Coastal Wastewater Management Plan

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EXECUTIVE SUMMARY

BACKGROUND

Leadership within Old Lyme recognizes that the Town, the Water Pollution Control Authority (WPCA) and the public all play important roles in addressing environmental challenges within their community. The Town has proactively accepted the responsibility of developing a progressive solution to the existing wastewater management challenges along the Old Lyme coastline. This updated Coastal Wastewater Management Plan Report is a continuation and culmination of prior work that the Town and chartered beach associates have completed and serves as an important planning tool. This Report was developed through tremendous collaboration of multiple parties and presents a comprehensive wastewater solution for specific areas of Old Lyme. It also serves as a guide to navigating the implementation plan for the recommendations.

STUDY AREA

The Study Area, shown in Figure ES-1, comprises the unsewered beach communities and neighborhoods south of and along Route 156, between the previously sewered Point-O-Woods neighborhood to the east, and the White Sand Beach neighborhood to the west. Certain on-site wastewater systems in the Study Area have been problematic for several decades, as a result of many combinations of factors including aging systems, poorly draining soils, soils that excessively drain with tidal movements, shallow groundwater, small lots, and excessive development density. Based upon the results of individual wastewater planning efforts by several of the chartered beach associations, it is clear that significant on-site septic system challenges and pollution problems exist in certain parts of the Study Area. Past planning documents recommended that centralized solutions with off-site treatment and disposal are needed due to those documented wastewater disposal limitations.

PROJECT GOALS

In response to current on-site wastewater management limitations, recent Consent Orders, comments received from CT-DEEP in response to the Town's 2012 Preliminary Study, public input, and the desire for a common solution for the Old Lyme coastal neighborhoods, the Town of Old Lyme retained Woodard & Curran to perform detailed evaluations of local and regional wastewater management alternatives for the Study Area. This project, termed the Coastal Wastewater Management Plan, focuses on the balance of short-term and long-term wastewater management needs within certain parts of the Study Area, while considering wastewater infrastructure (collection, treatment, disposal and reuse), operation and maintenance (O&M) costs, annual and lifecycle costs, as well as non-cost factors. Non-cost factors include capacity allocation, wastewater management goals, and implementation measures to support the Town's current character and desire to avoid future growth via sewer construction.

NEEDS ANLYSIS

The Study Area was divided into thirteen Sub-Areas, as shown in Figure ES-1. In order to evaluate and prioritize wastewater management needs for the thirteen Sub-Areas, a wastewater management needs analysis was conducted. Factors including lot size, soil permeability, density of development, nitrogen attenuation, coastal sea level rise, groundwater conditions, water supply and age of septic systems were used to prioritize wastewater management needs.

PROPOSED PROJECT AREA

The Sub-Areas with the greatest need for wastewater management solutions comprise the proposed High Needs Sub-Areas. Table ES-1 lists the five Sub-Areas identified as High Needs Sub-Areas, including estimated equivalent dwelling units (EDUs) and average daily flow for each Sub-Area. The High Needs Sub-Areas are also shown in Figure ES-2.

Table ES-1:High Needs Sub-Areas

Sub-Area ID	Association or Street Name	Number of Equivalent Dwelling Units (EDU)[1]	Average Daily Flow (GPD)
5A	Miami Beach	234	50,665
6	Sound View Beach	229	44,038
7	Old Colony Beach Club	236	47,207
8	Old Lyme Shores Beach	196	41,825
MTA B	Miscellaneous Town Area B	41	9,077
Total		**936**	**192,813**

1. Existing EDU counts for Sub-Areas 5A, 7, and 8 are taken from CT-DEEP Beach Associations Environmental Impact Evaluation. Existing EDU counts for all other Sub-Areas are based on Town Sanitarian records and include assumed commercial contributions.

Subsequent to submission of the December 2014 Facilities Plan Report to CT-DEEP, the WPCA, Town leadership, and Woodard & Curran engaged other Town boards/commissions/residents and CT-DEEP staff in meetings and discussions related to the proposed regional alternative for the Coastal Wastewater Management Plan. During these public meetings, a group of Hawks Nest residents expressed concern over the Groundwater quality data used to determine the High Needs Sub-Areas. To address these concerns, the Town and DEEP agreed to perform additional monitoring to more accurately delineate groundwater quality conditions and wastewater management needs. It is anticipated that a recommendation for Hawks Nest (HN) Sub-Area will be presented in a subsequent engineering report. HN Sub-Area will be further investigated through an additional groundwater monitoring program to be performed in two phases:

1. Phase 1 – Well Network Evaluation: This phase will include well condition evaluation and groundwater flow mapping. The intent of this phase is to monitor groundwater levels and map groundwater flow direction at Hawks Nest (HN) Sub-Area. Phase 1 results will be used to determine representative locations for water quality monitoring.

2. Phase 2 – Well Installation, Sampling Program and Report: Based upon the results of Phase 1, additional wells may be installed, a well sampling program will be developed and implemented, and a separate engineering report will be developed. The results of this program will be used to generate a recommendation for HN Sub-Area.

ALTERNATIVES ANALYSIS

Wastewater management systems are comprised of infrastructure components that generally include collection, treatment, disposal, and sometimes reuse. Two different primary wastewater management alternatives (the Local Alternative and the Regional Alternative) were developed and evaluated as part of the Coastal Wastewater Management Plan. The primary distinction between the two alternatives is that the Regional Alternative is predicated on the use of the existing New London WPCF to treat wastewater from the Project Area Sub-Areas, and the Local Alternative relies upon the construction of a new treatment facility in Old Lyme, coupled with either local subsurface disposal and reuse, or a new surface water discharge permit for the Connecticut River.

Each wastewater management alternative was evaluated and the collection, treatment and disposal/reuse options were summarized and estimates of probable costs were developed. Table ES-2 summarizes the anticipated costs for the Local and Regional Alternatives for the Project Area.

Table ES-2: Anticipated 2018 Costs for Local and Regional Alternatives for Project Area

	Capital[1]			Annual O&M		
System Component	Local #1 - Disposal/Reuse	Local #2 - CT River Discharge	Regional	Local #1 - Disposal/Reuse[1]	Local #2 - CT River Discharge	Regional
Collection	$18,889,000	$18,889,000	$25,186,000	$204,000	$204,000	$296,000
Treatment	$14,500,000	$14,500,000	$4,680,000	$532,000	$532,000	$58,000
Disposal	$12,800,000	$9,457,000	$0	N/A[2]	N/A[2]	N/A[2]
2014 Total	$46,189,000	$42,846,000	$29,866,000	$736,000	$736,000	$354,000
2018 Total[3]	$51,986,000	$48,224,000	$33,617,000	$828,000	$828,000	$398,000

1. Local and Regional Costs based on gravity sewer collection systems for Project Area.
2. Annual Disposal and Reuse costs are included with Treatment O&M.
3. Costs escalated to 2018 at an annual inflation rate of 3%

Relative to capital costs, the collection system costs for the Regional Alternative are significantly higher than those for the Local Alternatives. This is primarily because the Regional alternative includes pump station, force main and gravity sewer needs in East Lyme and Waterford that are triggered by the proposed connection. However, the anticipated treatment costs are much lower for the Regional Alternative than for the Local Alternatives, since new and costly treatment systems are not required for the Regional Alternative. In 2018 dollars, the Regional Alternative is approximately $18M less than the Local Alternatives. However, there is greater potential for major deferred capital expenses for the Regional Alternatives. For example, New London has not developed a capital plan for their WPCF, which would identify long term capital improvements for which Old Lyme would be required to contribute to in the future. The same can be said for the extent of future capital needs in East Lyme and Waterford, which would also require that Old Lyme contribute to these costs.

With regard to annual O&M costs, we estimate that the annual O&M costs for the Local Alternative are approximately $430,000 more expensive than that for the Regional Alternative. This cost differential could change depending in the extent of external contract operations services utilized by the Town and beaches. We also note that Old Lyme has less control over future escalations in annual O&M costs with the Regional Alternative.

There were several non-cost factors that were considered by the Town in this evaluation. These include:

- Implementation of New Utility: Both the Local and Regional Alternative included the establishment of a new wastewater utility, thus presenting unique implementation challenges. Initial years for a new utility can be difficult, as connections are being made, and systems are commissioned and connections are being made.
- Control of Flow Allocations: To ensure a successful project and meet the commitment to the new sewer users, the Town of Old Lyme will need to manage the allocation of sewer flows, capital costs, and annual costs. This will require active and continued participation from the Old Lyme Water Pollution Control Authority (WPCA) and an increased understanding of the various related factors.

RECOMMENDED PLAN

Despite the higher collection system costs for the Regional Alternative, as well as the anticipated deferred capital costs associated with the Regional Alternative, the Regional Alternative capital cost projection is approximately $18M lower than the Local Alternatives for the Project area. This is predicated upon a cooperative approach between the Town and the chartered beach associations. This collaboration includes common pump station/force main sharing and sewering across/through municipal boundaries, which facilitates the maximization of cost sharing. If the Town and the chartered beaches decided to connect to New London independently using multiple individual pump stations and force mains, the costs for the Regional Alternative would be much higher. Therefore, based on the cooperative effort, as described, and endorsed by CT-DEEP, we recommend the Regional Alternative be implemented. Figure ES-2 shows the regional alternative for the Project Area.

Woodard & Curran performed a cost analysis on the Regional Alternative to determine the net annual cost to the property owners in the Project Area for both capital cost and debt service. Figure ES-3 summarizes the anticipated project appropriations for each Sub-Area (Town managed and chartered beach areas), excluding the grant funds (25%) anticipated from CT-DEEP. The estimated cost sharing for the Town of Old Lyme is $9.13M, escalated to 2018.

During public outreach for this evaluation, residents in various Sub-Areas articulated a desire to expand public drinking water supply and potentially eliminate their reliance on private drinking water wells, thus eliminating a public health issue. The Town is talking to the Connecticut Water Company and the Connecticut Department of Public Health about expanding the public drinking water supply and may choose to incorporate a drinking water component into this project. This will be handled on a parallel path and will not in any way interfere nor impede the Coastal Wastewater Management program. No costs of potential drinking water improvements are quantified within this report.

IMPLEMENTATION PLAN

There are four major elements of the Implementation Plan for the Coastal Wastewater Management Project. These include:

1. Management planning with the Beach Communities;
2. Funding/finance considerations;
3. Continued public outreach and participation; and
4. Management of the schedule to complete the program.

Management Planning with the Beach Communities

The Town of Old Lyme and the Chartered Beach Communities have made tremendous progress in positioning the Coastal Wastewater Management Project for success. The parties have realized the power of collaboration and will realize significant cost savings through the implementation of a single unified program. Going forward, the stakeholders will need to continue to work together on the design elements of the project. The team will work collaboratively throughout the Project.

Funding/Finance Considerations

The representatives of the Project Area understand that the Coastal Wastewater Management Project will be self-funded, meaning that the users of the system will pay their pro-rata share of the project costs (on an EDU basis). The project will be implemented utilizing CT-DEEP Clean Water Funds. These funds reimburse the participant with a grant for 55% of planning costs, and 25% of design and construction costs. The Town of Old Lyme (Sound View Beach and Miscellaneous Town Area B) will appropriate funds for their respective share of the program while Miami Beach (Sub-Area 5A), Old Colony Beach (Sub-Area 7) and Old Lyme Shores (Sub-Area 8) have each already appropriated their respective shares.

Public Outreach & Participation

Public outreach and participation to date has been a key focus of the Town, the Old Lyme WPCA, and the chartered beaches. For example, the Town has had more than 30 public meetings and informational sessions on the project to date. Public input 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 implemented. The potential schedule of public outreach includes (but will not be limited to):

- Public Informational Meeting – Spring 2017
- Town Meeting/Referendum – Summer 2017

- Design Public Meeting – Fall 2017
- Construction Public Meeting – Summer/Fall 2018
- Startup Meeting – Summer 2020

Schedule to Complete the Program

Old Colony Beach Club and Old Lyme Shores Beach (Sub-Areas 7 and 8) have outstanding Consent Orders requiring completion of construction by June 30, 2016. An Environmental Impact Evaluation was developed for OCBCA, OLSBA, and MBA in October 6, 2015 and still under the Connecticut Environmental Policy Act (CEPA) public vetting process. While we believe that the Town's Regional Alternative can be implemented concurrently with the Beach Association projects, there will need to be an adjustment by CT-DEEP to the current Consent Order schedules.

We propose the following schedule milestones:

- Town/Referendum Meeting (appropriation of project funds) – Summer 2017;
- Design – Fall 2017 thru Summer 2018;
- Construction* – Fall 2018 thru Winter 2020; and
- Commissioning, start-up and integration – Winter 2020 thru Fall 2021.

* The construction schedule will be coordinated between the Town and the contractor.

Town of Old Lyme, CT

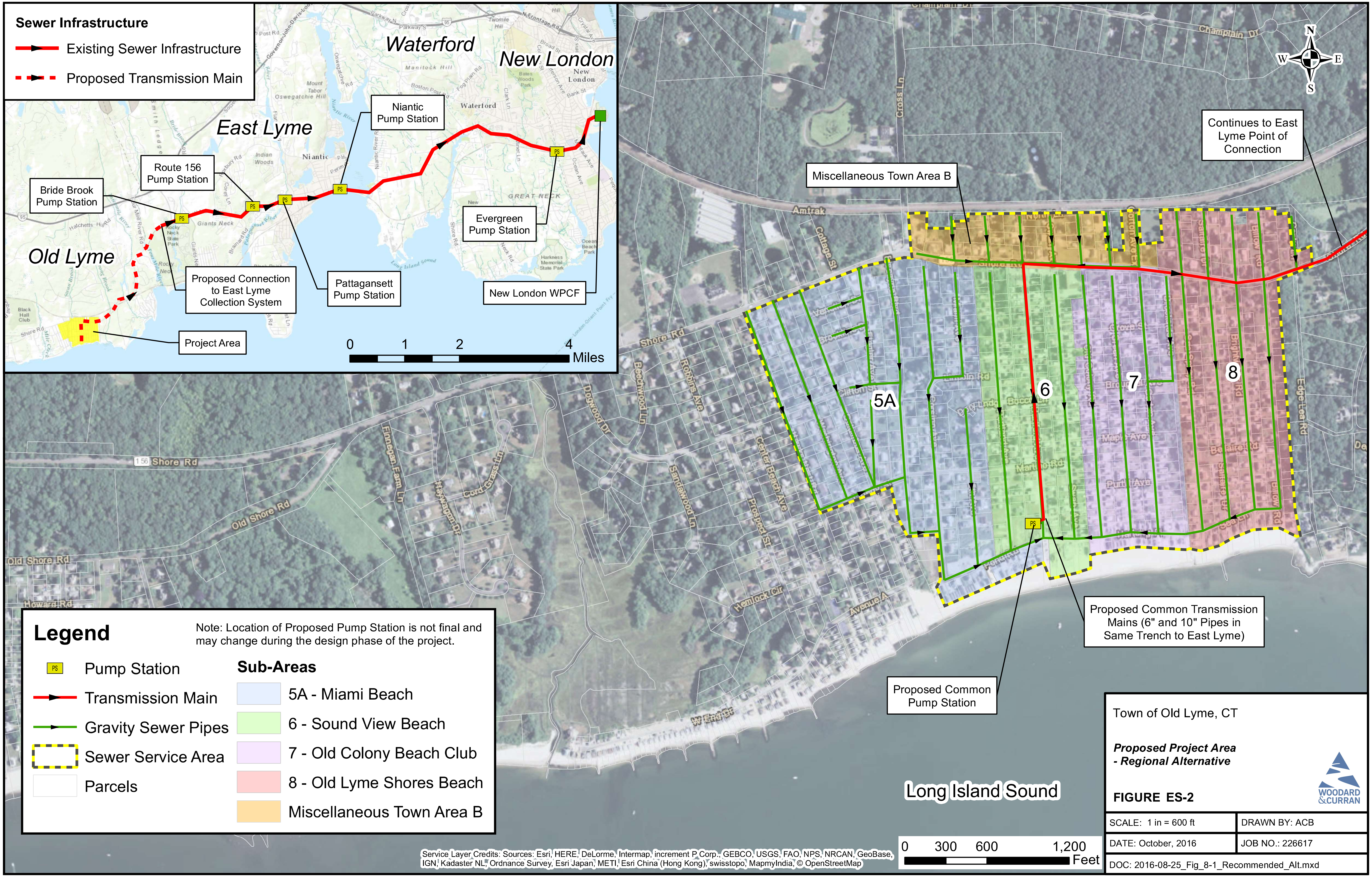
Study Sub-Areas

FIGURE ES-1

WOODARD & CURRAN

SCALE: 1 in = 1,000 ft
DRAWN BY: ACB
DATE: October, 2016
JOB NO.: 226617
DOC: 2014-11-18_Fig_2-1_Project_Sub_Areas.mxd

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Legend

Note: Location of Proposed Pump Station is not final and may change during the design phase of the project.

PS	Pump Station
🟥	Transmission Main
🟩	Gravity Sewer Pipes
▨	Sewer Service Area
☐	Parcels

Sub-Areas

- 5A - Miami Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- Miscellaneous Town Area B

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

Town of Old Lyme, CT

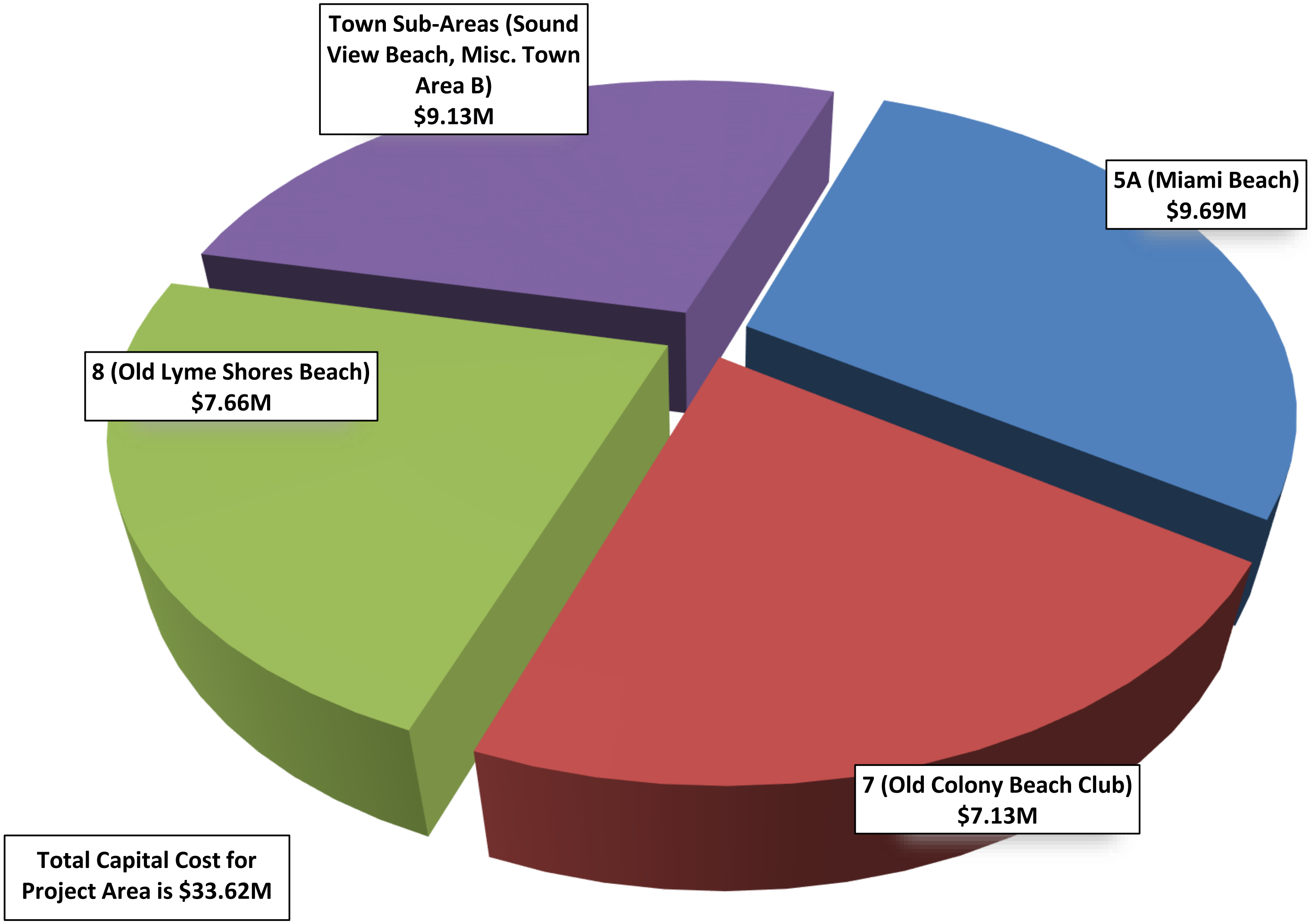
Proposed Project Area - Regional Alternative

FIGURE ES-2

WOODARD & CURRAN

SCALE: 1 in = 600 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_8-1_Recommended_Alt.mxd	

Figure ES-3: Summary of Anticipated Total Capital Cost Sharing (2018 Costs) Regional Alternative - Project Area



1. INTRODUCTION

This section of the Report provides an overview of the Study Area, a summary of past wastewater management studies, an outline of the Project goals, and an overview of the scope of work to facilitate a recommended plan to achieve the Town's wastewater management goals.

1.1 STUDY AREA

Old Colony Beach Club Association (Sub-Area 7)

The Study Area is shown in Figure 1-1, and comprises the currently unsewered neighborhoods and chartered beach associations south of and along Route 156, between the previously sewered Point-O-Woods neighborhood to the east, and the Griswold Point neighborhood to the west.

1.2 PAST WASTEWATER PLANNING IN STUDY AREA

On-site wastewater systems in certain parts of the Study Area have been problematic for several decades, due to the combination of aging systems, poor soils, shallow groundwater, small lots and density of development. Since many of the neighborhoods in the Study Area consist of chartered beach associations with Water Pollution Control Authorities (WPCAs) independent of the Town, there have been other prior efforts to evaluate on-site wastewater management challenges and alternative solutions. Due to the difficult on-site wastewater management conditions, some of these chartered beach associations have implemented, or are in the process of implementing, wastewater management solutions to address these challenges. An overview of recent wastewater management efforts in the Study Area follows.

1.2.1 Point-O-Woods Sewer System

Approximately ten years ago, the Point-O-Woods neighborhood became the first chartered beach associations in Old Lyme to construct sewer infrastructure. Centralized wastewater infrastructure was installed to alleviate poor on-site septic systems, driven primarily by shallow ledge, high groundwater and poor water quality resulting from the insufficient on-site systems. Point-O-Woods conveys its wastewater to New London through its own pump station and force main, flowing through the East Lyme and Waterford collection systems. The Point-O-Woods pump station and force main were not sized to accommodate future sewer needs to the west. The Point-O-Woods community is located east of the Study Area and is depicted on Figure 1-1.

1.2.2 Old Colony Beach Club Association and Old Lyme Shores Beach Club Association

Wastewater facilities plans were prepared for both the Old Colony Beach Club Association (OCBCA) and the Old Lyme Shores Beach Association (OLSBA) in 2011. The wastewater facilities plans were prepared by RFP Engineering and Fuss & O'Neill respectively, and both reports concluded conventional on-site septic systems were no longer sustainable in the neighborhoods. Centralized sewer systems, conveying wastewater to the New London Water Pollution Control Facility (WPCF), were recommended. In 2012, Fuss & O'Neill issued an addendum that consolidated the recommendations of both the OCBCA and OLSBA Facilities Plans, and recommended a joint collection system to convey sewers to the East Lyme collection system for treatment at the New London WPCF.

Town of Old Lyme, CT

Study Area

FIGURE 1-1

SCALE: 1 in = 1,200 ft
DRAWN BY: ACB
DATE: October, 2016
JOB NO.: 226617
DOC: 2014-11-18_Fig_1-1_Project_Study_Area.mxd

1.2.3 Town's 2012 Preliminary Study

Lombardo Associates, Inc. (LAI) was retained to perform a preliminary assessment of possible wastewater management alternatives for portions of the Study Area. In their October 12, 2012 Report, LAI summarized two alternatives: (1) installation of a collection system within OCBCA and OLSBA and conveyance of wastewater to the New London WPCF for treatment and disposal; and (2) on-site collection and local treatment/disposal. The second alternative was sub-divided into: (A) nearby off-site sub-surface disposal and/or reuse; (B) treatment and disposal within the Beach Association confines; and (C) treatment through multiple cluster systems. The LAI report concluded that the second alternative would be less costly, and recommended further evaluation of the local alternatives.

1.2.4 Miami Beach Wastewater Facilities Plan

In 2013, the Connecticut Department of Energy and Environmental Protection (CT-DEEP) approved a Plan of Study for a Wastewater Facilities Plan for the Miami Beach community. A revised Miami Beach Association (MBA) report dated June 19, 2015 has been submitted to DEEP for review. The revised MBA report recommended a joint regional solution among the chartered beach associations with consideration for the cost savings that can be achieved should Hawks Nest and Sound View Beach Associations be part of the joint solution. CT-DEEP continues to support a holistic solution that maximizes cost sharing opportunities, optimizes construction and operations of proposed conveyance infrastructure, and facilitates negotiations with downstream communities.

1.2.5 Summary

Based on the results of the individual wastewater planning efforts in three of the chartered beach associations, it is clear that on-site septic system challenges exist in certain parts of the Study Area. The CT-DEEP reviewed and approved the facilities plans, which recommended that more centralized treatment and disposal systems are needed due to the on-site wastewater management limitations. As a result of these independent efforts, the Town is proactively evaluating wastewater management alternatives that more holistically address wastewater management solutions that address the overall needs of the coastal community and the interests of all Town residents for short-term and long-term needs to: (1) mitigate the potential for overly redundant solutions for individual undersized infrastructure; (2) avoid secondary growth; and (3) address the needs of the Town-managed neighborhoods in the Study Area.

1.3 CURRENT REGULATORY FRAMEWORK

In addition to the past planning documents, there are several regulatory considerations that affect the framework of wastewater management needs in the Study Area. The following summary highlights these key regulatory considerations.

1.3.1 Long Island Sound Nitrogen

In 1998, the States of Connecticut and New York, together with the Environmental Protection Agency (EPA), adopted a plan for "Phase III Actions for Hypoxia Management" including nitrogen reduction targets of 58.5 percent for 11 "management zones" that comprise the Connecticut and New York portion of Long Island Sound watershed. CT-DEEP and the New York State Department of Environmental Conservation (NYSDEC) worked with the EPA and established a Total Maximum Daily Load (TMDL) for Long Island sound that included a 15-year plan for achieving water quality standards.

1.3.2 Consent Orders

When CT-DEEP approved the joint Wastewater Management Plan for OCBCA and OLSBA, they subsequently issued Consent Orders to the OCBCA and the OLSBA on August 14, 2012 and October 1, 2012, respectively. The Consent

Orders require completion of bidding documents within 850 days of the Orders (October 30, 2014). As shown on Appendix A, the Consent Orders also require that by June 30, 2016, on-site disposal system challenges will be alleviated by reviewing alternatives and complying with appropriate regulatory wastewater standards. An Environmental Impact Evaluation was developed for OCBCA, OLSBA, and MBA in October 6, 2015 and is still under the Connecticut Environmental Policy Act (CEPA) public vetting process.

1.3.3 Local Septic Regulations

The Town, through its Sanitarian, continues to maintain records for on-site systems throughout the Town, including the Study Area. In general, small lot size, poor soils and shallow groundwater necessitate that the Town to employ best-management practices for septic system upgrades at existing developed parcels. In some cases, substandard systems are repaired by optimizing the space available, but may not fully meet the requirements of the Public Health Code due to site constraints, nor meet the State's maximum density guidelines for excessive development contributing to nutrient pollution (i.e. nitrogen). These limitations were extensively documented in the Facilities Plans for aforementioned chartered beach associations, and are also summarized for the Town-managed portions of the Study Area in this Report.

1.4 PROJECT GOALS

In response to current on-site wastewater management limitations, recent Consent Orders, and the desire for a solution for the Study Area, the Town of Old Lyme selected Woodard & Curran to perform more detailed evaluations of local and regional wastewater management alternatives for the Study Area. This project, termed the Coastal Wastewater Management Plan, focused on a more comprehensive analysis of short-term and long-term wastewater management needs within the Study Area, as well as wastewater infrastructure (collection, treatment, disposal and reuse), operation and maintenance (O&M) costs, annual and lifecycle costs, as well as non-cost factors including supporting the Town's character and growth management goals, wastewater management preferences, and implementation measures to manage system capacity allocation.

1.5 SCOPE OF WORK

In order to build on the past planning documents, address the Project objectives, and maintain the intent of the Consent Orders and their respective schedules for the chartered beach associations, the following scope of work was developed:

- Task 1 – Grant Funding & Finance Assistance: Included securing a Clean Water Fund (CWF) grant from CT-DEEP for the planning phase work, as well as evaluating project funding and financing options once the recommended plan is finalized.
- Task 2 – Project Initiation and Key Meetings: Included meetings with the Wastewater Task Force, WPCA, and Selectmen, as well as dozens of Public Meetings to review observations, alternatives and recommendations, and incorporate public comment in the preparation of the Report.
- Task 3 – Evaluation of Sub Surface Disposal and Reuse Alternatives: Emphasized preliminary on-site testing at two sites including test pits, soil borings and monitoring wells, groundwater monitoring and slug testing, to estimate seasonal high water table, thus facilitating a hydraulic capacity analysis and hydrogeological modeling. The Task 3 scope resulted in a primary basis of design for use of these sites for disposal and reuse opportunities associated with the local alternative.
- Task 4 – Prioritization of Wastewater Needs in Study Area: Included a wastewater needs analysis for the thirteen (13) Sub-Areas, including an estimation of current and future sanitary flows. The prioritization of the

needs analysis was used to develop the proposed wastewater management service area for the highest-need Sub-Areas.

- Task 5 – Evaluation of Wastewater Treatment Alternatives: Included an evaluation of wastewater treatment alternatives for the local alternative, including the impacts of collection system selection on wastewater treatment needs, as well as capital and annual costs for the various wastewater treatment alternatives.
- Task 6 – Evaluation of wastewater Collection Alternatives: Included an evaluation of wastewater collection (i.e. sewer) alternatives for the local and regional alternatives, including the impacts of collection system flows relative to infiltration and inflow (I/I), as well as capital and annual costs for the collection system alternatives.
- Task 7 – Evaluation of Regional Wastewater Management Alternatives: Included an evaluation of the regional alternative, including meetings with East Lyme, Waterford and New London to estimate capital/O&M cost needs, and to facilitate comparison with the local alternative.
- Task 8 – Development of Recommended Plan and Implementation Schedule: Included development of the recommended plan, including integration of wastewater collection, treatment, disposal and reuse infrastructure, through capital, annual and lifecycle costs, implementation measures, and the preparation of a Project Report

The original scope of work was incorporated into our Draft Report of December 2013. In April 2014, the Town received review comments from CT-DEEP. The Town and Woodard & Curran met with CT-DEEP in May 2014 to review the comments, suggestions and requests for changes to the alternatives analysis and the recommended plan. In July 2014, CT-DEEP approved Amendment No.1 to the Scope of Services for the Coastal Wastewater Management Plan, which facilitated additional evaluation of local and regional wastewater management alternatives, serving to facilitate preparation of the updated Draft Report of October 2014. Following their review of the October 2014 Report, CT-DEEP provided additional review comments in November 2014, which served as the basis for the December 2014 Report.

The Town subsequently received additional review comments from CT-DEEP in April 2015, attended meetings with CT-DEEP staff, received administrative order in June 2015, and submitted a draft Environmental Impact Evaluation (EIE) report to CT-DEEP in October 2015. As a result of CT-DEEP administrative order, The Town (through its WPCA), First Selectman and Woodard & Curran have engaged other Town officials/boards/commissions and CT-DEEP staff in meetings and discussions related to the proposed regional alternative for the Coastal Wastewater Management Plan and the EIE report. In July 2016, CT-DEEP approved Amendment No.3 to the Scope of Services for the Coastal Wastewater Management Plan, which serves as the basis for the updates that are incorporated in this Final Report of October 2016.

2. WASTEWATER MANAGEMENT NEEDS ANALYSIS

This section includes an overview of how the Study Area was bifurcated into smaller sections, termed Sub-Areas, to facilitate an evaluation of the long-term suitability of onsite subsurface disposal systems, as well as an analysis of the need for alternative wastewater management solutions to mitigate on-site limitations, including pollution concerns. Wastewater management needs for each Sub-Area were compiled to prioritize flow allocations. The results for the wastewater management needs analysis serve as the basis for selection of wastewater collection, treatment, disposal, and reuse alternatives.

2.1 STUDY SUB-AREAS

The Study Area shown in Figure 2-1 is comprised of thirteen Sub-Areas along Long Island Sound. Each of the thirteen Sub-Areas is described below and listed in Table 2-1. In general, the Project Study Area consists of the currently unsewered beach communities and neighborhoods south of and along Route 156, between the previously sewered Point-O-Woods neighborhood to the east, and the White Sand Beach neighborhood to the west.

- Sub-Area 1: Includes Osprey and Griswold Point roads. This area is less densely populated with businesses among open space and farm land. The area is surrounded by the coastline to the south and west and lower lying wetlands.
- Sub-Area 2: Consists of the White Sand Beach community, and is densely developed up to the shoreline with homes on the beachfront.
- Sub-Area 3: Includes Haywagon Drive with new construction and larger lots than some of the other more densely populated Sub-Areas. This area is set back from the coastline and is primarily surrounded by wooded areas.
- Sub-Area 4: Similar to Sub-Area 3, Sub-Area 4 is comprised of newer construction homes and larger lot sizes than the other more densely populated beach communities. This Sub-Area is off of Dogwood Drive.
- Sub-Area 5A: Includes the Miami Beach Association. This chartered beach association is densely populated to the coastline.
- Sub-Area 5B: Includes the Town-managed Hawks Nest Beach Association. This area is densely populated up to the coastline with a strip of homes along the beach on West End Drive.
- Sub-Area 6: Includes Sound View Beach, and is densely populated EDUs up to the coastline. Residential as well as non-residential buildings along Route 156 and Hartford Avenue are included in this total.
- Sub-Area 7: Includes Old Colony Beach Club Association (OCBCA). This chartered beach association is densely populated, stretching from Route 156 to the coastline. This Sub-Area is currently under a Consent Order (refer to Section 1).
- Sub-Area 8: Includes Old Lyme Shores Beach Association (OLSBA). Similar to Sub-Area 7, this chartered beach association starts just north 156 and stretches down to the coast line. This Sub-Area is also currently under a Consent Order from the State of Connecticut as shown in Appendix A.
- Sub-Area 9: Includes Edge Lea, Dennis and Butler Roads, set in less dense wooded areas. A portion of this Sub-Area is along the coastline although the majority of properties do not border the beach area.

