produced and therefore oxygen input via the water surface can be effectively avoided.

Due to the flow on the water surface which is directed towards the shaft, all particles are distributed evenly throughout the tank. Finally, in the centre of the tank the water is again transported downwards along the shaft. A vortex-shaped main flow is thus created throughout the whole tank, which ensures excellent homogenization and mixing.
This way also short circuit currents can be efficiently prevented.

Optimal design guarantees high efficiency



Schematical representation of the hyperboloid mixer with indication of the streamlines

The Solution

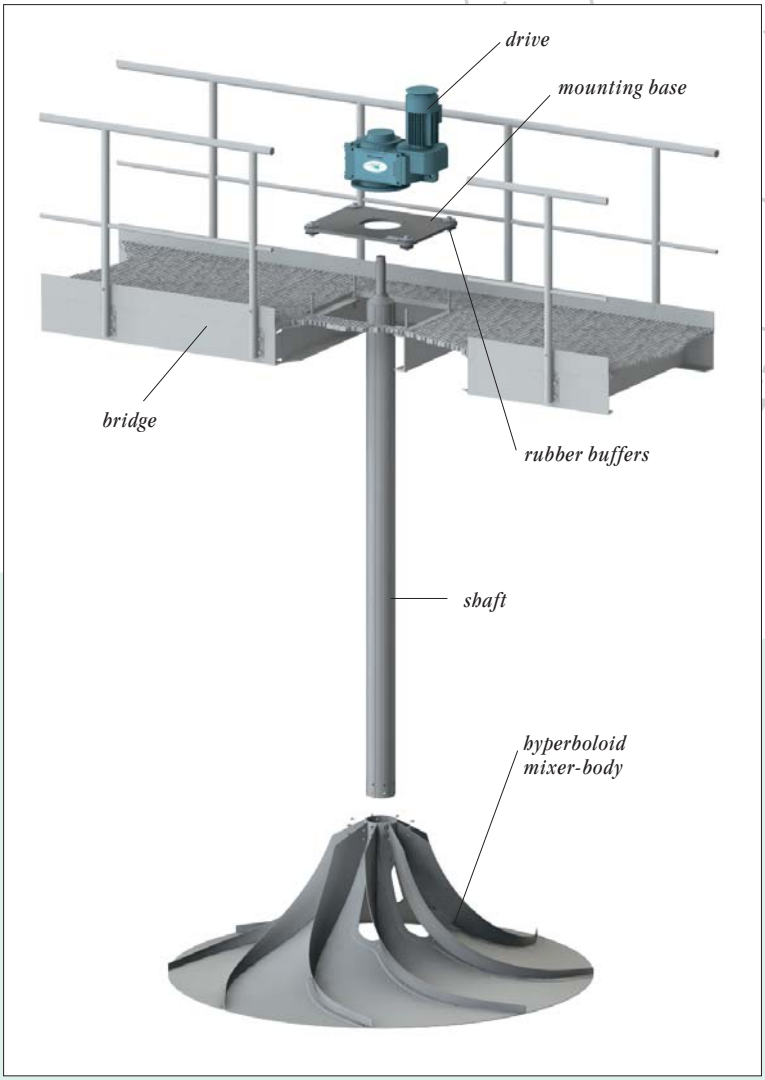
The shape of the hyperboloid mixer is based on complex potential-theoretical calculations and simulations in computational fluid dynamics (CFD[1]). This results in a flow pattern, which, in summary, exhibits the following basic advantages

- With regard to both quality and quantity, the produced macro-scale flow has the most favourable fluid-mechanical pattern. By actively re-directing the flow on the surface of the mixer, fixation losses are minimized and a high efficiency is achieved.
- The highest velocities and turbulent fluctuating velocities are induced at the bottom. This means that the energy input takes place directly at the bottom, so that the input energy is specifically used to whirl up and suspend sludge flocs and is not wasted anywhere else.
- The flow stays attached to the hyperboloid mixer surface. Flow separations, eddy formations and thus energy losses are prevented. This also boosts the efficiency.
- **HYPERCLASSIC**®-Mixers operate completely without pulsation due to the closed shape and the 8 motion fins (high number of blades).

6 out of 120
***HYPERCLASSIC®**-Mixers in a wwtp in Berlin, Germany*

- The uniform, radial flow-off over the complete mixer body facilitates a flow, which is largely free of periodic fluctuations. The effect of this flow is that the hyperboloid mixer centers itself. Therefore the forces on the gear and the bridges is small. In addition, no oscillations are transferred to the shaft and the bridges which allows a simple and economical bridge construction.
- All reaction forces on the gear and bridges are axial and directed downwards. The radial forces which are generated are very small. Therefore mixers with long shafts can also be constructed without problems.
- The finely graduated diameter range along with the selectable rotational direction, especially in long tanks with lengthwise through-flow, has big advantages with regard to the retention time and the flow in tanks of this type. This contributes decisively to a high operational safety level and clarification performance.

[1] CFD: Computational Fluid Dynamics



Design and Material Selection

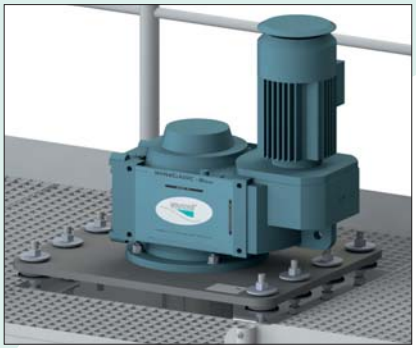
As illustrated in the accompanying blow-up drawing, the hyperboloid mixer is made up of three main components which are precisely fitted to each other: the drive, the shaft and the hyperboloid mixer-body.

Drive

The drive is assembled dry and is arranged on a bridge or mounting bracket where it is easily accessible for rarely needed maintenance work. For wastewater ponds or SBR plants with varying water levels, the hyperboloid mixer can also be mounted on a special float.

Only energy-saving and robust geared motors with reinforced bearings from renowned manufacturers are used. Normally, high service factors are selected and the calculated bearing life expectancy is more than 100.000 h. Special, customer-specific models can be built after clearance.

Well-proven, robust and safe to operate



The geared motor sits on a mounting base in a rubber buffer bearing. The propagation of sound waves is thus avoided and the complete mixer is thereby galvanically separated from the bridge.

Shaft

The shaft provides the connection between the drive and the mixer body. It transfers the required torque, in order to allow the hyperboloid mixer to rotate.
The shaft is manufactured from a specially developed FRP[1] pipe designed for the loads which occur. It is dimensioned with great care and designed for endurance. Through the use of high strength composite materials, the shaft is very light, extremely corrosion-resistant and flexible.

It is particularly easy to mount because of the light weight. All **HYPERCLASSIC**®-Mixers can be designed without a bearing because of their innovative design. The small bearing forces are transferred to the geared motor via the shaft and absorbed there. Consequently, no parts whatsoever which require maintenance are located below the water line.

Hyperboloid Mixer-Body

The hyperboloid mixer-body, developed out of the **INVENT** laboratory in accordance with the most up-to-date knowledge on the mechanics of fluids, is manufactured of special plastic components.
The use of the most modern composites also guarantees a high-strength, corrosion-resistant and light component here.

The hyperboloid mixer body is connected to the lower end of the shaft by means of a shaft/hub connection. The **INVENT**® ***Safety Lock Technology***® is used for this purpose. This enables a simple and rapid assembly as well as a simple removal even after many years of operation. Under operation conditions the connection is safely protected against self-loosening.

The complete hyperboloid mixer is not just producing a favourable flow field but is also absolutely non-clogging because of the optimal shape and the motion fins which are seamlessly integrated in the mixer-body.

The latest development step "***evolution 7***" uses the new by **INVENT** developed ***Progressive Fin Technology***®. In conjunction with an enlarged opening for the secondary current an increase in efficiency of up to 20% compared to the previous models was achieved.

[1]FRP: Fibre-reinforced Plastic

1 out of 32 **HYPERCLASSIC®** *-Mixers in a large wwtp in Vienna, Austria*

7 out of 33 **HYPERCLASSIC®** *-Mixers in the wwtp Berlin-Stahnsdorf, Germany*

The Installation

Due to the simple construction and the light weight of the components, the assembly can be carried out without big efforts. The hyperboloid mixer is normally delivered to the construction site in a disassembled state. There the shaft is first of all connected to the drive unit by pulling the top end of the shaft into the hollow shaft of the drive. Next both drive and shaft are placed on top of the prepared stainless-steel thread bolts or adhesion anchors on the bridge or the bracket. Then the drive is aligned and is ready for operation after the electrical connection and checking of the oil level.

The last step consists of screwing the hyperboloid mixer-body to the lower shaft flange. Just a short dry run and the **HYPERCLASSIC®**-Mixer is ready for operation.

Of course, the hyperboloid mixer can also be mounted and dismantled in a filled tank. In the unlikely but theoretically possible case of a motor or drive defect, these components can be exchanged without having to dismantle the complete mixer.

Simple, problem-free and quick

Low operational costs due to low energy consumption

3 out of 90 **HYPERCLASSIC®** *-Mixers in the wwtp Bowery Bay, New York, USA*

45 **HYPERCLASSIC®** *-Mixers in the wwtp Sulaibiya, Kuwait-City, Kuwait*

The Operation

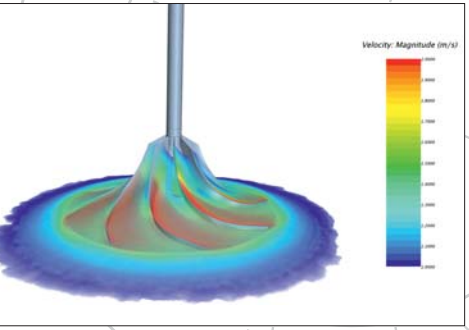
After a short dry run and a check of the direction of rotation the hyperboloid mixer can start operating without any further work. It is designed for permanent operation and does not require any maintenance work, except an occasional inspection of the oil level. Depending on the type of oil, an oil change is carried out once every 1 or 2 years.

Due to the location and the excellent accessibility of the drive this is child's play. There are no work-intensive and unpleasant pulling and cleaning jobs, which for example, is generally the case with submerged drives. Expensive maintenance work, such as the exchange of mechanical seals, are superfluous, because no parts which are subject to wear are installed below water level.

Low maintenance costs

2 out of 48 **HYPERCLASSIC®** *-Mixers in a wwtp in Stockholm, Sweden*

Competent and experienced



CFD Simulation of flow close to mixer body of the **HYPERCLASSIC®** ***evolution 7***

Layout and Design

For the layout and design of an optimum mixer it is also essential to consider the reactor design and any further marginal conditions (such as the shape of the tank, type and location of supply and discharge pipes, physical characteristics of the media, desired reactor behaviour, etc.). The mixer and the reactor must form a unit. After an extensive analysis of requirements and definition of the process engineering aims, this will be successful only if there is a range of innovative tools, measuring data and empirical values to fall back on in order to choose and lay out the perfect mixer.

For both the development and the determination of the basis for the layout of its mixers, **INVENT** always makes use of the latest developments in research and the associated technologies. Modern laser-Doppler-anemometry (LDA) and ultrasound-Doppler-anemometry (UDA) processes are therefore used for the determination of speed profiles in the laboratory and in large-scale models. In addition to conventional fluid mechanical methods for scale-up, the most up-to-date numeric simulations (CFD) are applied.

3D-CAD-programs and finite-element-methods (FEM) are used for the mixer design.

The application of mixers, however, also demands process engineering know-how, so that biological reactors can function optimally, short circuit currents can be avoided and the desired reactor behaviour is achieved.

The accompanying diagram shows a numerical simulation of an activated sludge tank with multiple thoroughly mixed stirring reactors, which are created by individual **HYPERCLASSIC®**-Mixers

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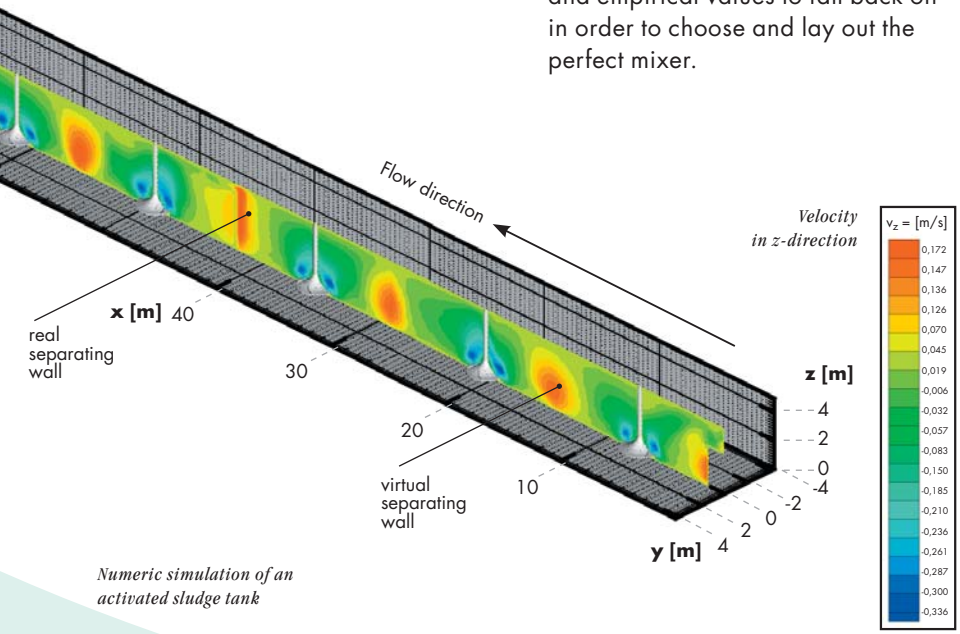


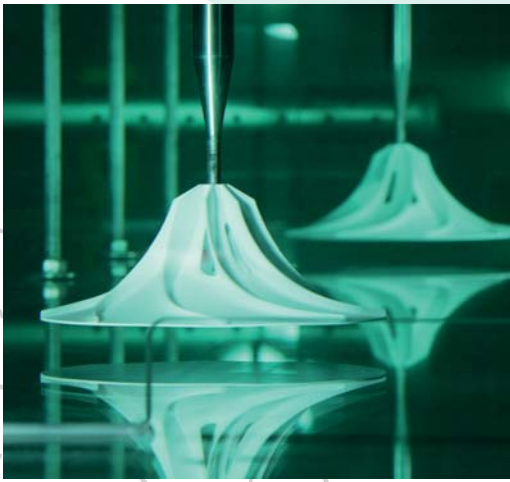
Numeric simulation of an activated sludge tank

[1] CFD: Computational Fluid Dynamics

Mixing test at the **INVENT** *laboratories*

The Laboratory

Apart from standard applications, time and time again very special terms of reference, tank geometries or mixing tasks must be mastered. In this case, **INVENT** can fall back on the instruments described above, but also on a very well-equipped mixing laboratory as well as on spacious testing facilities which are equipped with state-of-the-art testing and measuring technology.
All conceivable configurations can be replicated to scale and examined. This delivers further fundamental data in addition to the existing foundation for the layout and can of course also be used for the optimization of plants.



HYPERCLASSIC® *-Mixers* ***evolution 7***
in pilot scale test tank

Continuous improvement and quality contol

HYPERCLASSIC® *-Mixer* ***evolution 7***
in large scale test rig

HYPERCLASSIC®

INVENT Products worldwide

INVENT *Team meeting*

INVENT®, **HYPERCLASSIC**®, **Safety Lock Technology**® and **Progressive Fin Technology** ® are registered trademarks of **INVENT** Umwelt- and Verfahrenstechnik AG.

Chosen References

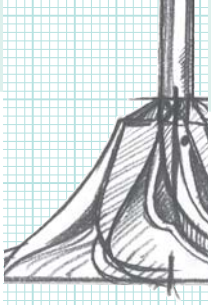
- Berlin Schönerlinde, Germany
  120 **HYPERCLASSIC**®-Mixers
- Berlin Stahnsdorf, Germany
  40 **HYPERCLASSIC**®-Mixers
- Berlin Münchehofe, Germany
  40 **HYPERCLASSIC**®-Mixers
- Berlin Wassmannsdorf, Germany
  30 **HYPERCLASSIC**®-Mixers
- Bremen, Germany
  40 **HYPERCLASSIC**®-Mixers
- Stockholm, Sweden,
  48 **HYPERCLASSIC**®-Mixers
- Barcelona, Spain
  72 **HYPERCLASSIC**®-Mixers
- Wien, Austria
  32 **HYPERCLASSIC**®-Mixers
- Zürich, Switzerland
  8 **HYPERCLASSIC**®-Mixers
- Davos, Switzerland
  10 **HYPERCLASSIC**®-Mixers
- Amsterdam, The Netherlands
  16 **HYPERCLASSIC**®-Mixers
- Maastricht, Niederlande,
  32 **HYPERCLASSIC**®-Mixers
- Kuwait City, Kuwait,
  45 **HYPERCLASSIC**®-Mixers
- Yokohama, Japan,
  12 **HYPERCLASSIC**®-Mixers
- Dubai, UAE
  32 **HYPERCLASSIC**®-Mixers
- Shanghai, China
  100 **HYPERCLASSIC**®-Mixers
- New York, Bowery Bay, USA
  90 **HYPERCLASSIC**®-Mixers
- New York, Jamaica, USA
  84 **HYPERCLASSIC**®-Mixers
- Washington, Blue Plains, USA
  132 **HYPERCLASSIC**®-Mixers

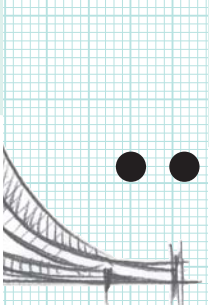
Successful worldwide

The Service

How can we support you with the planning, optimization, modernization of your plant, or just generally with the realization of your ideas? Please ask us about it!

In close co-operation with you, the **INVENT** team will draw up a first draft and will, if necessary, develop it further together with you via numerous iteration steps, until all requirements are met. After the order has been placed an experienced team of engineers will see to it that your project is carried out on schedule.
In accordance with the agreement we will deliver and install the plant for you and will also carry out the commissioning. Our service team will reliably take care of all necessary maintenance work.





Professional and innovative

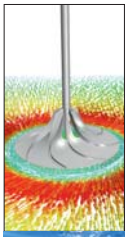
Beyond the delivery of components and plants we also offer you general advisory and engineering services in the field of stirring technology. This can be, for example, the layout or optimisation of a stirrer, or the experimental examination of a stirring tank on a laboratory-scale or through numeric simulation.

Furthermore, we carry out large-scale acceptance tests, whereby usually the velocity field, the solid matter concentration distribution and the detention distribution are examined.

Other Products and Services

INVENT is the market leader for mixers, mixing and aeration systems and membrane aeration systems for the water and wastewater treatment. Please do not hesitate to ask for information about our additional product lines. We would also be happy to offer you complete system solutions for your plant, such as a carefully laid-out and adapted equipment package. We simulate and optimize your plant with the help of appropriate software packages, or else we optimize your plant or building with regard to fluid mechanics.

We are your competent partner for all questions on water and wastewater treatment.



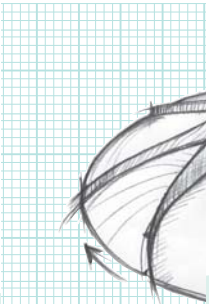
engineering & consulting

aeration technology

software-products

system solutions

research & development



locations

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worldwide
A list of our sales partners
abroad is available by request
or on the internet:
www.invent-uv.de

HCM 2.000 04.14-3 E
printed on chlorine-free bleached paper

HYPERCLASSIC® *evolution 7* Mixer design

May 05, 2015

Offer number	QT-1505003-HCM-Rev00
Project	Enfield, CT Primary Anoxic and Aerobic Zone 2
Sales contact	Patrick O'Donnell

Waste water properties		
Origin	municipal	
MLSS concentration	2,500	ppm
SVI	80	ml/g
Temperature	68	°F

Basin geometry		
Basin type	rectangular	
Width	24.0	ft
Length	61.2	ft
Water depth	16.1	ft
Freeboard	2.0	ft
Basin area	1,469	sqft
Basin volume	0.177	Mgal
Number of basins	1	-
Mixer rows	1	-
Mixers per row	1	-
Total number of mixers	1	-

Mixer		
Type	HCM/2500-24-3.0hp	
Selected diameter	98.4	in
Output speed	23.1	rpm
Rated power	3.0	hp
Power input	2.2	hp
Power consumption	2.7	hp
Power density	0.09	hp/1000 cuft
Mixing intensity	50	1/s
Bottom flow velocity	7.8	in/s
Average bottom flow velocity	19.0	in/s
Mixer pumping capacity	12,112	cuft/min
Effective service factor	4.1	-
Bottom distance	23.0	in
Total mixer weight	728	lb
Outer diameter	6.6	in
Shaft length	163.8	in
Flange diameter	13.8	in
Hollow shaft	2.4	in
Rated torque	8,054	lb.in
Start-up torque	20,135	lb.in
Static axial force	728	lbf
Dynamic axial force	904	lbf
Grid frequency	60	Hz
Rated voltage	460	V
Rated current	3.8	A
Start-up current	32.3	A
Power reserve	25	%

Carina Hart

From: Chris Shea [cshea@aquasolutionsinc.net]
Sent: Tuesday, May 5, 2015 10:49 AM
To: Amine Hanafi
Subject: FW: Invent Mixer for Enfield WPCF
Attachments: TD-1505003-HCM-Rev00.pdf; TD-1505003a-HCM-Rev00.pdf; HCM_Evo7_ENU_2014.pdf

See below and attached. Please let me know if we have the sixing right at this time? Budget is for 12 mixers.

Christopher Shea
AQUA Solutions, Inc
59 Locke st
Watertown ,ma 02472
WWW.aquasolutionsinc.net
Phone 617 923 3900
Mobile 617 834 6096
For parts 866-711-aqua(2782)

-----Original Message-----
From: Patrick O'Donnell [mailto:POdonnell@invent-et.com]
Sent: Tuesday, May 05, 2015 10:38 AM
To: 'Chris Shea'
Subject: RE: Invent Mixer for Enfield WPCF

Chris,

Have W&C check out the layout sheets for the sizing. I would recommend we just upsize the Secondary Anoxic Mixers to 3HP for Maintenance purposes. I attached the layout for the 2HP as the power consumption would be the same if a 3HP motor was supplied. These are our EVO 7 mixers so the HP is lower by about 30%.

Also, would we supply walkways?

A very conservative budget price for 12 Mixers, delivery, spares and Startup would be $290,000.

Please tell me if they need anything else at this time. Thanks.

Patrick

-----Original Message-----
From: Chris Shea [mailto:cshea@aquasolutionsinc.net]
Sent: Thursday, April 30, 2015 10:03 AM
To: Patrick O'Donnell
Subject: FW: Invent Mixer for Enfield WPCF

Little help. See below and attached.

Christopher Shea
AQUA Solutions, Inc
59 Locke st
Watertown ,ma 02472
WWW.aquasolutionsinc.net

Phone 617 923 3900
Mobile 617 834 6096
For parts 866-711-aqua(2782)

-----Original Message-----
From: Amine Hanafi [mailto:ahanafi@woodardcurran.com]
Sent: Thursday, April 30, 2015 9:30 AM
To: Chris Shea
Cc: Mike Burns
Subject: Invent Mixer for Enfield WPCF

Hi Chris

As you know , we're performing a facilities plan for the Town of Enfield, CT and we're seeking a proposal for Invent hyperbolic mixers based on the attached memorandum, which outlines the preliminary design parameters for the existing aeration tanks.

I also attached the existing hydraulic profile and 1969 record drawings for the aeration tanks.

We would like to receive a response with the requested information at your earliest convenience.

Regarding the UMJA project in Pennsburg, PA, we're still modeling the BNR process and finalizing the aeration tanks configuration.

Please feel free to call or reply if you need more information.

Thanks - Amine

Amine Hanafi
Project Engineer
Woodard & Curran
COMMITMENT & INTEGRITY DRIVE RESULTS
1699 King Street | Suite 406
Enfield, CT 06082
T 203.675.1511

APPENDIX G

SOLAR REFERENCE & CALCULATIONS

- *PVWATTS CALCULATIONS*
- *FAA NOTICE CRITERIA TOOL*

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at http://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

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The names DOE/NREL/ALLIANCE shall not be used in any representation, advertising, publicity or other manner whatsoever to endorse or promote any entity that adopts or uses the Model. DOE/NREL/ALLIANCE shall not provide

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SYSTEM INFO

RESTORE DEFAULTS

Modify the inputs below to run the simulation.

DC System Size (kW):	21.2
Module Type:	Standard
Array Type:	Fixed (open rack)
System Losses (%):	20.03
Tilt (deg):	20
Azimuth (deg):	180

Draw Your System

Click below to customize your system on a map. (optional)

Advanced Parameters

INITIAL ECONOMICS (Optional)

Modify the inputs below to provide an initial rough estimate of the cost of energy produced by the system. Note that complex utility rates and third-party financing can significantly change these values

System Type:	Commercial
Average Cost of Electricity Purchased from Utility ($/kWh):	0.12
Initial Cost ($/Wdc):	2.60

Available Incentives

The list below shows the available PV system incentives for the chosen location filtered for the selected capacity and type. Select or unselect each incentive by clicking on them. Recent changes might not yet be captured. Incentive data is drawn from the DSIRE database - **http://www.dsireusa.org**. These incentives were last updated by DSIRE on August 2013 - please see the note below for more information.

Capacity Based Incentives (CBI)

CCEF - Residential Solar PV Rebate Program
Rate: $0.00 - Maximum Amount: $15,000.00

Investment Tax Credit (ITC)

Residential Renewable Energy Tax Credit
Percent of Cost: 30%

The DSIRE database, which is managed by the North Carolina Solar Center and provides the quantitative

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RESULTS

24,444 kWh per Year *

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Energy Value ($)
January	2.67	1,432	178
February	3.53	1,692	210
March	4.20	2,191	272
April	5.13	2,458	305
May	5.40	2,580	320
June	5.98	2,686	333
July	5.77	2,649	329
August	5.39	2,492	309
September	4.61	2,135	265
October	3.54	1,752	217
November	2.47	1,223	152
December	2.18	1,154	143
Annual	4.24	24,444	$ 3,033

Location and Station Identification

Requested Location	90 Parsons Road, enfield, ct
Weather Data Source	(TMY2) HARTFORD, CT 4.8 mi
Latitude	41.93° N
Longitude	72.68° W

PV System Specifications *(Commercial)*

DC System Size	21.2 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	20.03%
Inverter Efficiency	96%
DC to AC Size Ratio	.9

Initial Economic Comparison

Average Cost of Electricity Purchased from Utility	0.12 $/kWh
Initial Cost	2.60 $/Wdc
Cost of Electricity Generated by System	0.14 $/kWh

These values can be compared to get an idea of the cost-effectiveness of this system. However, system costs, system financing options (including 3rd party ownership) and complex utility rates can significantly change the relative value of the PV system.

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SYSTEM INFO

RESTORE DEFAULTS

Modify the inputs below to run the simulation.

DC System Size (kW):	37.2
Module Type:	Standard
Array Type:	Fixed (open rack)
System Losses (%):	20.04
Tilt (deg):	20
Azimuth (deg):	180

Draw Your System

Click below to customize your system on a map. (optional)

Advanced Parameters

DC to AC Size Ratio:	.9
Inverter Efficiency (%):	96
Ground Coverage Ratio:	0.4

INITIAL ECONOMICS (Optional)

Modify the inputs below to provide an initial rough estimate of the cost of energy produced by the system. Note that complex utility rates and third-party financing can significantly change these values

System Type:	Commercial
Average Cost of Electricity Purchased from Utility ($/kWh):	0.124
Initial Cost ($/Wdc):	2.60

Available Incentives

The list below shows the available PV system incentives for the chosen location filtered for the selected capacity and type. Select or unselect each incentive by clicking on them. Recent changes might not yet be captured. Incentive data is drawn from the DSIRE database - **http://www.dsireusa.org**. These incentives were last updated by DSIRE on August 2013 - please see the note below for more information.

Capacity Based Incentives (CBI)

CCEF - Residential Solar PV Rebate Program
Rate: $0.00 - Maximum Amount: $15,000.00

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RESULTS

42,886 kWh per Year *

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Energy Value ($)
January	2.67	2,512	311
February	3.53	2,968	368
March	4.20	3,845	477
April	5.13	4,313	535
May	5.40	4,526	561
June	5.98	4,712	584
July	5.77	4,648	576
August	5.39	4,372	542
September	4.61	3,745	464
October	3.54	3,073	381
November	2.47	2,145	266
December	2.18	2,026	251
Annual	4.24	42,885	$ 5,316

Location and Station Identification

Requested Location	90 Parsons Road, enfield ct
Weather Data Source	(TMY2) HARTFORD, CT 4.8 mi
Latitude	41.93° N
Longitude	72.68° W

PV System Specifications *(Commercial)*

DC System Size	37.2 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	20.04%
Inverter Efficiency	96%
DC to AC Size Ratio	.9

Initial Economic Comparison

Average Cost of Electricity Purchased from Utility	0.12 $/kWh
Initial Cost	2.60 $/Wdc
Cost of Electricity Generated by System	0.14 $/kWh

These values can be compared to get an idea of the cost-effectiveness of this system. However, system costs, system financing options (including 3rd party ownership) and complex utility rates can significantly change the relative value of the PV system.

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SYSTEM INFO

RESTORE DEFAULTS

Modify the inputs below to run the simulation.

DC System Size (kW):	179.2
Module Type:	Standard
Array Type:	Fixed (open rack)
System Losses (%):	20.03
Tilt (deg):	20
Azimuth (deg):	180

Draw Your System

Click below to customize your system on a map. (optional)

Advanced Parameters

INITIAL ECONOMICS (Optional)

Modify the inputs below to provide an initial rough estimate of the cost of energy produced by the system. Note that complex utility rates and third-party financing can significantly change these values

System Type:	Commercial
Average Cost of Electricity Purchased from Utility ($/kWh):	0.12
Initial Cost ($/Wdc):	2.60

Available Incentives

The list below shows the available PV system incentives for the chosen location filtered for the selected capacity and type. Select or unselect each incentive by clicking on them. Recent changes might not yet be captured. Incentive data is drawn from the DSIRE database - **http://www.dsireusa.org**. These incentives were last updated by DSIRE on August 2013 - please see the note below for more information.