Town of Old Lyme, CT

Study Sub-Areas

FIGURE 2-1

WOODARD & CURRAN

SCALE: 1 in = 1,000 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
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- Sub-Area 10: Includes Hatchet Point Road. This sparsely developed Sub-Area is a narrow stretch of land from 156 to the coastline surrounded by woodland areas to the north, east, and west and coastline to the south. Sub-Area 10 is the furthest Sub-Area to the east in the Study Area.
- Miscellaneous Town Area A: This sub-area is adjacent to Sub-Area 2 and consists of Griswold Avenue, Brighton Road and Seaside Lane.
- Miscellaneous Town Area B: This sub-area is located north of Route 156 bordering Sub-Areas 5A, 6, 7 and 8, with some residential and non-residential developments.

2.2 FIRST STAGE ANALYTICAL APPROACH - COMMON CRITERIA IMPACTING ON-SITE SYSTEMS

All of the existing development in the Study Area is currently served by on-site subsurface disposal systems. Previously approved planning reports for Sub-Areas 7[1] and 8[2] concluded that on-site septic systems are no longer viable. Based on historical data, discussions with Town staff, and past planning documents, several other Sub-Areas also have similar challenges and limitations. Examples of some challenges in the Study Area are depicted in Photos 1 and 2.

Photo 1: Example of small lot size

Photo 2: Example of close spacing between

In their January 13, 2000 letter (attached as Appendix G), the Connecticut Department of Public Health (CTDPH) summarized their concern for groundwater pollution in densely developed residential areas, specifically focusing on nitrogen pollution. In the letter, soils with adequate hydraulic capacity are described by CTDPH as still being at risk for groundwater pollution from nitrogen or microorganisms in high-density developments. The CTDPH technical standards for on-site subsurface sewage disposal systems[3] allow construction of septic systems on small lots, provided the soil is hydraulically capable of handling the wastewater flows. However, the letter recommends nitrogen analysis on parcels where the density of development exceeds one bedroom per 0.167 acre, or 6 bedrooms per acre.

Woodard & Curran performed a needs analysis to evaluate and prioritize wastewater management needs for each of the Sub-Areas within the Study Area. Data obtained from prior Reports, the CT-DEEP, Assessor's files, sanitarian records, and the National Oceanic and Atmospheric Administration (NOAA) were used to summarize land uses, associated soil drainage conditions, density of development, nitrogen attenuation, and sea level rise concerns. The objective of the needs analysis was to determine the specific Sub-Areas where conventional on-site subsurface disposal systems are inadequate.

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[1] Old Colony Beach Club Association Draft Wastewater Management Plan, October 2011 – RFP Engineering

[2] Old Lyme Shores Beach Association Wastewater Facilities Planning Report, December 2011 – Fuss & O'Neill

[3] Connecticut Public Health Code – On-Site Sewage Disposal Regulations, and Technical Standards for Subsurface Sewage Disposal Systems, January 2011 – Connecticut Department of Public Health

We used a two-stage analytical approach in the needs analysis evaluation. The first stage approach was based on a rating criteria matrix and common criteria to all 13 Sub-Areas within the study area that would impact on-site septic systems. The second stage approach considered additional qualitative criteria pertaining to specific Sub-Areas that would impact the overall needs analysis.

We utilized an analytical quantitative approach in the first stage of the needs analysis. First, we evaluated each Sub-Area based on lot size, development density, soil drainage classification, coastal flooding impacts, and nitrogen attenuation. Second, we developed a rating matrix to evaluate the thirteen previously defined Sub-Areas to rank their needs. The quantitative needs analysis criteria are summarized as follows:

- Lot Size – Individual parcels were rated based on the acreage of the property. Properties with less than 0.25 acres of land were rated the highest, while properties larger than 1.0 acre were rated the lowest. Individual parcel ratings were averaged together to determine the overall rating for each Sub-Area. More than 75% of lots throughout the Study Area are less than 0.25 acres, while over 13% of lots are between 0.25 and 0.5 acres. The remaining 12% of lots are greater than 0.5 acres. Figure 2-2 illustrates the predominance of small lots (< 0.25 acres, shown in blue) within specific Sub-Areas, primarily Sub-Areas 2, 5A, 5B, 6, 7, 8, and MTA-B. Sub-Areas 1, 9, and 10 show a distinct lack of small lots, where the majority of lots are over 1.0 acre. Sub-Areas 3, 4, and MTA-A include moderately sized lots between 0.25 and 1.0 acre. As a rule of thumb, a lot size of at least 0.75 acres is required to site a fully compliant septic system, where an on-site well also exists. Approximately 8% of lots within the Study Area meet this recommended acreage.
- Development Density – Density of development is a surrogate for assessing unit wastewater loading. For this analysis, the number of EDUs, total area per Sub-Area, and number of people per EDU (or bedrooms per EDUs) were used to calculate the development density for each Sub-Area, in units of bedrooms per acre. Connecticut Department of Health (CTDPH) established a guideline ratio of six (6) bedrooms per acre as the threshold for appropriate development density for subsurface disposal and onsite wells. Table 2-1 summarizes the development density of each Sub-Area and compares it to CT-DPH guidelines. Sub-Areas with more than 16 bedrooms per acre were rated the highest, and those with less than 6 bedrooms per acre were rated the lowest. As shown in Table 2-1, each Sub-Area within the Study Area does not satisfy CT-DPH guidelines. Table 2-1 and Figure 2-2 show a similar distribution between high development density and small lot size among the Sub-Areas.
- Soil Drainage Classification – CT-DEEP classified soils throughout the State in terms of drainage characteristics. Soil drainage classification was used to approximate the ability of soils in each Sub-Area to accept wastewater from on-site septic systems. CT-DEEP's soil drainage classification is based on observations of the water table, soil saturation, proximity to water bodies, and soil characteristics. Figure 2-4 depicts the Study Area overlaid with CT-DEEP's soil drainage data. Soils are classified by drainage ability, including "excessively drained," "well drained," and "poorly drained." Soils considered "very poorly drained," "poorly drained," and "somewhat poorly drained" factored greatest in terms of need. The overall rating for each Sub-Area is based on percentage of each soil present in that Sub-Area. Soils classified as "excessively drained" are considered good for accepting large volumes of flow, but may negatively impact retention time for removal of nutrients and bacteria attenuation. Also, the seasonality and significant wastewater fluctuations may limit the effectiveness of the onsite treatment systems during certain times of the year. In terms of wastewater acceptance, excessively drained soils are rated low as negative effects on retention time are accounted for by development density. As shown in Figure 2-4, most of the Study Area is comprised of moderately well drained soil with some very poorly drained and excessively drained soils.
- Sea Level Rise & Coastal Flooding Impacts – Those Sub-Areas containing low-lying areas and significant coastline are most prone to coastal flooding from sea level rise and flooding. Figure 2-5 shows the parts of the Study Area affected by sea level rise at heights of 1, 3, and 5 feet, based on data obtained from the National Oceanic and Atmospheric Administration (NOAA). Each Sub-Area was rated based on susceptibility to flooding according to percent area affected by sea level rise at 1, 3, and 5 feet. While 5-foot sea level rise

has the greatest impact, it is the least likely sea level rise to occur, and therefore rated the lowest. Accordingly, 1-foot sea level rise areas were rated the highest. Figure 2-6 shows flood hazard zones from the Federal Emergency Management Agency (FEMA), which is similar to the NOAA data, but shows areas inundated by flood waters for 100-year and 500-year flood events. Wastewater infrastructure that will be located in flood prone areas need to be flood-proofed. Due to the similarities in the data represented by each data set, only the NOAA sea level rise data was used as part of the needs analysis.

- Nitrogen Attenuation – Nitrogen is attenuated in groundwater through natural physical and biological processes, and the rate of attenuation is dependent upon many factors including the overall land area available for nitrogen attenuation and the number of EDUs in each Sub-Area. For the need analysis, A total effluent flow rate for each Sub-Area was calculated assuming an average water use rate of 180 gallons per day (gpd) / EDU (2.39 people per household multiplied by 75 gallons per capita per day (gpcd)). Assuming an average effluent total nitrogen concentration of 40 mg/L-N, and an average rate of rainfall in Connecticut of 50 inches per year, the average attenuated total nitrogen concentration in groundwater for each Sub-Area was calculated as the mass of nitrogen entering the ground via effluent divided by the volume of rainfall. Table 2-2 summarizes the attenuated total nitrogen concentrations for each Sub-Area. Those Sub-Areas with the highest attenuated nitrogen concentrations were rated highest for the needs analysis. For each Sub-Area, a higher density of development may result in a lower capacity for attenuation of nitrogen.

According to the CTDPH guidelines, nitrogen analysis should be performed on high-density developments. Table 2-1 summarizes the Study Area data relative to the CTDPH guidelines for development density for each Sub-Area, assuming an average number of bedrooms per EDU of 3.0 for those Sub-Areas where Town Sanitarian records were not available. According to the United States Census Bureau American Factfinder[4], the majority of homes in the Town of Old Lyme (41.8%) have 3 bedrooms each, followed by 23.2% at 4 bedrooms, and 21.6% at 2 bedrooms each. A total of eight Sub-Areas in the Study Area exceed the CTDPH's development density guideline. Existing EDUs were estimated using Town records (offices of the Assessor and Sanitarian), Old Lyme's GIS building layer and Fuss & O'Neill's Sub-Area shape files. Primary buildings of area greater than 400 square feet and labeled as type generic were considered one EDU where sanitarian records were not available.

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[4] http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml – 2008-2012 American Community Survey 5-Year Estimates. Accessed October 10, 2014.

Table 2-1: Density of Development by Sub-Area

Sub-Area ID	Description	EDUs[1]	Average Number of Bedrooms per EDU[2]	Total Land Area (Acres)	Number of Bedrooms per Acre	DPH Guideline Bedrooms per Acre[3]	Guideline Exceeded?
1	Griswold Point & Osprey Road	26	3.0	189.5	0.4	6.0	No
2	White Sand Beach	159	3.0	36.9	12.9	6.0	Yes
3	Haywagon Drive	27	3.0	32.2	2.5	6.0	No
4	Dogwood Drive	36	3.0	33.4	3.2	6.0	No
5A	Miami Beach	234	3.0	66.4	10.6	6.0	Yes
5B	Hawks Nest Beach	269	3.1	60.2	13.8	6.0	Yes
6	Sound View Beach	229	2.7	34.4	18.0	6.0	Yes
7	Old Colony Beach Club	236	3.0	34.2	20.7	6.0	Yes
8	Old Lyme Shores Beach	196	3.0	45.8	12.8	6.0	Yes
9	Edge Lea and Cutler Road	28	3.0	68.4	1.2	6.0	No
10	Hatchet Point Road	11	3.0	33.3	1.0	6.0	No
MTA-A	Miscellaneous Town Area A	28	3.0	8.9	9.4	6.0	Yes
MTA-B	Miscellaneous Town Area B	41	2.6	14.0	7.6	6.0	Yes

1. Existing EDU counts for Sub-Areas 5A, 7, and 8 are taken from CT-DEEP Beach Associations Environmental Impact Evaluation. Existing EDU counts for all other Sub-Areas are based on Town Sanitarian records and include assumed commercial contributions.
2. Average Number of Bedrooms per Residential EDU calculated for Sub-Areas 5B, 6, and MTA-B based on provided Town Sanitarian data. 3.0 assumed for other Sub-Areas
3. From Connecticut Department of Public Health 2011 Regulations and Technical Standards for Subsurface Sewage Disposal Systems.

Figure 2-2: Lot Size Distribution of Study Area

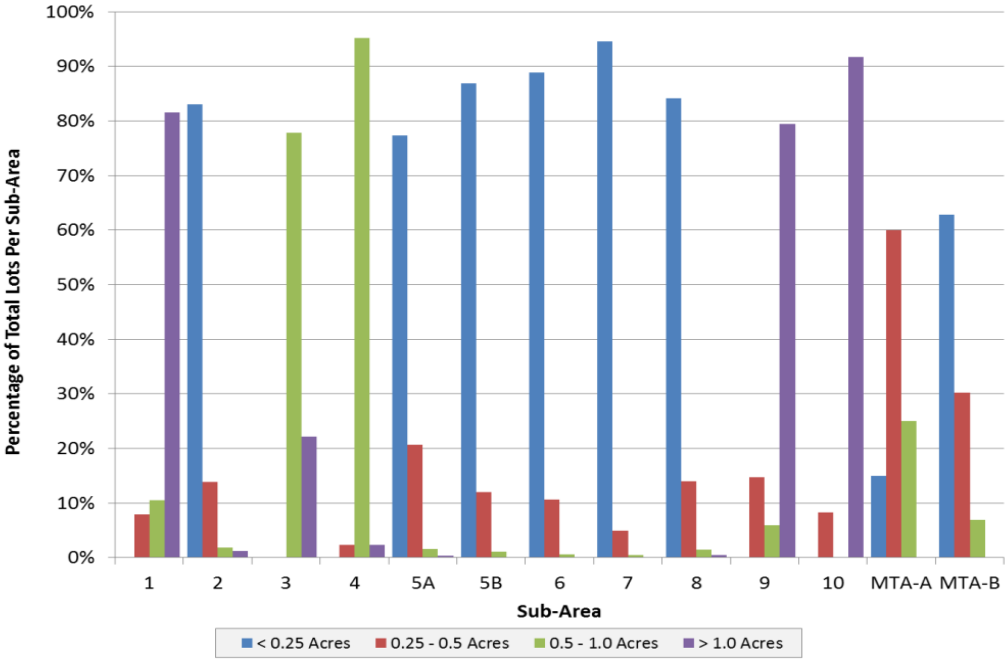


Table 2-2: Nitrogen Attenuation

Sub-Area ID	Description	EDUs	Average Daily Flow (gpd)[1]	Total Land Area (Acres)	Average Annual CT Rainfall (in/year)[2]	Effluent Total Nitrogen Concentration (mg/L)[3]	Attenuated Total Nitrogen Concentration (mg/L)
1	Griswold Point & Osprey Road	26	4,680	189.5	50.0	40.0	0.3
2	White Sand Beach	159	28,620	36.9	50.0	40.0	8.3
3	Haywagon Drive	27	4,860	32.2	50.0	40.0	1.6
4	Dogwood Drive	36	6,480	33.4	50.0	40.0	2.1
5A	Miami Beach	234	42,120	66.4	50.0	40.0	6.8
5B	Hawks Nest Beach	269	48,420	60.2	50.0	40.0	8.6
6	Sound View Beach	229	41,220	34.4	50.0	40.0	12.9
7	Old Colony Beach Club	236	42,480	34.2	50.0	40.0	13.4
8	Old Lyme Shores Beach	196	35,280	45.8	50.0	40.0	8.3
9	Edge Lea and Cutler Road	28	5,040	68.4	50.0	40.0	0.8
10	Hatchet Point Road	11	1,980	33.3	50.0	40.0	0.6
MTA-A	Miscellaneous Town Area A	28	5,040	8.9	50.0	40.0	6.1
MTA-B	Miscellaneous Town Area B	41	7,380	14.0	50.0	40.0	5.7

1. Assumes 180 gpd/EDU.

2. Average annual Connecticut precipitation source: http://www.weather.com/weather/wxclimatology/monthly/graph/06371

3. Effluent nitrogen concentration of 40 mg/L per Metcalf and Eddie, 4th Ed. 2003, assuming medium strength wastewater.

2.3 SUMMARY OF STUDY AREA COMMON WASTEWATER MANAGEMENT NEEDS

Each Sub-Area was given a total ranking based on a weighted sum of the five needs analysis criteria. As stated previously, the first stage of the needs analysis is based solely on data available for all 13 Sub-Areas within the Study Area. Subsequent data impacting the overall needs analysis is presented in Section 2.4. Overall a wide range of values was observed, where high values are indicative of cumulative needs that negatively impact on-site disposal system suitability. Table 2-3 summarizes the rating by criteria and total ranking for each Sub-Area. Based upon the total value, each Sub-Area was assigned a priority, indicating its need for an alternative solution of wastewater management to on-site subsurface disposal. As shown in Table 2-3, the factors with the greatest effect on overall need appear to be lot size, development density, and nitrogen attenuation since soil drainage classification and sea level rise are relatively consistent throughout the Study Area.

Table 2-3: Initial Study Area Needs Ranking

Sub-Area ID	Description	Criteria Name (Weighting Factor)					Total Ranking	Priority[6]
		Lot Size[1]	Development Density[2]	Soil Drainage Classification[3]	Sea Level Rise[4]	Nitrogen Attenuation[5]		
		(4)	(5)	(4)	(3)	(3)		
1	Griswold Point & Osprey Road	1.3	1.0	1.3	1.3	1.0	22.3	Low
2	White Sand Beach	3.8	3.0	1.1	1.2	3.0	47.2	High
3	Haywagon Drive	1.8	1.0	1.0	1.0	1.0	22.2	Low
4	Dogwood Drive	2.0	1.0	1.2	1.3	1.0	24.7	Low
5A	Miami Beach	3.7	3.0	1.2	1.4	3.0	47.8	High
5B	Hawks Nest Beach	3.9	3.0	1.1	1.4	3.0	48.2	High
6	Sound View Beach	3.9	4.0	1.1	1.2	4.0	55.6	High
7	Old Colony Beach Club	3.9	4.0	1.1	1.2	4.0	55.6	High
8	Old Lyme Shores Beach	3.8	3.0	1.0	1.1	3.0	46.5	High
9	Edge Lea and Cutler Road	1.4	1.0	1.6	1.1	1.0	23.3	Low
10	Hatchet Point Road	1.2	1.0	1.2	1.2	1.0	21.2	Low
MTA-A	Miscellaneous Town Area A	2.9	2.0	1.0	1.6	3.0	39.4	Medium
MTA-B	Miscellaneous Town Area B	3.6	2.0	1.6	1.0	3.0	42.8	High

1. 1 point assigned for percent of lots greater than 1.0 acre, 2 points for 0.5 to 1.0 acres, 3 points for 0.25 to 0.5 acres, and 4 points for less than 0.25 acres.

2. 1 point assigned for a density of less than 6 bedrooms per acre, 2 points for 6-10, 3 points for 10-16, and 4 for greater than 16.

3. Percent of Sub-Area that is Very poorly drained = 4 points, Poorly drained = 3, Somewhat poorly drained = 2, Moderately well drained or better = 1.

4. Percentage of Sub-Area within 1 foot sea level rise zone is assigned 4 points, 3 foot zone is 3 points, 5 foot zone is 2 points, and else is 1.

5. Attenuated Nitrogen Concentration of less than 1 mg/L is assigned 1 point, 1 - 6 mg/L 2 points, 6 - 12 mg/L 3 points, greater than 12 mg/L 4 points.

6. A Total Ranking of more than 40 is high priority, between 30 and 40 medium, and less than 30 low. Minimum possible is 19.

The first stage of the needs analysis results closely parallel population densities in the Study Area. For example, Sub-Areas 2, 5A, 5B, 6, 7, 8, and Miscellaneous Town Area B ranked as high priority with total ratings of more than 40 each. By comparing these results with the lot size distribution shown in Figure 2-2 and the development density shown on Table 2-1, it is clear that these Sub-Areas have elevated needs.

After Miscellaneous Town Area B, with a total ranking of 42.8, the next highest ranked Sub-Area is Miscellaneous Town Area A, with a total ranking of 39.4. This was the only Sub-Area to receive a medium priority primarily due to smaller lot size, but development density and nitrogen attenuation were also factors. In general, the lowest priority Sub-Areas has the most advantageous conditions to support properly functioning on-site septic systems, including lower development density, larger lot sizes and better ability to attenuate nitrogen.

2.4 SECOND STAGE ANALYTICAL APPROACH - ADDITIONAL QUALITATIVE CRITERIA

During the second stage of the needs analysis, we considered five additional criteria pertaining to specific Sub-Areas, including White Sand Beach, Hawks Nest Beach, Sound View Beach, and Miscellaneous Town Area-B. The five criteria are:

- Existing septic system compliance;
- Age of septic systems;
- Percentage of properties with onsite water supply wells;
- Depth to groundwater; and
- Groundwater quality data.

The supplemental information related to these five additional criteria was provided by the Town Sanitarian.

- Septic Systems and Private Wells: The CT-DPH has defined minimum setback distances for subsurface sewage disposal systems. Shown in Table 2-4, are typical setback distances required by CT-DPH.

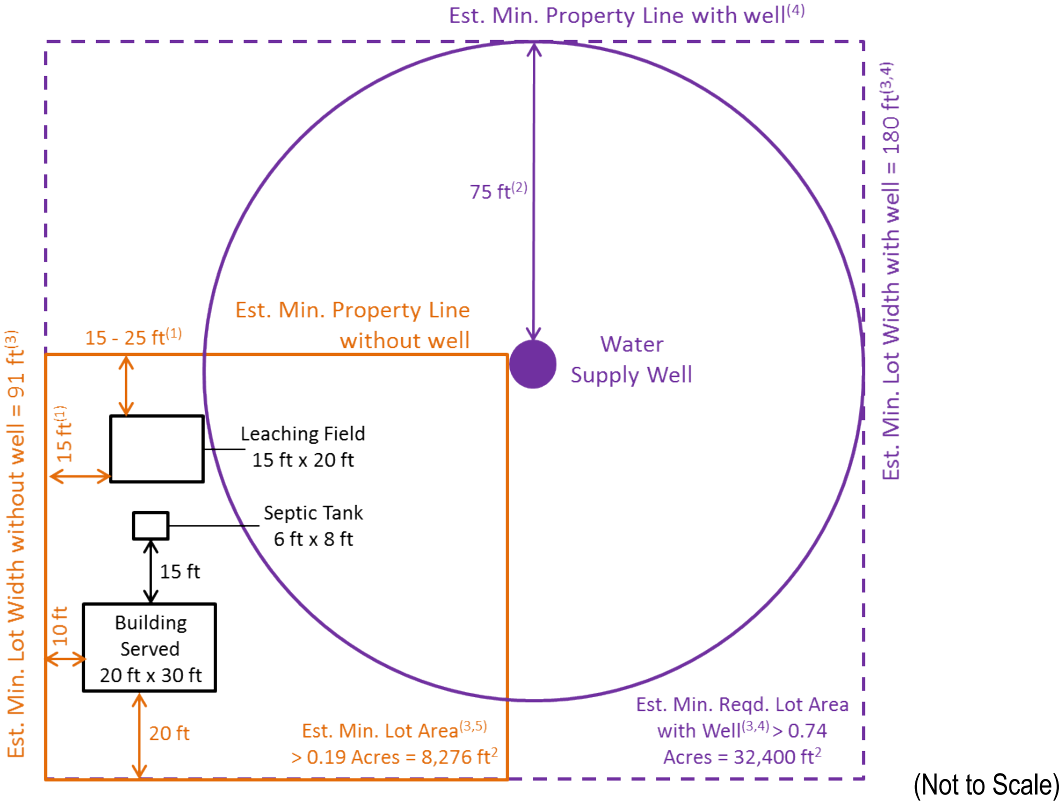
Table 2-4: Selected Subsurface Sewage Disposal System Setbacks Based on CT-DPH Standards

Item	Separating Distance[1] (Feet)
Water Supply Well (< 10, 10-50, > 50 gpm)	75, 150, 200
Human habitation on adjacent property	15
Building served	15
Open watercourse	50
Property Line (Upgradient or on sides, downgradient)	15, 25
Potable water lines	10
Accessory Structure	10

1. *From Table 1 of CT DPH Onsite Sewage Disposal Regulations and Technical Standards for Subsurface Sewage Disposal, 2011.*

Illustrated in Figure 2-3, is an example property with a subsurface disposal system and the estimated minimum required lot size for the property with and without a water supply well. The estimated minimum lot size with an onsite well are based on CT-DPH standards for subsurface sewage disposal systems, while the minimum lot size without a well is based on the minimum acreage to attenuate a typical effluent total nitrogen concentration to 10 mg/L, the EPA and CT-DPH limit for drinking water. On average, all of the high and medium priority Sub-Areas identified in Table 2-3 have lot areas smaller than 0.7 acres, which suggest that many of these lots have a very high likelihood of not complying with CT-DPH standards assuming they have water supply wells onsite. On average, Hawks Nest Beach and Sound View Beach have lot areas smaller than 0.19 acres, suggesting that most likely these two Sub-Areas do not meet the minimum estimated required lot area with or without an onsite well. As shown in Table 2-4, houses in adjacent parcels also have a minimum separation distance of 15 feet from subsurface sewage disposal systems.

Figure 2-3: Estimated Minimum Subsurface Disposal System Setbacks for CT-DPH Compliance



1. *15 ft if property line is upgradient or on sides of leaching field, 25 ft if downgradient.*
2. *75 ft for withdrawal rate of less than 10 gpm, 150 ft for 10 to 50 gpm, or 200 ft for greater than 50 gpm.*
3. *Assuming square lots.*
4. *Assuming minimum setbacks (75+75+15+15 = 180 ft).*
5. *Minimum lot size necessary for total nitrogen concentration at property line of less than 10 mg/L.*

Age of septic system construction were provided by the Town sanitarian for four Sub-Areas, including White Sand Beach, Hawks Nest Beach, Sound View Beach, and Miscellaneous Town Area B. Table 2-5 summarizes the percent of septic systems in each of these four Sub-Areas that were constructed prior to 1980. Septic systems built prior to 1980 typically were not designed to meet long term acceptance rates (LTAR). Therefore, on-site wastewater disposal systems built before 1980 have a very high likelihood of failure due to insufficient soil porosity or loss of acceptance over time, and due to the lack of design and construction controls placed on these systems prior to this date. The significance of this date is that prior to 1980 there were rules pertaining to the design and construction monitoring of onsite wastewater disposal systems, but these requirements were significantly less stringent and enforcement by the State Department of Public Health was ineffective.

Table 2-5 shows that the fraction of septic systems constructed before 1980 in White Sand Beach is approximately one quarter less than that of Sound View Beach and Miscellaneous Town Area B, and half than that of Hawks Nest Beach. Of these four Sub-Areas, White Sand Beach has the smallest fraction of septic systems which may not meet LTAR design considerations. LTAR are necessary to maintain natural attenuation of nutrients, pathogens, and flow. Septic system leaching fields may become fouled over time due to poor soils or over loading. Overall, less than 32% of properties have septic systems that were built prior to 1980.

The Town Sanitarian also provided a list of properties with onsite wells for three Sub-Areas, including Hawks Nest Beach, Sound View Beach and Miscellaneous Town Area B. Table 2-5 shows the percentage of properties with onsite water supply wells in each Sub-Area. According to the data provided, Hawks Nest Beach and Miscellaneous Town Area B have the highest percentage of properties with on-site wells instead of public water supply.

A list of geocoded addresses that are connected to the public water supply system within the Study Area was provided by Connecticut Water (CT Water). Based on this data, parcels that are connected to the public water supply system were estimated for each Sub-Area and presented in Figure 2-7. Figure 2-7 suggests that there is likely a large number of properties within Hawks Nest Beach and Miscellaneous Town Area B that have onsite water supply wells, which correlates with the data presented in Table 2-5.

- Depth to Groundwater: Presented in Table 2-5, are the percentages of test pits with observed groundwater. Insufficient depth to groundwater increases the risk of wastewater breakout and reduces attenuation of effluent. According to CT-DPH guidelines, the bottom of any leaching system should be at a minimum of 18 inches above the maximum groundwater level, while a typical leaching field requires 24 inches of cover. In general, minimum depth to groundwater for a typical septic system should be greater than 42 inches to facilitate proper separation from groundwater without a mounded system. All Sub-Areas show a minimum test pit depth to groundwater of 40 inches or less, which is less than the typical design minimum of 42 inches recommended by CT-DPH.

  Table 2-5 shows that White Sand Beach has a distinctly lower frequency of groundwater observance at 26.8%, about one third than that of Sound View Beach. While the majority of test pits in each Sub-Area were drilled to similar depths, White Sand Beach test pits often showed roots rather than groundwater or evidence of mottling. Table 2-5 also shows a high percentage of test pits with groundwater observed for Sound View (approximately 92%), which suggests the existence of shallow groundwater in Sound View. In addition, the average test pit depth to groundwater for Sound View appears to be the shallowest compared to the other Sub-Areas investigated, with an average depth to groundwater estimated at 52 inches below the surface.

Table 2-5: Comparison of Additional Data for Selected Sub-Areas[1]

Sub-Area ID	Description	% of Septic Systems Built prior to 1980	Percentage of Properties with onsite Wells	Minimum Test Pit Depth to Groundwater (in)	Maximum Test Pit Depth to Groundwater (in)	Percentage of Test Pits with Groundwater Observed
2	White Sand Beach	15.9%	-	40	89	26.8%
5B	Hawks Nest Beach	31.7%	73.4%	38	108	61.4%
6	Sound View Beach	20.8%	42.6%	16	96	91.8%
MTA-B	Miscellaneous Town Area B	21.4%	79.2%	38	90	81.8%

1. Based on data provided by the Town Sanitarian

- Groundwater Quality Data: Groundwater quality data was also provided by the Town sanitarian for the Hawks Nest Beach and Sound View Beach Sub-Areas, and included nitrogen species concentrations and bacterial counts. Figure 2-8 shows the approximate location of each groundwater monitoring well used during the groundwater monitoring campaign. Table 2-6 summarizes the groundwater monitoring results for each sampling location, including average and maximum nitrogen species concentrations and bacterial counts. Table 2-7 summarizes the number of occurrences where nitrogen and bacteria limits for drinking water and wastewater effluent were exceeded. The presented data was collected between June 25, 1998 and June 19, 2012 from seven sample stations within the Hawks Nest Beach Sub-Area and five sample stations within the Sound View Sub-Area, and was retrieved from the 2012 Nathan Jacobson (NLJ) report[5] (see Appendix D).

Table 2-6: Groundwater Monitoring Results - Nitrogen Species (EPA Drinking Water Limit, mg/L) and Bacterial Count (EPA Freshwater Limit Colonies per 100 mL)

Sample Location ID	Statistic	Nitrate (10 mg/L)	Nitrite (1 mg/L)	TKN[1]	Ammonia[1]	TN[1]	Total Coliform (200)	Fecal Coliform (200)[2]	Fecal Strepto-coccus (200)	E Coli (126)[2]
HN-1-98	Average	5.52	0.01	0.64	0.07	6.16	12	13	10	13
	Maximum	11.00	0.02	2.80	0.28	11.10	60	60	30	20
HN-2-98	Average	3.49	0.01	0.63	0.16	4.13	11	10	21	12
	Maximum	6.20	0.06	1.40	0.73	6.60	40	20	300	20
HN-3-98	Average	0.75	0.01	1.56	0.47	2.28	122	28	59	37
	Maximum	4.70	0.03	3.80	1.40	7.10	580	360	640	300
HN-4	Average	1.88	0.01	0.53	0.07	2.44	163	50	53	50
	Maximum	3.90	0.02	1.50	0.31	4.80	1200	400	700	500
HN-5D	Average	5.92	0.01	0.50	0.07	6.43	15	11	11	13
	Maximum	7.70	0.01	1.30	0.28	8.10	60	20	20	20
HN-5S	Average	6.99	0.01	0.77	0.07	7.75	17	11	11	13
	Maximum	22.00	0.01	2.30	0.25	24.30	75	20	20	20
HN-6	Average	1.94	0.01	0.68	0.09	2.64	18	11	11	13
	Maximum	3.60	0.02	3.50	0.46	5.90	100	20	20	20
Hawks Nest	***Average***	***3.78***	***0.01***	***0.76***	***0.14***	***4.55***	***51***	***19***	***25***	***21***
	Maximum	***22.00***	***0.06***	***3.80***	***1.40***	***24.30***	***1200***	***400***	***700***	***500***
SV-1	Average	3.33	0.01	0.86	0.10	4.20	13	14	18	13
	Maximum	5.50	0.02	2.00	0.74	6.90	80	100	100	20
SV-2	Average	0.04	0.02	6.32	4.54	6.82	11	23	22	13
	Maximum	0.18	0.09	9.60	7.20	13.10	20	250	160	20
SV-3	Average	4.07	0.06	1.41	0.18	5.54	23	17	21	12
	Maximum	7.80	0.89	12.00	1.60	14.70	120	100	100	20
SV-4	Average	0.05	0.03	7.87	7.03	7.90	16	16	65	12
	Maximum	0.28	0.08	12.00	11.00	12.00	100	100	600	20
SV-6	Average	0.05	0.01	2.10	0.76	2.16	64	73	71	41
	Maximum	0.23	0.05	6.00	2.50	6.10	300	1000	600	300
Sound View	***Average***	***1.51***	***0.03***	***3.71***	***2.52***	***5.33***	***25***	***28***	***39***	***18***
	Maximum	***7.80***	***0.89***	***12.00***	***11.00***	***14.70***	***300***	***1000***	***600***	***300***

1. No EPA established limits for drinking water.

2. EPA limit for drinking water is zero colonies per 100 mL and no more than 5% of samples positive per month or no more than one positive sample per month for less than 40 samples per month. No more than one sample was collected in any given month for the sampling program.

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[5] 8/21/2012 Nathan Jacobson Report on Town of Old Lyme Groundwater Quality

Table 2-6 shows that Hawks Nest and Sound View have experienced elevated levels of total nitrogen, ammonia and nitrate during the sampling period. Within the Hawks Nest Sub-Area, the total nitrogen consisted mostly of nitrate. As shown in Table 2-7, the EPA[6] standard for nitrate in drinking water was exceeded four times. The data analysis shows that total nitrogen consisted mostly of ammonia and organic nitrogen, a strong indicator of the presence of raw wastewater. The presence of high levels of nitrate in Hawks Nest groundwater compared to Sound View suggests that nitrification may be occurring at a faster rate within this Sub-Area.