Capacity Based Incentives (CBI)

CCEF - Residential Solar PV Rebate Program
Rate: $0.00 - Maximum Amount: $15,000.00

Investment Tax Credit (ITC)

Residential Renewable Energy Tax Credit
Percent of Cost: 30%

The DSIRE database, which is managed by the North Carolina Solar Center and provides the quantitative

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RESULTS

206,617 kWh per Year *

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Energy Value ($)
January	2.67	12,103	1,501
February	3.53	14,299	1,773
March	4.20	18,524	2,297
April	5.13	20,779	2,577
May	5.40	21,806	2,704
June	5.98	22,703	2,815
July	5.77	22,396	2,777
August	5.39	21,066	2,612
September	4.61	18,043	2,237
October	3.54	14,805	1,836
November	2.47	10,335	1,282
December	2.18	9,759	1,210
Annual	4.24	206,618	$ 25,621

Location and Station Identification

Requested Location	90 Parsons Road, enfield, ct
Weather Data Source	(TMY2) HARTFORD, CT 4.8 mi
Latitude	41.93° N
Longitude	72.68° W

PV System Specifications *(Commercial)*

DC System Size	179.2 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	20.03%
Inverter Efficiency	96%
DC to AC Size Ratio	.9

Initial Economic Comparison

Average Cost of Electricity Purchased from Utility	0.12 $/kWh
Initial Cost	2.60 $/Wdc
Cost of Electricity Generated by System	0.14 $/kWh

These values can be compared to get an idea of the cost-effectiveness of this system. However, system costs, system financing options (including 3rd party ownership) and complex utility rates can significantly change the relative value of the PV system.

Federal Aviation Administration

« OE/AAA

Notice Criteria Tool

Notice Criteria Tool - Desk Reference Guide V_2014.2.0

The requirements for filing with the Federal Aviation Administration for proposed structures vary based on a number of factors: height, proximity to an airport, location, and frequencies emitted from the structure, etc. For more details, please reference CFR Title 14 Part 77.9.

You must file with the FAA at least 45 days prior to construction if:

- your structure will exceed 200ft above ground level
- your structure will be in proximity to an airport and will exceed the slope ratio
- your structure involves construction of a traverseway (i.e. highway, railroad, waterway etc...) and once adjusted upward with the appropriate vertical distance would exceed a standard of 77.9(a) or (b)
- your structure will emit frequencies, and does not meet the conditions of the FAA Co-location Policy
- your structure will be in an instrument approach area and might exceed part 77 Subpart C
- your proposed structure will be in proximity to a navigation facility and may impact the assurance of navigation signal reception
- your structure will be on an airport or heliport
- filing has been requested by the FAA

If you require additional information regarding the filing requirements for your structure, please identify and contact the appropriate FAA representative using the Air Traffic Areas of Responsibility map for Off Airport construction, or contact the FAA Airports Region / District Office for On Airport construction.

The tool below will assist in applying Part 77 Notice Criteria.

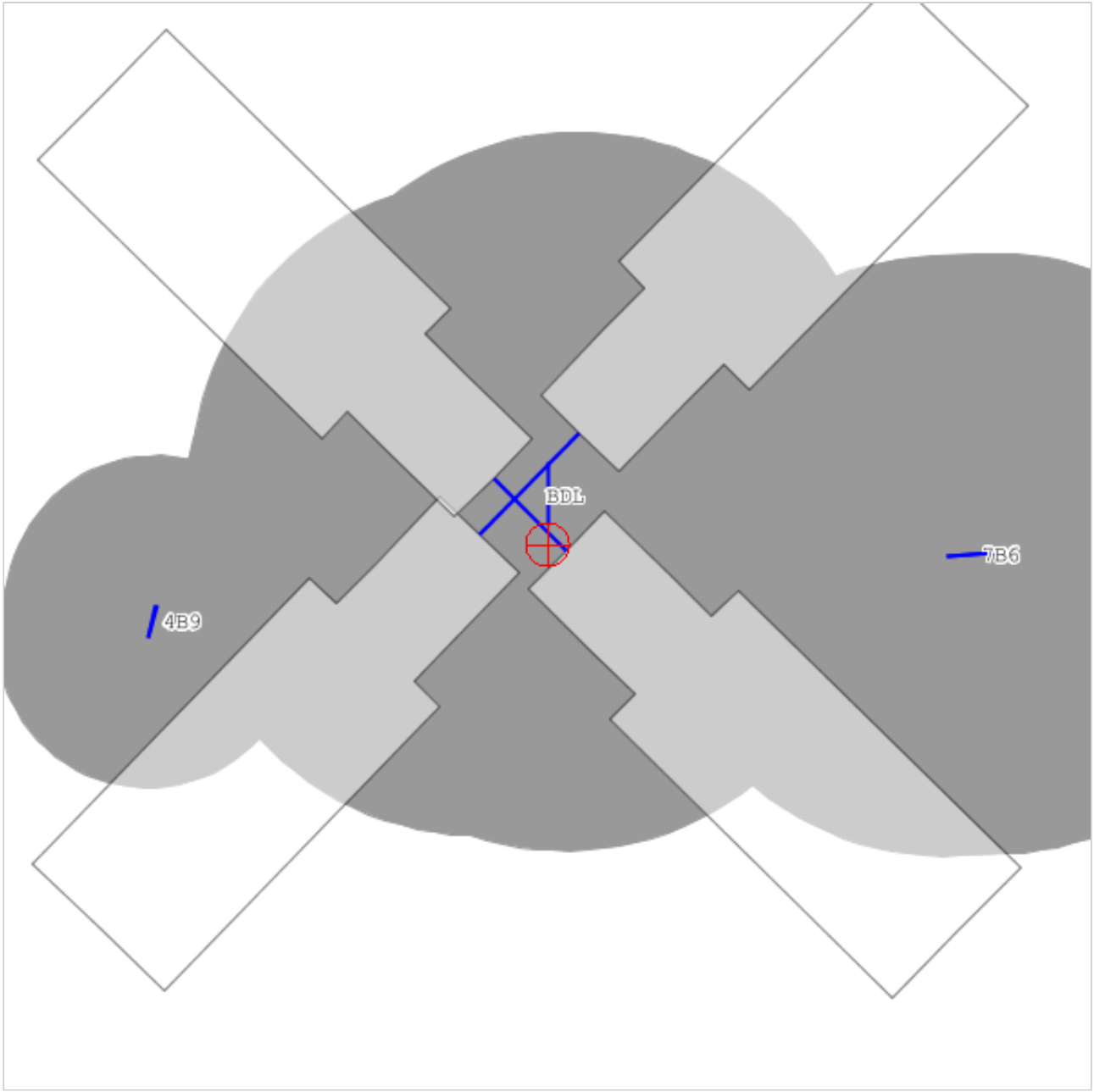
Latitude:	41 Deg 55 M 48 S N ▼
Longitude:	72 Deg 40 M 48 S W ▼
Horizontal Datum:	NAD83 ▼
Site Elevation (SE):	40 (nearest foot)
Structure Height (AGL):	40 (nearest foot)
Traverseway:	No Traverseway ▼ (Additional height is added to certain structures under 77.9(c))
Is structure on airport:	◉ No ○ Yes

Results

You exceed the following Notice Criteria:

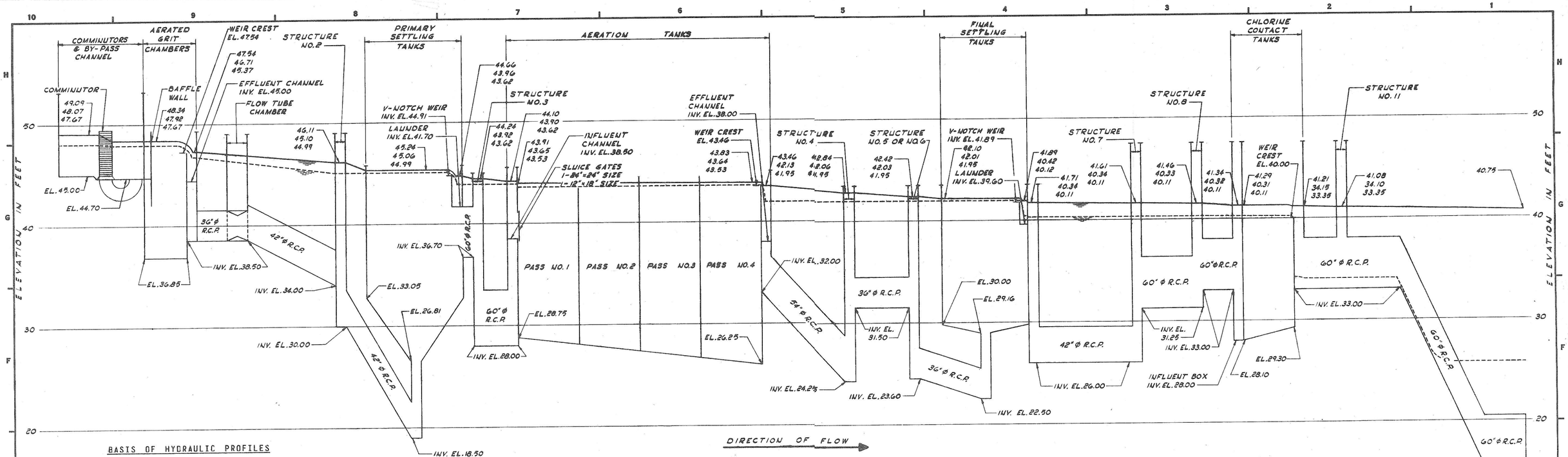
Your proposed structure is in proximity to a navigation facility and may impact the assurance of navigation signal reception. The FAA, in accordance with 77.9, requests that you file.

The FAA requests that you file


BDL
7B6
4B9

APPENDIX H

HYDRAULIC PROFILE



HYDRAULIC PROFILE

SCALE: HOR. NO SCALE
VER. 1" = 4'

BASIS OF HYDRAULIC PROFILES

FLOW DESCRIPTION	SEWAGE FLOW	*PERCENT RETURN SLUDGE	RETURN SLUDGE FLOW	NUMBER OF TANKS IN SERVICE
FUTURE PEAK	30 MGD	50	6.25 MGD	2 CHLORINE CONTACT TANKS 3 FINAL SETTLING TANKS 4 AERATION TANKS 1 PRIMARY SETTLING TANK 2 AERATED GRIT CHAMBERS
DESIGN AVERAGE	10 MGD	25	2.5 MGD	2 CHLORINE CONTACT TANKS 4 FINAL SETTLING TANKS 4 AERATION TANKS 2 PRIMARY SETTLING TANKS 2 AERATED GRIT CHAMBERS
INITIAL MINIMUM	1 MGD	10	0.4 MGD	1 CHLORINE CONTACT TANK 2 FINAL SETTLING TANKS 2 AERATION TANKS 1 PRIMARY SETTLING TANK 1 AERATED GRIT CHAMBER

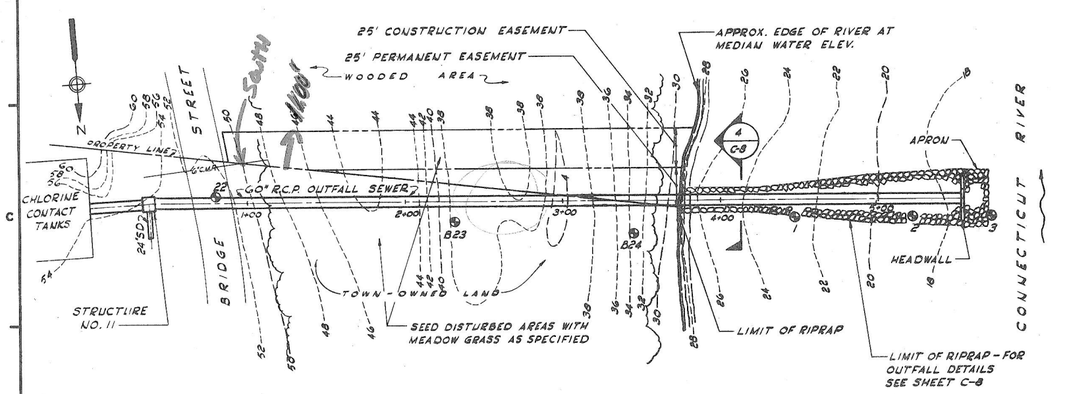
* BASED ON AVERAGE DAILY FLOW

ELEVATION LEGEND

46.11 — WATER SURFACE ELEVATION AT FUTURE PEAK FLOW
45.10 — WATER SURFACE ELEVATION AT DESIGN AVERAGE FLOW
44.99 — WATER SURFACE ELEVATION AT INITIAL MINIMUM FLOW
T — TOP OF EXTERIOR WALL

NOTES:

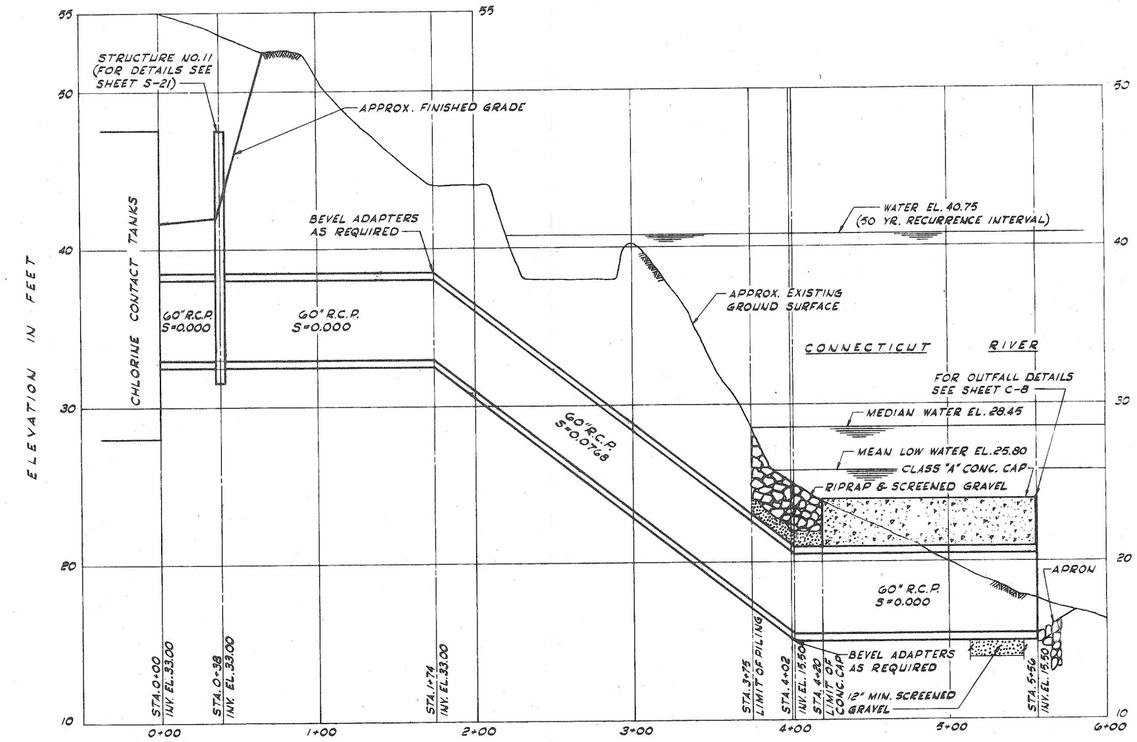
1. ADDITIONAL FLOW RESULTING FROM THE PLANTS SEWAGE SYSTEM, PROCESS WATER AND RECYCLED FLOWS OTHER THAN RETURN SLUDGE FLOWS HAVE BEEN INTENTIONALLY NEGLECTED.
2. THE HYDRAULIC PROFILE FOR 30 MGD IS BASED ON A CONNECTICUT RIVER ELEVATION OF 40.75 FEET WHICH HAS 50 YEAR RECURRENCE INTERVAL.
3. ELEVATIONS INDICATED REFER TO USGS MEAN SEA LEVEL DATUM.



OUTFALL PLAN

SCALE: 1" = 40'

NOTE: STEEL SHEET PILING SHALL BE INSTALLED FROM STA. 3+75 TO THE END OF THE OUTFALL.



OUTFALL PROFILE

SCALE: HOR. 1" = 40'
VER. 1" = 4'

THIS IS A HALF SIZE REPRODUCTION.

NUMBER	DATE	MADE BY	CHECKED BY	DESCRIPTION

REVISIONS

DRAWN BY P.J.F.
DEPT. CHECK F.G.R.-R.F.D.-A.J.
PROJ. CHECK A.F.G.

M&E METCALF & EDDY, INC. | ENGINEERS
BOSTON - NEW YORK - PALO ALTO - CINCINNATI

REG. PROF. ENGR. CONN. NO. 2610 — DATE 3-17-69

SCALE: AS SHOWN
0 40 80 120 SCALE IN FEET
UNLESS OTHERWISE NOTED OR CHANGED BY REPRODUCTION

TOWN OF ENFIELD, CONNECTICUT
WATER POLLUTION CONTROL PLANT AND APPURTENANT WORK
HYDRAULIC PROFILE AND OUTFALL SEWER
CIVIL

JOB 8836
FILE NO. K-00007-i
SHEET C-6

APPENDIX V: DYNAMIC TREATMENT PROCESS MODEL RESULTS

PROCESS MODELLING RESULTS

1. INTRODUCTION

Mathematic modelling and computer simulation have become a powerful tool to determine the most suitable design, optimize the control, forecast future behavior of full-scale WPCFs under varying operating conditions, and educate operators. GPS-X and Biowin are among the WPCF modelling software packages in the market. In this report, GPS-X software developed by Hydromantis was used to develop and evaluate models of the existing and proposed WPCF biological treatment configurations for the Town of Enfield.

A number of factors can be considered with regard to activated sludge modelling and model applications, and a step-wise approach is typically utilized to a prepare a model that can provide useful simulations of a full-scale WPCF. To reach that goal, the following main steps were completed during the process modelling task:

- Definition of the WPCF model purpose or the objectives of the model application (control, design, simulation)
- Model selection: choice of the models needed to describe the different WWTP units to be considered in the simulation, i.e. selection of the activated sludge model, the sedimentation model, etc.
- Wastewater and biomass characterization
- Model building and calibration of the activated sludge model parameters
- Scenario evaluations

2. MODEL BUILDING AND CALIBRATION

The Enfield WPCF is a complex, large-scale plant. Even though in GPS-X it is possible to model all individual unit processes, the data requirement for such a detailed analysis can be quite extensive. Usually it is more appropriate to aggregate some of the parallel unit processes (e.g. clarifiers, aeration tanks) together, assuming that the flow split between these units is approximately equal. The calibration can then be performed on a simplified existing layout of the WPCF such as shown in Figure 1. The calibrated model parameters can subsequently be imported into the full layout for more detailed analyses.

Plant layout including two grit chambers, flow splitters, flow combiners, two primary clarifiers, bioreactor, and four secondary clarifiers was transferred on the GPS-X screen as first step using user-friendly graphical icons. After constructing the layout of the WPCF, the process models were chosen and some necessary data on physical specifications of the units, and characteristics of the aerators entered into the program. Daily average values of influent wastewater constituents and influent wastewater flowrate were used as input to the model.

Model calibration is an important step in any modelling effort. For calibration purposes, we used data from two sources:

1. Routinely logged plant daily records, usually composite samples (influent and effluent BOD, TSS, Ammonia, Nitrate and Nitrite, TKN, etc.)
2. Data from additional tests performed to establish necessary stoichiometric fractions (COD/VSS, VSS/TSS, Ammonia/TKN, soluble BOD/BOD, etc.)

We prepared a limited sampling campaign to complement the existing plant data. The modelling sample collection campaign focused on additional wastewater characterization and on nutrient removal profiles within the existing process reactors. The sampling duration was 2-weeks, with sample collection frequency of 2-3 days per week. Table 1 shows all the parameters targeted during the sampling protocol.

In calibration, values are assigned to the parameters used in the model such that the difference between model predictions and observations is at its minimum. Manual and mathematical optimization approaches are used for model calibration. In this evaluation, a manual approach was used for model calibration. Default values of stoichiometric, kinetic, and other parameters related to biochemical processes were employed initially. Then, differences between predicted and observed values noted and adjustments made in parameter values until an efficient match between observed and calculated values of desired variables was reached. Change in the default values of five model parameters gave a reasonable match for the investigated variables. Calibrated parameters and their values are given in Table 2.

The results of the calibration process are summarized in Figures 2, 3, and 4. The model reasonably predicted system performance during the period when model sampling campaign was performed. . As shown in these figures, there is a reasonable agreement between measured and modelled values for effluent CBOD, TN, TKN, alkalinity, and sTKN, which suggests the suitability of the calibrated model in predicting the plant behavior under various operations and different scenarios.

3. SIMULATION RESULTS AND DISCUSSION

Using the calibrated model, the bioreactor configuration was reconfigured to simulate the recommended biological alternative (Variable Operating Mode (VOM) process), which gives the operator the ability to operate the biological process in various modes using “swing zones” that could be operated with either aerobic or anoxic conditions. The bioreactor was divided into six (6) compartments as shown in Figure 5 and the following scenarios were simulated:

- VOM 1: To simulate the Modified Ludzack-Ettinger (MLE) process (anoxic and aerobic configuration), the dissolved oxygen (DO) was controlled in each compartment of the bioreactor in order to keep the first two compartment anoxic and the rest of the compartments aerobic. The nitrate (NO_3) rich mixed liquor was recycled from compartment No.6 to compartment No.1.
- VOM 2: To simulate the 4-stage Bardenpho process (anoxic, aerobic, anoxic, and aerobic configuration), DO control was adjusted to keep the first compartment anoxic, compartment No.3 aerobic, and the rest of the compartments were kept swing zones (aerobic or anoxic). The nitrate recycle was simulated from compartment No.4 to compartment No.1
- VOM 3: This scenario evaluated the robustness of the upgraded WPCF to accommodate short-term peak flows by simulating intensive rainfall events. Under these conditions, the process would operate in the contact stabilization mode to protect against secondary clarifier overload and potential washout. The internal recycle of mixed liquor is terminated during this mode of operation.

The simulation results for VOM-1 scenario are displayed in Figures 6, 7, and 8. Data shown in these figures indicate the following:

- According to the Ammonia profile (Figure 7), most of the ammonia was converted to nitrate by compartment No.5.
- Low ammonia effluent concentrations were predicted (< 1 mg/L) as shown on Figure 7.
- Low sTKN effluent concentrations were calculated (< 2 mg/L)
- Ammonia and Nitrate profiles (Figures 6 and 7) suggest that better nitrification/denitrification was achieved during this scenario compared to the existing configuration primarily due to the release of ammonia related to cell decay. In fact, the ammonia concentration was lower in the aerobic zones and the nitrate concentration were higher in the anoxic zones.

The simulation results for VOM-2 scenario are summarized in Figures 9, 10, and 11. Data shown in these figures indicate the following:

- Low ammonia effluent concentrations were predicted (< 2 mg/L)
- Ammonia and Nitrate profiles (Figure 11) show lower ammonia level in aerobic zones and higher nitrate level in anoxic zones compared to the existing configuration, which suggests that better nitrogen removal was achieved.
- Low CBOD effluent values were predicted compared to VOM-1 scenario and the existing configuration.

The simulation for the VOM-3 mode of operation was conducted differently than for the VOM-1 and the VOM-2 simulations. The evaluation of VOM-3 mode performance was simulated as a 7-day wet weather event while the system is operating in the VOM-1 mode. For this scenario, the simulation starts with the system operating in the VOM-1 mode for a 7-day period (days 0-7). At that time, a 7-day period of high flow is simulated during which the VOM-3 configuration is utilized (days 8-14). After the 14th day, the flow is reduced to the flow rate that preceded the storm event and the system is returned to VOM-1 mode of operation to evaluate system recovery. The simulation results for VOM-3 scenario are displayed in Figures 12, 13 and 14. Data shown in these figures indicate the following:

- The level of nitrogen removal was, as expected, affected during the simulated storm events.
- Ammonia and nitrate profiles (Figure 14) suggest that despite the simulation of intensive rainfall events, the nitrifiers were retained in the system although complete nitrification was not achieved.
- A limited level of denitrification and resulting total nitrogen removal was also achieved during the wet weather event.
- The system recovered to the same level of performance achieved in typical VOM-1 mode as illustrated by the Figures 8 and 14. A similar response is expected when the VOM-2 mode is in operation.
- Effluent TSS is predicted to experience a modest increase during the storm event but remains well below permit limits.

4. CONCLUSION

The simulation results for all three (3) scenarios suggest that the proposed VOM process could achieve better performance than the existing 4-stage configuration. The simulation results also indicate that the VOM configuration has the capability to enhance BOD and nitrogen removal, achieve effluent requirements, minimize operating cost and handle extreme weather flow conditions within the existing reactor volumes and at minimal supplementary investments. It is recommended that during the design phase, additional process model simulations be performed to fine-tune the VOM configuration and evaluate the effects of different operational parameters (anoxic volume, recycle flow, step feeding, etc.) on process performance and operating cost.

Table 1: Enfield WPCF Process Modeling Limited Sampling/Testing Campaign

Date	Parameters	Locations	Sample Type
3/26/2015	CBOD, sCBOD, COD, sCOD (GF), sCOD (0.45), sTKN (0.45)	Influent, Primary Effluent, Secondary Effluent	Composite
	Alkalinity	Influent, Primary Effluent, Secondary Effluent	Grab
3/27/2015	CBOD, sCBOD, COD, sCOD (GF), sCOD (0.45), sTKN (0.45)	Influent, Primary Effluent, Secondary Effluent	Composite
	Alkalinity	Influent, Primary Effluent, Secondary Effluent	Grab
3/31/2015	CBOD, sCBOD, COD, sCOD (GF), sCOD (0.45), sTKN (0.45)	Influent, Primary Effluent, Secondary Effluent	Composite
	Alkalinity	Influent, Primary Effluent, Secondary Effluent	Grab
4/1/2015	CBOD, sCBOD, COD, sCOD (GF), sCOD (0.45), sTKN (0.45)	Influent, Primary Effluent, Secondary Effluent	Composite
	Alkalinity	Influent, Primary Effluent, Secondary Effluent	Grab
4/2/2015	CBOD, sCBOD, COD, sCOD (GF), sCOD (0.45), sTKN (0.45)	Influent, Primary Effluent, Secondary Effluent	Composite
	Alkalinity	Influent, Primary Effluent, Secondary Effluent	Grab

Table 2: Calibrated Parameters

Parameter	Unit	Range[1]	Typical Value[1]	Default Value	Actual Value
Maximum specific growth rate for heterotrophic biomass (μ_{mh})	$g\ VSS/g\ VSS.d$	3.0 – 13.2	6.0	3.2	7.0
Maximum specific growth rate for autotrophic biomass (μ_{ma})	$g\ VSS/g\ VSS.d$	0.20 – 0.90	0.75	0.90	0.70
Ammonia half-saturation coefficient for autotrophic biomass (K_n)	$mg\ NH_4 - N/L$	0.5 – 1.0	0.74	0.7	0.85
Arrhenius correction factor for heterotrophic biomass (θ_h)	Unitless	1.03 – 1.08	1.07	1.072	1.03
Arrhenius correction factor for autotrophic biomass (θ_a)	Unitless	1.06 – 1.123	1.07	1.072	1.06

1. Range and typical values are based on Metcalf & Eddy "Wastewater Engineering Treatment & Reuse", Fourth Edition

FIGURE 1: GPS-X WPCF LAYOUT

enfield_existing_conf_

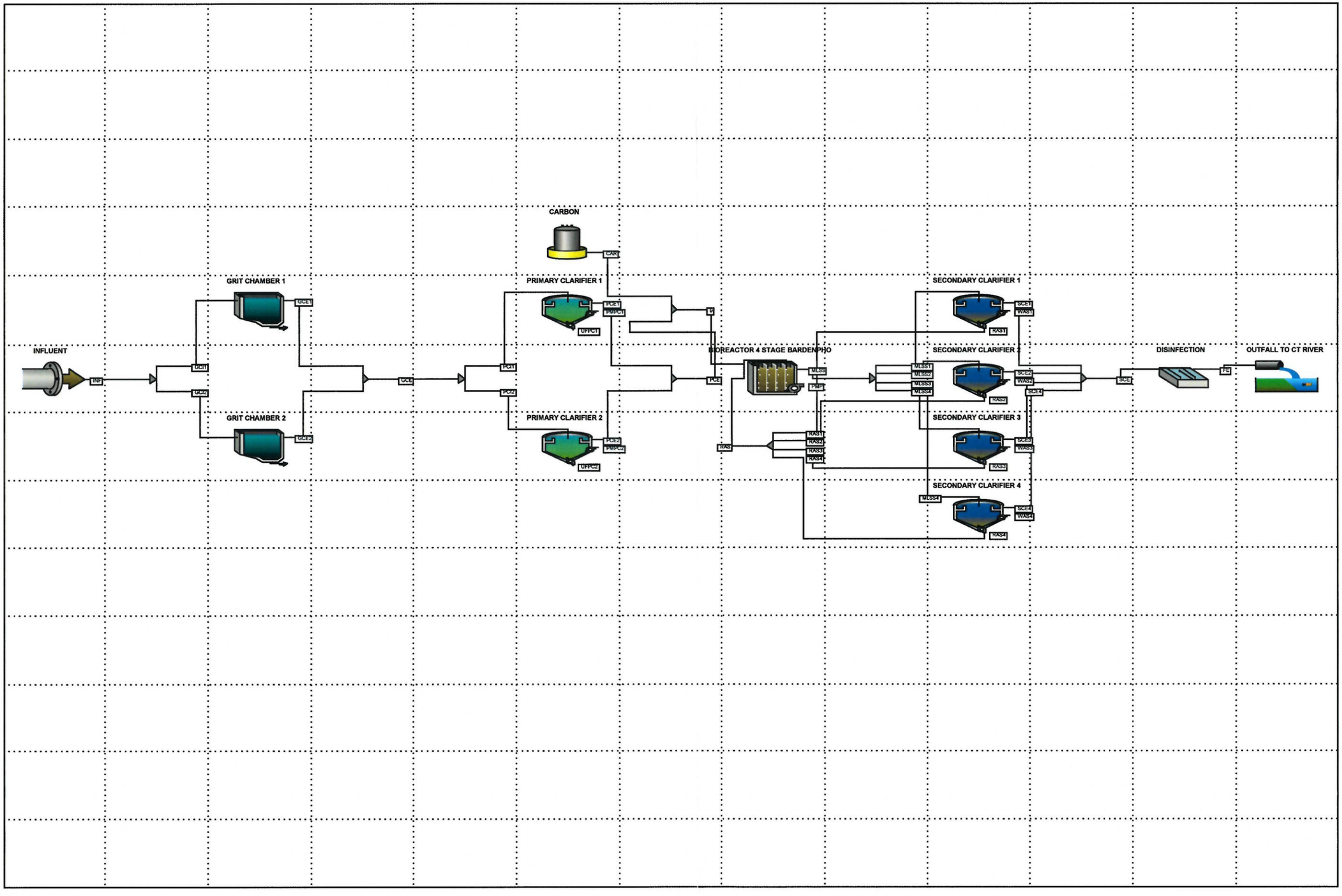


Figure 2: Measured and Predicted Values of the Selected Effluent Parameters Using Existing Configuration