As a point of comparison, a USGS report[7] investigating the changes in nitrogen concentrations and loads as a result of sewering, indicated a positive correlation between nitrogen load reduction in groundwater and sewering a coastal community in Niantic, Connecticut. The pine grove neighborhood targeted by this USGS study is located on a peninsula in the Niantic River between East Lyme and Waterford. The peninsula area contains 172 residences previously relying on onsite subsurface wastewater disposal systems and recently connected to a newly installed sewer system. The USGS study concluded that the median and mean Total Dissolved Nitrogen (TDN) concentrations decreased in 14 of the 17 wells tested in the study area between the presewering and postsewering periods. Decreases in mean concentrations of TDN ranged from 0.34 to 11.7 mg/L. Note that the total nitrogen loads investigated in the groundwater of this community consisted primarily of nitrate and nitrite, similar to the groundwater conditions in Hawks Nest and Sound View beaches.

According to the same USGS report, undeveloped or forested areas within the Connecticut River, Housatonic River, and Thames River basins have median groundwater concentrations of 0.11 to 0.14 mg/L nitrate plus nitrite. Taking this range of values as a median background concentration, the typical average concentrations of nitrate alone in Hawks Nest and Sound View are an order of magnitude greater at 3.78 and 1.51 mg/L, respectively, as shown in Table 2-6.

Both Hawks Nest and Sound View have shown elevated levels of multiple varieties of bacteria, as shown in Table 2-6. The limits presented in Table 2-7 are required by the EPA[8] to ensure safe public use of wastewater effluent receiving waters. However, the EPA's safe drinking water standards are much more stringent. Two principal drinking water standards are adopted by the EPA, including (1) Maximum Contaminant Level Goal (MCLG) – a non-enforceable, health based goal set at a level with an adequate margin of safety to ensure no adverse effect on human health, and (2) Maximum Contaminant Level (MCL) – an enforceable standard set as close to the MCLG as feasible using best available treatment technology and taking cost and analytical capability into consideration. While these standards do not apply to private systems serving less than 25 individuals, they give a good reference for drinking water safety.

The Total Coliform Rule in the Safe Drinking Water Act (SDWA) specifies a MCLG of zero for total coliforms, which includes fecal coliforms and Escherichia coliform (E. coli). The MCL for total coliforms allows for a limited number of positive samples, at most 5% of samples per month. Where less than 40 samples are collected per month, as is the case with the data collected for the NLJ report, the limit is one positive sample per month. Samples for Hawks Nest and Sound View were collected approximately biannually. Approximately 95% of samples in Hawks nest were positive for fecal coliform, and 92% of samples in Sound View were positive. It should be noted that fecal coliforms are indicative of human waste contamination, and are only a fraction of the total coliforms that may be present. The regular occurrence of coliform bacteria in Hawks Nest and Sound View samples suggests

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[6] EPA National Primary Drinking Water Regulations - https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants#four – Accessed August 26, 2016

[7] USGS Scientific Investigations Report 2015-5011 – Evaluation of the Effects of Sewering on Nitrogen Loads to the Niantic River, Southeastern Connecticut, 2005-11. Mullaney, J.R. 2015. - http://pubs.usgs.gov/sir/2015/5011/pdf/sir2015-5011.pdf - Accessed September 30, 2016.

[8] EPA Recreational Water Quality Criteria - https://www.epa.gov/sites/production/files/2015-10/documents/rwqc2012.pdf - Accessed August 26, 2016

inadequate treatment of wastewater prior to discharge into the ground, and likely contamination of drinking water for onsite wells in these areas.

Table 2-7: Nitrogen and Bacterial Limits Number of Exceedances[1]

Sub-Area ID	Description	Nitrate	Nitrite	Total Coliform	Fecal Coliform	Fecal Streptococcus	E. Coli
Limit (Source)		10 mg/L as N (EPA Drinking Water Std)	1 mg/L as N (EPA Drinking Water Std)	200 #/100 mL[2]	200 #/100 mL (EPA)	200 #/100 mL[2]	126 #/100 mL (EPA)
5B	Hawks Nest Beach	4	0	8	3	4	2
6	Sound View	0	0	2	2	5	1

1. *Based on 2012 NLJ Report*
2. *The US EPA's fecal coliform limit is used for analytical purposes.*

Additional data on marine bacterial counts were provided by the Town Sanitarian (see Appendix E) and summarized in Table 2-8. This data set pertains to six Sub-Areas, including White Sand Beach, Miami Beach, Hawks Nest Beach, Sound View Beach, Old Colony Beach Club, and Old Lyme Shores Beach. The marine water bacterial data was collected between May 22 and September 17, 2014. Generally, the average bacterial count varies little between the Sub-Areas and in every case it is below the threshold for public safety established by the EPA of 35 enterococci colonies per 100 mL for marine water. The CTDPH standards for bathing water are less strict, with a limit at 104 enterococci colonies per 100 mL. However, the EPA limit was exceeded by individual samples several times throughout the sampling period in five out of six of the Sub-Areas tested, as shown in Table 2-8.

Table 2-8: Marine Bacterial Counts

Sub-Area ID	Description	Average Enterococci Count[1] (Colonies/100mL)	Times EPA Limit Exceeded[1]
2	White Sand Beach	8	2
5A	Miami Beach	19	4
5B	Hawks Nest Beach	16	3
6	Sound View Beach	10	1
7	Old Colony Beach Club	8	0
8	Old Lyme Shores Beach	11	1

1. Data provided by the Town Sanitarian

The second stage of the needs analysis suggests that White Sand Beach has a lower number of old septic systems (constructed prior to 1980) and has far fewer test pits with shallow depth to groundwater compared to the other high priority Sub-Areas. In addition, White Sand Beach is located approximately 5,000 feet from the rest of the high priority Sub-Areas.

2.5 BALANCING WASTEWATER MANAGEMENT NEEDS AND COSTS

The Town of Old Lyme presented needs analysis information and a preliminary cost summary to Town residents on September 30, 2014. During the presentation, a few residents within the High Needs Sub-Areas expressed concern over various pollution factors (development density, soils, septic system failures, depth to groundwater, etc.) and net costs per EDU. To address these concerns, CT-DEEP facilitated a Project Workshop on October 15, 2014 to review the need analysis, costs, and concerns expressed by the public. As a result of the workshop and unique Needs Analysis factors as mentioned in Section 2.4 (soils, age of septic systems, cost, depth to groundwater, and groundwater quality data), CT-DEEP, Woodard & Curran, the Town and Fuss & O'Neill (representatives to the chartered beach associations), agreed to remove White Sand Beach (Sub Area 2) and Miscellaneous Town Area A (MTA-A) from the proposed Project Area, and make those two Sub Areas designated as future High Needs Sub Areas.

Subsequent to submission of the December 2014 Facilities Plan Report to CT-DEEP, the WPCA, Town leadership, and Woodard & Curran engaged other Town boards/commissions/residents and CT-DEEP staff in meetings and discussions related to the proposed regional alternative for the Coastal Wastewater Management Plan. During these public meetings, a group of Hawks Nest residents expressed concern over the Groundwater quality data used to determine the High Needs Sub-Areas. To address these concerns, the Town and DEEP agreed to perform additional monitoring to more accurately delineate groundwater quality conditions and wastewater management needs. It is anticipated that a recommendation for Hawks Nest (HN) Sub-Area will be presented in a subsequent engineering report. HN Sub-Area will be further investigated through an additional groundwater monitoring program to be performed in two phases:

1. Phase 1 – Well Network Evaluation: This phase will include well condition evaluation and groundwater flow mapping. The intent of this phase is to monitor groundwater levels and map groundwater flow direction at Hawks Nest (HN) Sub-Area. Phase 1 results will be used to determine representative locations for water quality monitoring.
2. Phase 2 – Well Installation, Sampling Program and Report: Based upon the results of Phase 1, additional wells may be installed, a well sampling program will be developed and implemented, and a separate engineering report will be developed. The results of this program will be used to generate a recommendation for HN Sub-Area.

Overall, we recommend that White Sand Beach (Sub Area 2), Hawk Nest (Sub Area 5B) and Miscellaneous Town Area A (MTA-A) Sub-Areas be monitored and further evaluated based on future pollution and/or septic failure concerns. All parties agreed that no other unique conditions exist within the High Needs Sub Areas that would justify the exclusion of other Sub-Areas from the proposed Project Area. The final results of the needs analysis are shown in Table 2-9 and shown graphically in Figure 2-9, with color coding assigned by priority.

Table 2-9: Final Needs Prioritization by Sub-Area

Sub-Area ID	Description	EDUs	Priority
1	Griswold Point & Osprey Road	26	Low
2	White Sand Beach	159	Medium
3	Haywagon Drive	27	Low
4	Dogwood Drive	36	Low
5A	Miami Beach	234	High
5B	Hawks Nest Beach	269	Medium
6	Sound View	229	High
7	Old Colony Beach Club	236	High
8	Old Lyme Shores Beach	196	High
9	Edge Lea and Cutler Road	28	Low
10	Hatchet Point Road	11	Low
MTA-A	Miscellaneous Town Area A	28	Medium
MTA-B	Miscellaneous Town Area B	41	High

2.6 PROPOSED PROJECT AREA

Sub-Areas 5A, 6, 7, 8, and Miscellaneous Town Area B have the highest need for wastewater management solutions in lieu of the existing on-site septic systems. These Sub-Areas make up the proposed Project Area and are the focus of the alternatives analysis presented in the remainder of this Report. The proposed Project Area is shown in Figure 2-10. The five Sub-Areas in the proposed Project Area represent about 66% of the sanitary flow from the Study Area. This is due to these Sub-Areas representing the most densely populated fraction of the Study Area.

Table 2-10 provides a summary for the Project Area, consisting of four (4) beach associations within these five (5) Sub-Areas. Table 2-10 also summarizes the number of homes (or EDUs) in each of the Sub-Areas.

Table 2-10: Project Area Sub-Areas

Sub-Area	Description	Number of Equivalent Dwelling Units (EDU)
5A	Miami Beach	234
6	Sound View Beach	229
7	Old Colony Beach Club	236
8	Old Lyme Shores Beach	196
MTA-B	Miscellaneous Town Area B	41
Total		**936**

2.7 CONSISTENCY WITH STATE PLAN OF CONSERVATION AND DEVELOPMENT

The Office of Policy and Management has developed a Plan of Conservation and Development (POCD) for the State of Connecticut outlining six growth management principles for guiding intelligent community development. The POCD is intended for comparison to community and municipal plans where development will make use of state funding. The six growth management principles are listed in Table 2-11 and the project's applicability to each is briefly summarized.

Table 2-11: Project Applicability to OPM Growth Management Principles

Growth Management Principle #	Description	Project Area Applicability
1	Redevelop and revitalize regional centers and areas with existing or currently planned physical infrastructure	N/A
2	Expand housing opportunities and design choices to accommodate a variety of household types and needs	N/A
3	Concentrate development around transportation nodes and along major transportation corridors to support the viability of transportation options	Project Area is centered around route 156. A Bike path and bus route are planned for alternative modes of transportation.
4	Conserve and restore the natural environment, cultural and historical resources, and traditional rural lands	Collection and treatment of wastewater will reduce nitrogen loading to Long Island sound and protect local groundwater quality
5	Protect and ensure the integrity of environmental assets critical to public health and safety	Protects quality of groundwater supplying public and private water systems by removal of non-compliant septic systems
6	Promote integrated planning across all levels of government to address issues on a statewide, regional and local basis	Inter-municipal agreements encourage sharing of existing wastewater infrastructure, assuming regional solution is adopted.

Growth management principles 4 and 5 are primarily concerned with protecting the environment and natural resources that contribute to public health, including aquifers for public and private water supply. Principle number 3 encourages growth and development around existing transportation hubs to reduce congestion due to traffic and offer alternative forms of transportation. Planned upgrades to the Hartford Avenue corridor include a bus route and a bike path from route 156 to the beachfront. The Regional Alternative (discussed further in Chapter 4) is consistent with growth management principle 6 in that it requires inter-municipal agreements between the Town of Old Lyme, East Lyme, Waterford, and New London, and encourages sharing of existing and potentially under-utilized infrastructure.

Wastewater collection systems typically facilitate growth and development within the sewer service area; however, the Town of Old Lyme is concerned with overdevelopment within the Project Area. Maintaining appropriate zoning regulations is the single best measure to avoid induced growth. Existing lots within the proposed Project Area are mostly quarter acre residential, with some quarter acre commercial lots in MTA-B, and a strip of mixed development along Hartford Avenue in Sound View Beach. The preponderance of existing high-density residential development on highly desirable lots near beachfront reduces the possibility of undesirable additional development. There are also very few undeveloped parcels within the proposed Project Area, lessening the potential for urban sprawl. Note that urban sprawl or induced development will also be limited by the contractual flow amount that will be included in the inter-municipal agreement with downstream communities.

The recommended plan, described further in Section 8, is based solely on existing development in the proposed Project Area. There are no allowances for future development or growth, which will otherwise have to be supported by on-site systems. The Town of Old Lyme has a sewer avoidance policy, and the WPCA has made exception only to facilitate a solution to on-going existing on-site problems for those lots included in the proposed Project Area.

2.8 IMPACTS ASSOCIATED WITH HURRICANE IRENE AND STORM SANDY

In addition to the above Needs Analysis, one of the goals of this Project is to improve coastal resiliency in the Project Area. During Storm Sandy, the Old Lyme coastline communities were hit hard, including a storm surge that brought waters from the Long Island Sound further inland than normal. Several homes were damaged, and the high waters flooded properties and septic systems along the coastline. Following are several photos that illustrate the damage left in the wake of Storm Sandy.

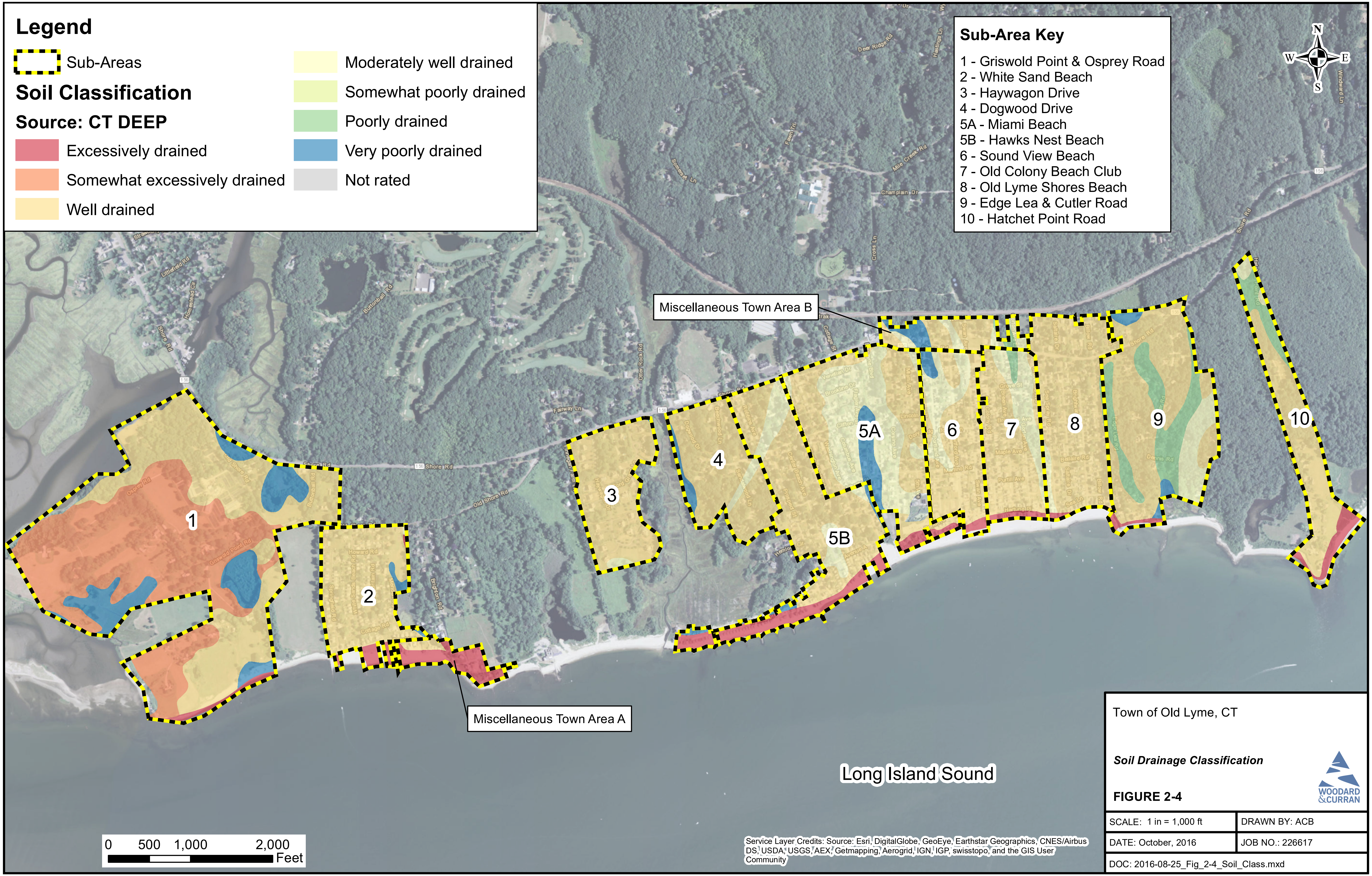
Examples of Damage Left by Storm Sandy in Old Lyme Beach Associations
(Source: Town of Old Lyme, October 2012)

Examples of Damage Left by Storm Sandy in Old Lyme West End Drive, Hawks Nest Beach
(Source: Hartford Courant, October 30, 2012)

The proposed project will reinforce coastal infrastructure by eliminating flood-prone septic systems in the Project Area. In addition, washouts by rising tides will no longer compromise the septic systems, as evidenced in the above center photo. This will allow homeowners to better fortify their properties by using parts of their properties that were previously occupied by a leaching field. Gravity sewers with deeper infrastructure and flood-proof manhole covers will protect the wastewater infrastructure. The proposed pump station(s) will be sited at elevations above flood levels, with flood protection measures, emergency generators, and independent fuel sources, to maintain sewer service during extreme events.

The proposed sewers will allow homeowners to upgrade their properties, better use parts of the lots currently occupied by septic systems, to provide more storm-ready reinforcements. Specifically, the proposed pump station to be constructed as part of this project will be constructed above flood waters, of concrete and reinforced materials, including an emergency generator and remote monitoring system with back-up, allowing continuous sewer service to the project area, providing safe and sanitary conditions that have never existed in this area.

The undersized and failing septic systems that currently discharge to groundwaters and surface waters in the project area negatively impact surrounding environmentally sensitive areas. The proposed sewers will eliminate these discharges. In addition, since there is almost no undeveloped land in the project area, there will not be secondary development pressures that would otherwise impact environmental areas in other communities that extend sewer service. The proposed sewer project will incorporate low impact development (LID) and green infrastructure components to further lessen potential impacts from secondary development pressures once sewers are constructed. Beach closures related to bacterial contamination in the project area will also be eliminated, thus improving swimming and recreational activities that allow the residents to enjoy the natural beauty of the wildlife throughout the project area. Lastly, the odors from surface breakout at leaching systems will no longer occur after sewers are constructed. This has been a significant source of past nuisance conditions for residents.



Legend

▭ Sub-Areas

Soil Classification

Source: CT DEEP

🟥 Excessively drained

🟧 Somewhat excessively drained

🟨 Well drained

🟨 Moderately well drained

🟨 Somewhat poorly drained

🟩 Poorly drained

🟦 Very poorly drained

⬜ Not rated

Sub-Area Key

1 - Griswold Point & Osprey Road
2 - White Sand Beach
3 - Haywagon Drive
4 - Dogwood Drive
5A - Miami Beach
5B - Hawks Nest Beach
6 - Sound View Beach
7 - Old Colony Beach Club
8 - Old Lyme Shores Beach
9 - Edge Lea & Cutler Road
10 - Hatchet Point Road

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

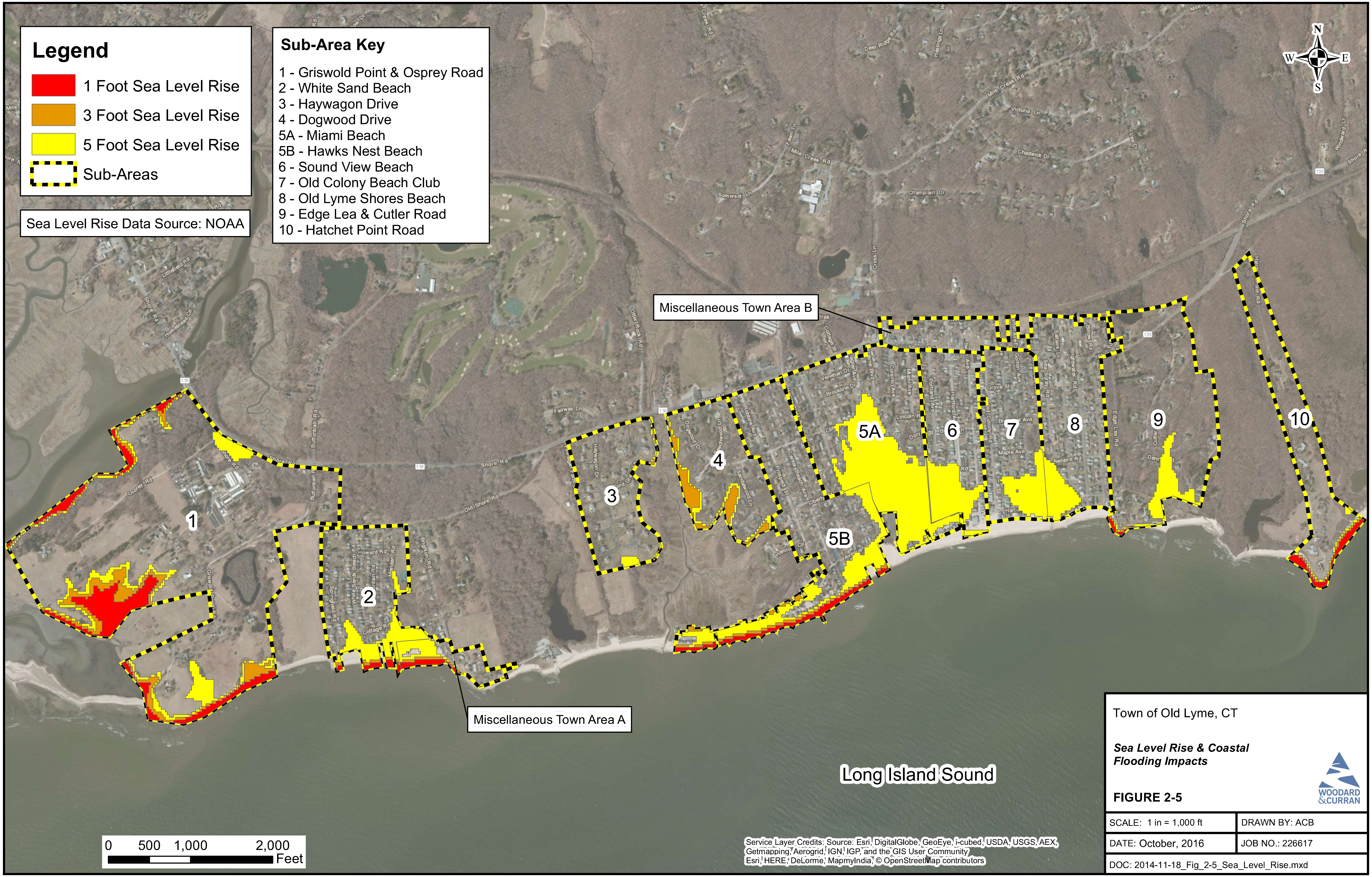
Town of Old Lyme, CT

Soil Drainage Classification

FIGURE 2-4

WOODARD & CURRAN

SCALE: 1 in = 1,000 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_2-4_Soil_Class.mxd	



Legend

- 🟥 1 Foot Sea Level Rise
- 🟧 3 Foot Sea Level Rise
- 🟨 5 Foot Sea Level Rise
- ▨ Sub-Areas

Sea Level Rise Data Source: NOAA

Sub-Area Key

1 - Griswold Point & Osprey Road
2 - White Sand Beach
3 - Haywagon Drive
4 - Dogwood Drive
5A - Miami Beach
5B - Hawks Nest Beach
6 - Sound View Beach
7 - Old Colony Beach Club
8 - Old Lyme Shores Beach
9 - Edge Lea & Cutler Road
10 - Hatchet Point Road

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

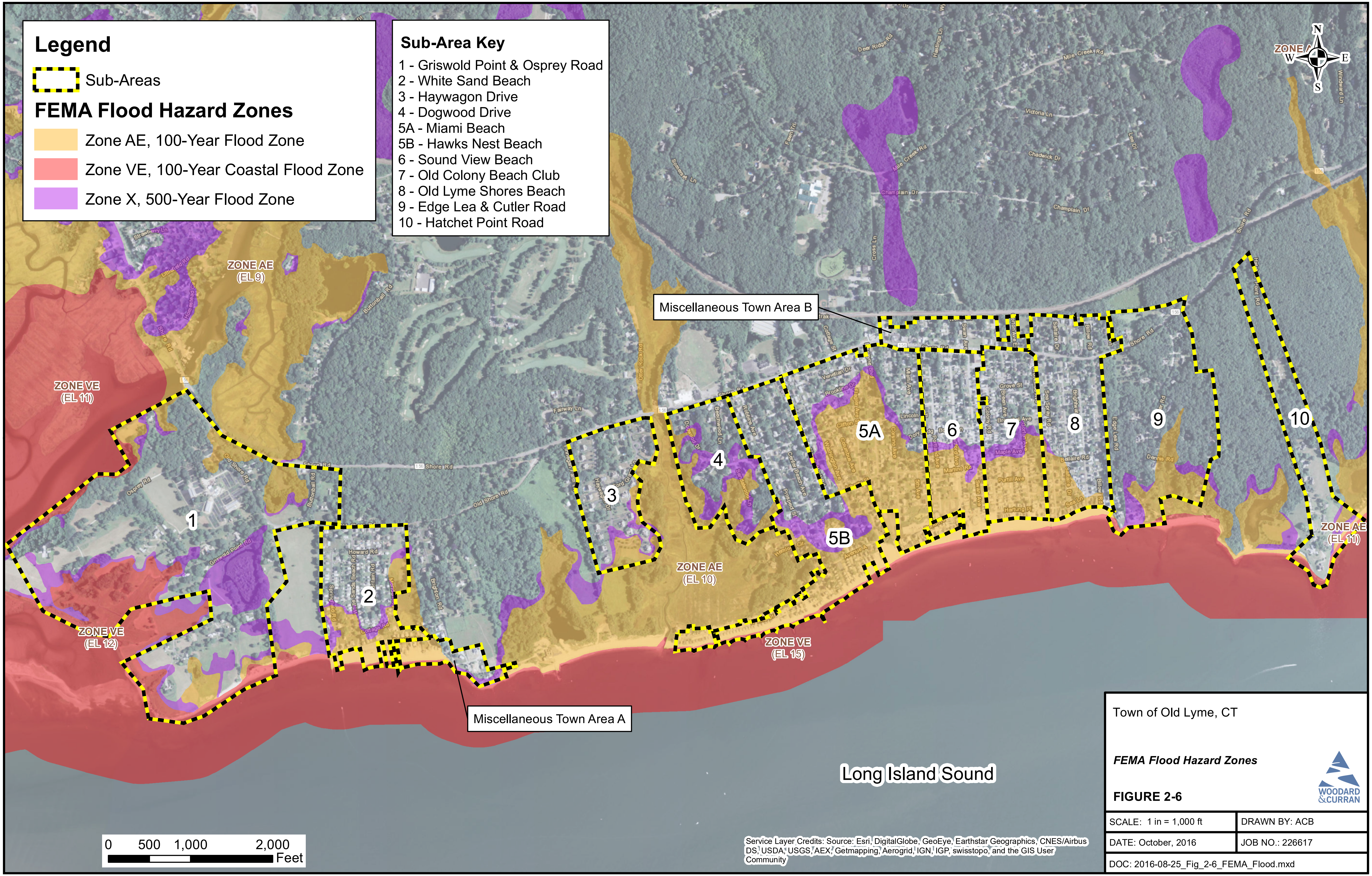
Town of Old Lyme, CT

Sea Level Rise & Coastal Flooding Impacts

FIGURE 2-5

WOODARD & CURRAN

SCALE: 1 in = 1,000 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2014-11-18_Fig_2-5_Sea_Level_Rise.mxd	



Legend

⬚	Sub-Areas

FEMA Flood Hazard Zones

🟨	Zone AE, 100-Year Flood Zone
🟥	Zone VE, 100-Year Coastal Flood Zone
🟪	Zone X, 500-Year Flood Zone

Sub-Area Key

1 - Griswold Point & Osprey Road
2 - White Sand Beach
3 - Haywagon Drive
4 - Dogwood Drive
5A - Miami Beach
5B - Hawks Nest Beach
6 - Sound View Beach
7 - Old Colony Beach Club
8 - Old Lyme Shores Beach
9 - Edge Lea & Cutler Road
10 - Hatchet Point Road

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Town of Old Lyme, CT

FEMA Flood Hazard Zones

FIGURE 2-6

WOODARD & CURRAN

SCALE: 1 in = 1,000 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_2-6_FEMA_Flood.mxd	

Legend

▨ Sub-Areas

Parcel Water Supply Source

🟩 Onsite

🟦 Public

Note: Parcels connected to public water systems are estimated and based on geocoded addresses supplied by Connecticut Water Company. Remaining parcels are assumed to have onsite water systems.

Sub-Area Key

1 - Griswold Point & Osprey Road
2 - White Sand Beach
3 - Haywagon Drive
4 - Dogwood Drive
5A - Miami Beach
5B - Hawks Nest Beach
6 - Sound View Beach
7 - Old Colony Beach Club
8 - Old Lyme Shores Beach
9 - Edge Lea & Cutler Road
10 - Hatchet Point Road

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

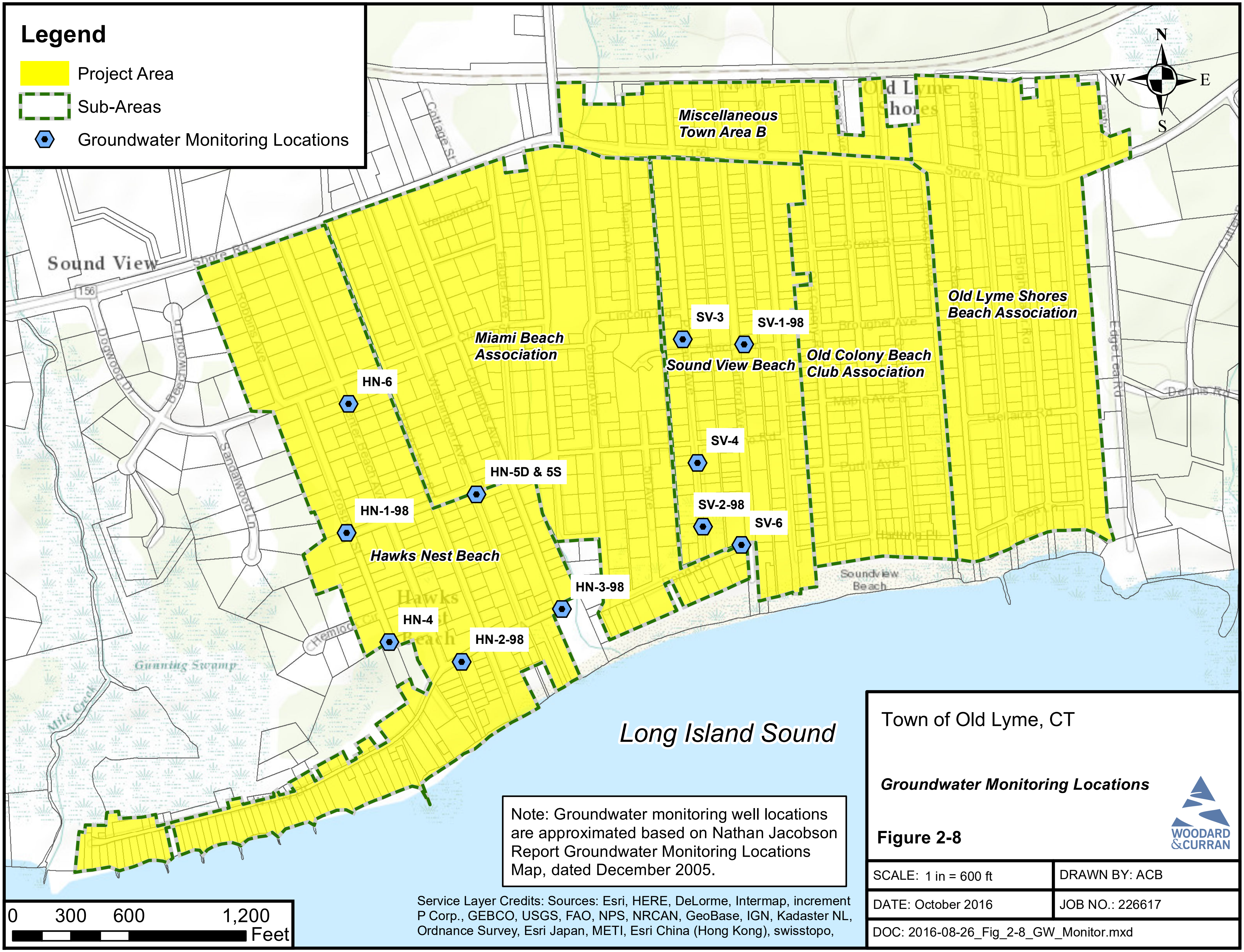
Town of Old Lyme, CT

Water Supply Sources

FIGURE 2-7

WOODARD & CURRAN

SCALE: 1 in = 1,000 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2014-11-18_Fig_2-7_Water_Supply.mxd	



Note: Groundwater monitoring well locations are approximated based on Nathan Jacobson Report Groundwater Monitoring Locations Map, dated December 2005.