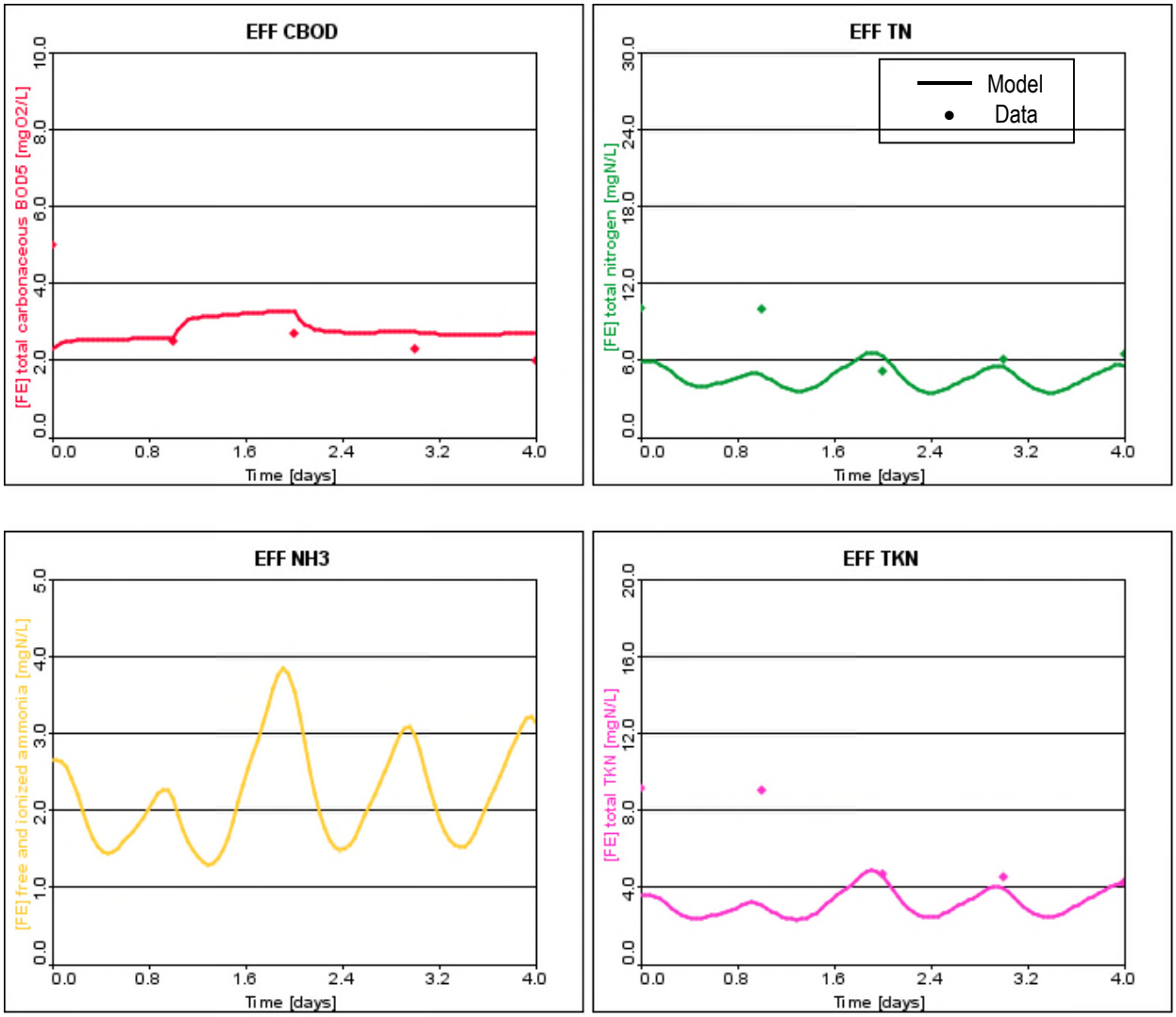


Figure 3: Measured and Predicted Values of the Selected Effluent Parameters Using Existing Configuration

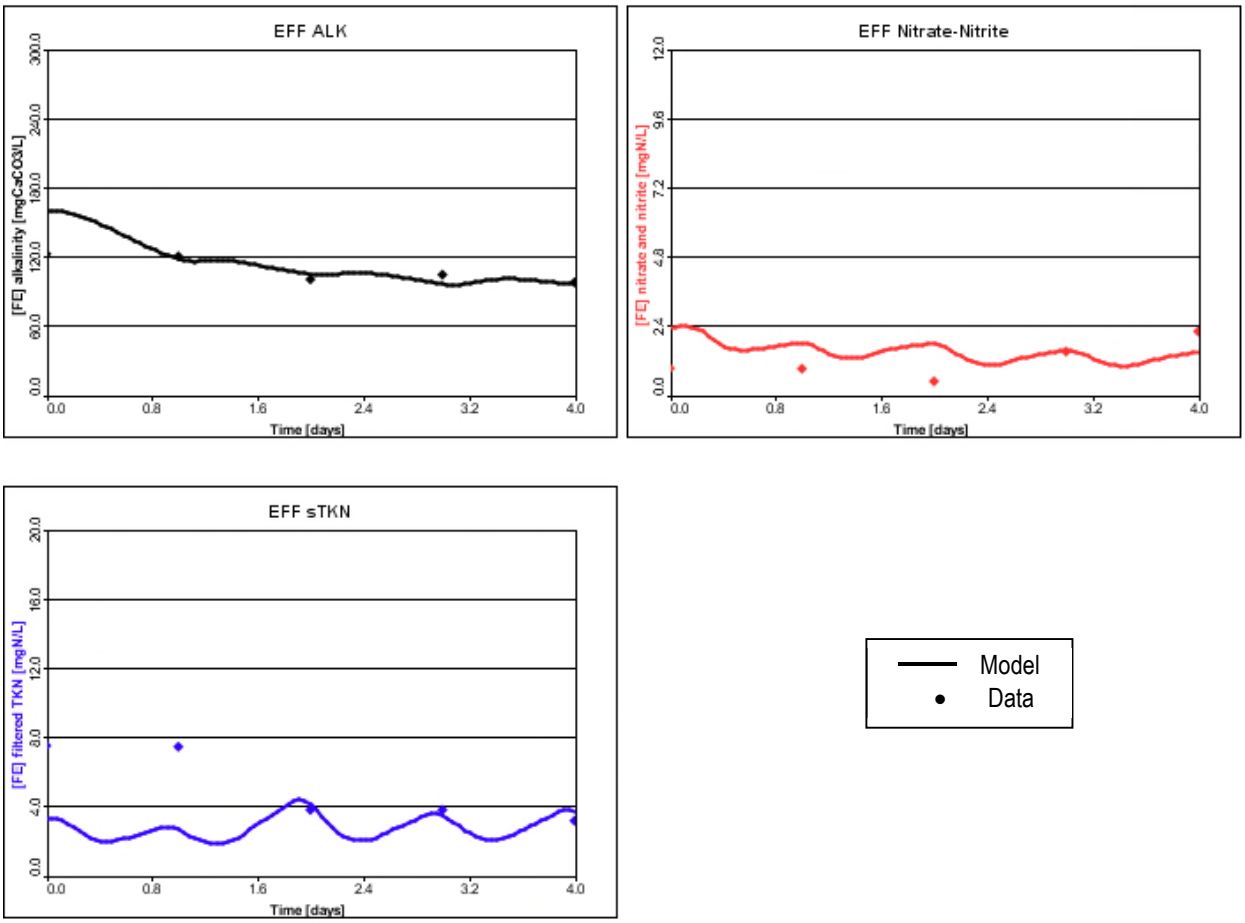
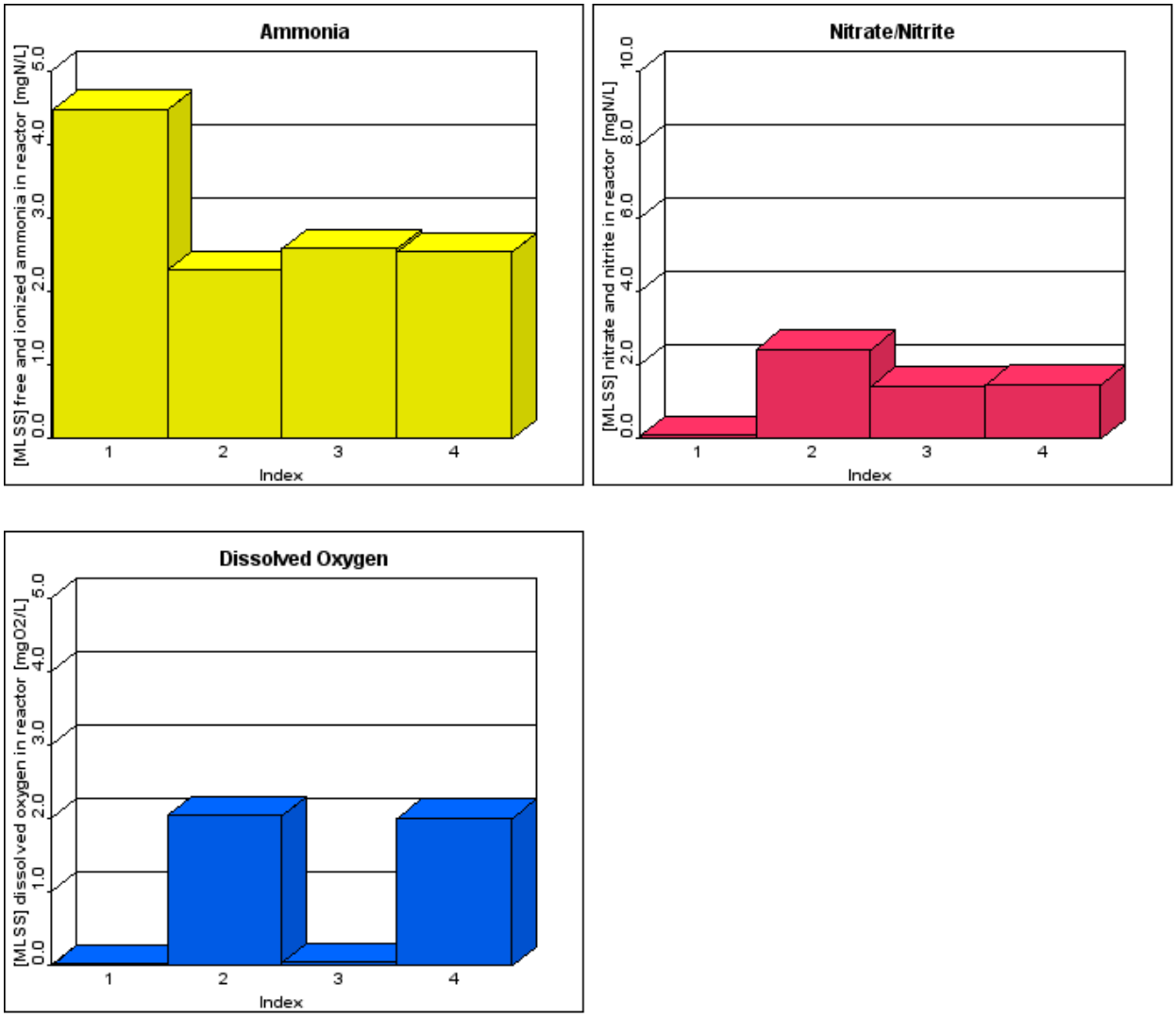
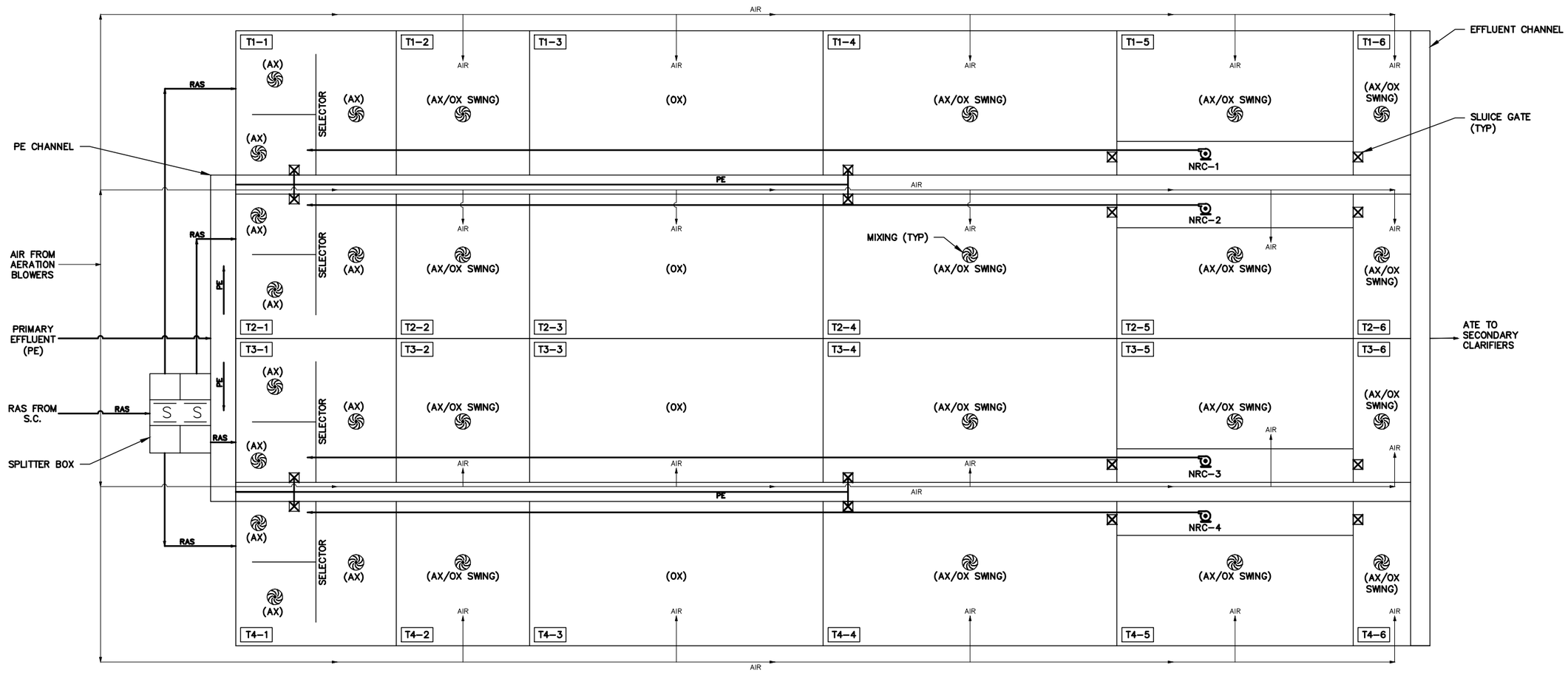


Figure 4: Existing Configuration Profiles along Treatment Train





VARIABLE OPERATING MODE (VOM) ALTERNATIVE CONCEPTUAL PROCESS FLOW DIAGRAM

SCALE: N.T.S.

LEGEND

ABBREVIATIONS

ATE	AERATION TANK EFFLUENT
AX	ANOXIC ZONE
NRC	NITRIFIED RECYCLE PUMP
OX	OXIC (AEROBIC) ZONE
PE	PRIMARY EFFLUENT
RAS	RETURN ACTIVATED SLUDGE
S	SLIDE GATE
SC	SECONDARY CLARIFIER
T1-1	TRAIN 1, ZONE 1 (TYP FOR ALL ZONES)

1699 King Street, Suite 406
Enfield, Connecticut 06082
855.347.6788 | www.woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

VARIABLE OPERATING MODE ALTERNATIVE

DESIGNED BY: AH
DRAWN BY: DMB
CHECKED BY: MJB
227363-FIGURE_6-3.dwg

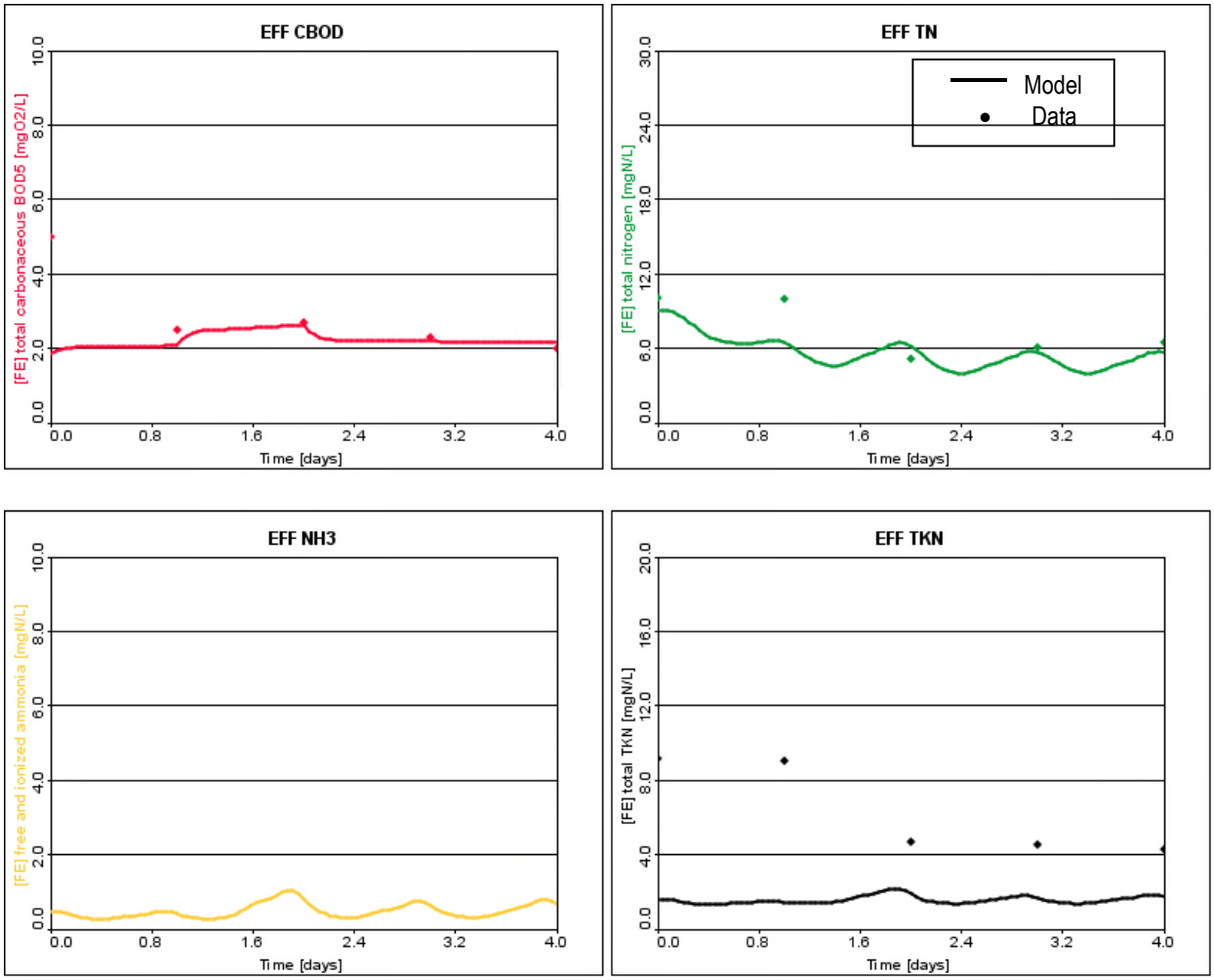
TOWN OF ENFIELD WPCF
ENFIELD, CONNECTICUT

WASTEWATER FACILITIES PLAN

JOB NO: 227363
DATE: JULY 2015
SCALE: N.T.S.

FIGURE 5

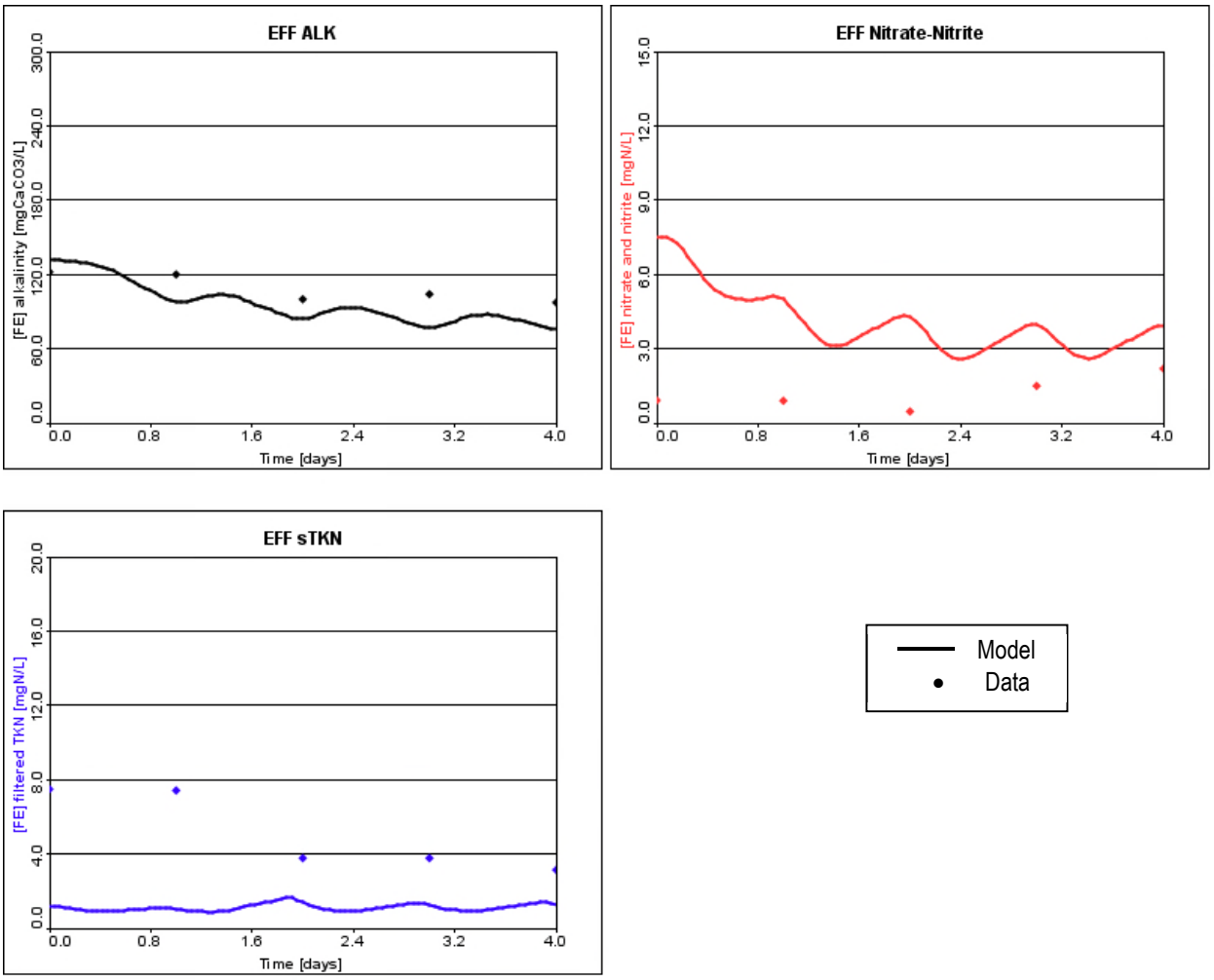
Figure 6: Comparison of Predicted and Measured Effluent Values of the Selected Parameters – VOM 1 Scenario



Notes:

- The Measured Values are based on calibrated existing configuration
- The Predicted Values are based on VOM-1 Scenario

Figure 7: Comparison of Predicted and Measured Effluent Values of the Selected Parameters – VOM 1 Scenario



Notes:

- The Measured Values are based on calibrated existing configuration
- The Predicted Values are based on VOM-1 Scenario

Figure 8: Profiles along Treatment Train - VOM 1 Scenario

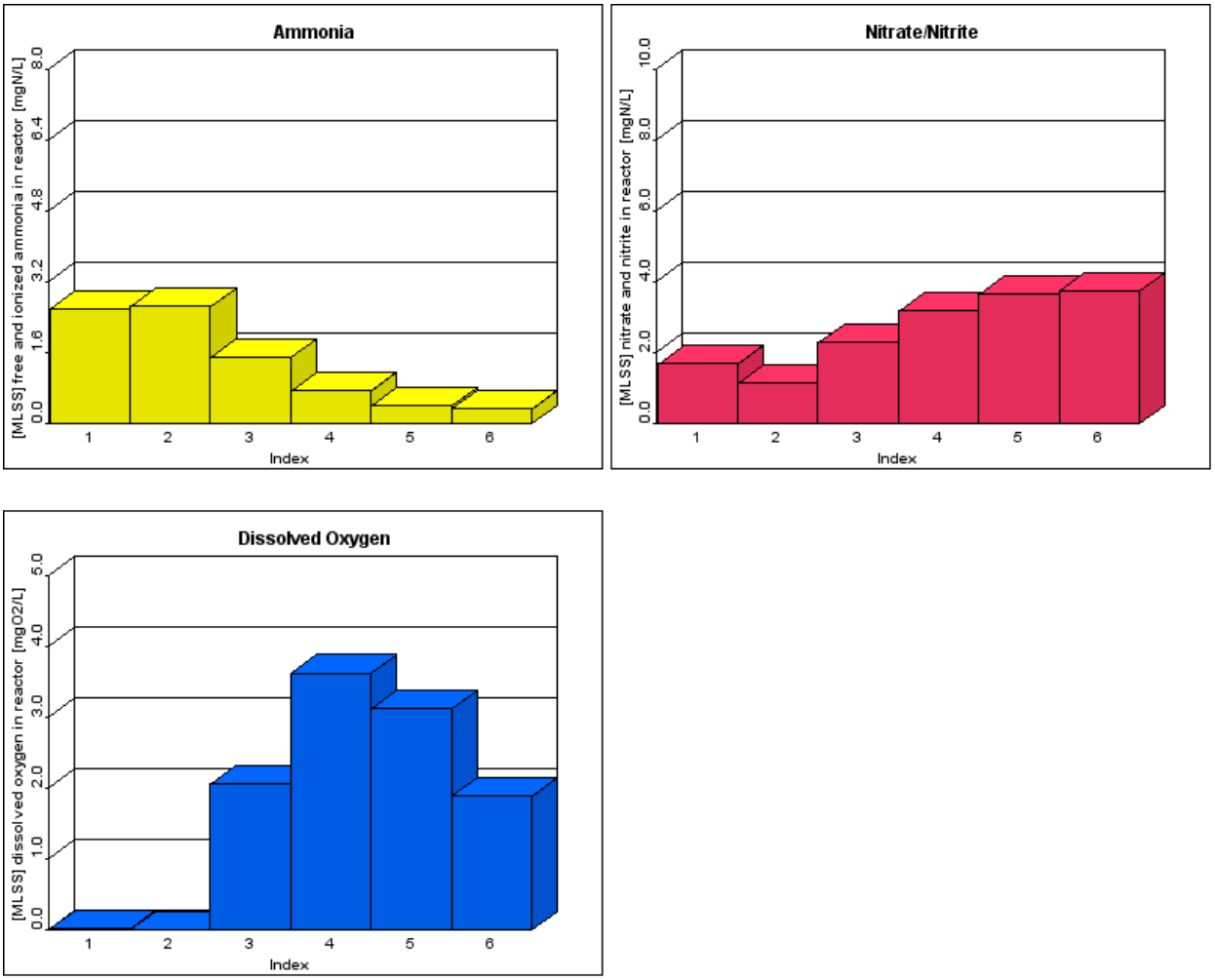
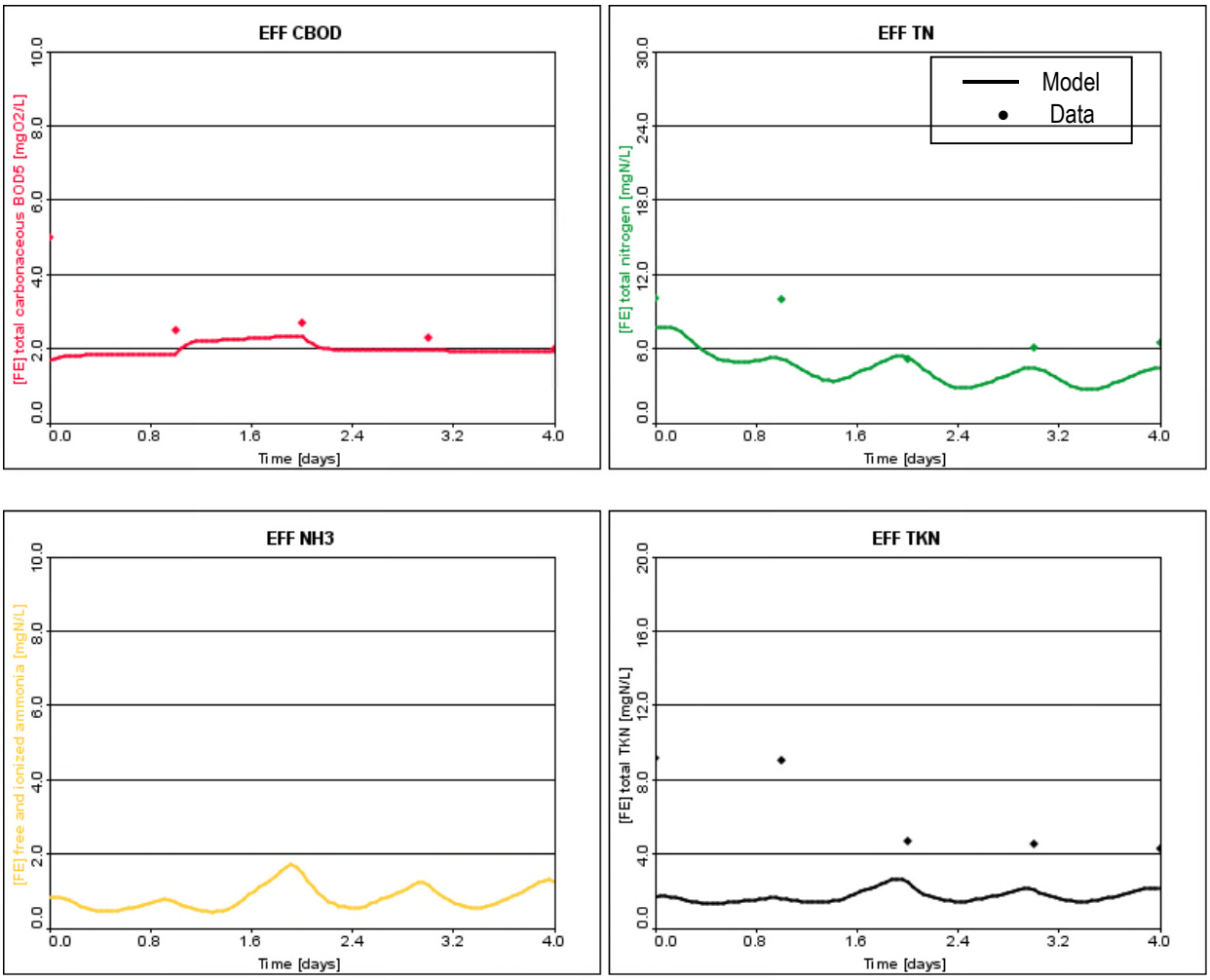