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,

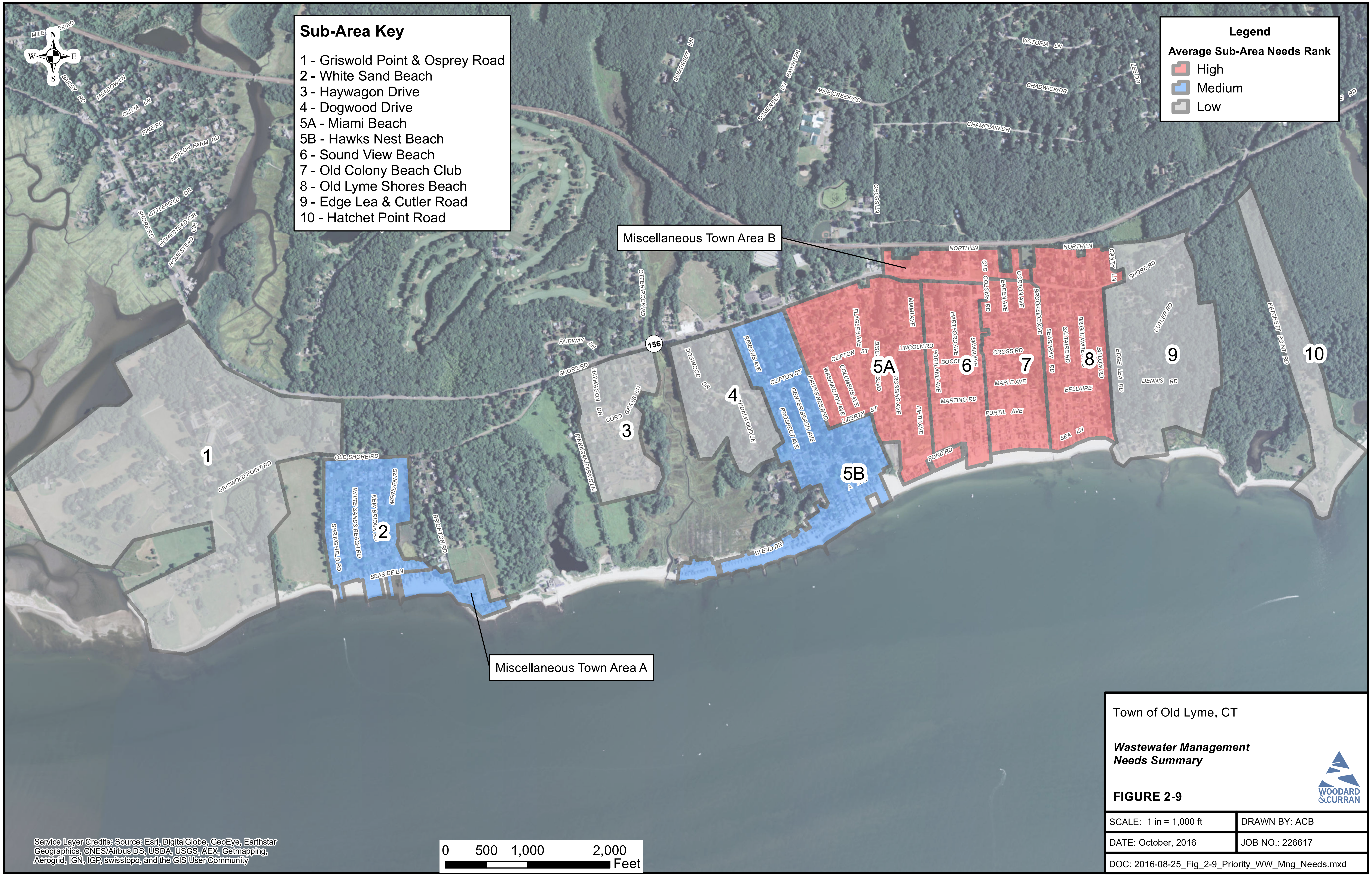
Town of Old Lyme, CT

Groundwater Monitoring Locations

Figure 2-8

WOODARD &CURRAN

SCALE: 1 in = 600 ft	DRAWN BY: ACB
DATE: October 2016	JOB NO.: 226617
DOC: 2016-08-26_Fig_2-8_GW_Monitor.mxd	



Sub-Area Key

1 - Griswold Point & Osprey Road
2 - White Sand Beach
3 - Haywagon Drive
4 - Dogwood Drive
5A - Miami Beach
5B - Hawks Nest Beach
6 - Sound View Beach
7 - Old Colony Beach Club
8 - Old Lyme Shores Beach
9 - Edge Lea & Cutler Road
10 - Hatchet Point Road

Legend

Average Sub-Area Needs Rank

🟥 High
🟦 Medium
⬜ Low

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 500 1,000 2,000
Feet

Town of Old Lyme, CT

Wastewater Management Needs Summary

FIGURE 2-9

WOODARD & CURRAN

SCALE: 1 in = 1,000 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617

DOC: 2016-08-25_Fig_2-9_Priority_WW_Mng_Needs.mxd

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend

Sub-Areas

🟦 5A - Miami Beach

🟩 6 - Sound View Beach

🟪 7 - Old Colony Beach Club

🟥 8 - Old Lyme Shores Beach

🟧 Miscellaneous Town Area B

Town of Old Lyme, CT

Project Area Sub-Areas

FIGURE 2-10

WOODARD & CURRAN

SCALE: 1 in = 300 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_2-10_High_Needs_WW_Svc_A.mxd	

3. CURRENT AND FUTURE FLOW PROJECTIONS

Section 3 provides a summary as to how current and future flows were estimated for the proposed Project Area. These estimated sanitary flows were used in Section 5, together with other estimated flow sources, including infiltration and inflow (I/I), to develop and evaluate collection system alternatives for the individual Sub-Areas comprising the Project Area.

3.1 ASSUMPTIONS FOR FLOW CALCULATIONS

For existing developed properties in the Project Area, the following assumptions were used for flow calculations:

- The average daily flow is the sum of sanitary flow (residential and non-residential) and estimated inflow/infiltration (I/I).
- I/I was estimated for each Sub-Area based on 2011 TR-16 design guidelines (Guides for the Design of Wastewater Treatment Works) based on an I/I allowance of 400 gpd/idm (gallons per day per inch-diameter-mile of pipe), using assumed 8-inch diameter pipes and a gravity sewer system layout. A lower unit I/I rate of 100 gpd/idm was used for the low pressure and vacuum sewer alternatives.
- The average daily sanitary flow was estimated using the Town's census data of 2.39 people per household with an average water consumption of 75 gallons per capita per day. The unit water consumption assumption is also consistent with TR-16 guidelines.
- The maximum daily sanitary flow was calculated as twice the average daily sanitary flow, plus I/I.
- Peak hour flows were estimated to determine pump station capacities and sewer pipe diameters. The peak hour flow was calculated by multiplying the sanitary flow by a peaking factor of 4, plus I/I, based on Figure 2-1 of TR-16 design guidelines.
- There are no future flow allocations from currently undeveloped parcels in the project area.
- The number of EDUs used for the flow projections is based on a combination of: (1) the Town Assessor's data for the Town-management high-needs Sub-Areas comprising the Project Area; (2) data provided by Fuss & O'Neill for the three chartered beach associations; and (3) the Town's GIS data, including building/structure counts for the Sub-Areas that were excluded from the recommended Project Area.
- All parcels were assumed to be residential. Commercial contributions to the total EDU count will be determined during the design phase.

3.2 FLOW PROJECTIONS

Table 3-1 shows the flow projections for gravity and septic tank effluent gravity (STEG) collective systems. Estimated flows for gravity and STEG options are presented together because STEG systems rely on conventional gravity sewers to convey wastewater. A value of 400 gpd/idm (gallons per day per inch diameter mile) was used to estimate I/I flow contributions for these systems, which is a conservative estimate consistent with TR-16 guidelines. Table 3-1 also shows peak hour hourly flows in gallons per minute (gpm), and maximum daily flows in gallons per day (gpd). Maximum daily flows are twice the average daily flow, plus I/I. These flows are used to design the size of the proposed Water Pollution Control Facility (WPCF) for the Local Alternative. Maximum daily flow is also used to determine the necessary size of the effluent disposal and reuse systems for the Local Alternatives, as well as the size of the transmission force main for the Regional Alternative.

Table 3-2 is similar to Table 3-1 but shows the potential flows from a low pressure sewer (LPS) or septic tank effluent pump (STEP) system. LPS and STEP systems rely on smaller diameter pressure piping without traditional sewer manholes associated with a gravity or STEG system. This difference allows for a more moderate I/I flow estimate since it is hard for groundwater to infiltrate LPS/STEP systems. An I/I allowance of 100 gpd / idm from TR-16 was used for these pressurized collection systems. The primary benefit of less I/I in a system is reduced treatment and disposal capital and annual costs for the Local Alternative, as well as lower pumping costs for the Regional Alternative. Based on the estimated pipe lengths to serve the Project Area, a LPS or STEP system would reduce maximum daily flows by an estimated 26,000 gallons per day, or 6% of the max daily flow.

Figure 3-1 summarizes the flow projections per Sub-Area for the gravity sewer alternative, and shows all the Sub-Areas included as part of the proposed Project Area. Note that I/I allowances vary based on the type of collection system selected. An overview of each type of collection system alternative is included in Section 5.

Table 3-1: Summary of Gravity and STEG Projections for Project Area

Sub-Area ID	Description	Equivalent Dwelling Units (EDU)	Average Daily Flow (GPD) Sanitary Flow	I/I[3]	Total	Max Daily Flow (GPD)[4]	Peak Hourly Flow (GPD)[5]
5A[2]	Miami Beach	234	42,120	8,545	50,665	92,785	177,025
6 [1]	Sound View Beach	229	41,220	2,818	44,038	85,258	167,698
7 [2]	Old Colony Beach Club	236	42,480	4,727	47,207	89,687	174,647
8 [2]	Old Lyme Shores Beach	196	35,280	6,545	41,825	77,105	147,665
MTA-B[1]	Miscellaneous Town Area B	41	7,380	1,697	9,077	16,457	31,217
Total		**936**	**168,480**	**24,333**	**192,813**	**361,293**	**698,253**

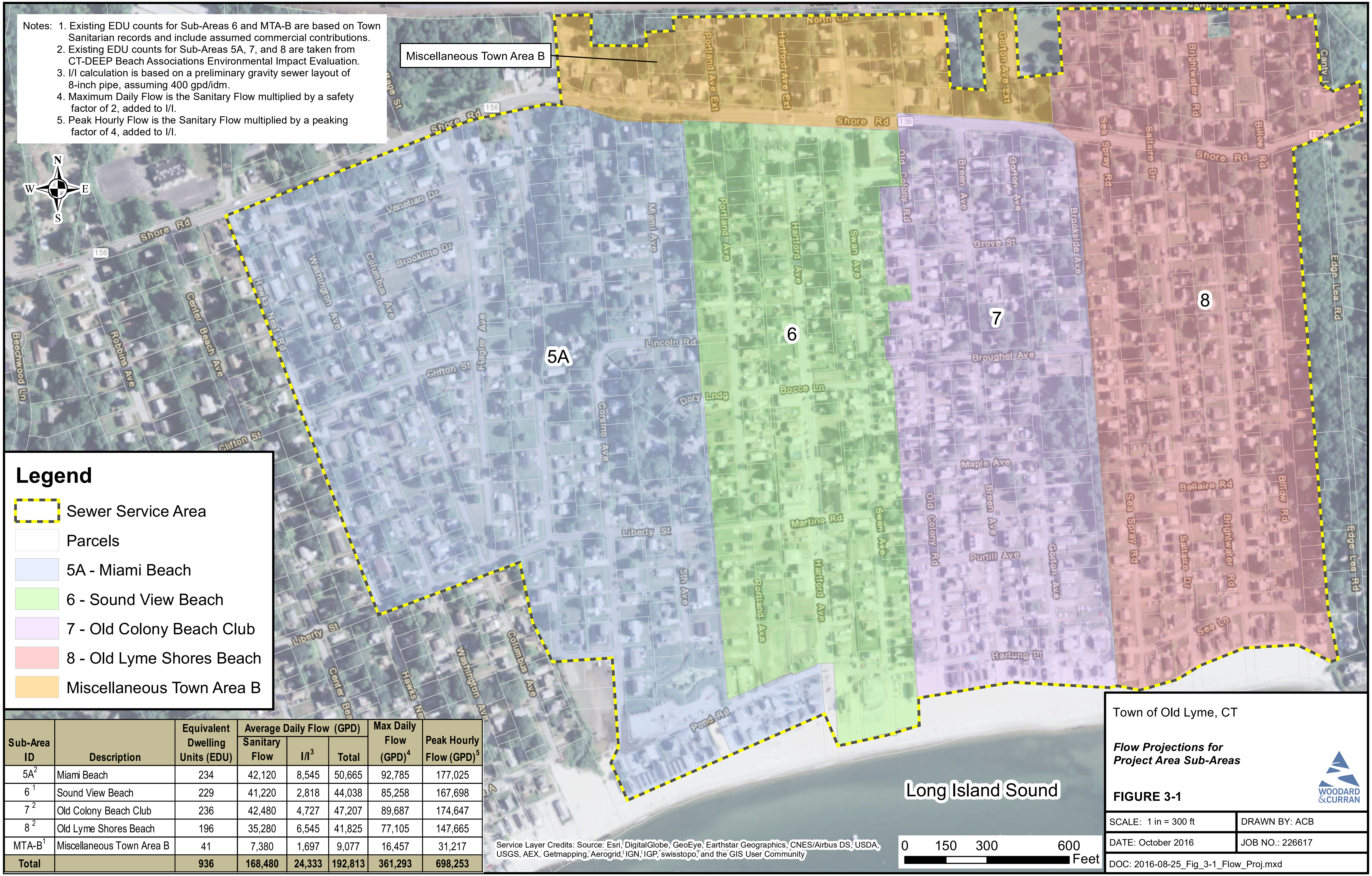
1. Existing EDU counts for Sub-Areas 6 and MTA-B are based on Town Sanitarian records and include assumed commercial contributions.
2. Existing EDU counts for Sub-Areas 5A, 7, and 8 are taken from CT-DEEP Beach Associations Environmental Impact Evaluation.
3. I/I estimate is based on a preliminary gravity sewer layout of 8-inch pipe, assuming 400 gpd/idm.
4. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
5. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.

Table 3-2: Summary of LPS and STEP Projections for High Needs Sub-Areas

Sub-Area ID	Description	Equivalent Dwelling Units (EDU)	Average Daily Flow (GPD)			Max Daily Flow (GPD)[4]	Peak Hourly Flow (GPD)[5]
			Sanitary Flow	I/I[3]	Total		
5A[2]	Miami Beach	234	42,120	2,136	44,256	86,376	170,616
6 [1]	Sound View Beach	229	41,220	705	41,925	83,145	165,585
7 [2]	Old Colony Beach Club	236	42,480	1,182	43,662	86,142	171,102
8 [2]	Old Lyme Shores Beach	196	35,280	1,636	36,916	72,196	142,756
MTA-B[1]	Miscellaneous Town Area B	41	7,380	424	7,804	15,184	29,944
Total		**936**	**168,480**	**6,083**	**174,563**	**343,043**	**680,003**

1. Existing EDU counts for Sub-Areas 6 and MTA-B are based on Town Sanitarian records and include commercial contributions.
2. Existing EDU counts for Sub-Areas 5A, 7, and 8 are taken from CT-DEEP Beach Associations Environmental Impact Evaluation.
3. I/I estimate is based on a preliminary gravity sewer layout of 8-inch pipe, assuming 400 gpd/idm.
4. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
5. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.

Notes:
1. Existing EDU counts for Sub-Areas 6 and MTA-B are based on Town Sanitarian records and include assumed commercial contributions.
2. Existing EDU counts for Sub-Areas 5A, 7, and 8 are taken from CT-DEEP Beach Associations Environmental Impact Evaluation.
3. I/I calculation is based on a preliminary gravity sewer layout of 8-inch pipe, assuming 400 gpd/idm.
4. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
5. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.



Legend

▨ Sewer Service Area

☐ Parcels

🟦 5A - Miami Beach

🟩 6 - Sound View Beach

🟪 7 - Old Colony Beach Club

🟥 8 - Old Lyme Shores Beach

🟧 Miscellaneous Town Area B

Sub-Area ID	Description	Equivalent Dwelling Units (EDU)	Average Daily Flow (GPD)			Max Daily Flow (GPD)[4]	Peak Hourly Flow (GPD)[5]
			Sanitary Flow	I/I[3]	Total		
5A[2]	Miami Beach	234	42,120	8,545	50,665	92,785	177,025
6[1]	Sound View Beach	229	41,220	2,818	44,038	85,258	167,698
7[2]	Old Colony Beach Club	236	42,480	4,727	47,207	89,687	174,647
8[2]	Old Lyme Shores Beach	196	35,280	6,545	41,825	77,105	147,665
MTA-B[1]	Miscellaneous Town Area B	41	7,380	1,697	9,077	16,457	31,217
Total		**936**	**168,480**	**24,333**	**192,813**	**361,293**	**698,253**

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Town of Old Lyme, CT

Flow Projections for Project Area Sub-Areas

FIGURE 3-1

WOODARD &CURRAN

SCALE: 1 in = 300 ft
DRAWN BY: ACB
DATE: October 2016
JOB NO.: 226617
DOC: 2016-08-25_Fig_3-1_Flow_Proj.mxd

3.3 SEASONAL FLOW VARIATIONS

Portions of the proposed Project Area include seasonal use. Since a good portion of the Project Area does not have metered drinking water, it is difficult to estimate current water consumption, future sanitary flows, and thus challenging to predict seasonal flow variations. It is our understanding that some of the residents close up their homes for the winter. Overall, the Town of Old Lyme estimates a 50% decline in population during the winter months. Based on data provided by the Town of East Lyme for the previously sewered Point-O-Woods neighborhood, where sewers were constructed approximately four years ago, actual wastewater flows are considerably lower than projected design flows. The average flow from May 2013 through August 2014 was approximately 20,000 gpd, which is approximately 19% of the 105,000 gpd design flow estimated during the design phase for that project. These seasonal flows are important to acknowledge when considering treatment and disposal alternatives and costs for the Local Alternatives, as well as the timing of downstream infrastructure needs (i.e. East Lyme, Waterford and New London) for the Regional Alternative.

Figure 3-2 presents the projected average daily flow, maximum daily flow, and peak hourly flow for the proposed Project Area. Figure 3-3 illustrates Point-O-Woods flow data from April 2013 to July 2014. Based on our review of the Point-O-Woods flow data, as well as discussions with CT-DEEP, we estimate that the initial flow rates, upon completion of the sewer construction activities, will be approximately one third of the design flow projections. This data is shown, along with the design flows, in Figure 3-2.

Figure 3-2: Flow Projections for Project Area (Gravity Sewer System)

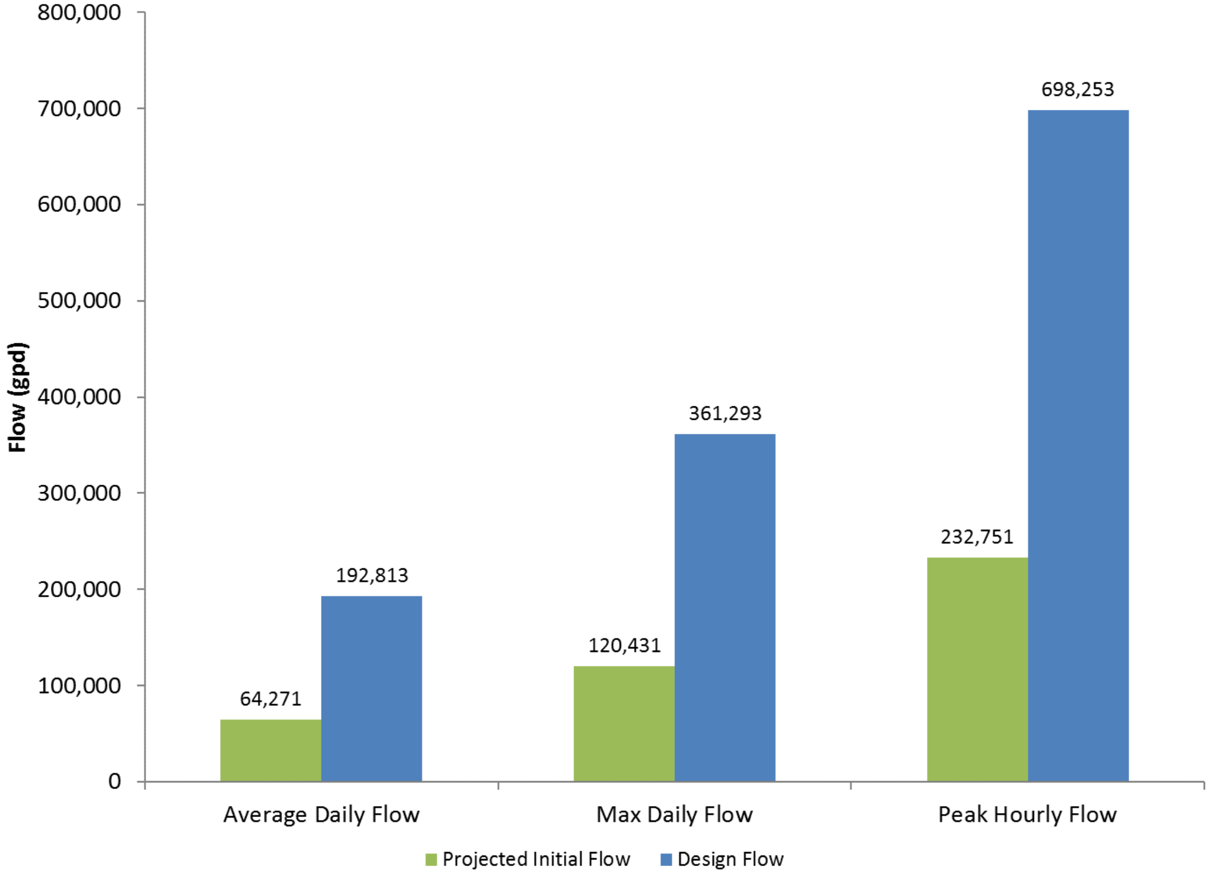
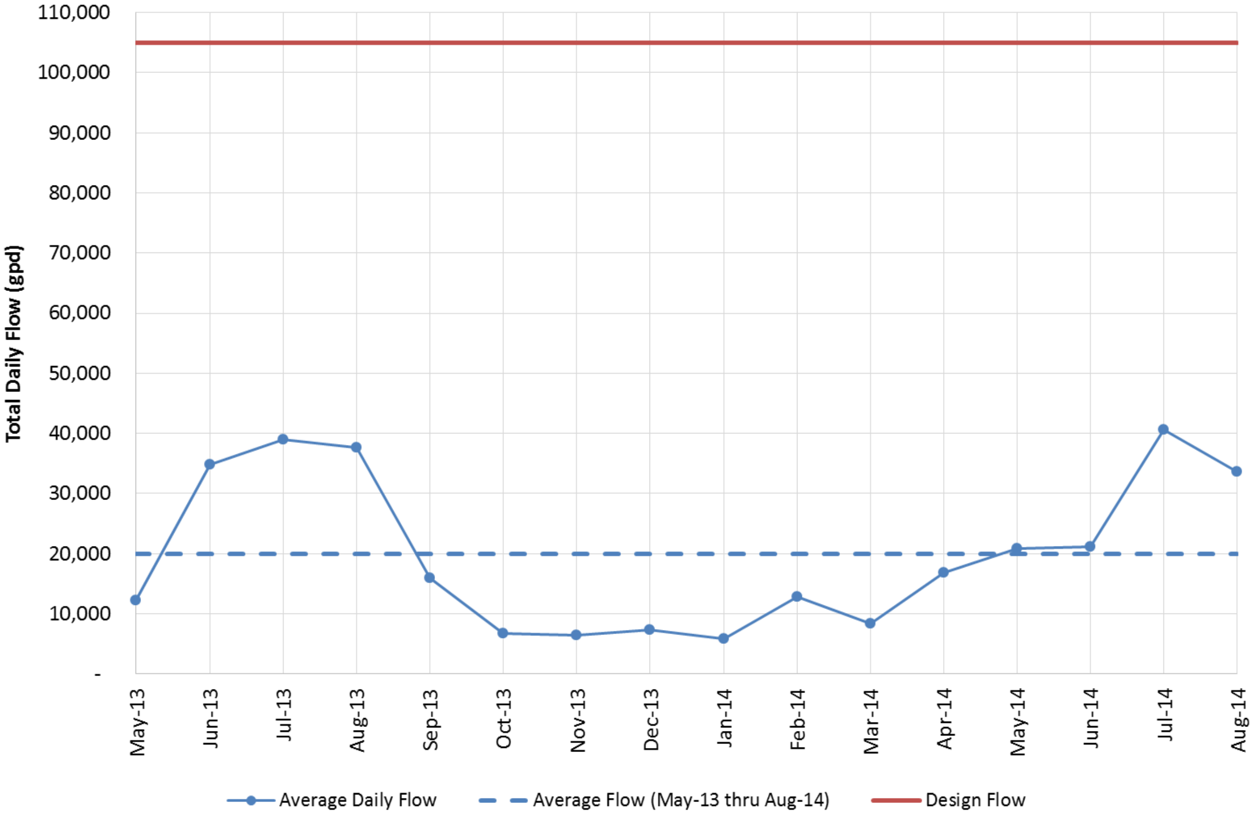


Figure 3-3: Flow Summary – Point-O-Woods



4. OVERVIEW OF LOCAL AND REGIONAL ALTERNATIVES

4.1 OVERVIEW

Sections 1, 2 and 3 presented an overview of the Project, a summary of past planning projects, the wastewater management needs analysis, and flow projections. This Section presents the overall wastewater management alternatives for the Project Area, including: (1) a Local Alternative with subsurface disposal and/or reuse; (2) a Local Alternative with surface disposal; and (3) a Regional Alternative.

4.2 WASTEWATER MANAGEMENT SYSTEMS OVERVIEW

Wastewater management systems consist of various infrastructure components which generally include: collection, treatment, disposal, and sometimes reuse. Figure 4-1 illustrates the wastewater management framework for these infrastructure components as they relate to the alternatives in Old Lyme. This graphic was used as a guide early in the Project, particularly during the public informational meetings, to educate the public on the options that were explored as part of the planning phase.

For all of the alternatives, the collection, treatment, disposal and reuse components are driven by the location of the treatment system and disposal site. For example, the Regional Alternative is predicated on the use of the existing New London WPCF to treat wastewater from the Project Area. Both Local Alternatives on the other hand rely on the construction of a new WPCF in Old Lyme, coupled with either local subsurface disposal/reuse or surface disposal to a nearby surface water (i.e. Connecticut River). The difference between the two Local Alternatives is the location(s) where treated effluent is disposed of or reused.

4.3 LOCAL ALTERNATIVES

4.3.1 Local Alternative 1 with Subsurface Disposal and Reuse

Local Alternative 1 includes multiple collection, treatment, disposal and reuse options. Following is a brief overview of each component of Local Alternative 1:

- Collection and Transmission System: Collection will utilize sewer infrastructure within the Project Area to collect wastewater and convey it to a common point for transmission to the treatment location. The collection and transmission system alternatives are discussed in Chapter 5.
- Treatment: Treatment will be accomplished with a local water pollution control facility (WPCF) in Old Lyme. The level of treatment required will depend of the permit requirements associated with the permit(s) issued for disposal and/or reuse. Treatment alternatives are discussed in Chapter 6.
- Disposal and Reuse: Disposal of treated effluent will be accomplished by discharging effluent into the ground, commonly referred to as subsurface disposal. To supplement disposal, effluent reuse for surface irrigation is a key component of the Local Alternative 1. Disposal and Reuse alternatives are discussed in Chapter 7.

4.3.2 Local Alternative 2 with Surface Disposal to the Connecticut River

Local Alternative 2 also includes multiple collection, treatment, and disposal options. Following is a brief overview of each component of this second Local Alternative:

- Collection and Transmission System Similar to Local Alternative 1: Collection will utilize sewer infrastructure within the Project Area to collect wastewater and convey it to a common point for transmission to the treatment location. The collection and transmission system alternatives are identical to those identified for Local Alternative 1 and are discussed in Chapter 5.

- Treatment: Treatment will be accomplished with a local WPCF in Old Lyme. The level of treatment required will depend of the permit requirements associated with the permit issued for disposal. Treatment alternatives are identical to those identified for Local alternative 1 and are discussed in Chapter 6.
- Disposal: Disposal of treated effluent will be accomplished by discharging effluent to the Connecticut River. Disposal alternatives are discussed in Chapter 7.

Figure 4-2 summarizes the key components of collection, treatment, disposal and/or reuse infrastructure associated with both of the Local Alternatives.

4.4 REGIONAL ALTERNATIVE

The Regional Alternative also includes collection, treatment and disposal components. Following is a brief overview of each component for the Regional Alternative:

- Collection and Transmission System: Similar to the Local Alternatives, collection for the Regional Alternative will utilize sewer infrastructure within the Project Area. In addition to the proposed transmission main from the Project Area to existing sewer in East Lyme, the Regional Alternative transmission system will use approximately ten miles of existing gravity sewer and force mains, and five existing pump stations in East Lyme, Waterford, and New London to convey wastewater to the New London WPCF. The collection and transmission system alternatives are discussed in Section 5.
- Treatment: Treatment will be accomplished at the existing WPCF in New London. New London has an existing NPDES permit dictating the level of treatment and permit criteria. Treatment alternatives are discussed in Chapter 6.
- Disposal: The New London WPCF performs surface water discharge of treated effluent to the Thames River, which is in close proximity to Long Island Sound.

Figure 4-3 depicts the key components of collection, treatment and disposal infrastructure associated with the Regional Alternative.

Figure 4-4 illustrates the common aspects of the Local and Regional Alternatives, together with the key differences between them, especially related to treatment and disposal/reuse. The collection, treatment, disposal, and reuse components for the Local and Regional Alternatives were used in Sections 5, 6 and 7 to develop and evaluate specific alternatives and costs for both options.

Figure 4-1: Summary of Framework for Wastewater Management Alternatives in Old Lyme

Wastewater Management Plan Project
Town of Old Lyme, Connecticut

Updated October 2016

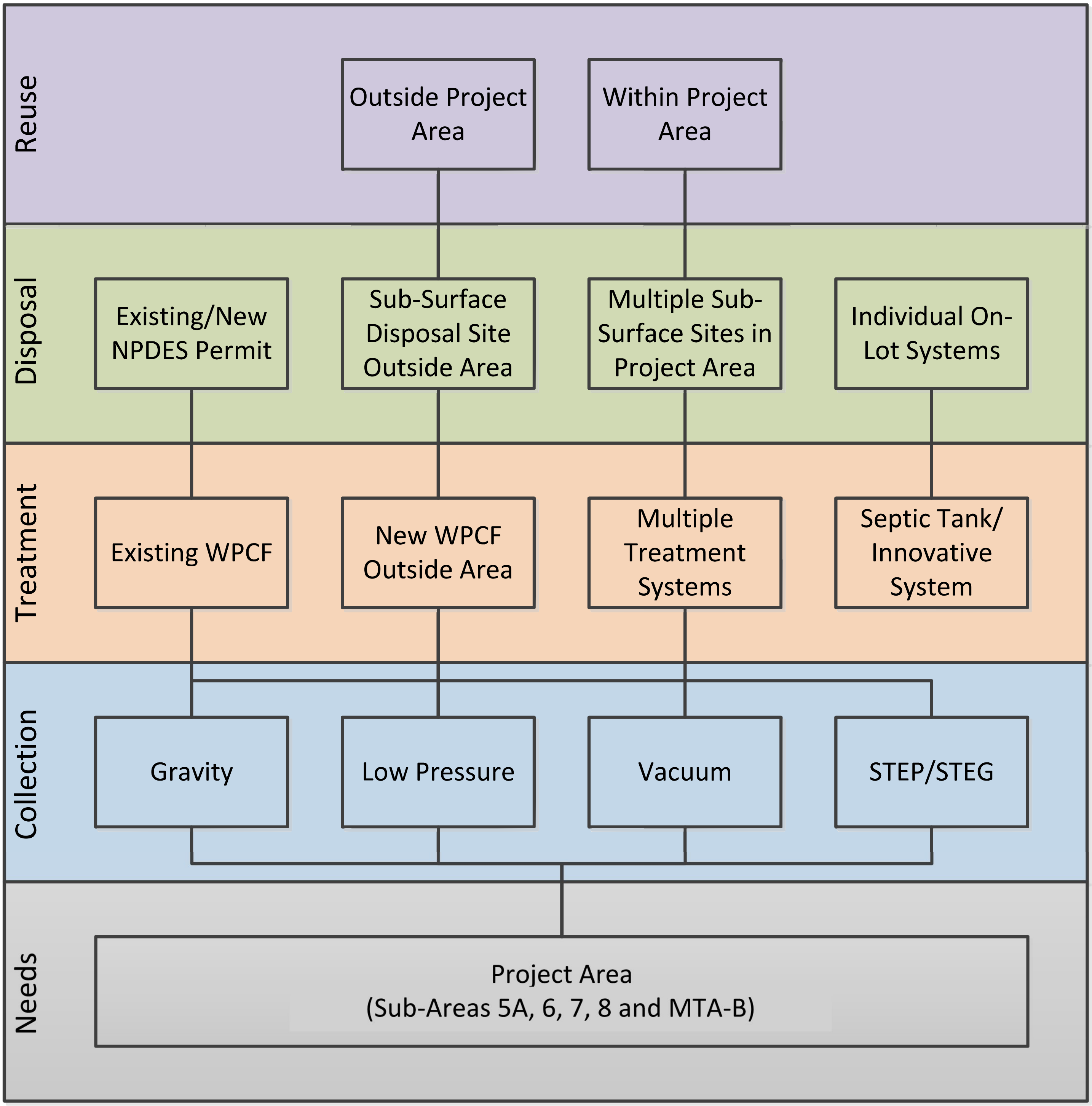
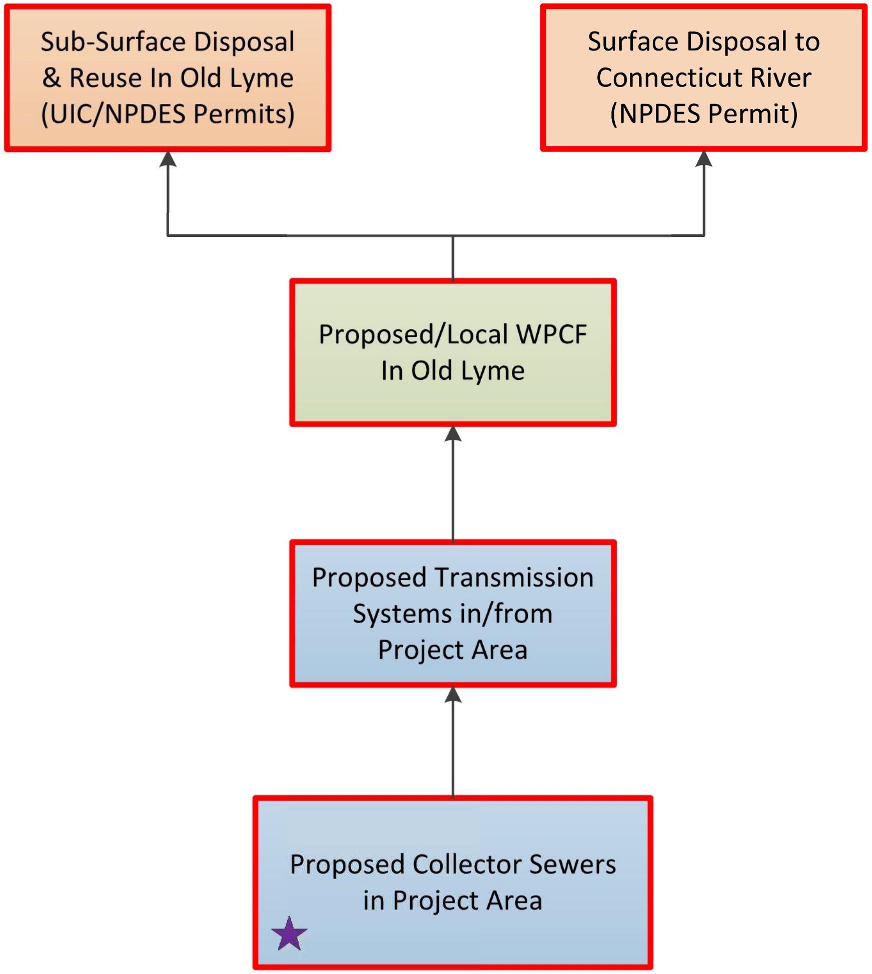


Figure 4-2: Local Alternatives Stick Diagram

Wastewater Management Plan Project

Town of Old Lyme, Connecticut

Updated October 2016



LEGEND:

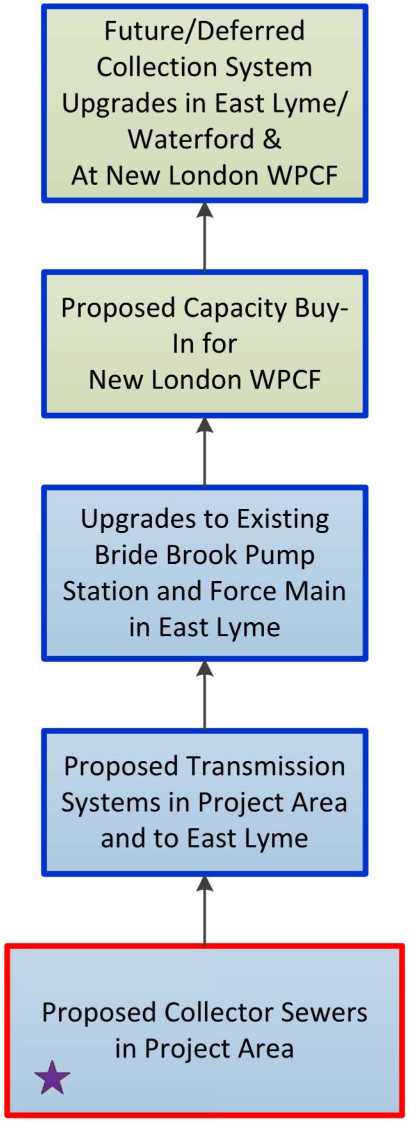
🟦	Collection Alternatives	🟧	Disposal/Reuse Alternatives	★	936 EDUs Total
🟩	Treatment Alternatives	🟥	Local Alternatives		

Figure 4-3: Regional Alternative Stick Diagram

Wastewater Management Plan Project

Town of Old Lyme, Connecticut

Updated October 2016



LEGEND:

🟦 Collection Alternatives

🟧 Disposal/Reuse Alternatives

★ 936 EDUs Total

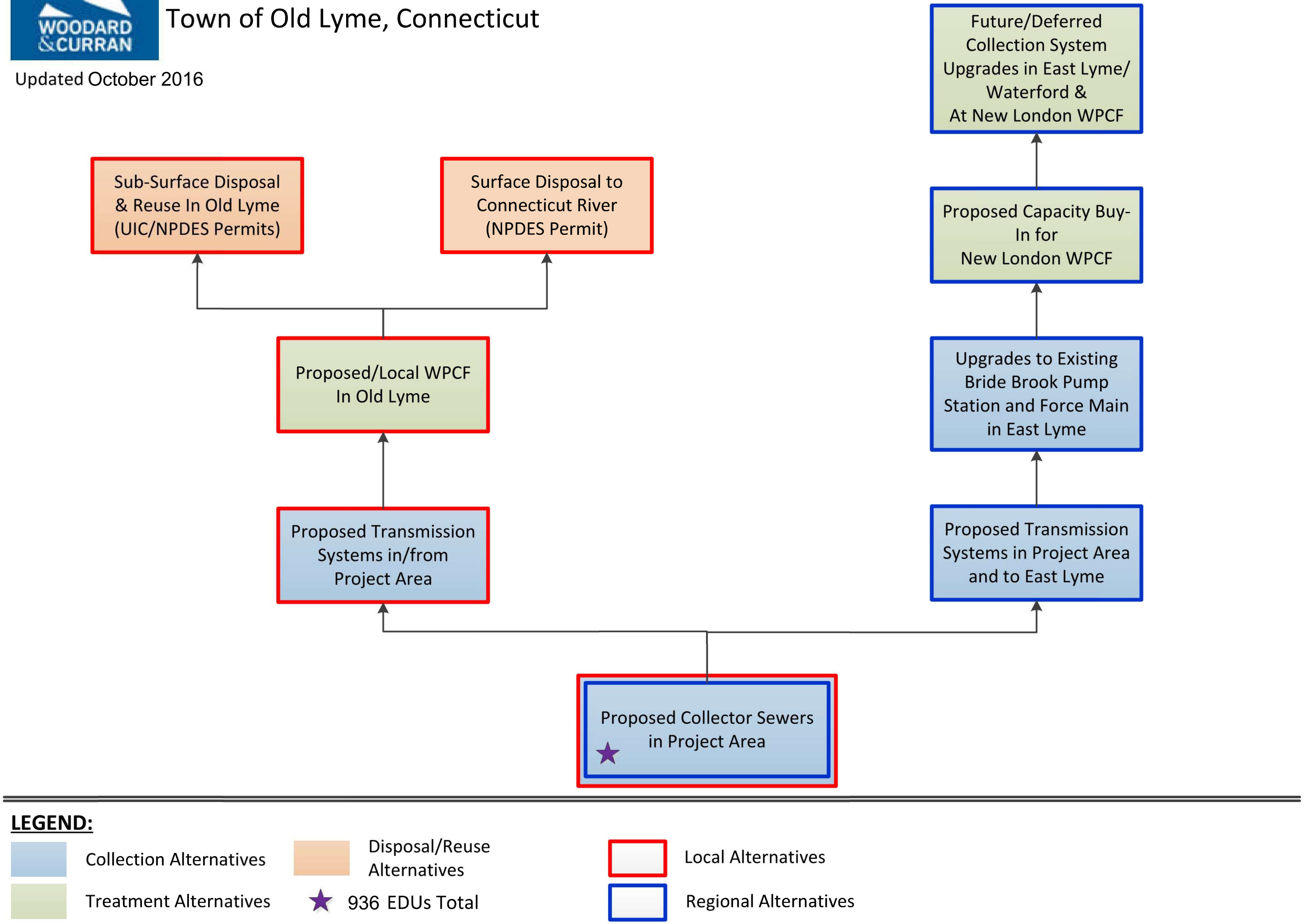
🟩 Treatment Alternatives

🟥 Local Alternatives

Figure 4-4 – Summary of Local and Regional Alternatives

Wastewater Management Plan Project
Town of Old Lyme, Connecticut

Updated October 2016



5. COLLECTION AND TRANSMISSION SYSTEM ALTERNATIVES

5.1 OVERVIEW

As part of the Coastal Wastewater Management Plan, we evaluated collection and transmission system alternatives and developed an opinion of probable cost (OPC) for each collection system (type and component) for both the Local and Regional Alternatives. This Section includes an overview of each collection and transmission system alternative, capital and annual operation and maintenance cost projections, as well as other non-cost considerations related to the collection and transmission system components for the Local and Regional Alternatives.

In order to project the total anticipated capital cost to the homeowners, the OPC for each alternative includes ancillary items that are sometimes paid by each homeowner after construction. For example, the low pressure system option includes the costs associated with the on-site grinder pumps, as well as electrical improvements in the home. However, all collection system alternatives exclude the cost of abandoning the existing septic system, and connecting the plumbing from the home to either the lateral stub or pumping unit.

5.2 COLLECTION SYSTEM TERMINOLOGY

There are several collection system configurations. These include: gravity; low pressure; septic tank effluent gravity/pumping; and vacuum. In order to evaluate the options for the Local and Regional Alternatives, a brief summary of each sewer system option follows.

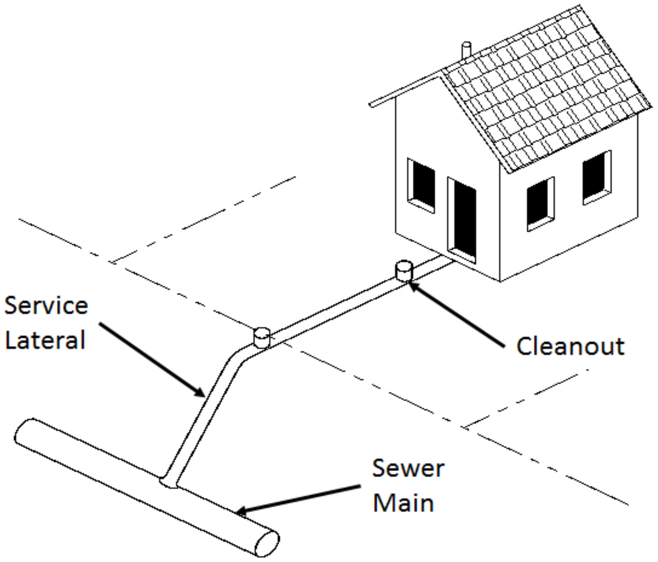
5.2.1 Gravity Sewer

A gravity collection system is the most conventional sewer collection system. A gravity sewer relies on an integrated system of pipes that are sloped to a lower elevation. In those systems where the low point is below the treatment system elevation or below other downstream parts of the collection system, a pump station is required to convey the wastewater to a higher desired elevation through a force main. This process is repeated until the wastewater reaches the treatment facility. Figure 5-1 illustrates the common features of a sewer lateral for a gravity sewer system. A well-constructed gravity system needs little maintenance (aside from the pump stations) because the majority of the system is non-mechanical, relying on the natural force of gravity to convey the wastewater.

5.2.2 Low Pressure Sewer

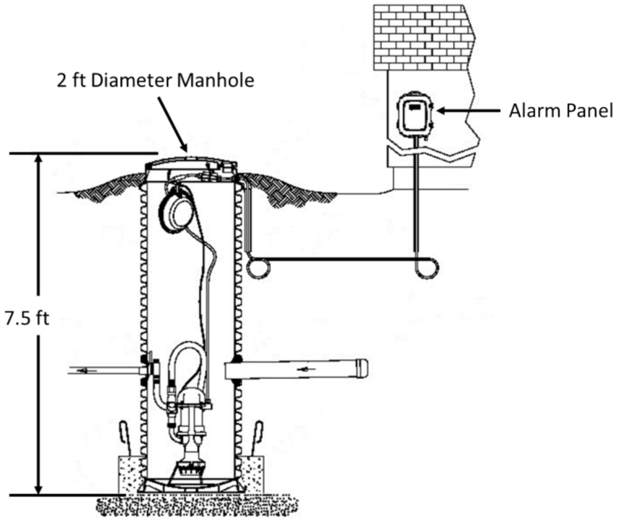
A low pressure system conveys wastewater through individual grinder pumps at each dwelling unit. The low pressure collection system relies on individual pumps and valves to each property. A typical low pressure sewer system is depicted in Figure 5-2. Due to the higher level of reliance on mechanical systems, low pressure sewers have a higher operation and maintenance cost than gravity sewers. Benefits to this type of system are that the pipes conveying the sewer flows are smaller in diameter than a gravity system and can be buried at a constant elevation just below the frost line. These factors make construction easier, and reduce the time and cost of excavation. In addition, I/I is generally lower in a low pressure sewer system than a gravity system.

Figure 5-1: Typical Gravity Sewer Service Lateral



Adapted from source: *http://www.stpete.org/water/wwater_collection_and_maintenance.asp*

Figure 5-2: Typical Low Pressure Sewer Grinder Pump System



Adapted from source: http://thelakesatoxford.com/Sewer%20information/E-One%20manual.html

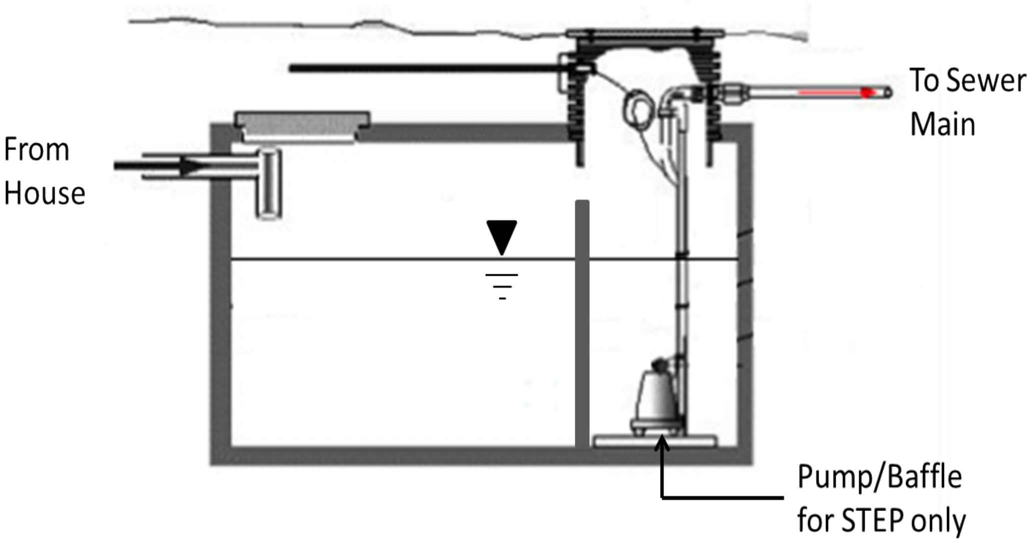
5.2.3 Septic Tank Effluent Gravity Sewer

A septic tank effluent gravity (STEG) system incorporates a conventional on-site septic tank with a conventional gravity collection system. The purpose of a STEG system is to pre-treat the wastewater, reducing solids and the biological load that needs to be treated. For some smaller STEG systems, septic tanks are the only treatment that occurs, and the gravity portion of the system allows the effluent to be redirected to a site where it can be disposed of, often through sub-surface disposal, which may not have been possible on the individual home lots due to poor soils and/or high groundwater conditions. A STEG system schematic is shown in Figure 5-3. The advantages and disadvantages of the STEG system are similar to a gravity system. However, for small lots, the task of siting a modern/compliant septic tank can be challenging and costly, as compared to a gravity system.

5.2.4 Septic Tank Effluent Pump Sewer

A septic tank effluent pumping (STEP) system is very similar to the STEG system, where conventional on-site septic tanks are used to pre-treat the wastewater, reducing solids and the biological load that needs to be treated. The difference is based on how the wastewater is conveyed to the treatment plant for the STEP option. Instead of a STEG system, each individual septic tank would incorporate a pump to convey wastewater under pressure to the treatment, in a manner similar to that of a low pressure. A STEP system schematic is shown in Figure 5-3. The advantages and disadvantages of the STEP system are similar to a low pressure sewer system. Similar to the STEG option, the task of siting a modern/compliant septic tank can be challenging and costly for the STEP alternative, as compared to the low pressure option.

Figure 5-3: Typical STEG/STEP Septic Tank Configuration



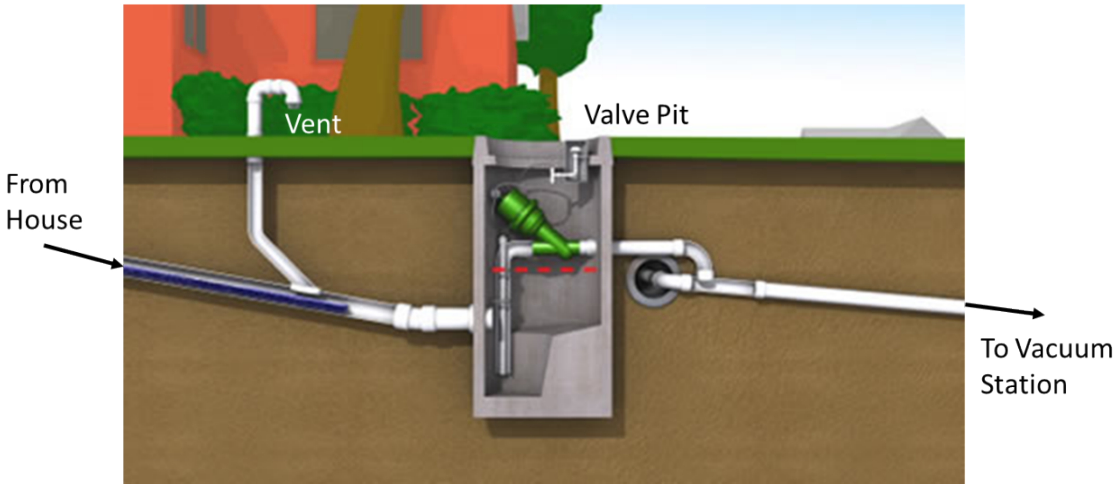
Typical Septic Tank Dimensions: 10 ft long x 5 ft wide x 6 ft deep

Adapted from source: http://lillyseptic.com/septic-system-services/septic-tank-pumping-service/

5.2.5 Vacuum Sewer

A vacuum sewer system is a unique sewer option that can be seen as a cross between a gravity system and a low pressure sewer system. This is because the collection system conveys flow from the home to the street line via gravity, and then under pressure through smaller diameter pipes, similar to a low pressure sewer system. Vacuum systems are less common and make up a small percentage of the collection systems in the northeast. A vacuum sewer system is shown in Figure 5-4. Vacuum pump stations have limited capabilities for conveying flows over large differences in elevation, which require higher head or pressure requirements. Vacuum sewers are best implemented over flat areas where one vacuum pump station can be used to convey a high percentage of the collection system flows similar to what may be seen in the central to mid-west areas of the United States. Vacuum sewer systems have a narrow hydraulic operating range

Figure 5-4: Typical Vacuum Sewer Lateral



Adapted from source: http://www.technohaus.ru/index.php?ukey=auxpage_ob-ugle-naklona-i-ego-roli-v-kanalizacionnoj-sisteme

5.3 COLLECTION SYSTEM ALTERNATIVE IN PROJECT AREA

The collection system alternatives within the Project Area are very similar for the Local and Regional Alternatives. Therefore, the following text highlights some of the key aspects of each sewer alternative, advantages, disadvantages, and costs.

Example of large pump station building in coastal community

Example of small pump station building near beach coastal neighborhood

5.3.1 Gravity Alternative

In general, the Project Area would have one pump station set back from the shoreline where wastewater would flow by gravity, and then be pumped to an interceptor or common transmission system in or along Route 156. One advantage to a gravity system that directly relates to a shoreline community is its ability to be storm ready. With the majority of the Project Area adjacent to the ocean and in some cases adjacent to flood zones, a gravity system can be designed with flood-proof features including watertight manholes and backup generators at the pump stations that would keep the system functioning during severe weather events. A common disadvantage to a gravity type system is the elevated I/I potential, which can increase conveyance and treatment costs, entering the system.

Capital costs for the gravity system are presented in Table 5-1. Considerations for the gravity sewer capital costs include a cost per linear foot of gravity pipe installed, which incorporates installation of sewer services and sewer manholes. Preliminary layouts of the gravity system were prepared to estimate how many pump stations are required. It should be noted that the costs associated with connection of individual houses to the gravity sewer and the demolition and/or removal of the existing septic and/or leaching systems are not included.

5.3.2 Low Pressure System Alternative

Costs for a LPS system include the expenses for all equivalent dwelling units to have a grinder pump system installed at the house/building, which included an assumption that many of the homes would need electrical upgrades to accommodate the grinder pumps. Also, many homes would need a watertight system for the grinder pump due to their proximity to the ocean (flood zone). Other costs included the installation of pipe per linear foot and include costs for valves and cleanouts. Table 5-2 includes the capital cost summary for the low pressure sewer alternative. Note that the costs associated with the connection of individual houses to the low pressure system (LPS) and the demolition and/or removal of the existing septic and/or leaching systems are not included. However, and as mentioned before, the costs related to the installation of the grinder pumps, as well as anticipated electrical improvements in the home are included. Due to the density of development in the Project Area, and the number of grinder pumps required, the LPS costs are high. In addition, maintenance of grinder pumps during power outages would be operator intensive.

5.3.3 Septic Tank Effluent Gravity Alternative

Costs associated with a STEG system include the costs for a gravity system and additional costs for a new septic tank to be installed on many of the properties. Table 5-3 includes the capital cost summary for the STEG sewer alternative. Maintenance costs for the collection system must also incorporate hauling sludge, while the treatment plant capital and maintenance must also reflect differences in tank size needed for clarification and BOD removal and less yearly chemical addition. Note that the costs associated with the STEG sewer connection system to the individual houses and the demolition and/or removal of the existing septic and/or leaching systems are not included.

5.3.4 Septic Tank Effluent Pump Alternative

Costs incorporated with a STEP system include the LPS system components and the additional costs of a new septic tank to be installed on each property. Table 5-4 includes the capital cost summary for the STEP sewer alternative. Maintenance costs for the collection system must also incorporate hauling sludge, while the treatment plant capital and maintenance must also reflect differences in tank size needed for clarification and BOD removal and

Typical STEP Sewer Configuration. Source: http://www.orenco.com/systems/wastewater_collection.cfm less yearly chemical addition. Note that the costs associated with the STEP sewer connection system to the individual houses and the demolition and/or removal of the existing septic and/or leaching systems are not included.

5.3.5 Vacuum Alternative

For the purpose of this Coastal Wastewater Management Plan, vacuum sewers were preliminarily evaluated and eliminated from further consideration, due to the size and topography of the Project Area, as well as the distance from the East Lyme receiving systems.

5.4 TRANSMISSION SYSTEM INFRASTRUCTURE

Each of the Project Area Sub-Areas are evaluated independently for the types of collection systems that would provide the best fit, both in terms of costs and non-cost factors. At the same time, all the individual collection systems are being conveyed to one local or regional treatment plant for the best economies of scale for treatment. Also, construction and maintenance of independent collection systems must be considered when building and operating the system. To provide the best fit for the Project Area Sub-Areas by combining and conveying flows to a common wastewater treatment plant for the Local Alternative, or a common pump station for the Regional Alternative, the cost for a transmission system was estimated and preliminarily designed separately.

5.4.1 Local Alternative Transmission System

The Local Alternative transmission system would primarily be composed of a combination of force main and gravity sewer in Route 156 that would for the (purpose of this report) convey flows to a wastewater treatment facility just north of Sub-Area 5A. Table 5-5 includes a capital cost summary for the gravity/STEG transmission system associated with the Local Alternative. The costs for this option include one pump station at the Sound View Beach Association (Sub-Area 6) to convey flows from the Project Area Sub-Areas to the proposed Water Pollution Control Facility (WPCF). Table 5-6 includes a capital cost summary for the LPS/STEP transmission system associated with the Local Alternative. This option would potentially not need any additional pump station to convey the flows to the gravity sewer in Route 156. Figure 5-5 shows the proposed transmission system for the local alternatives. The location of the proposed pump station is not finalized and may change during the design phase of the project.

5.4.2 Regional Alternative Transmission System

The Regional Alternative transmission system would convey wastewater in a similar configuration as the Local Alternative. The wastewater would be conveyed primarily through a force main to a common pump station, potentially located in Sub-Area 6, as shown in Figure 5-6. The Regional Alternative transmission system differs from the Local Alternative transmission system by the additional force main to get to the East Lyme collection system. For the purpose of this report, the additional costs to get from Old Lyme to East Lyme are assumed to be similar to the quantities as provided in the 2012 Joint Facilities Plan Addendum for Sub-Areas 7 and 8 plus any additional force main costs to account for the assumed location of the common pump station in Sub-Area 6.

Table 5-7 includes a capital cost summary for the gravity/STEG transmission system associated with the Regional alternative, and Table 5-8 summarizes the capital cost for the LPS/STEP transmission system associated with the Regional Alternative.

5.4.3 Odor Control Measures for the Transmission System

Based on the length of the proposed force main from the proposed Old Lyme Pump Station to the East Lyme collection system, coupled with the seasonal flow variations, the elevated hydraulic residence time in the force main, may result in the potential generation of hydrogen sulfide. Hydrogen sulfide can lead to odors and corrosion problems downstream. Therefore, the proposed Project includes several measures to minimize odor and corrosion potential. These include:

- Since the initial flows following construction will likely be far lower than the projected design flows for the entire Project Area, we have incorporated two parallel force mains between the pump station and the East Lyme collection system. The smaller 6-inch diameter pipe will convey low flows in initial years, as well as off-peak seasonal flows during winter months. This will significantly decrease the hydraulic residence time in the pipe and decrease the potential for odors and corrosion. As flows increase, and during peak summer months, the second larger (10-inch) force main will convey flows, maintaining a higher pumping rate.

- In addition to the two force mains, provisions for an odor control chemical (i.e. Bioxide) will be integrated in the Pump Station design. This will minimize the potential for odors at the Pump Station, especially during warmer months.

- Lastly, a second chemical system will provide additional odor control provisions, to minimize the potential for odor and corrosion concerns at the downstream discharge in East Lyme. This secondary odor control unit can be built into an existing pump station in East Lyme thereby negating the need for additional chemical facilities along Route 156 in Old Lyme.

It should be noted that the increase in flows to the East Lyme and Waterford pump stations will increase average daily flows through the system, absent increases in pumping rates, and therefore the potential for odors and corrosion in downstream receiving sewers should actually decrease following connection of the Old Lyme system to the downstream sewers.

5.5 ANNUAL O&M COSTS

Annual O&M costs for all of the collection system options, for both the Local and Regional Alternatives, are summarized in Table 5-9.

As part of this project, we reviewed available wastewater flow data for the Point-of-Woods sewer system. Roughly four years after sewers were constructed in Point-of-Woods, average annual flows are approximately 20% of the design flows estimated during the planning phase for that project. Since the Town's current project included similar flow criteria as did Point-of-Woods, we believe that Year 1 flows following construction will be much lower than design flow estimates. For the purpose of estimating flows and respective O&M costs, we assumed that Year 1 flows would be approximately one-third (33%) of the design flow estimate. Therefore, the annual costs associated with the project, which will be based on gallons-used, will be much lower in initial years following construction than they may be 5 to 10 years after sewers are constructed.

5.6 REGIONAL ALTERNATIVE SEWER SYSTEM CONFIGURATIONS

The Regional Alternative collection system facilities comprise the future individual Sub-Area collection systems, the future regional transmission system in Old Lyme, as well as the existing downstream conveyance infrastructure, which is comprised of approximately 10 miles of existing force main and gravity sewers to get to the New London Water Pollution Control Facility (WPCF). As shown in Figure 5-7, the collection system route to New London also consists of five downstream pump stations in East Lyme and Waterford (Bride Brook, Route 156, Pattagansett, Niantic, and Evergreen pump stations).

The collection system for the Regional Alternative includes the majority of the potential capital and annual costs. This is attributed to the overall distance the wastewater would need to travel, as shown in Figures 5-6 and 5-7. To best match the current agreement between Point-O-Woods and East Lyme, capital and annual costs were estimated based on flow percentages. Additionally, costs for potential capital upgrades for each pump station are divided based on a flow percentage for each community along with a conservative price sharing contingency for Old Lyme flows, due to the accelerated timing of capacity upgrades in East Lyme. Based on discussion with CT-DEEP, East Lyme and

Waterford, future downstream capital cost upgrades will be implemented on as-needed basis as Old Lyme flows increase to projected design capacities.

5.6.1 Downstream Sewers in East Lyme and Waterford

Table 5-10 depicts the capacities and flows for each of the downstream community pump stations, the downstream communities' future needs, and the additional flows the Project Area would reflect on each pump station. As shown in Table 5-10, the Old Lyme flow contribution from the Project Area is estimated under two different flow conditions: (1) flows expected one year after project completion (initial flows) and (2) design flows, which correspond to complete community connection to sewer within the Project Area. As discussed in Section 3.3, Year One flow is expected to be approximately one third of the Project Area design flow, based on data collected from Point O' Woods. The basis of Table 5-10 is the 2007 East Lyme Capacity Analysis and Planning Report. The Waterford pump station flows and capacities are from the 2011 Waterford Wastewater Facilities Plan Update.

As mentioned in section 5-4, we are planning to incorporate two parallel force mains (6" and 10") between the pump station and the East Lyme collection system. This will allow Old Lyme to minimize peak flows to East Lyme until the flows go above 33% of design projections. This could be several years down the road, if consistent with post-construction flow trends from Point-O-Woods.

As shown in Table 5-10 and based on initial flow projections, it does not appear that any of the East Lyme pump stations will be above their rated capacities. However, we did include relocation and replacement of the Bride Brook Pump Station, per the on-going mechanical and hydraulic limitations, as part of the proposed Project.

Table 5-11 summarizes the downstream infrastructure capital needs for the Regional Alternative. As shown, all capital needs for the downstream infrastructure, except Bride Brook pump station and force main, are to be deferred and will be implemented on an as needed basis, to be discussed with East Lyme and Waterford.

Table 5-11 also shows the assumed percentage of costs that would be allocated to the Project Area, as percentage of peak hourly design flow. The downstream pump station, force main, and collection system gravity main upgrades contribute to the cost of the Regional Alternative capital collection system costs.