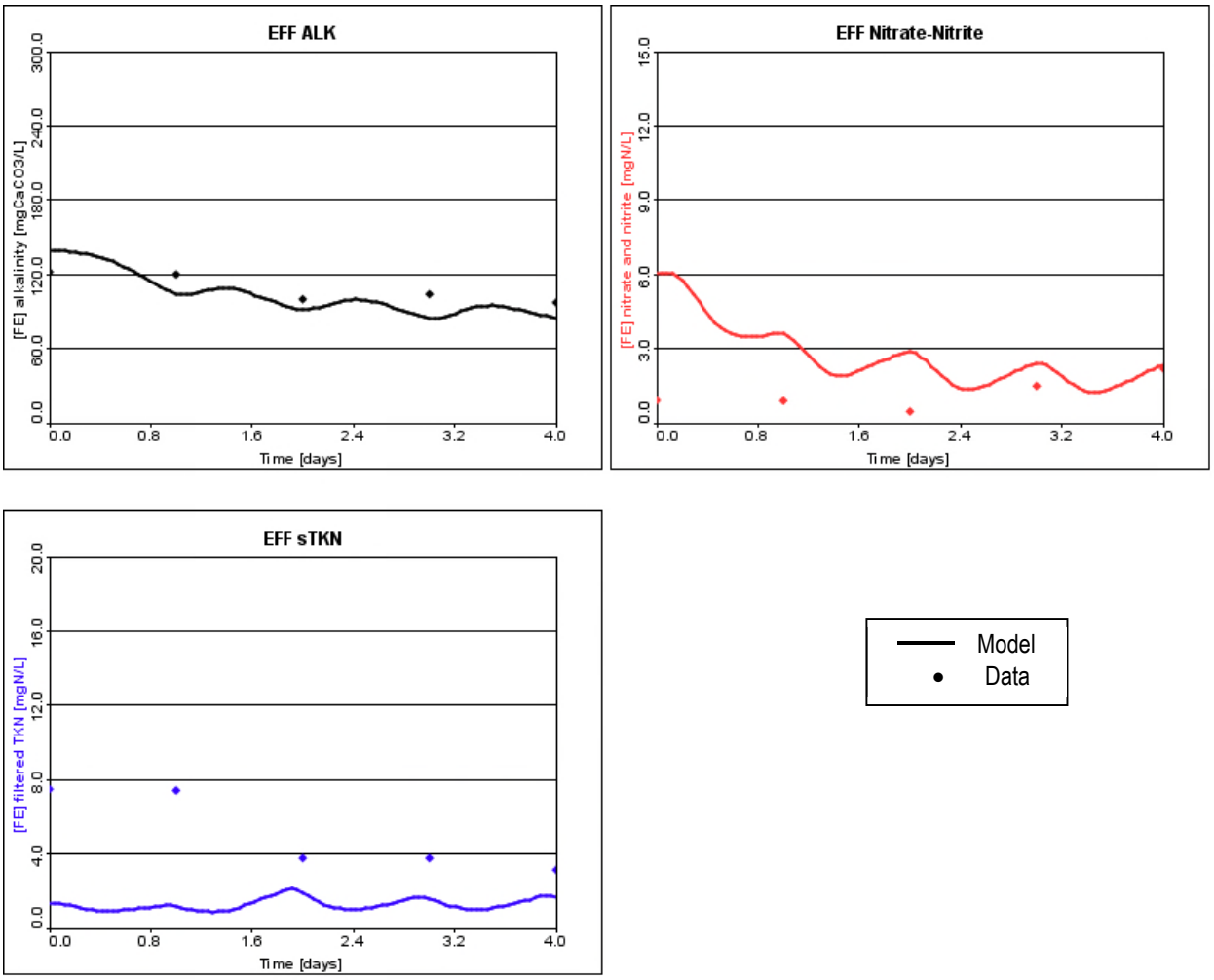
Figure 9: Comparison of Predicted and Measured Effluent Values of the Selected Parameters – VOM 2 Scenario



Notes:

- The Measured Values are based on calibrated existing configuration
- The Predicted Values are based on VOM-2 Scenario

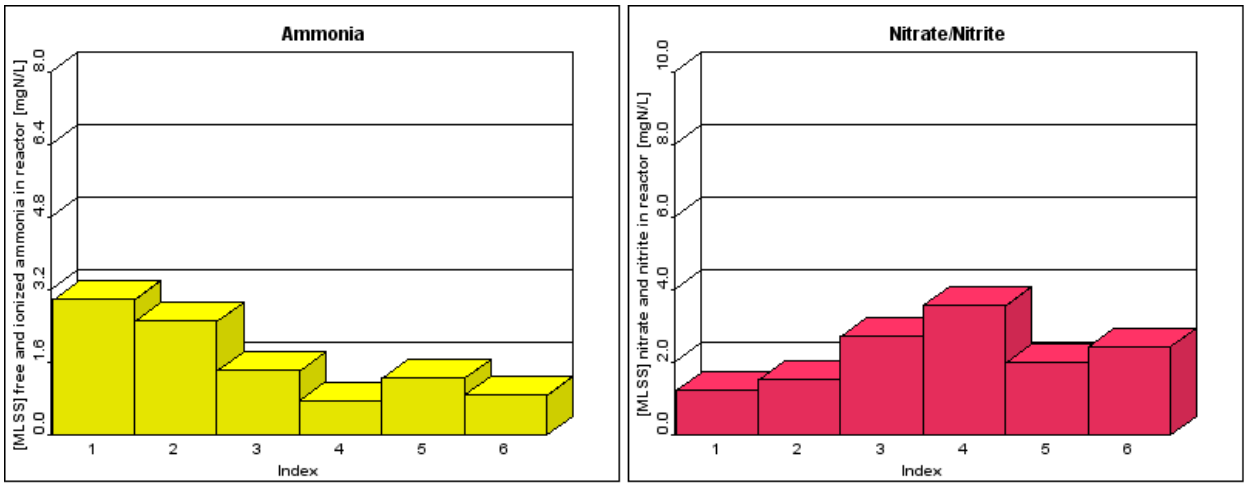
Figure 10: Comparison of Predicted and Measured Effluent Values of the Selected Parameters – VOM 2 Scenario



Notes:

- The Measured Values are based on calibrated existing configuration
- The Predicted Values are based on VOM-2 Scenario

Figure 11: Profiles along Treatment Train - VOM 2 Scenario



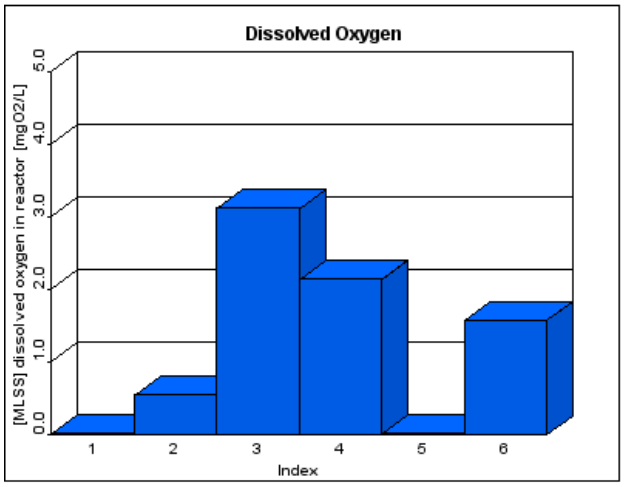


Figure 12: Predicted Effluent Values of the Selected Parameters
VOM 3 Scenario

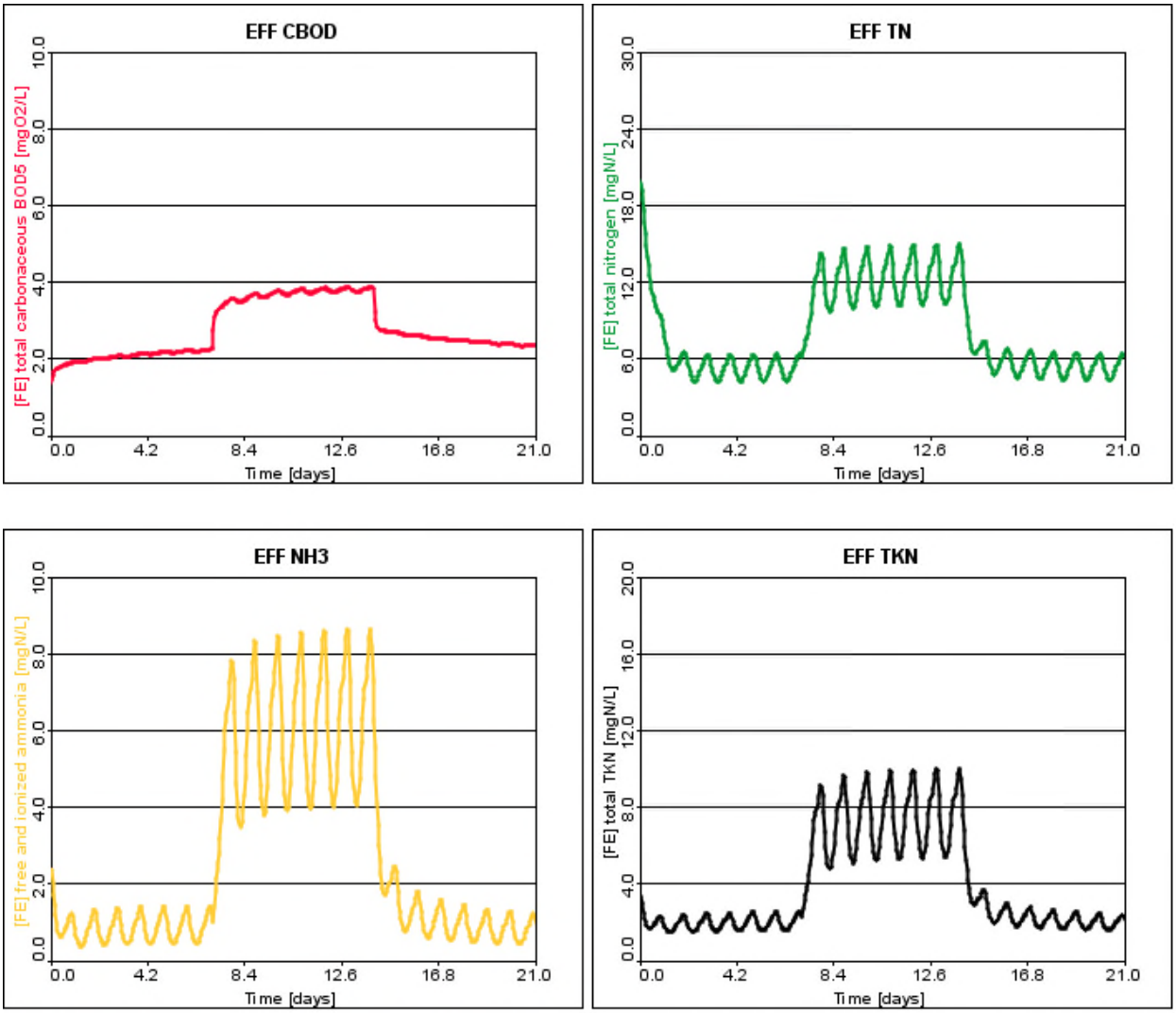


Figure 13: Predicted Effluent Values of the Selected Parameters
VOM 3 Scenario

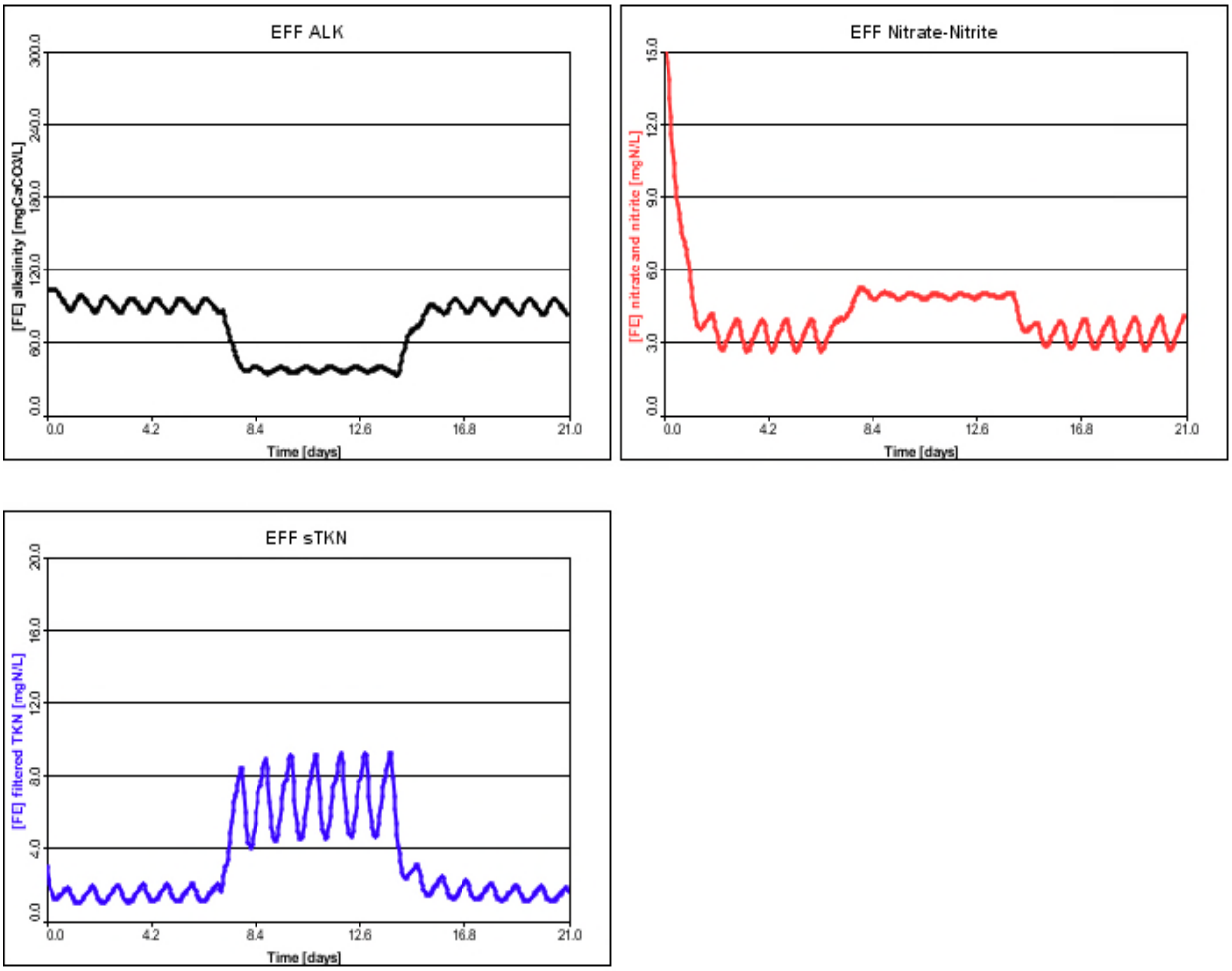
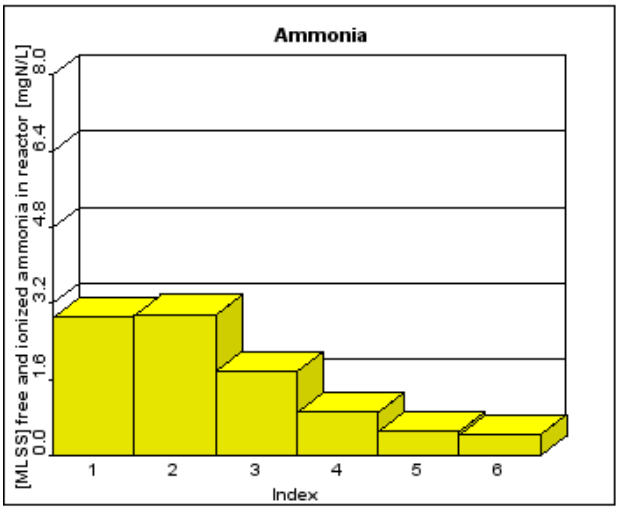
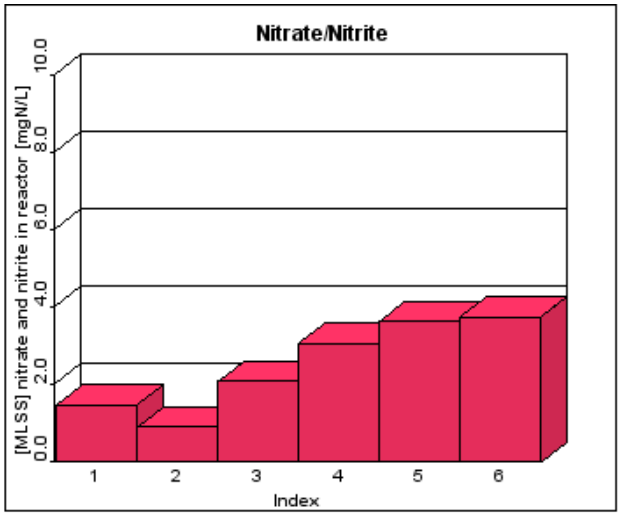
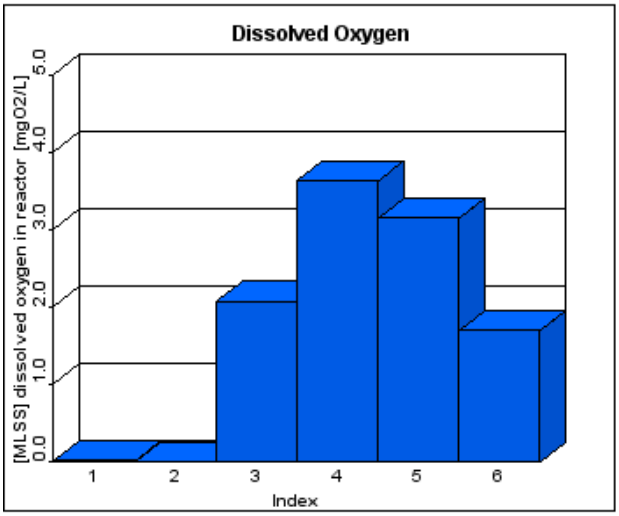