Table 5-1: 2014 Capital Costs for Gravity Sewer Alternative – Collector Sewer

			Sub-Area									
Gravity Sewer Items			5A - Miami Beach		**6 - Sound View Beach**		7 - Old Colony Beach Club		8 - Old Lyme Shores Beach		**Misc. Town Area B**	
Equivalent Dwelling Units			234		229		236		196		41	
	Unit	Unit Price	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total
8" Gravity Pipe[1]	LF	$100	11,800	$1,180,000	5,900	$590,000	6,600	$660,000	9,600	$960,000	4,200	$420,000
12" Gravity Pipe[1]	LF	$125	1,700	$213,000	700	$88,000	800	$100,000	700	$88,000	0	$0
Trench Repair[2]	LF	$20	13,500	$270,000	6,600	$132,000	7,400	$148,000	10,300	$206,000	4,200	$84,000
Milling[3]	LF	$35	13,500	$473,000	6,600	$231,000	7,400	$259,000	10,300	$361,000	4,200	$147,000
Full Width Overlay	LF	$35	13,500	$473,000	6,600	$231,000	7,400	$259,000	10,300	$361,000	4,200	$147,000
Rock Excavation[4]	CY	$70	2,500	$175,000	1,200	$84,000	1,400	$98,000	1,900	$133,000	800	$56,000
Trench Dewatering	LF	$40	13,500	$540,000	6,600	$264,000	7,400	$296,000	10,300	$412,000	4,200	$168,000
Environmental Protection	LF	$10	3,375	$34,000	1,650	$17,000	1,850	$19,000	2,575	$26,000	1,050	$11,000
Police Detail[5]	Days	$960	284	$273,000	139	$133,000	155	$149,000	216	$207,000	88	$84,000
Subtotal				$3,631,000		$1,770,000		$1,988,000		$2,754,000		$1,117,000
40% Contingency, Legal and Engineering Services				$1,452,000		$708,000		$795,000		$1,102,000		$447,000
TOTAL[6]				**$5,083,000**		**$2,478,000**		**$2,783,000**		**$3,856,000**		**$1,564,000**
Combined Project Area[7]												**$15,764,000**

1. Sewer Manholes and Service lateral stubs are included in the unit cost of gravity piping

2. Trench Repair assumes 3" of pavement at 6.5 ft wide

3. Milling assumes 1.5" of pavement at full width of the road

4. Rock Excavation is assumed to be a 1 foot depth for every linear feet of trench for Gravity Piping

5. Assuming pipe is laid at a rate of 100 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

6. All Totals rounded to the nearest $1,000

7. Costs associated with the connection of individual houses to the gravity sewer and the demolition and/or removal of existing septic and/or leaching systems are not included

Table 5-2: 2014 Capital Costs for Low Pressure Sewer Alternative – Collector Sewer

			Sub-Area									
Low Pressure Sewer Items			5A - Miami Beach		**6 - Sound View Beach**		7 - Old Colony Beach Club		8 - Old Lyme Shores Beach		**Misc. Town Area B**	
Equivalent Dwelling Units			234		229		236		196		41	
	Unit	Unit Price	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total
1.5"-6" PVC Force Main[1]	LF	$40	13,600	$544,000	6,500	$260,000	7,400	$296,000	10,300	$412,000	4,200	$168,000
Grinder Pumps[2]	EA	$7,000	234	$1,638,000	229	$1,603,000	236	$1,652,000	196	$1,372,000	41	$287,000
Electrical Panel Upgrades[2]	EA	$2,000	59	$117,000	57	$115,000	59	$118,000	49	$98,000	10	$21,000
Trench Repair[3]	LF	$20	13,600	$272,000	6,500	$130,000	7,400	$148,000	10,300	$206,000	4,200	$84,000
Milling[4]	LF	$35	13,600	$476,000	6,500	$228,000	7,400	$259,000	10,300	$361,000	4,200	$147,000
Full Width Overlay	LF	$35	13,600	$476,000	6,500	$228,000	7,400	$259,000	10,300	$361,000	4,200	$147,000
Rock Excavation[5]	CY	$70	1,300	$91,000	600	$42,000	700	$49,000	1,000	$70,000	400	$28,000
Trench Dewatering	LF	$20	13,600	$272,000	6,500	$130,000	7,400	$148,000	10,300	$206,000	4,200	$84,000
Environmental Protection	LF	$10	3,400	$34,000	1,625	$16,000	1,850	$19,000	2,575	$26,000	1,050	$11,000
Police Detail[6]	Days	$960	286	$275,000	115	$110,000	131	$126,000	182	$175,000	74	$71,000
Subtotal				$4,195,000		$2,862,000		$3,074,000		$3,287,000		$1,048,000
40% Contingency, Legal and Engineering Services				$1,678,000		$1,145,000		$1,230,000		$1,315,000		$419,000
TOTAL[7]				$5,873,000		**$4,007,000**		$4,304,000		$4,602,000		**$1,467,000**
Combined Project Area[8]												**$20,253,000**

1. PVC unit costs include all cleanouts, valve connections and vaults

2. Grinder pump unit costs include installation. Electrical panel upgrades are assumed to be required by 1/4 of homes

3. Trench Repair assumes 3" of pavement at 6.5 ft wide

4. Milling assumes 1.5" of pavement at full width of the road

5. Rock Excavation is assumed to be a 0.5 foot depth for every linear feet of trench for LPS Piping

6. Assuming pipe is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

7. All Totals rounded to the nearest $1,000

8. Costs associated with the connection of individual houses to the LPS and the demolition and/or removal of existing septic and/or leaching systems are not included

Table 5-3: 2014 Capital Costs for STEG Sewer Alternative – Collector Sewer

			Sub-Area									
STEG Sewer Items			5A - Miami Beach		**6 - Sound View Beach**		7 - Old Colony Beach Club		8 - Old Lyme Shores Beach		**Misc. Town Area B**	
Equivalent Dwelling Units			234		229		236		196		41	
	Unit	Unit Price	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total
8" Gravity Pipe[1]	LF	$100	13,000	$1,300,000	6,300	$630,000	6,800	$680,000	9,600	$960,000	2,500	$250,000
12" Gravity Pipe[1]	LF	$125	2,200	$275,000	200	$25,000	800	$100,000	700	$88,000	0	$0
Septic Tanks[2]	EA	$4,500	117	$527,000	115	$515,000	118	$531,000	98	$441,000	21	$92,000
Trench Repair[3]	LF	$20	15,200	$304,000	6,500	$130,000	7,600	$152,000	10,300	$206,000	2,500	$50,000
Milling[4]	LF	$35	15,200	$532,000	6,500	$228,000	7,600	$266,000	10,300	$361,000	2,500	$88,000
Full Width Overlay	LF	$35	15,200	$532,000	6,500	$228,000	7,600	$266,000	10,300	$361,000	2,500	$88,000
Rock Excavation[5]	CY	$70	2,800	$196,000	1,200	$84,000	1,400	$98,000	1,900	$133,000	500	$35,000
Trench Dewatering	LF	$40	15,200	$608,000	6,500	$260,000	7,600	$304,000	10,300	$412,000	2,500	$100,000
Environmental Protection	LF	$10	3,800	$38,000	1,625	$16,000	1,900	$19,000	2,575	$26,000	625	$6,000
Police Detail[6]	Days	$960	152	$146,000	65	$62,000	76	$73,000	103	$99,000	25	$24,000
Subtotal				$4,458,000		$2,178,000		$2,489,000		$3,087,000		$733,000
40% Contingency, Legal and Engineering Services				$1,783,000		$871,000		$996,000		$1,235,000		$293,000
TOTAL[7]				$6,241,000		**$3,049,000**		$3,485,000		$4,322,000		**$1,026,000**
Combined Project Area[8]												**$18,123,000**

1. Sewer Manholes and Service connections are included in the unit cost of gravity piping

2. Septic tank unit costs include installation and are assumed for 50% of all existing homes.

3. Trench Repair assumes 3" of pavement at 6.5 ft wide

4. Milling assumes 1.5" of pavement at full width of the road

5. Rock Excavation is assumed to be a 1 foot depth for every linear feet of trench for Gravity Piping

6. Assuming pipe is laid at a rate of 100 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

7. All Totals rounded to the nearest $1,000

8. Costs associated with the connection of individual houses to the STEG sewer and the demolition and/or removal of existing septic and/or leaching systems are not included

Table 5-4: 2014 Capital Costs for STEP Sewer Alternative – Collector Sewer

			Sub-Area									
STEP Sewer Items			5A - Miami Beach		**6 - Sound View Beach**		7 - Old Colony Beach Club		8 - Old Lyme Shores Beach		**Misc. Town Area B**	
Equivalent Dwelling Units			234		229		236		196		41	
	Unit	Unit Price	Qty	Total	Qty	Total	Qty	Total	Qty	Total	Qty	Total
1.5"-6" PVC Force Main[1]	LF	$40	13,600	$544,000	6,500	$260,000	7,400	$296,000	10,300	$412,000	4,200	$168,000
Grinder Pumps[2]	EA	$7,000	234	$1,638,000	229	$1,603,000	236	$1,652,000	196	$1,372,000	41	$287,000
Electrical Panel Upgrades[2]	EA	$2,000	59	$117,000	57	$115,000	59	$118,000	49	$98,000	10	$21,000
Septic Tanks[3]	EA	$4,500	117	$527,000	115	$515,000	118	$531,000	98	$441,000	21	$92,000
Trench Repair[4]	LF	$20	13,600	$272,000	6,500	$130,000	7,400	$148,000	10,300	$206,000	4,200	$84,000
Milling[5]	LF	$35	13,600	$476,000	6,500	$228,000	7,400	$259,000	10,300	$361,000	4,200	$147,000
Full Width Overlay	LF	$35	13,600	$476,000	6,500	$228,000	7,400	$259,000	10,300	$361,000	4,200	$147,000
Rock Excavation[6]	CY	$70	1,300	$91,000	600	$42,000	700	$49,000	1,000	$70,000	400	$28,000
Trench Dewatering	LF	$20	13,600	$272,000	6,500	$130,000	7,400	$148,000	10,300	$206,000	4,200	$84,000
Environmental Protection	LF	$10	3,400	$34,000	1,625	$16,000	1,850	$19,000	2,575	$26,000	1,050	$11,000
Police Detail[7]	Days	$960	240	$230,000	115	$110,000	131	$126,000	182	$175,000	74	$71,000
Subtotal				$4,677,000		$3,377,000		$3,605,000		$3,728,000		$1,140,000
40% Contingency, Legal and Engineering Services				$1,871,000		$1,351,000		$1,442,000		$1,491,000		$456,000
TOTAL[8]				**$6,548,000**		**$4,728,000**		**$5,047,000**		**$5,219,000**		**$ 1,596,000**
Combined Project Area[9]												**$23,138,000**

1. PVC unit costs include all cleanouts, valve connections and vaults

2. Grinder pump unit costs include installation. Electrical panel upgrades are assumed to be required by 1/4 of homes

3. Septic tank unit costs include installation and are assumed for 50% of all existing homes

4. Trench Repair assumes 3" of pavement at 6.5 ft wide

5. Milling assumes 1.5" of pavement at full width of the road

6. Rock Excavation is assumed to be a 0.5 foot depth for every linear feet of trench for LPS Piping

7. Assuming pipe is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

8. All Totals rounded to the nearest $1,000

9. Costs associated with the connection of individual houses to the STEP sewer and the demolition and/or removal of existing septic and/or leaching systems are not included

Table 5-5: 2014 Capital Costs for Local Alternative Gravity/STEG Transmission System

Sub-Areas		5A, 6, 7, 8 and MTA-B	
Dwelling Units		**936**	
Item Description	Unit Cost	Qty	Total
12" Gravity Pipe (LF)	$125	2,422	$303,000
Forcemain 6"-8" (LF)	$50	1,950	$98,000
Pump Stations (EA)	$1,300,000	1	$1,300,000
Trench Repair[1] (LF)	$15	4,372	$66,000
Permanent Trench Paving[2] (LF)	$20	4,372	$87,000
Milling[3] (LF)	$20	4,372	$87,000
Rock Excavation[4] (CY)	$70	400	$28,000
Trench Dewatering (LF)	$40	4,372	$175,000
Environmental Protection (LF)	$10	618	$6,000
Police Detail (Days)[5]	$960	85	$82,000
Subtotal			$2,232,000
40% Contingency, Legal, & Engineering Services			$893,000
TOTAL			**$3,125,000**

1. Trench Repair assumes 3" of pavement repair at a 6.5 ft width

2. Permanent Trench Pavement assumes 2" of pavement and 15 ft wide travel lane

3. Milling assumes 15 ft wide travel lane for all state roads

4. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)

5. Assuming gravity pipe is laid at a rate of 100 ft/day, forcemain at 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

Table 5-6: 2014 Capital Costs for Local Alternative LPS/STEP Transmission System

Sub-Areas		**5A, 6, 7, 8 and MTA-B**	
Dwelling Units		**936**	
Item Description	Unit Cost	Qty	Total
12" Gravity Pipe (LF)	$125	2,422	$303,000
Trench Repair[1] (LF)	$15	2,422	$36,000
Permanent Trench Paving[2] (LF)	$20	2,422	$48,000
Milling[3] (LF)	$20	2,422	$48,000
Rock Excavation[4] (CY)	$70	200	$14,000
Trench Dewatering (LF)	$20	2,422	$48,000
Environmental Protection (LF)	$10	606	$6,000
Police Detail (Days)[5]	$960	51	$49,000
Subtotal			$552,000
40% Contingency, Legal, & Engineering Services			$221,000
TOTAL			**$773,000**

1. Trench Repair assumes 3" of pavement repair at a 6.5 ft width

2. Permanent Trench Pavement assumes 2" of pavement and 15 ft wide travel lane

3. Milling assumes 15 ft wide travel lane for all state roads

4. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)

5. Assuming gravity pipe is laid at a rate of 100 ft/day, forcemain at 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

Table 5-7: 2014 Capital Costs for Regional Alternative Gravity/STEG Transmission System

Sub-Areas		**5A, 6, 7, 8 and MTA-B**	
Dwelling Units		**936**	
Item Description	Unit Cost	Qty	Total
6" Force Main[1] (LF)	$35	15,760	$552,000
10" Force Main[1] (LF)	$45	15,760	$709,000
Pump Stations (EA)	$1,500,000	1	$1,500,000
Odor Control	$400,000	1	$400,000
Air Release Manholes	$15,000	6	$90,000
Trench Repair[2] (LF)	$15	15,760	$236,000
Permanent Trench Paving[3] (LF)	$20	15,760	$315,000
Milling[4] (LF)	$20	15,760	$315,000
Rock Excavation[5] (CY)	$70	1,500	$105,000
Stream Crossing[6] (EA)	$30,000	3	$90,000
Railroad Bridge Crossing Premium[6] (EA)	$200,000	1	$200,000
Trench Dewatering (LF)	$40	31,520	$1,261,000
Environmental Protection (LF)	$10	3,940	$39,000
Police Detail[7] (Days)	$960	278	$267,000
Sub- Totals			$6,079,000
40% Contingency, Legal, & Engineering Services			$2,432,000
TOTAL			**$ 8,511,000**

1. 6" and 10" Force Mains laid in same trench to accommodate seasonal flow variations

2. Trench Repair assumes 3" of pavement repair at a 6.5 ft width

3. Permanent Trench Pavement assumes 2" of pavement and 15 ft wide travel lane

4. Milling assumes 15 ft wide travel lane for all state roads

5. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)

6. Based on July 2012 Addendum to Wastewater Facilities Planning Reports

7. Assuming forcemain is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

Table 5-8: 2014 Capital Costs for Regional Alternative LPS/STEP Transmission System

Sub-Areas		5A, 6, 7, 8 and MTA-B	
Dwelling Units		**936**	
Item Description	Unit Cost	Qty	Total
6" Force Main[1] (LF)	$35	15,760	$552,000
10" Force Main[1] (LF)	$45	15,760	$709,000
Pump Stations (EA)	$1,500,000	1	$1,500,000
Odor Control	$400,000	1	$400,000
Air Release Manholes	$15,000	6	$90,000
Trench Repair[2] (LF)	$15	15,760	$236,000
Permanent Trench Paving[3] (LF)	$20	15,760	$315,000
Milling[4] (LF)	$20	15,760	$315,000
Rock Excavation[5] (CY)	$70	1,500	$105,000
Stream Crossing[6] (EA)	$30,000	3	$90,000
Railroad Bridge Crossing Premium[6] (EA)	$200,000	1	$200,000
Trench Dewatering (LF)	$20	31,520	$630,000
Environmental Protection (LF)	$10	3,940	$39,000
Police Detail[7] (Days)	$960	278	$267,000
Sub- Totals			$5,448,000
40% Contingency, Legal, & Engineering Services			$2,179,000
TOTAL			**$7,627,000**

1. 6" and 10" Force Mains laid in same trench to accommodate seasonal flow variations

2. Trench Repair assumes 3" of pavement repair at a 6.5 ft width

3. Permanent Trench Pavement assumes 2" of pavement and 15 ft wide travel lane

4. Milling assumes 15 ft wide travel lane for all state roads

5. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)

6. Based on July 2012 Addendum to Wastewater Facilities Planning Reports

7. Assuming forcemain is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, overlay at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day

Table 5-9: 2014 Annual O&M Costs for Collection System

Annual Cost Details		Collection Systems							
		Old Lyme Collection Systems				Regional Costs			
Category	**Annual Description**	**Gravity**	**LPS**	**STEP**	**STEG**	**Gravity**	**LPS**	**STEP**	**STEG**
Labor	Operation[1]	$62,000	$62,000	$62,000	$62,000				
	Engineering & legal	$15,000	$15,000	$15,000	$15,000				
	Tech Support[2]	$19,700	$19,700	$19,700	$19,700				
Power & Billing	Electricity	$25,000	$15,000	$15,000	$25,000				
	Billing (Additional Town Admin)	$10,000	$10,000	$10,000	$10,000				
Liquid/Solids	Chemical addition (odor Control)[3]	$30,000	$40,000	$40,000	$30,000				
	Septic Pumping[4]			$215,800	$215,800				
	Chemical addition (Carbon Addition)								
Mech.	Equipment Replacement[5]	$42,000	$28,000	$28,000	$42,000				
Other	Downstream East Lyme and Waterford Fees[6,7]					$92,000	$82,000	$82,000	$92,000
	Sub-Totals	**$204,000**	**$190,000**	**$406,000**	**$420,000**	$92,000	$82,000	$82,000	$92,000
	Regional Totals[8]					**$296,000**	**$272,000**	**$488,000**	**$512,000**

1. Operation assumes an allowance for contract operation of the collection systems

2. Tech Support assumes 40 hours annually for mechanical, electrical, and instrumentation a year

3. Odor control assumes small amount of chemical addition needed for off season conditions at pump stations

4. Septic Pumping Rates assume 3,500 gal tanks pumped every 2 years at 8 Cents per gallon and $20 tipping fee

5. Equipment Replacement assumes 1% to 3% of potential equipment capital costs annually

6. Regional Downstream costs assumes $3.92 per 1000 gallons for East Lyme Waterford O&M fees (based on East Lyme current costs and 33% of the Average Daily Flow)

7. Regional Downstream Costs are based on anticipated average daily flows per Tables 3-1 and 3-2

8. Total Regional combines downstream costs to the annual collection costs in Old Lyme

Table 5-10: 2014 Downstream Pump Station Capacities (Regional Alternative)

Downstream Pump Station Capacities (Regional Alternative)

Town	Pump Station (PS)	Pump Station Capacity[1] (GPD)	*Existing Conditions*			*East Lyme Moderate Zoning Buildout[4]*			*With Old Lyme Contribution at Year One Flow[5]*			*With Old Lyme Contribution at Design Flow*		
			Peak Hour (GPD)	Capacity Used	Potential Capacity Limitations	Peak Hour (GPD)	Capacity Used	Potential Capacity Limitations	Peak Hour (GPD)	Capacity Used	Potential Capacity Limitations	Peak Hour (GPD)	Capacity Used	Potential Capacity Limitations
East Lyme	Bride Brook[2]	2,880,000	668,000	23%	Not likely	1,661,000	58%	Not Likely	901,000	31%	Not likely	2,359,000	82%	Not likely
	Route 156[2]	2,703,000	680,000	25%	Not likely	1,880,000	70%	Not Likely	913,000	34%	Not likely	2,578,000	95%	Appears likely
	Pattagansett[2]	5,164,000	1,096,000	21%	Not likely	4,337,000	84%	Not Likely	1,329,000	26%	Not likely	5,035,000	98%	Appears likely
	Niantic[2]	6,273,000	1,823,000	29%	Not likely	5,456,000	87%	Not Likely	2,056,000	33%	Not likely	6,154,000	98%	Appears likely
Waterford	Evergreen[3]	10,397,000	9,034,000	87%	Not likely	N/A	N/A	N/A	9,267,000	89%	Not likely	9,732,000	94%	Appears likely

1. Calculated with largest pump offline.

2. Based on Fuss & O'Neil 2007 Wastewater System Capacity Analysis Planning Report.

3. Based on Wright-Pierce 2011 Waterford Wastewater Facilities Plan Update.

4. Based on Fuss & O'Neil Wastewater Collection System Capacity Analysis Planning Report, Table V-2, page 42, dated September 2007.

5. Total flows including Old Lyme contribution at Year One are the sum of existing conditions flows and Year One peak hourly flow.

Table 5-11: 2014 Estimated Downstream Capital Needs (Regional Alternative)

Estimated Downstream Capital Needs (Regional Alternative)

Town	Downstream Sewer Infrastructure	Old Lyme % of Peak Hourly Design Flow	Estimated Additional Capital Cost Premium %	Capital Upgrade Cost[1]	Estimated Old Lyme Capital Share	Estimated Non-Old Lyme Capital Share
East Lyme	**Bride Brook PS**	30%	10%	$2,000,000	$792,000	$1,208,000
	Bride Brook FM	30%	10%	$300,000	$119,000	$181,000
	Route 156 PS[2]	27%	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)
	Gravity Sewer Downstream of Route 156 FM Discharge[2]	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)
	Pattagansett PS[2]	14%	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)
	Niantic PS[2]	11%	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)
	Niantic FM[2]	11%	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)
Waterford	**Evergreen PS[2]**	8%	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)
New London	**New London WPCF[2]**	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)	Deferred (TBD)
Total				**$2,300,000**	**$911,000**	**$1,389,000**

1. Capital Upgrade Costs include 40% engineering, contingency, and legal fees

2. Upgrades to infrastructure are deferred capital costs to be determined (TBD)

Niantic Pump Station (East Lyme)

Bride Brook Pump Station (East Lyme)

Route 156 Pump Station (East Lyme)

Pattagansett Pump Station (East Lyme)

5.7 COST COMPARISON

Table 5-12 shows the breakdown of capital costs for each type of collection system within the Project Area. Table 5-13 shows the total cost of the Local and Regional Alternative collection systems including anticipated annual Operation & Maintenance (O&M) costs.

Table 5-12: 2014 Wastewater Service Area Capital Collection Costs

Collection System Type	Collector Sewer[3]	Local Alternative Transmission System[1,2,4]	Regional Alternative Transmission System[1,4]
Gravity	$15,764,000	$3,125,000	$8,511,000
Low Pressure	$20,253,000	$773,000	$7,627,000
STEG	$18,123,000	$3,125,000	$8,511,000
STEP	$23,138,000	$773,000	$7,627,000

1. Transmission System layouts consist of a combination of gravity sewer and force main required to convey flows from the Project Area to the treatment site (local or regional)

2. Two Local Alternatives were investigated but share the same Collector Sewer and Transmission System Costs.

3. Collector Sewer Costs are based on total costs in Tables 5-1, 5-2, 5-3, and 5-4

4. Transmission Costs are based on total costs in Tables 5-5, 5-6, 5-7, and 5-8

Table 5-13 shows the capital and annual O&M costs for the Local and Regional Alternatives. Costs under the Regional Alternative represent the sum of all the Project Area Sub-Areas collection systems, the transmission system, and any downstream pump station and collection system upgrades.

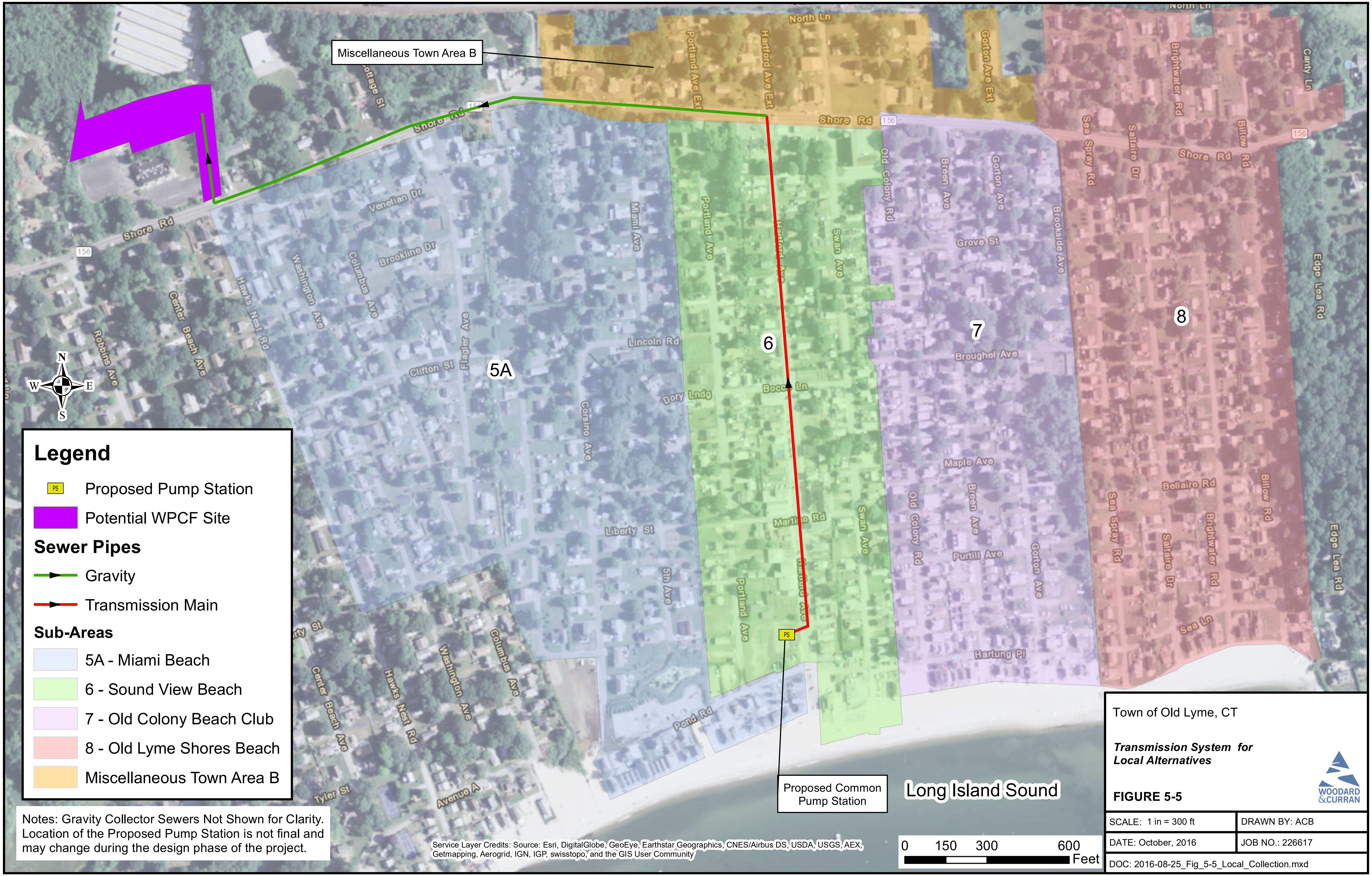
The Local Alternatives are significantly less expensive for both capital and annual costs for the collection system aspect of this report. The costs under the Local Alternatives represent only the sum of the Project Area Sub-Areas collection systems and the transmission system in Old Lyme. A breakdown of annual costs for both the Local and Regional Alternative are provided in Table 5-9.

Table 5-13: 2014 Total Capital and Annual Collection Costs

Collection System Type	Local Alternative[1]		Regional Alternative	
	Capital	Annual O&M[2]	Capital	Annual O&M[2]
Gravity	$18,889,000	$204,000	$25,186,000	$296,000
Low Pressure	$21,026,000	$190,000	$28,791,000	$272,000
STEG	$21,248,000	$420,000	$27,545,000	$512,000
STEP	$23,911,000	$406,000	$31,676,000	$488,000

1. Two Local Alternatives were investigated but share the same collection system costs.

2. Annual O&M Costs are based on total costs in Table 5-9



Legend

🟨 Proposed Pump Station

🟪 Potential WPCF Site

Sewer Pipes

Gravity

Transmission Main

Sub-Areas

5A - Miami Beach

6 - Sound View Beach

7 - Old Colony Beach Club

8 - Old Lyme Shores Beach

Miscellaneous Town Area B

Notes: Gravity Collector Sewers Not Shown for Clarity. Location of the Proposed Pump Station is not final and may change during the design phase of the project.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 150 300 600
Feet

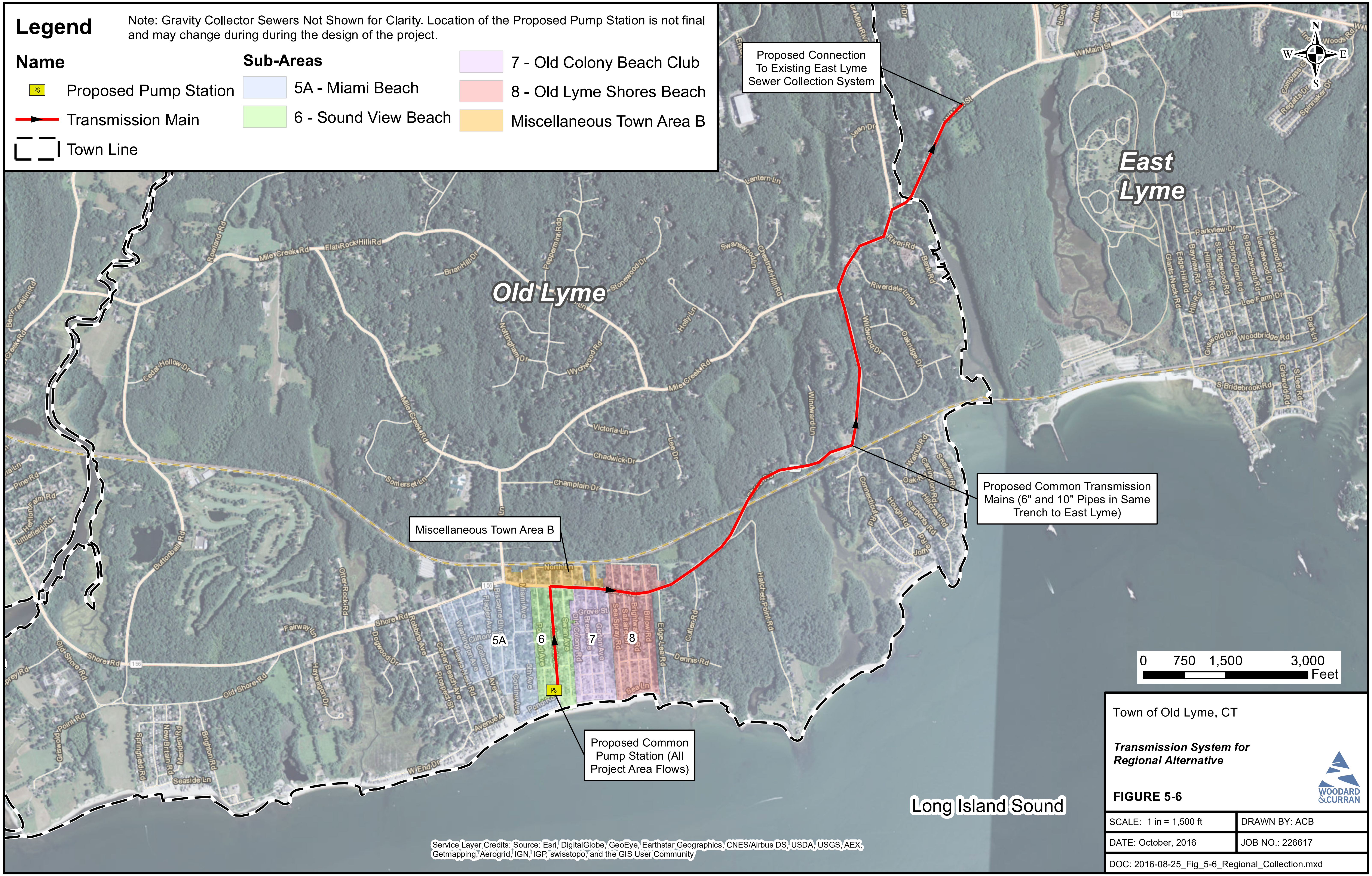
Town of Old Lyme, CT

Transmission System for Local Alternatives

FIGURE 5-5

WOODARD & CURRAN

SCALE: 1 in = 300 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_5-5_Local_Collection.mxd	



Legend

Note: Gravity Collector Sewers Not Shown for Clarity. Location of the Proposed Pump Station is not final and may change during during the design of the project.

Name	**Sub-Areas**	
PS Proposed Pump Station	5A - Miami Beach	7 - Old Colony Beach Club
Transmission Main	6 - Sound View Beach	8 - Old Lyme Shores Beach
Town Line		Miscellaneous Town Area B

Proposed Connection To Existing East Lyme Sewer Collection System

Proposed Common Transmission Mains (6" and 10" Pipes in Same Trench to East Lyme)

Miscellaneous Town Area B

Proposed Common Pump Station (All Project Area Flows)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

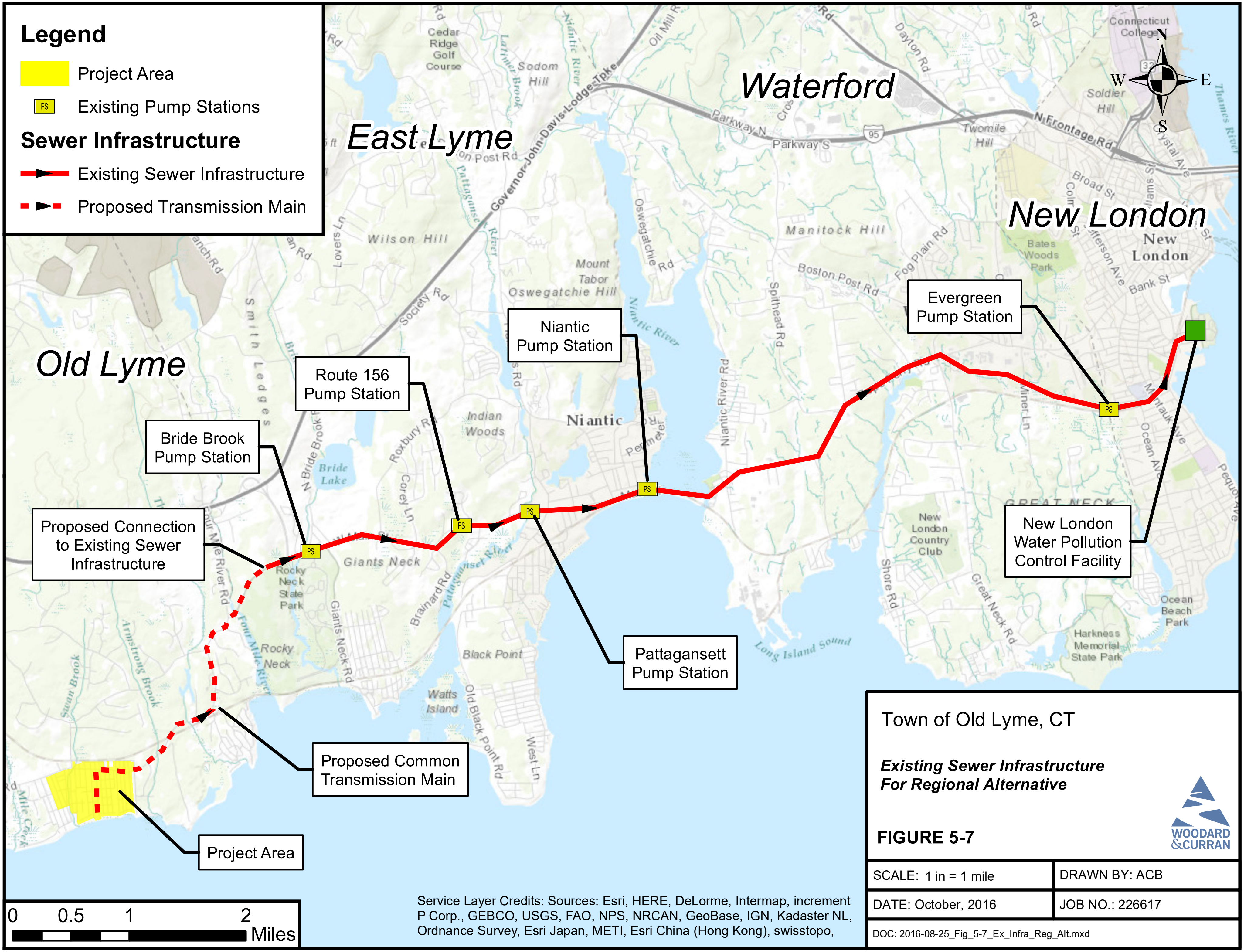
Town of Old Lyme, CT

Transmission System for Regional Alternative

FIGURE 5-6

WOODARD & CURRAN

SCALE: 1 in = 1,500 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_5-6_Regional_Collection.mxd	



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,

Town of Old Lyme, CT

Existing Sewer Infrastructure
For Regional Alternative

FIGURE 5-7

WOODARD &CURRAN

SCALE: 1 in = 1 mile	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617

DOC: 2016-08-25_Fig_5-7_Ex_Infra_Reg_Alt.mxd

6. TREATMENT ALTERNATIVES

6.1 INTRODUCTION

Woodard & Curran developed an opinion of probable cost (OPC) for each treatment component for both the Local and Regional Alternatives as part of the Coastal Wastewater Management Plan. This Section includes: an overview of each treatment alternative; capital and annual operation and maintenance cost projections; as well as other non-cost considerations related to the treatment components of the Local and Regional Alternatives.