Figure 14: Profiles along Treatment Train - VOM 3 Scenario at Day 21







APPENDIX W: NEIWPCC STAFFING ANALYSIS

NEIWPCC
New England Interstate Water Pollution Control Commission

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS

Choose Staffing Shifts: One Plus Shift

Enter Plant Design Flow: 5.0-10.0 mgd

Data Notes	# of Units	Process/Activity/Flow	Hours	Calculated	Subtotal
		Begin Chart 1 – Basic and Advanced Operations and Processes			
Data Notes	**# of Units**	**Process**	**Hours**	**Calculated**	**Subtotal**
	1	Preliminary Treatment	2.00	520.00	
# of units	2	Primary Clarification	1.00	520.00	
Choose Range	1	Activated Sludge	7.00	1820.00	
Choose Range	1	Activated Sludge w/BNR	9.00	2340.00	
	0	Rotating Biological Contactor	6.00	0.00	
# of tanks	0	Sequencing Batch Reactor	1.00	0.00	
		Extended Aeration (w/o primary)	*X*		
		Extended Aeration w/BNR	*X*		
Choose Range	0	Pure Oxygen Facility	9.00	0.00	
Choose Range	0	Pure Oxygen Facility w/BNR	10.00	0.00	
	0	Trickling Filter	3.00	0.00	
		Oxidation Ditch (w/o primary)	*X*		
		Oxidation Ditch w/BNR	*X*		
		Aeration Lagoon	*X*		
		Stabilization Pond	*X*		
		Innovative Alternative Technologies	*X*		
	1	Nitrification	0.50	130.00	
	1	Denitrification	0.50	130.00	
	0	Phosphorus Removal (Biological)	0.50	0.00	
	0	Phosphorus Removal (Chemical/Physical)	2.00	0.00	
	0	Membrane Processes	0.50	0.00	
	0	Cloth Filtration	0.50	0.00	
	0	Granular Media Filters (Carbon, sand, anthracite, garnet)	1.50	0.00	
	0	Water Reuse	0.50	0.00	
	1	Plant Reuse Water	0.15	39.00	
	1	Chlorination	1.00	260.00	
	0	Dechlorination	1.00	0.00	
	0	Ultraviolet Disinfection	1.00	0.00	
# of units	1	Wet Odor Control	1.00	260.00	
# of units	0	Dry Odor Control	0.50	0.00	
	1	Septage Handling	1.00	260.00	
		End of Chart 1 – Basic and Advanced Operations and Processes SUBTOTAL:			**10205.00**

** Secondary Clarification has been built into basic operations processes.*
** Activated Sludge process includes RAS and WAS pumping.*

Begin Chart 2 – Maintenance

Unit Descriptons	# of Units	Activity/Flow	Hours	Calculated	Subtotal
# of screens	0	Manually Cleaned Screens	0.25	0.00	
# of screens	1	Mechanically Cleaned Screens	1.00	260.00	
# of screens	0	Mechanically Cleaned Screens with grinders/washer/ compactors	2.00	0.00	
# of units	1	Comminutor/Macerator	0.50	130.00	
# of chambers	2	Aerated Grit Chambers	0.50	260.00	
# of units	0	Vortex Grit Removal	0.50	0.00	
# of units	0	Gravity Grit Removal	0.20	0.00	
# of tanks	4	Additional Process Tanks	0.10	104.00	
# of chemicals added for processes	1	Chemical Addition (varying dependent upon degree of treatment)	0.10	26.00	
# of clarifiers	6	Circular Clarifiers	0.50	780.00	
# of clarifiers	0	Chain and Flight Clarifiers	0.50	0.00	
# of clarifiers		*Traveling Bridge Clarifiers*	*X*		
# of clarifiers	0	Squircle Clarifiers	0.50	0.00	
X		Pumps	500.00	0.00	
# of trains	0	Rotating Biological Contactor	0.25	0.00	
# of TFs	0	Trickling Filters	0.25	0.00	
# of tanks	0	Sequencing Batch Reactor	0.25	0.00	
# of mixers	0	Mechanical Mixers	0.10	0.00	
# of blowers	5	Aeration Blowers	0.20	260.00	
# of cartridges	0	Membrane Bioreactor	0.20	0.00	
# of systems	0	Subsurface Disposal System	0.10	0.00	
X	0	Groundwater Discharge	0.10	0.00	
# of digesters	0	Aerobic Digestion	0.10	0.00	
# of digesters	0	Anaerobic Digestion	0.30	0.00	
# of basins	0	Gravity Thickening	0.10	0.00	
# of belts	0	Gravity Belt Thickening	0.25	0.00	
# of presses	2	Belt Filter Press	0.25	130.00	
# of units	0	Mechanical Dewatering (Plate Frame and Centrifuges)	0.25	0.00	
# of units	0	Dissolved Air Floatation	0.10	0.00	
X		Chlorination (gas)	0.20	0.00	
X		Chlorination (liq.)	0.30	0.00	
X		Dechlorination (gas)	0.20	0.00	
X		Dechlorination (liq.)	0.30	0.00	
# of racks	0	Ultraviolet	0.15	0.00	
# of units	0	Biofilter	0.50	0.00	
# of units	0	Activated Carbon	0.75	0.00	
# of units	0	Wet Scrubbers	0.15	0.00	
# of screens	0	Microscreens	0.15	0.00	
# of units	0	Pure Oxygen	0.20	0.00	
# of units	0	Final Sand Filters	0.20	0.00	
# of different types of probes		Probes/Instrumentation/Calibration	0.10	0.00	
		End of Chart 2 – Maintenance SUBTOTAL:			3539.00

Begin Chart 3 – Laboratory Operations

Frequency of test	# of times test is run for selected time frame	Tests	Hours	Calculated	Subtotal
4	0	Acidity	0.75	0.00	
4	0	Alkalinity, total	0.75	0.00	
52	8	Biochemical Oxygen Demand (BOD)	2.50	1040.00	
4	0	Chemical Oxygen Demand (COD)	2.50	0.00	
4	0	Chloride	0.50	0.00	
4	1	Chlorine, Total Residual	0.25	420.00	
52	3	Coliform, Total, Fecal, E.Coli	1.00	156.00	
52	10	Dissolved Oxygen (DO)	0.25	130.00	
52	12	Hydrogen Ion (pH)	0.25	156.00	
4	2	Metals	3.00	24.00	
4	1	Toxicity	2.00	8.00	
12	3	Ammonia	2.00	72.00	
4	0	Total Nitrogen	2.00	0.00	
4	0	Oil and Grease	3.00	0.00	
12	0	Total and Dissolved Phosphorus	2.00	0.00	
52	5	Solids, Total, Dissolved, and Suspended	3.00	780.00	
4	0	Specific Conductance	0.25	0.00	
4	0	Sulfate	1.00	0.00	
4	0	Surfactants	1.00	0.00	
52	8	Temperature	0.25	104.00	
4	0	Total Organic Carbon (TOC)	0.25	0.00	
52	4	Turbidity	0.25	52.00	
4	0	Bacteriological Enterococci	1.00	0.00	
4	1	Lab QA/QC Program	1.00	4.00	
52	12	Process Control Testing	3.00	1872.00	
52	8	Sampling for Contracted Lab Services	0.25	104.00	
4	0	Sampling for Monitoring Groundwater wells	0.50	0.00	

End of Chart 3 – Laboratory Operations SUBTOTAL: **4922.00**

**Sampling time is built into testing time estimates.*

Begin Chart 4 – Biosolids/Sludge Handling

Unit Descriptons	# of Units	Process	Hours	Calculated	Subtotal
	1	Belt Filter Press	8.00	2080.00	
	0	Plate & Frame Press	8.00	0.00	
	0	Gravity Thickening	0.50	0.00	
	0	Gravity Belt Thickening	0.50	0.00	
	0	Rotary Press	0.50	0.00	
	0	Dissolved Air Floatation	1.00	0.00	
	0	Alkaline Stabilization	0.25	0.00	
	0	Aerobic Digestion	1.00	0.00	
	0	Anaerobic Digestion	1.50	0.00	
	0	Centrifuges	8.00	0.00	
	0	Composting	8.00	0.00	
		Incineration	*X*		
		Air Drying – Sand Beds	*X*		
		Land Application	*X*		
	0	Transported Off-Site for Disposal	8.00	0.00	
		Static Dewatering	*X*		

End of Chart 4 – Biosolids/Sludge Handling SUBTOTAL: **2600.00**

Begin Chart 5 – Yardwork

Unit Descriptons	# of Units	Process	Hours	Calculated	Subtotal
	0	Janitorial/Custodial Staff	200	0.00	
	0	Snow removal	120	0.00	
	1	Mowing	120	120.00	
# of vechicles	2	Vehicle Maintenance	25	50.00	
	0	Facility Painting	80	0.00	
	0	Rust removal	80	0.00	
		End of Chart 5 – Yardwork SUBTOTAL:			**490.00**

Begin Chart 6 – Automation/SCADA

Automation/SCADA	Yes/No
Automated attendant or Interactive voice recognition (IVR) equipment	No
Automated Meter Reading (AMR), Touchpad meters or other automated metering technology	No
Automatic Call Director (ACD)	No
Billing system	No
Computerized Facilities Management (FM) System	Yes
Computerized preventative maintenance	Yes
Computerized recordkeeping	Yes
E-mail	Yes
Geographical Information System (GIS)	No
Integrated purchasing and inventory	No
Internet website	No
Laboratory Information Management System (LIMS)	Yes
Local Area Network (LAN)	Yes
Supervisory Control and Data Acquisition (SCADA)	Yes
Telemetry	Yes
Utility customer information system (CIS) package	No

End of Chart 6 – Automation/SCADA

Begin Chart 7 – Considerations for Additional Plant Staffing

		Activities	Yes/No	
52 wk / year	2 hr / wk	Management responsibilities (i.e., training, scheduling,) and responsible for clerical duties (i.e.,correspondence, phones, time sheets, etc.)	Yes	520.00
18 stations	3 hrs / wk / sta	Plant staff responsible for operation and maintenance of pump stations and inspections.	Yes	2808.00
16 hr/month	8 mo/yr	Wetwell Grease Removal	Yes	128.00
		Plant staff involved in generating additional energy	No	
		Plant receives an extra high septage and/or grease load (higher than designed organic and grease loadings) or plant takes in sludge from other treatment plants	No	
		Plant is producing a Class A Biosolid product	No	
		Plant operators responsible for operating generators and emergency power	Yes	
5 hr / wk	20 wk / year	Lawn and grounds maintenance	Yes	260.00
		Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)	yes	
		Plant operators responsible for machining parts on-site	No	
		Age of plant and equipment (over 15 years of age)	Yes	

End of Chart 7 – Considerations for Additional Plant Staffing

NEIWPCC
New England Interstate Water Pollution Control Commission

THE NORTHEAST GUIDE FOR ESTIMATING STAFFING AT PUBLICLY AND PRIVATELY OWNED WASTEWATER TREATMENT PLANTS (One Shift)

Plant Name: Town of Enfield WPCF

Design Flow: 5.0-10.0 mgd	**Actual Flow: 5.3 Average**

FINAL ESTIMATES

Chart #	**Annual Hours**
Chart 1 – Basic and Advanced Operations and Processes	10205.00
Chart 2 – Maintenance	3539.00
Chart 3 – Laboratory Operations	4922.00
Chart 4 – Biosolids/Sludge Handling	2600.00
Chart 5 – Yardwork	490.00
Estimated Operation and Maintenance Hours	21756.00
Estimated Operation and Maintenance Staff	14.50
Estimated Additional Staff from Chart 7	**2.00**
TOTAL STAFFING ESTIMATE	**16.50**

Note: The Total Staff estimate from Charts 1-5 will not be the final amount of staff necessary to run the facility. Please review Chart 7 for additional staffing needs.

Chart 6 - Automation/SCADA

Computerized Facilities Management (FM) System
Computerized preventative maintenance
Computerized recordkeeping
E-mail
Laboratory Information Management System (LIMS)
Local Area Network (LAN)
Supervisory Control and Data Acquisition (SCADA)
Telemetry

Chart 7 - Considerations for Additional Plant Staffing

Management responsibilities (i.e., training, scheduling,) and responsible for clerical duties (i.e.,correspondence, phones, time sheets, etc.)

Plant staff responsible for operation and maintenance of pump stations and inspections.
Wetwell Grease Removal
Plant operators responsible for operating generators and emergency power
Lawn and grounds maintenance
Plant staff responsible for plant upgrades and large projects done both on-site and off-site (i.e., collection systems, manholes, etc.)
Age of plant and equipment (over 15 years of age)

Note: The user should attach supporting information to justify additional staffing needs from Chart 7.

Final Comments:

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