6.2 OVERVIEW OF LOCAL TREATMENT ALTERNATIVES

6.2.1 Treatment Configurations

Three general types of treatment configurations were evaluated for the Local Alternative. These configurations comprise on-site, neighborhood / cluster, and centralized. It was determined that on-site septic systems and larger cluster systems would not be practical forms of treatment for the Project Area. There are physical constraints making smaller systems an unviable option within the High Needs Sub-Areas, including poor soils and high groundwater. Due to the high density of homes, lot sizes do not provide adequate amounts of space for proper treatment with traditional septic systems. Larger cluster systems could provide higher degrees of effluent quality advanced treatment systems but are also limited by available space. Similar to the conclusions of previous Wastewater Management Plans for Sub-Areas 5A, 7 and 8, a centralized treatment facility with off-site disposal would provide the best economies of scale for treatment. A WPCF would treat the flows from all the Project Area while providing the highest wastewater effluent quality. The effluent quality is an important factor for not only pollution removal but also providing options for water reuse opportunities.

Example of on-site sub-surface disposal system construction in coastal community.

6.2.2 Local WPCF

For the purpose of planning development of alternatives and cost estimates, a potential WPCF site was-evaluated at a location just north of Route 156 and Sub-Areas 5A and 5B, as shown in Figure 6-1. This site (Site 3) was identified as a possible location that provides a central location to the Project Area. Other locations are also being screened as possible WPCF sites.

Example of local WPCF with packaged treatment system

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Town of Old Lyme, CT

Potential Treatment Sites
For Local Alternatives

FIGURE 6-1

WOODARD & CURRAN

SCALE: 1 in = 600 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_6-1_Trtmnt_Sites_Local.mxd	

The following four criteria were used to consider Site 3 as a potential location for a local WPCF:

1. Site Land Use: An undeveloped site, such as Site 3, may be desirable because of the site preparation costs, with fewer potential infrastructure conflicts to be resolved than a currently occupied site or previously developed non-residential site.
2. Natural Resources: Sites within specially designated natural resource areas should be avoided. The development of areas designated as wild, scenic, recreational, or habitats of endangered species may be prohibited, or at minimum, result in complicated permitting processes. In addition, the presence of a sensitive feature, such as a wetland, would affect site suitability.
3. Elevation and Topography: Site 3 is a relatively low level site that would facilitate the flow of wastewater from portions of the service area by gravity, and minimize the number of pumping stations in the collection system. In addition, Site 3 is a relatively flat site compared to the other potential sites, which generally should facilitate construction activities and minimize grading differentials on the site.
4. Buffer Zones: The site suitability is affected by the amount of isolation and buffer area needed between plant processes and sensitive features and between plant processes and other property owners. By selecting Site 3, additional buffer area was secured to reduce the potential for odors and noise intrusion to the surrounding community.

Other factors such as economical and technical considerations may also influence the selection of sites and should be considered as part of the Local Alternative.

Two types of centralized wastewater treatment facilities were considered within Task 5 (Evaluation of Wastewater Treatment Alternatives): (1) Sequenced Batch Reactor (SBR); and (2) Membrane BioReactor (MBR). These two types of facilities would meet high quality effluent standards while being flexible to accommodate seasonal flow variations anticipated within the Project Area.

6.2.2.1 SBR WPCF

The SBR process is designed to treat wastewater while eliminating the need for secondary clarifiers and return activated sludge (RAS). A series of five steps occurs within each reactor, where first it is filled with wastewater and secondly completely mixed and aerated for a specific reaction time. Thirdly, after the reaction time, mixing and aeration cease and solids are settled out. Fourthly, decanting is performed, where effluent is drawn from the middle of the reactor above the sludge blanket. The fifth and last step allows for idle time. A minimum of two reactors, and preferably three, are necessary for continuous flow application to allow one reactor to fill while the other reacts, settles and drains.

SBR systems are common in the northeast and can reduce the size of the facility needed when compared to a conventional activated sludge plant. Depending on effluent quality requirements, tertiary treatment, such a denitrification filter, is often used to help polish the effluent before disinfection.

6.2.2.2 MBR WPCF

The MBR process is a newer technology rapidly growing in the industry, especially with smaller localized facilities. An MBR process reduces tank volumes needed by replacing conventional clarification processes with membranes that filter solids and other nutrients. The size reduction with an MBR facility commonly allows for a completely enclosed WPCF. Due to the filtration that occurs with a membrane process, MBR plants are able to achieve high quality effluent standards with fewer treatment steps.

6.2.3 Local WPCF Recommendations

Due to the potential of using a portion of the treated wastewater effluent as reuse water for irrigation, the highest quality effluent is required. An MBR treatment facility would be best capable of meeting and consistently maintaining both the Connecticut guidelines for advanced pretreatment and EPA reuse guidelines for unrestricted irrigation applications. By investing in high quality treatment, reuse options become available and will provide more cost effective effluent disposal options for the Town. An MBR facility could also be constructed fully enclosed, for aesthetics, reducing the footprint of the facility. Other alternatives for treatment facilities exist that could meet the necessary requirements and a conceptual design and permit clarification would be needed to fully understand the optimum treatment facility and potential cost savings.

Example of local WPCF adjacent to athletic fields.

6.2.3.1 Collection System Impacts on Treatment System and Costs

As noted in previous sections, the type of collection system used to convey the wastewater to the treatment facility will affect the capital and operation and maintenance (O&M) cost of treatment. No matter which collection system is selected, an MBR process or similar would need to be installed to achieve the anticipated treatment level requirements.

The costs in Table 6-1 below have been presented for an MBR facility including the four types of collection systems evaluated. As shown in Table 6-1, the costs differ per type of collection system used. For example, LPS and STEP systems could both reduce I/I flows to the WPCF and STEP / STEG systems could reduce the influent nutrient and solids loading at the treatment plant. Each option has its benefits and limitations. When STEP / STEG systems reduce nutrients at the WPCF, collection costs go up for homeowners required to pay for septic tank pumping (approximately every 1 to 2 years). Also, nutrient reduction can have a negative impact on plant costs, and an additional carbon source is likely to be needed. These costs are summarized in Tables 6-3 and 6-4.

Table 6-1: 2014 Summary of Local Treatment Costs for Different Collection System Options

Item No.	Description	Gravity	LPS	STEG	STEP
1	Headworks Building[1]	$807,000	$767,000	$646,000	$613,700
2	MBR Building[2,6]	$4,994,000	$4,994,000	$4,744,000	$4,744,000
3	Pre-anoxic & Anoxic Tanks[3]	$458,000	$435,000	$412,000	$391,000
4	Administration Building	$144,000	$144,000	$144,000	$144,000
5	Influent Equalization[4]	$465,000	$442,000	$465,000	$233,000
6	Effluent Equalization[5]	$2,850,000	$2,708,000	$2,850,000	$2,708,000
7	Land Acquisition	$500,000	$500,000	$500,000	$500,000
Subtotal		$10,300,000	$10,000,000	$9,800,000	$9,400,000
Contingency & Engineering Services	40%	$4,200,000	$4,000,000	$4,000,000	$3,800,000
Local Treatment Total		**$14,500,000**	**$14,000,000**	**$13,800,000**	**$13,200,000**

1. STEP and STEG systems assume no coarse screening is needed in the headworks.

2. STEP and STEG systems assume 5% reduction in total MBR building costs.

3. STEG System assumes a 10% reduction in Pre & Post Anoxic tanks.

4. STEP Systems assume 50% reduction for influent equalization and 5% reduction in Pre & Post Anoxic tanks.

5. LPS and STEP systems assume a 5% decrease in effluent equalization.

6. MBR Building costs include disinfection and backup power generation facilities costs.

As shown above in Table 6-1, the costliest capital treatment alternative occurs when treatment is combined with a gravity collection system. This is due to higher annual flows when including I/I considerations and the fact that there is no preceding solids removal in the collection system as occurs with a STEP /STEG system. The lowest capital cost is when treatment is combined with a STEP system because both flows and solids would be reduced prior to treatment. Overall, the costs of the WPCF vary minimally with different collection systems options. The higher total capital and O&M costs of implementing a STEP system still make the gravity system a more economical choice for the Project Area.

A non-cost factor that treatment for the Local Alternative would provide for the Town of Old Lyme is control over their future needs and water use. This could be an invaluable aspect as wastewater systems become regulated more stringently while existing infrastructure ages, resulting in costly upgrades and restrictions.

6.3 REGIONAL TREATMENT ALTERNATIVE

For the Regional Alternative, wastewater would be treated at the existing New London WPCF and discharged to the Thames River. An aerial view of New London WPCF is shown in Figure 6-2. No other options have been evaluated for a Regional Treatment Alternative. Although New London does not currently have a WPC capital plan, we assume that the New London WPCF will undergo a facilities evaluation and series of upgrades in the future related to renewal of mechanical equipment and emerging permit requirements. Typically, the cost of such capital upgrades would be spread out to all the users based on the flow allocations from each community. Given the lack of a capital plan, the costs associated with upgrading the New London WPCF are difficult to project and were considered as future/deferred costs as shown in Table 6-2.

The Old Lyme buy-in fee from New London will be a set price, on an EDU basis, based on preliminary conversations with the New London governing authorities. This report includes a conservative allowance, per EDU, for planning purposes. The regional treatment capital costs are presented and compared to the Local Alternatives treatment costs in Table 6-2. Also, the annual costs for both treatment alternatives are estimated and presented in Tables 6-3 and 6-4.

Table 6-2: 2014 Regional Treatment Capital Cost Summary

Description	Cost Range
New London Buy in[1]	$2,808,000 - $4,680,000
New London WPCF Upgrade[2]	Future (TBD)
Total[3]	**$4,680,000**

1. *Based on the anticipated range for connection fee to New London ($3,000 to $5,000 per EDU)*
2. *Upgrade the New London WPCF is a future/deferred capital cost to be determined (TBD)*
3. *Based on a maximum conservative allowance (per EDU) pending discussions between Old Lyme and New London*

6.4 COST COMPARISON

The Local Treatment and the Regional Treatment Alternatives capital and annual O&M costs for the Project Area are presented below in Tables 6-3 and 6-4. The Local Alternative is more expensive than the Regional Alternative relative to treatment alone. This is due to the cost sharing that the New London WPCF is able to provide for the existing WPCF, as opposed to constructing a new WPCF. Although the Regional Alternative incorporates the use of the existing New London WPCF for treatment, there are still substantial treatment/disposal buy-in costs for Old Lyme residents to become regional sewer user.

Annual treatment O&M costs for the Local Alternative include additional operators, power usage, equipment maintenance and chemical addition. Disposal and reuse annual costs such as power and potential Black Hall fee for reuse have been included with the Local Alternative Treatment annual costs. The Regional Alternative annual costs are based on flow percentages that incorporate all the necessary items represented in the Local Treatment. This is currently how the Agreement between East Lyme and New London is written. Flow meters would be used to measure the amount of flow treated, and for every thousand gallons sent to the WPCF, approximately $2.50 would be charged to Old Lyme. This value is based on the current rates that New London charges East Lyme and was scheduled to go up by 8% in October 2014 according to the Town of East Lyme.

Table 6-3: 2014 Annual O&M Costs for Treatment System

Annual Cost Details		Treatment			
		Local		Regional	
Category	**Annual Description**	**Gravity & LPS**	**STEP / STEG**	**Gravity / STEG**	**LPS / STEP**
Labor	Operation[1]	$237,600	$237,600		
	Engineering & legal	$15,000	$15,000		
	Technical Support[2]	$39,500	$39,500		
Power & Billing	Electricity	$30,000	$30,000		
	Billing (Additional Town Admin)				
Liquid/Solids	Chemical Addition[3]	$14,000	$4,200		
	Septic / Solids Pumping[3]	$19,700	$5,900		
	Carbon Addition[4]	$6,800	$15,000		
Mechanical	Equipment Replacement[5]	$104,000	$93,600		
Other	New London WPCF Fees[6,7]			$58,000	$53,000
	Black Hall Fee[8]	$65,000	$65,000		
	Totals	**$532,000**	**$506,000**	**$58,000**	**$53,000**

1. Local Treatment Operation assumes 2 full time class III and class II operators and 1 laborer for treatment.

2. Technical support assumes 80 hours annually for mechanical, electrical, and instrumentation a year.

3. STEP/STEG assumes a 30% decrease in solids handling and chemical addition (not including carbon addition).

4. Carbon addition for STEP/STEG assumed to be 10,000 Gallons Annually at $1.50/gallon.

5. Equipment Replacement Assumes 1% to 3% of potential equipment capital costs annually.

6. Regional Treatment Costs are based on $2.50 per 1000 gallons annually and 50% of the Average Daily Flow

7. Regional Treatment Costs are based on anticipated average daily flows per Tables 3-1 and 3-2

8. Black Hall Reuse fee assumed to be a tax credit for use of property or O&M fee.

Table 6-4: 2014 Treatment Cost Summary

Treatment System Based on Type of Sewer System	Local Alternative		Regional Alternative	
	Capital Cost[1]	Annual O&M Cost[2]	Capital Cost[3]	Annual O&M Cost[2]
Gravity	$14,500,000	$532,000	$4,680,000	$58,000
Low Pressure	$14,000,000	$532,000	$4,680,000	$53,000
STEP	$13,200,000	$506,000	$4,680,000	$53,000
STEG	$13,800,000	$506,000	$4,680,000	$58,000

1. Capital Costs for the Local Alternative are based on total costs in Table 6-1

2. Annual O&M Costs are based on total costs in Table 6-3

3. Capital Costs for the Regional Alternative are based on total cost in Table 6-2

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Town of Old Lyme, CT

New London WPCF, Existing Treatment System for Regional Alternative

FIGURE 6-2

WOODARD &CURRAN

SCALE: 1 in = 200 feet	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_6-2_NL_WPCF_Regional.mxd	

7. DISPOSAL AND REUSE ALTERNATIVES

This section of the Report summarizes the effluent disposal and reuse alternatives associated with the two Local Alternatives. Local Alternative 1 consists of pumping effluent from the local treatment site to a primary subsurface disposal site (Cherrystone), a storage reservoir for reuse and irrigation, and a secondary subsurface disposal site (Black Hall) when needed. Local Alternative 2 consists of pumping effluent from the local treatment site to the Connecticut River via a new surface water discharge permit. An evaluation of each Local Alternative follows.

7.1 LOCAL ALTERNATIVE 1 WITH SUBSURFACE DIPOSAL AND REUSE

Flow projections from Section 3 served as the basis for locating sufficient disposal and reuse resources. These effluent flow allocations are summarized in Figure 7-1. The projected Year One and design flow patterns were estimated based on Point O' Woods flow data multiplied by a ratio of averages. The average expected Year One flow was assumed to be one third of the average design flow. As part of the Coastal Wastewater Management Plan, initial on-site testing was performed at two of the more than four potential sites in Old Lyme, as shown in Figure 7-2. However, there are likely several additional potential disposal and reuse sites adjacent to the Study Area. The Town may choose to evaluate these sites at a later date based on future needs.

Commencement of test pits at Cherrystone site.

7.1.1 Local Subsurface Investigations

A subsurface investigation was performed as a part of Task 3 (Evaluation of sub surface Disposal and Reuse Alternatives) of the Scope of Services, as summarized in Section 1 of this Report. A few sites have been identified as locations for potential disposal and reuse systems. The Lombardo Associates Alternatives Analysis Report identified four potential sites. This investigation focuses on two of those sites they had identified. Field investigations were performed in May and June of 2013 at the Black Hall Golf Course (Black Hall) and former driving range (Cherrystone) in Old Lyme. The purpose of Woodard & Curran's investigation was to evaluate the soil properties at both locations and simulate the disposal of treated wastewater effluent at Cherrystone. A site map of the two properties is shown in Figure 7-2.

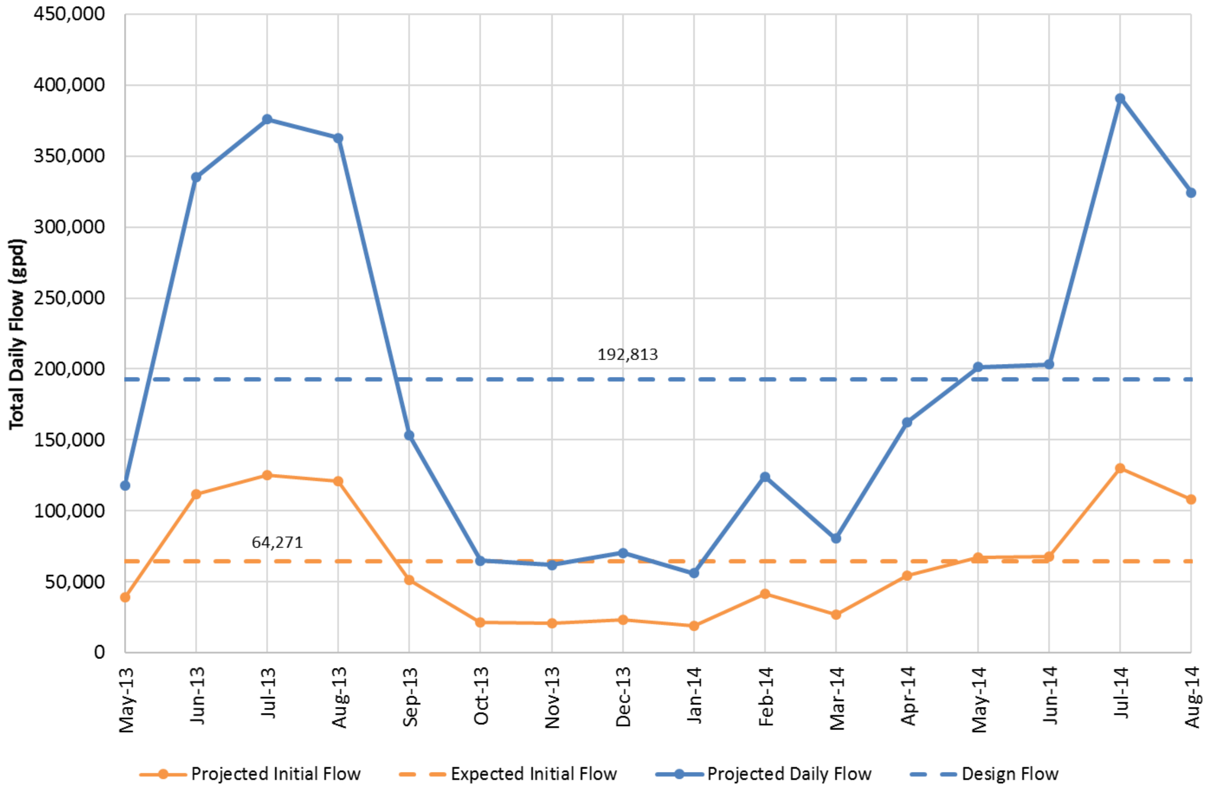
Woodard & Curran conducted the following activities:

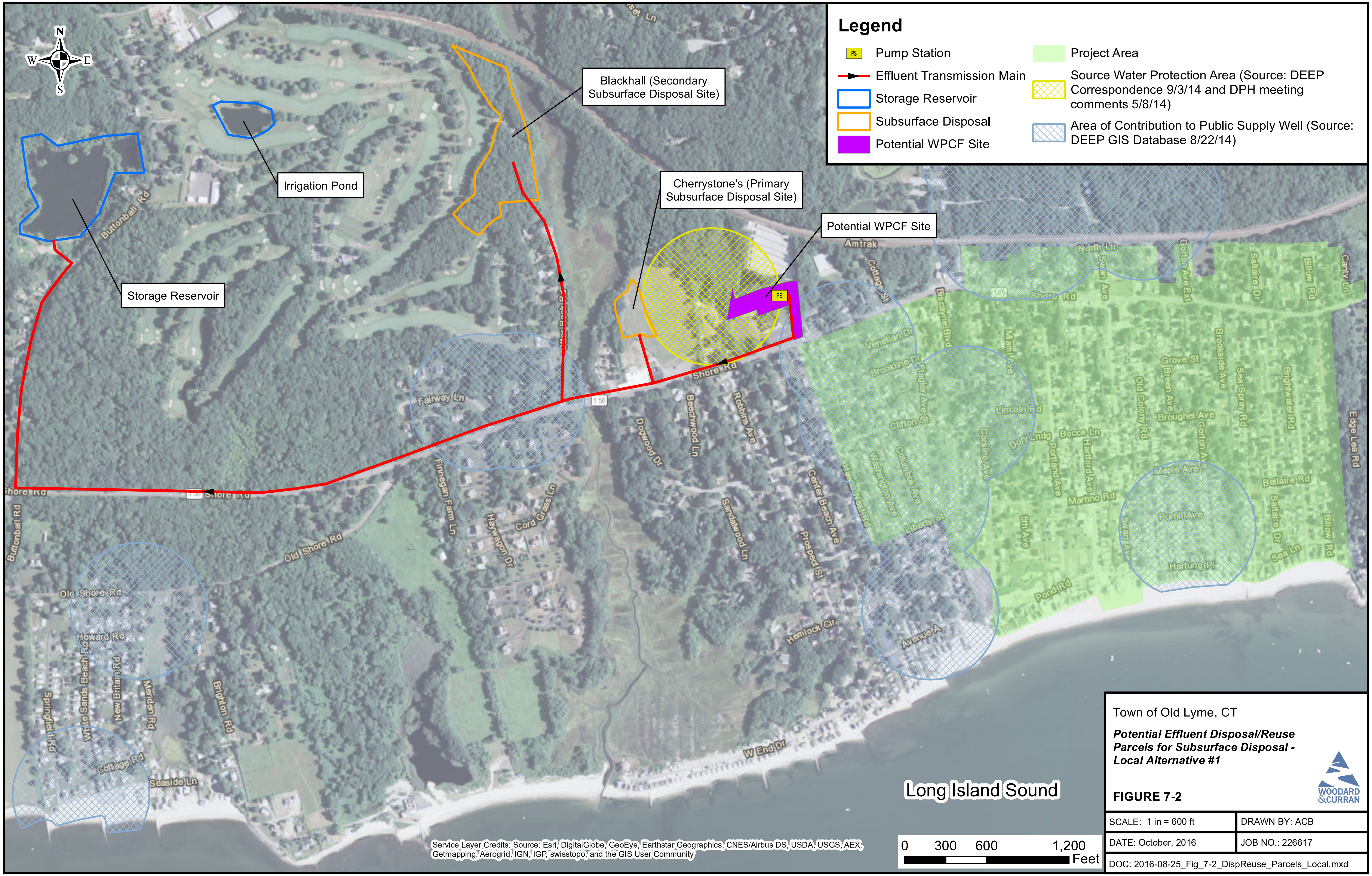
- Test Pitting (Cherrystone)
- Soil Borings/Monitoring Well Installation (Black Hall, Cherrystone)
- Seasonal High Water Table (SHWT) Calculations
- Aquifer Testing (Black Hall, Cherrystone)
- Water Level Monitoring (Black Hall, Cherrystone)
- Delineation of subsurface Soil Absorption System (SAS) facility (Cherrystone)
- Groundwater Mound Simulations (Cherrystone)

Open test pit at Cherrystone site.

Each of the aforementioned activities is summarized below. All Figures and Tables for the Subsurface Investigation are presented in Appendix B.

Figure 7-1: Anticipated Year-Round Flows for High Needs Sub-Areas





Legend

- PS Pump Station
- Effluent Transmission Main
- Storage Reservoir
- Subsurface Disposal
- Potential WPCF Site
- Project Area
- Source Water Protection Area (Source: DEEP Correspondence 9/3/14 and DPH meeting comments 5/8/14)
- Area of Contribution to Public Supply Well (Source: DEEP GIS Database 8/22/14)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Town of Old Lyme, CT

Potential Effluent Disposal/Reuse Parcels for Subsurface Disposal - Local Alternative #1

FIGURE 7-2

WOODARD & CURRAN

SCALE: 1 in = 600 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_7-2_DispReuse_Parcels_Local.mxd	

7.1.1.1 Test Pitting – Cherrystone

Backfilled test pit at Cherrystone pit with standpipe.

Typical soil column obtained during test pits.

In May 2013, Woodard & Curran, the Town of Old Lyme, and the Connecticut Department of Energy & Environment (CT-DEEP) monitored the excavation of seven test pits at the Cherrystone site. A map of historical and recent test-pit locations is included as Figure B-2. Details of the test pits are summarized in Table B-1. The objective of test pitting was to characterize the bedding, grain size, and transitions of various soil types. Historical test-pit data are available at Cherrystone, and the new pits are intended to fill spatial data gaps both laterally and vertically. Test pits were excavated to a depth of roughly 10 feet, or shallower if bedrock was encountered. Test pits TP-01, TP-04, and TP-05 encountered refusal, which is interpreted as granitic bedrock. Test pits TP-02, TP-03, TP-07, and TP-08 did not encounter refusal conditions. Boring logs of each test pit are included in Appendix C. In general, the test pits contained: less than one foot of topsoil; roughly one to two feet of silty/sandy loam; and unconsolidated sands, gravel, cobbles, and boulders to the bottom of the test pit. The material beneath the loam was visually classified as permeable aquifer material. Perforated plastic standpipes were installed in each test pit prior to backfilling for future monitoring events and to mark the location of test pits.

7.1.1.2 Soil Borings and Groundwater Wells – Cherrystone and Black Hall

In May 2013, Woodard & Curran contracted with Northeast Geotech, Inc. (NE Geotech) to advance soil borings and install monitoring wells at the Cherrystone and Black Hall properties. Monitoring wells allow soils to be classified at greater depths than do test pits, and allow water-level measurements and groundwater-flow directions to be obtained. Black Hall has an existing network of monitoring wells near its central irrigation pond (Figure B-3); therefore, soil investigations were conducted east of the pond. At four of the five locations (BH-1, BH-2, BH-4, and BH-5), the drill rig encountered refusal conditions prior to intersecting the water table, and monitoring wells therefore were not installed. At location BH-3, groundwater was encountered before refusal, permitting the installation of a shallow (MW-3S) and deep (MW-3D) monitoring well couplet. Boring logs of soils and monitoring wells at Black Hall are included in Appendix C. In general, the

Advancement of soil boring at Black Hall site.

top several feet of soils are silty with roots and other organic matter, underlain by sandy soils with varying amounts of gravel and silt.

In May 2013, Woodard & Curran observed NE Geotech advance four soil borings and complete the borings as monitoring wells at the Cherrystone property. The locations of the wells are shown on Figure B-2. Observations of soil generated from the borings are similar to those from test pits. The top two or three feet of soils are silty/sandy loams with roots and other organic matter, underlain by unconsolidated sands and gravel with varying amounts of cobbles and boulders. Visual observation suggests permeable aquifer material beneath the loam. Depths of the soil borings range from 11.5 feet (WC-4) to 30 feet (WC-2, WC-3). Locations WC-1 and WC-4 encountered refusal conditions, presumably bedrock, at 20.3 feet and 11.5 feet, respectively; locations WC-2 and WC-3 did not encounter refusal at the maximum proposed depth of 30 feet. The depths of refusal from historic and recent test pits (Table B-1) corroborate the interpretation of thicker soils in the western part of the Cherrystone property as noted during the advancement of soil borings. Boring logs of the Cherrystone wells are included in Appendix C.

7.1.1.3 Seasonal High Water Table – Black Hall and Cherrystone

In May and June 2013, Woodard & Curran monitored water levels at Cherrystone (four wells) and Black Hall (six wells) to determine the seasonal high water table (SHWT). The SHWT is calculated by comparing the water level at an observation well with the minimum depth to water (SHWT) at a sentinel well operated by the US Geological Survey (USGS) using the formula:

$$DTW_{SHWT,SITE} = DTW_{T,SITE} \times \frac{DTW_{SHWT,USGS}}{DTW_{T,USGS}},$$

Where:

$DTW_{SHWT,SITE}$ = Depth to water at the site during seasonal high water table;

$DTW_{T,SITE}$ = Depth to water at the site at time T during the monitoring period;

$DTW_{SHWT,USGS}$ = Depth to water at USGS sentinel well during seasonal high water table; and

$DTW_{T,USGS}$ = Depth to water at USGS sentinel well at time T during the monitoring period.

Time “T” was selected as 00:00 on June 16, 2013, the average time when site wells experienced a high water table (several precipitation events) during the May-June 2013 monitoring period. Using the above calculations for two USGS sentinel wells with similar water depths as those measured at Cherrystone and Black Hall, the seasonal high water table at the Cherrystone property is approximately 7 feet (WC-3) to 15 feet (WC-1, WC-2) (Table 2). The USGS sentinel wells are located in the Towns of Southbury and Durham, Connecticut (shown as identifiers 412916073121701 and 412825072410501, respectively). The SHWT calculations at Cherrystone are roughly 1.5 to 2.5 feet shallower than the shallowest depth to water measured during the May-June 2013 monitoring period. The SHWT for WC-4 was not considered, as this well likely does not represent aquifer conditions, but rather is ponded water on top of a bedrock surface. The SHWT at Black Hall for the newly installed wells MW-3S and MW-3D ranges from approximately 12 to 19 feet (Table 2). SHWT calculations for the remaining Black Hall wells are not considered, as these wells are located in an area inaccessible to potential SAS construction and have prohibitively low hydraulic conductivity. A time series of USGS depth to water data is provided as Appendix C, and a time series of depth to water data at Cherrystone and Black Hall with superimposed USGS data is also provided in Appendix C.

It should be noted that the Southbury and Durham sentinel wells were selected to establish seasonal high groundwater conditions because of: (1) the availability of daily water-level records during the monitoring period and (2) the similarity of water level depths to the Cherrystone and Black Hall site wells. There is another USGS well closer to the Project Area, but the water level data for that well was not appropriate for this analysis.

7.1.1.4 Aquifer Testing – Black Hall and Cherrystone

In May 2013, Woodard & Curran conducted slug testing at five wells at Black Hall and three wells at Cherrystone to quantify the permeability of saturated soils. A slug test involves removing a slug of water from a monitoring well and measuring the rate of water-level recovery. The recovery rate and information about the aquifer geometry and well construction allow a calculation of saturated hydraulic conductivity (K), the ability of a geologic material to transmit water. Two wells, WC-1 (Cherrystone) and MW-H (Black Hall), did not receive slug testing due to an inadequate column of water in the well.


Monitoring wells installed at Black Hall site.

A summary of hydraulic conductivity calculations for each well at Cherrystone is presented in Table B-3. Hydraulic conductivity was calculated using the Bouwer & Rice solution, which applies to wells installed in unconfined aquifers (Bouwer & Rice, 1976). The program AquiferWin32 was used to process and model the aquifer response to slug testing (ESI, 2013). As noted, water-level data from well WC-4 may not be representative of aquifer conditions, as water in this well likely is "ponded" on a bedrock surface. Wells WC-2 and WC-3 at Cherrystone are interpreted as representative aquifer hydraulic conductivity values (250 ft/day and 80 ft/day, respectively), which fall within the literature range for unconsolidated sands and gravels (Freeze & Cherry, 1979). The notably greater value of hydraulic conductivity in WC-2 compared with the conductivity of WC-3 may reflect the greater thickness of saturated soils at WC-2, which allows a greater volume of material to recharge the well after the slug of water is removed. A printout of the slug-test results at WC-2 is shown in Figure B-4, illustrating the fitting of water-level response data.

A summary of hydraulic conductivity calculations for each well at Black Hall is presented in Table B-3. The hydraulic conductivity ranges from less than 1 ft/day to approximately 16 ft/day, suggesting silty sands as the aquifer material. The soils at Black Hall appeared to contain a greater proportion of silt than did soils at Cherrystone, and grain size is an important factor in the ability of a geologic material to transmit water. Variations in the hydraulic conductivity of preexisting wells MW-A, MW-E, and MW-I may reflect the amount of silt in the soils, although it should be noted that boring logs and construction details for these wells are not available.

7.1.1.5 Monitoring Well Survey and Groundwater Flow

Existing monitoring well at Black Hall site.

In August 2013, Pereira Engineering, Inc. (Pereira) completed an elevation survey of groundwater wells, soil borings, and test pits at the Cherrystone and Black Hall properties (Table B-1). The surveyed elevations allowed a determination of groundwater-flow direction at each property. The direction of groundwater flow at Cherrystone is to the west, toward Mile Creek (Figure B-5); and the direction of flow at Black Hall is toward the west, and there may be a southerly component discharging to wetlands south of the golf course (Figure B-6). A time series of water-table elevations for Cherrystone and Black Hall is presented in Appendix C.

Measurements of groundwater elevation and resulting contours (Figure B-5 and Figure B-6) allow a calculation of the groundwater-flow velocity at each parcel, using the equation:

$$v = \frac{K}{n_e} \times \frac{dh}{dx}\text{, where}$$

v: Average macroscopic flow velocity (ft/day);

K: Hydraulic conductivity (ft/day);

n_e: Effective porosity (unitless);

dh: Change in hydraulic head (groundwater elevation);

dx: Lateral distance over which dh is measured; and

dh/dx: Hydraulic gradient (unitless).

At Black Hall, an average hydraulic conductivity of 5 ft/day, hydraulic gradient (dh/dx) of 0.01 (dh = 15 ft, dx = 1,400 ft), and effective porosity of 0.15 (literature value) were used to obtain a flow velocity of approximately 0.4 ft/day.

At Cherrystone, the hydraulic gradient was estimated using hydraulic head measurements from WC-1, WC-2, and WC-3; WC-4 likely represents water ponded in a bedrock depression and was not considered in calculations or subsequent simulations. These three wells are arranged in a linear fashion, which creates some uncertainty in determining the direction in which hydraulic head is changing at the greatest rate. However, during the subsurface investigation, attempts to install WC-1 east of its current location failed due to refusal conditions. The groundwater velocity was obtained using an average hydraulic conductivity of 150 ft/day, effective porosity of 0.20, and gradient of 0.003 (dh = 0.5 ft, dx = 170 ft), for a value of approximately 2.25 ft/day. Using the groundwater velocity, which was rounded to 2.5 ft/day, the 21-day travel time of groundwater at Cherrystone is about 55 feet.

7.1.1.6 Delineation of Facility

Assigning the aerial footprint of the subsurface absorption system (SAS) at the Cherrystone parcel was accomplished using hydrologic data collected from historical test pits logs and the recent groundwater investigation. The criteria for selecting a SAS area include thickness of permeable soils and boundaries imposed by surface-water bodies and property bounds. Ground-elevation data obtained by Pereira during summer 2013 were contoured using the computer program Surfer (Golden Software, 2004) and incorporated with geologic data to produce several cross sections through the study area. Depth to average SHWT (Table B-2) was confirmed and interpreted depths to bedrock then were superimposed on the cross sections. Using the calculated 21-day travel time, a buffer of 55 feet was given to the wetland and property boundaries surrounding Cherrystone. Two SAS delineations were assigned, as described below; both SASs are depicted on Figure B-7.

The first facility extent, the “small” SAS, was assigned assuming at least five feet of saturated soils beneath the average SHWT elevation. The western bounds of the SAS followed the buffer around property boundaries and the wetland. The northern, southern, and eastern extensions were based on cross sections and an interpreted five-foot-thick zone of saturated aquifer material; approximately 15 feet of unsaturated soils are present throughout the SAS delineation. The area of the “small” SAS is approximately 1.67 acres, or roughly 72,750 ft^2.

The “large” SAS was assigned assuming at least 10 feet of unsaturated soils above the average SHWT elevation or above the interpreted bedrock surface; a criterion of saturated soil thickness was not applied. Using the lateral extent of permeable soils, the eastern boundaries of this SAS were extended notably farther than those of the “small” SAS, for a total area of 3.52 acres, or approximately 153,300 ft^2.

7.1.1.7 Groundwater Model – Cherrystone

Groundwater mounding at the Cherrystone parcel was simulated using the Hantush equation for groundwater mounding beneath an infiltration basin (USGS 2010). Additional simulations were run using the MODFLOW numeric code with the graphical user interface Groundwater Vistas (ESI, 2011); mounding results of the MODFLOW simulations were less than those generated using the USGS Hantush simulations and are therefore not presented. The USGS mounding simulator incorporates the following input parameters to calculate mound height: Recharge Rate (ft/day), Specific yield (unitless), Hydraulic Conductivity (ft/day), Basin Dimensions (the simulator assumes a rectangular basin), Time (day), and Saturated Thickness (ft). For each simulation, the specific yield of the Cherrystone aquifer was set to 0.20 based on reference values for sandy material, and the time set to 250 days, a conservative estimate of the time for water at the eastern extent of the facility to reach the wetland.

Results of mounding simulations at the “Small” facility are summarized in Appendix C. Output, displayed as mounding heights at the center of the facility, is grouped by infiltration/recharge rate, and then subdivided by a range of hydraulic conductivity. The facility area, 1.67 acres, is simulated as a rectangle measuring 365 feet by 200 feet. The outline on Figure 7 for the small facility is not rectangular, but for the purposes of the simulator, both the small and large facilities are delineated as rectangles. A saturated thickness of 20 feet is used for the small facility, as suggested by cross sections. Mound heights exceeding eight feet are highlighted. The facility is assumed to penetrate three feet into the ground, and three feet of separation from the SHWT to the facility is required. Assuming the grade at well WC-3, the lowest lying well at Cherrystone, is raised to a level comparable with those of WC-2 and WC-1, eight feet of mounding is acceptable to maintain adequate separation. At the prescribed maximum infiltration rate of 1.2 gallons per day per square foot (gpd/ft2) (87,600 gpd), the facility can maintain separation; simulated mounding does not surpass three feet. The infiltration rates were increased to 2 gpd/ft^2 and 3 gpd/ft^2 (146,000 gpd and 219,000 gpd, respectively) to evaluate the mounding during potential periodic high flows. As simulated, the mounding at the facility will be limited to five feet at 2 gpd/ft^2 and to seven feet at 3 gpd/ft^2.

The “Large” facility also was simulated, with results shown in Appendix C. The facility is roughly 3.52 acres, and is simulated as a rectangle with dimensions 510 feet by 310 feet. The mounding results include simulations at saturated thicknesses of 15 feet and 20 feet; extending the large facility to include unsaturated soils east of the small facility necessitated a consideration of reduced average thickness of saturated soils. Using the eight-foot mound cutoff, simulation results suggest that the large facility can withstand 1.2 gpd/ft^2 (190,000 gpd) at either saturated thickness. As the infiltration rate is increased to 2 gpd/ft^2 (316,000 gpd), mounding is acceptable at the higher end of hydraulic conductivity (150 ft/day and 200 ft/day).

Results of mounding simulations at the small and large facilities suggest that either facility can receive treated wastewater at 1.2 gpd/ft^2 (87,600 gpd at the small facility, 190,000 gpd at the large facility). As a greater area for wastewater disposal results in increased mounding, the simulated large facility can receive up to 2 gpd/ft^2 (316,000 gpd) at the interpreted average hydraulic conductivity of 150 ft/day, whereas the small facility can receive up to 3 gpd/ft^2 (219,000 gpd).

7.1.2 Summary of Local Alternative 1 – Subsurface Disposal and Reuse

The subsurface investigations determined that there is enough capacity available on the Cherrystone and Black Hall sites to handle the proposed range of flows anticipated from the Wastewater Service Area. The Cherrystone site will likely handle all winter flows. The Black Hall site is capable of handling additional summer flows on its irrigated turf and/or within wooded areas to the east of the site, all within its current water diversion permit. Additional sub-surface disposal is available along the east side of the Black Hall site for peak flow events.

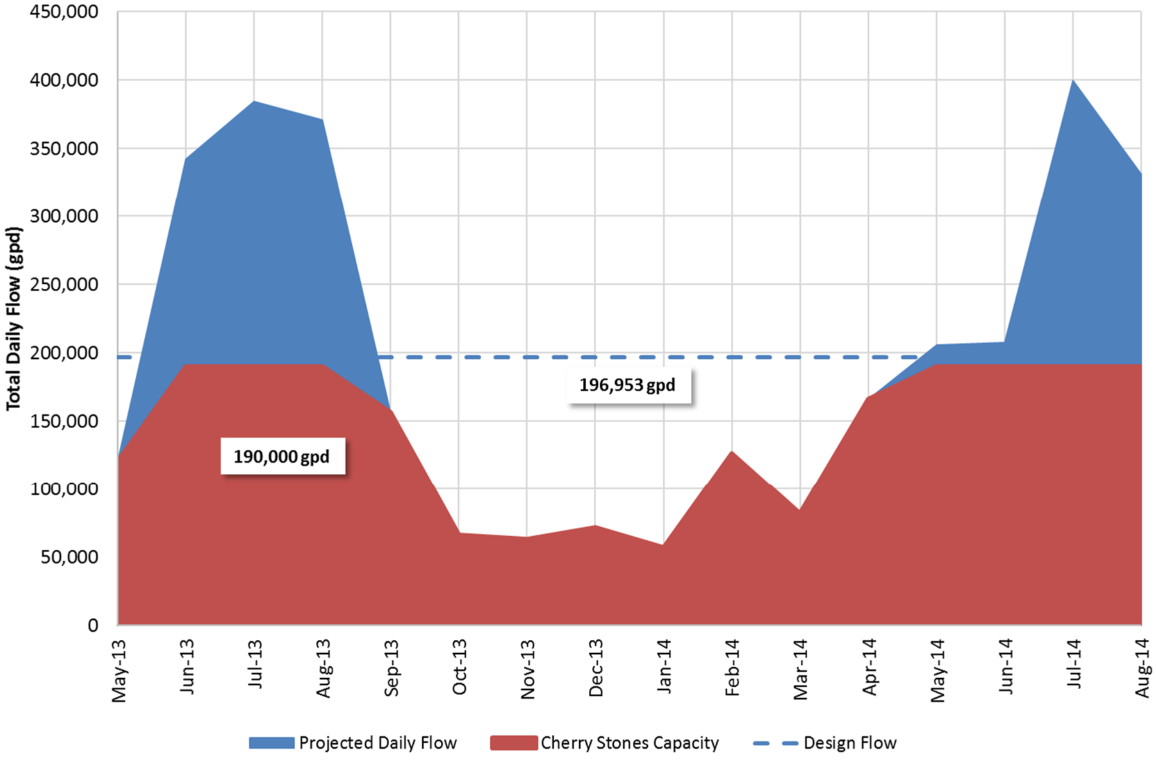
7.1.2.1 Sub-Surface Disposal at the Cherrystone Site

The max day flow increases due to seasonal variations and are expected to be at the highest during the summer time. Figure 7-1 presents the expected max day flow over the course of the year. Figure 7-3 presents the max day flow capacity at the Cherrystone site versus the anticipated annual max day flows. The Cherrystone site has the potential to take 100% of the winter time flow, as shown in Figure 7-3, where the flow curve remains below the 190,000 gpd capacity of the Cherrystone site.

Following submittal of the December 2013 Draft Report, CT-DEEP provided information on the existence of three drinking water wells located east of the Cherrystone site as shown in Figure 7-2, including two community wells operated by Connecticut Water Company and one non-community well owned by South Shore landing. It should be noted that according to the CT-DEEP GIS data base, accessed on August 22, 2014, these wells are not part of the GIS layer representing the area of contribution to public supply wells as shown in Figure 7-2.

Although it is unclear whether the presence of these potable wells represents a conflict with the proposed use of the Cherrystone site as a primary subsurface disposal site, or whether the wells could be relocated, given their modest capacities. Additional onsite testing and groundwater modeling would be necessary to evaluate the real impact of subsurface discharge on a drinking water well. However, based on the timing of the data provided by CT-DEEP during May 2014 meeting with CTDPH, coupled with the timetables for the existing Consent Orders, the Cherrystone site and Local Alternative 1 were not further studied or considered as part of this updated Report.

Figure 7-3: Year Round Flows vs. Primary Subsurface Disposal

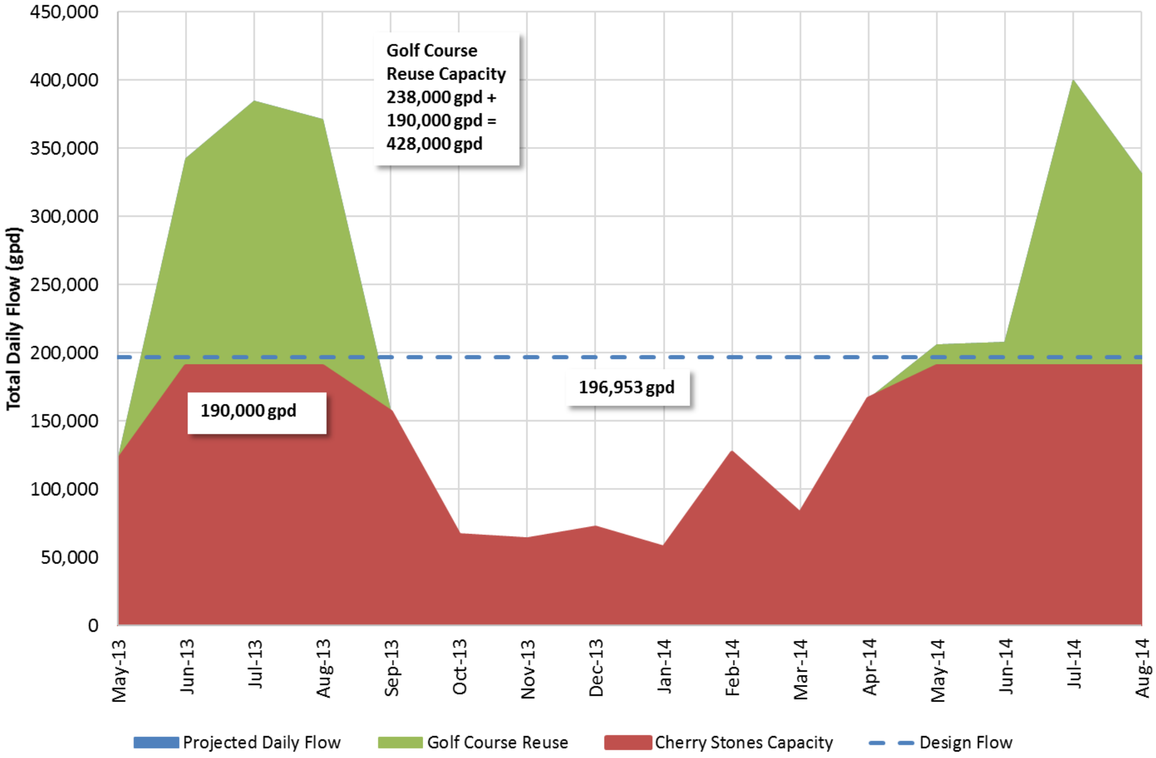


demand of the Project Area. Specifically, when flows from the Project Area peak during the summer, the irrigation demands on the Black Hall Golf Course peak.

Figure 7-4 shows the additional max day disposal capability of Black Hall Golf Course reuse irrigation. However, the max day disposal capacity over the entire 163-acre parcel is controlled by and therefore limited to the golf course irrigation needs. Currently the Golf Course has a water diversion permit of 238,000 gpd for irrigation purposes, but golf course management has indicated that they would like to use more.

Irrigation for the Black Hall Golf Course currently comes from the reservoir just west of the Black Hall parcel, which is believed to be a man-made rock quarry with no inlets or outlets. From the quarry, it is pumped to a central pond on the golf course where it is then used as irrigation water. Golf course irrigation is dependent upon the time of day and weather conditions, so it will be necessary to have sufficient storage to maintain max day flows from the WPCF. Storage would be accomplished by pumping to the existing quarry, where one foot of water level increase would be approximately one full day of storage at max flow and two days at average summer time flow.

Figure 7-4: Year Round Flows vs. Primary Subsurface Disposal and Black Hall Reuse for the Project Area



7.1.2.3 Sub-Surface Disposal at Black Hall Site

It is also possible for additional disposal capacity on the Black Hall parcel through an increased water diversion permit or additional subsurface discharge systems similar to Cherrystone. As shown in Figure 7-4, the Cherry Stones site and golf course reuse would accommodate the projected peak flows. Additional capacity, if required could be accommodated through a secondary sub-surface site located on the Black Hall parcel. The secondary subsurface systems are proposed on the east side of the Black Hall parcel. The additional area needed is approximately two acres at an infiltration rate of 1.2 gpd/ft^2; this additional sub-surface disposal would need further detailed hydrogeological analysis prior to design.

7.1.3 Local Alternative 1 – Subsurface Disposal & Reuse Costs

The combined effluent disposal systems are consistent with the intention of allowing the water to go back to the aquifers from which it came. This system of subsurface disposal of large areas and limited infiltration rates becomes an expensive option that is not an additional cost for the Regional Alternative. The Regional Alternative cost for disposal is inexpensive due to the surface water discharge permit the New London WPCF currently operates under. These costs are included with annual treatment O&M. The local subsurface disposal and reuse costs are summarized in Table 7-4 based on conservative effluent disposal options. It is likely that open sand bed disposal systems at Cherrystone and alternate force main routes to Black Hall could drive down the cost of the sub-surface and Black Hall Reuse options. For cost breakdowns and assumptions, refer to Tables 7-1, 7-2 and 7-3. Based on the timing of the additional drinking water well data provided by CT-DEEP in May 2014, together with the timelines for the Consent Orders at the chartered beaches, the local reuse alternatives were not further explored as part of this updated Draft Report.

Table 7-1: 2014 Primary Subsurface Disposal Costs

Item	Unit	Unit/Cost	QTY	Cost[3]
Additional Fill	CY	$27	18,000	$486,000
10" Force Main[1]	LF	$275	1,800	$495,000
Pump Station	EA	$1,500,000	1	$1,500,000
Site Preparation[2]	SY	$10	36,000	$360,000
Piping	LF	$35	19,500	$683,000
Permitting	EA	$200,000	1	$200,000
Subtotal				$3,724,000
Contingency, Legal and Engineering Services		40%		$1,490,000
Total				$5,214,000

1. Force Main from proposed WPCF area assumes complete installation unit costs

2. Assumes 2 feet of top soil to be used on site

3. All costs are rounded to the nearest $1,000

Table 7-2: 2014 Reuse Costs

Item	Unit	Unit/Cost	QTY	Cost[4]
10" Force Main to Black Hall[1]	LF	$275	6,700	$1,843,000
Water Main Extension[2]	LF	$275	2,800	$770,000
Storage Reservoir Clay Lining[3]	SY	$60	3,000	$180,000
Permitting	EA	$200,000	1	$200,000
Subtotal				$2,993,000
Contingency, Legal and Engineering Services		40%		$1,197,000
Total				$4,190,000

1. Force Main from Cherrystone to Black Hall assumes complete installation

2. Assumes potential cost of watermain extension to Black Hall

3. Assumes 3 inch thick clay lining for Storage Reservoir at Black Hall

4. All costs are rounded to the nearest $1,000

Table 7-3: 2014 Secondary Subsurface Disposal Costs

Item	Unit	Unit/Cost	QTY	Cost[4]
Drip Piping[1]	LF	$70	23,000	$1,610,000
10" Forcemain[2]	LF	$275	2,000	$550,000
Easement[3]	SY	$300	220	$66,000
Permitting	EA	$200,000	1	$200,000
Subtotal				$2,426,000
Contingency, Legal and Engineering Services		40%		$970,000
Total				$3,396,000

1. Unit costs based on similar system construction costs.

2. Forcemain from Route 156 along Otter Rock Road.

3. Easement required to pass through empty Residential Lot at end of Otter Rock Road, assumed 10 ft wide.

4. All costs are rounded to the nearest $1,000

Table 7-4: 2014 Local Alternative 1 – Subsurface Disposal and Reuse Cost Summary

Description	Capital Cost	Disposal Capacity Range GPD
Primary Subsurface Disposal System[1]	$5,214,000	190,000[4]
Reuse[2]	$4,190,000	238,000[5]
Secondary Subsurface Disposal System[3]	$3,396,000	110,000[6]
Total	$12,800,000	538,000

1. Cherrystone Driving Range - Capital Costs based on Table 7-1

2. Irrigation at Black Hall Golf Course - Capital Costs based on Table 7-2

3. Black Hall Golf Course - Capital Costs based on Table 7-3

4. Disposal capacity based on infiltration rate of 1.2 gallons per SF per day, 21 days of travel time, while maintaining 3 feet of separation during mounding

5. Disposal capacity based on the permit for Black Hall Golf Course

6. Disposal capacity based on disposal area of 2.8 acres

7.2 LOCAL ALTERNATIVE 2 WITH SURFACE DISPOSAL TO CONNECTICUT RIVER

In addition to Local Alternative 1, where disposal of effluent consisted of groundwater discharge and reuse for irrigation, a surface-water-discharge alternative was recommended by CT-DEEP in their April 2014 comments, and subsequently investigated in this updated Report. Local Alternative 2 consists of sewer infrastructure necessary to convey treated effluent from a local WPCF site to a potential outfall located along the Connecticut River. Figure 7-5 illustrates the potential force main route used to evaluate surface water discharge for Local Alternative 2.

The Connecticut River was chosen as the receiving water body due to its proximity to the Project Area, its large size, and its established capacity for assimilation of effluent. No other surface water bodies near the Project Area are of sufficient size to absorb the projected effluent flows. A pump station located at the local WPCF site would convey effluent through approximately five miles of force mains along route 156 to the outfall at Ferry Road. This route crosses three bridges over rivers and one bridge over a railroad. Due to the length of the route and the elevation changes associated with it, multiple air release structures will be required to avoid air binding of the pipe. A potential outfall is located at Ferry Road adjacent to the Connecticut River, about 2.5 miles north of Long Island Sound.

7.2.1 Disposal Costs

Table 7-5 shows the costs associated with Local Alternative 2. This cost estimate included trench work, and paving for one lane of a State Road at 15 feet wide. Also included in this cost estimate are the anticipated administrative and legal fees associated with a new NPDES permit required for the new surface water discharge to the Connecticut River.

Table 7-5: 2014 Local Alternative 2 – Surface Water Discharge to CT River - Disposal Cost Summary

Gravity Sewer Items	Unit	Unit Cost	Quantity	Cost[8]
10-inch Transmission Main[1]	LF	$ 60	26,555	$ 1,593,000
Air Release Manholes	EA	$ 15,000	6	$ 90,000
Pump Station	EA	$ 1,500,000	1	$ 1,500,000
Chemical Addition	EA	$ 400,000	1	$ 400,000
Trench Repair[2]	LF	$ 15	26,555	$ 398,000
Permanent Trench Paving[3]	LF	$ 20	26,555	$ 531,000
Milling[4]	LF	$ 20	26,555	$ 531,000
Rock Excavation[5]	CY	$ 70	2,500	$ 175,000
Trench Dewatering	LF	$ 20	26,555	$ 531,000
River/Bridge Crossing[6]	EA	$ 30,000	3	$ 90,000
Railroad Bridge Crossing Premium[6]	EA	$ 200,000	1	$ 200,000
Environmental Protection	LF	$ 10	6,639	$ 66,000
Police Detail[7]	Days	$ 960	469	$ 450,000
Permitting	EA	$ 200,000	1	$ 200,000
Subtotal				$ 6,755,000
40% Contingency and Engineering Services				$ 2,702,000
Total Cost				$ 9,457,000

1. Transmission main unit costs include all cleanouts and valve connections
2. Trench Repair assumes 3" of pavement at 6.5 ft wide
3. Permanent Trench Pavement assumes 2" of pavement and 15 ft wide travel lane
4. Milling assumes 15 ft wide travel lane for all state roads
5. Assumes 0.5 feet of rock per every LF of trench (5 foot trench)
6. Based on July 2012 Addendum to Wastewater Facilities Planning Reports
7. Assuming forcemain is laid at a rate of 150 ft/day, trench repaired at 100 ft/day, paving at 1000 ft/day, and 2 officers charge $60/hr at 8 hr/day
8. All costs are rounded to the nearest $1,000

7.3 ANTICIPATED PERMITS

There are three different disposal alternatives that were explored as part of this project, including:

- Groundwater discharge – a fairly straightforward permitting process with CT DEEP;
- Wastewater reuse – a more complicated permitting process with CT DEEP, which is not well established in the State of Connecticut; and
- Surface water discharge – a straight-forward but very detailed permitting process. However, there have been very limited new surface water discharge permits for a new WPCF in the past 20+ years.

7.3.1 Groundwater Discharge Permitting

CT-DEEP's Groundwater Discharge Permit Program regulates discharges to groundwater from any source, including large septic systems, sewer service areas, agricultural waste management systems, and landfills. Groundwater discharge permitting is a well-defined process in Connecticut.

The Old Lyme WPCA would develop and submit a permit application to CT-DEEP. CT-DEEP would review the application and determine if the proposed discharges will cause pollution to the waters of the State. To accomplish this, CT-DEEP staff will review the application potential for:

1. adverse effects on existing and designated uses of the waters of the state as defined in Connecticut's Water Quality Standards and Criteria;
2. interference with or adverse effects upon the operation of a Publicly Owned Treatment Works (POTW); and
3. systems and methodologies proposed to counteract such adverse effects and to minimize the discharge of pollutants.

All groundwater investigations performed to date have been conducted in accordance and under the supervision of the CT-DEEP. Therefore, several of the preliminary elements required in a Groundwater Discharge Permit application have already been initiated.

7.3.2 Surface Water Discharge Permitting

CT-DEEP's Wastewater Discharge from Domestic Sewage Treatment Works regulates wastewater treated by domestic sewage treatment facilities which discharge to surface waters of the state. Surface water discharge permitting is a straight-forward but very detailed application process in Connecticut. However, new surface water discharge permits are very rare (the most recent new approved surface discharge was for Deep River, prior to 1990).

The Old Lyme WPCA would develop and submit a permit application. CT-DEEP will review the application and determine if the proposed discharges will cause pollution to the waters of the State. The application will be reviewed by CT-DEEP for:

- Adherence to public notice requirements;
- Consistency with the Connecticut Coastal Management Act;
- Compliance with 2011 Connecticut Water Quality Standards;
- Site plans including a process flow diagram; and
- Proposed operations and maintenance plan.

Based upon the aforementioned surface water discharge permitting application requirements, we believe that surface water discharge permitting carries a relatively high-cost of approval and an unknown likelihood of success.

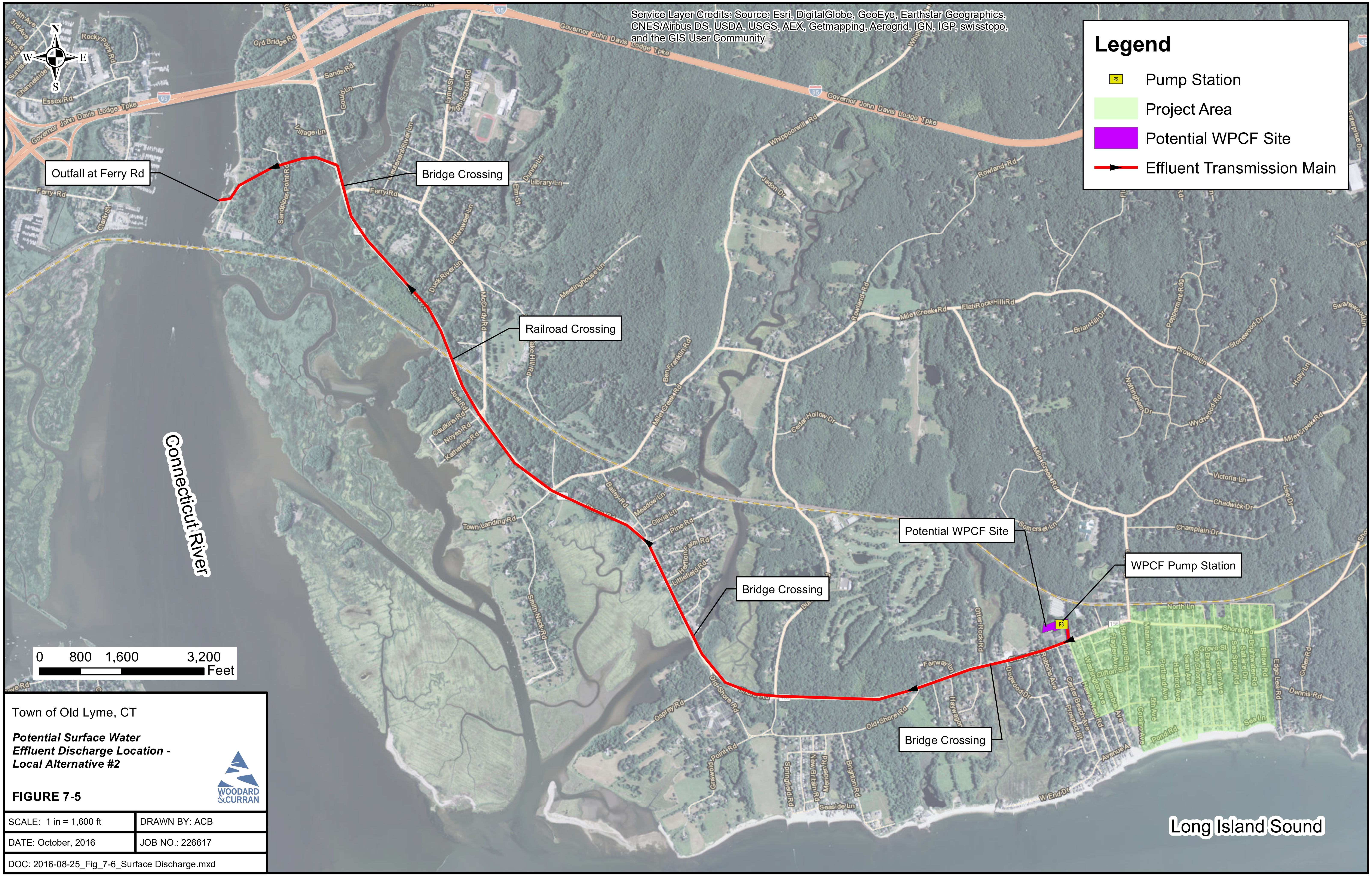
7.3.3 Wastewater Reuse Permitting

As water sources are becoming increasingly stressed throughout the country, utilities have turned to water reuse. Currently, most of the reclaimed water in the United States is used for irrigation (47%) and groundwater recharge (13%). Three states (CA, CO, and TX) currently utilize “potable reuse,” which is the treatment of sanitary wastewater to a high standard which is then utilized for drinking water.

Permitting wastewater reuse in Connecticut can be somewhat challenging because the State of Connecticut is one of four remaining states in the country without a Wastewater Reuse Policy or wastewater reuse permitting process. However, there is precedent for wastewater reuse in the State of Connecticut and therefore three different permitting options under existing CT-DEEP programs. Table 7-6 outlines the three currently known options for permitting wastewater reuse in Connecticut.

Table 7-6: Current Wastewater Reuse Permitting Options in Connecticut

Considerations	Permitting Options		
	Pretreatment Permit	**Underground Injection Control (UIC)**	**NPDES Permit**
Precedent in CT?	Yes	Yes	Yes
If so, where?	Lake of Isles, LLC (Foxwoods) Golf Course	- Indirect Reuse: ○ Brunswick School in Greenwich (2013 draft UIC permit to use portion of discharge for grey water)	- Convent of Sacred Heart in Greenwich had an existing discharge into a pond system used by Fairview Farms Country Club for irrigation. In 2012, a NPDES permit was issued to reauthorize the existing discharge
Complexity of Permitting Process	Above Average	Average	Above Average
Estimated Permitting Time	9 months	9 months	12 months
Potential Eligible Discharge Locations	- Locations where human health contact is controlled. Locations include: ○ Agriculture ○ Golf courses	- All locations into the ground	- All discharge locations into a pond, river, stream or other waterbody
General Permitting Steps	- Draft Permit Conditions & meet with CTDEEP. - Gather additional data; conduct Health Risk Assessment, etc. (as required). - Finalize Permit Conditions and submit final Permit application to CTDEEP. - Applicant is responsible for publishing a Notice of Application with a 30-day comment period.	- Draft Permit Conditions & meet with CTDEEP. - Gather additional data; conduct Health Risk Assessment, etc. (as required). - Finalize Permit Conditions and submit final Permit application to CTDEEP. - Applicant is responsible for publishing a Notice of Application with a 30-day comment period.	- Draft Permit Conditions & meet with CTDEEP. - Gather additional data; conduct Health Risk Assessment, etc. (as required). - Finalize Permit Conditions and submit final Permit application to CTDEEP. - Applicant is responsible for publishing a Notice of Application with a 30-day comment period.
Pros	- Precedent - Anticipate less than 1 year to permit. - Established permit process.	- Wastewater reuse already permitted under UIC Permit. - Anticipate less than 1 year to permit. - Established permit process. - More flexible permit option.	- Wastewater reuse already permitted under NPDES permit at Sacred Heart in Greenwich - Anticipate about 1 year to permit. - Established permit process.
Potential Issues	- None known	- No precedent for spray irrigation.	- The 2011 Connecticut Water quality standards prohibit the discharge of treated wastewater into class A or SA waterbodies, which includes manmade reservoirs.



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Town of Old Lyme, CT

Potential Surface Water
Effluent Discharge Location -
Local Alternative #2

FIGURE 7-5

WOODARD
&CURRAN

SCALE: 1 in = 1,600 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617

DOC: 2016-08-25_Fig_7-6_Surface Discharge.mxd

8. COMPARISON OF ALTERNATIVES AND RECOMMENDATIONS

8.1 INTRODUCTION

This Section includes a comparison of the Local and Regional Alternatives, including capital costs, operation and maintenance costs, and net annual costs; the recommended plan including the proposed alternative; and the framework for an implementation plan including coordination with other on-going wastewater planning efforts in the Project Area, input needed from CT-DEEP, and the anticipated schedule for implementing the recommended plan.

8.2 COMPARISON OF ALTERNATIVES

The following sub-sections highlight the differences between the Local and Regional Alternatives including cost and non-cost factors, thus facilitating an objective decision by the Town that is in the best short-term and long-term interests of the Town and the Project Area Sub-Areas. The advantages and limitations of each alternative proposed are summarized in Table 8-1.

Table 8-1: Summary of Advantages & Limitations of Alternatives Proposed

Alternative	Advantages	Limitations
Local Alternative 1 Disposal/Reuse	- No intermunicipal agreements required - Higher quality effluent - More control over annual O&M costs - Possibility of water reuse opportunities	- Higher capital and O&M costs - New local WPCF and permitting required - Additional pump station required at WPCF - More substantial land requirements - Complicated permitting process
Local Alternative 2 CT River Discharge	- No intermunicipal agreements required - More control over O&M costs	- Higher capital and O&M costs - New local WPCF required - Additional pump station required at WPCF - Land requirements - Additional permitting to cross resources - Easement(s) required
Regional Alternative	- Lower capital and O&M costs - No new WPCF required - Moderate permitting requirements - Minimal property acquisitions - Less construction required	- Multiple intermunicipal agreements required - Future downstream infrastructure upgrades anticipated - Less control over future escalations in annual O&M costs by downstream communities

8.2.1 Capital Costs for Project Area

Table 8-2 includes a summary of total projected capital costs for the Project Area for the Local and Regional Alternatives, including subtotals for collection, treatment and disposal/reuse. The collection system subtotal is based on the gravity sewer option, due to its lowest capital cost compared to the other collection system alternatives.

Table 8-2: Total 2018 Capital and Annual O&M Costs for Project Area

	Capital[1]			Annual O&M		
System Component	Local #1 - Disposal/Reuse	Local #2 - CT River Discharge	Regional	Local #1 - Disposal/Reuse[1]	Local #2 - CT River Discharge	Regional
Collection	$18,889,000	$18,889,000	$25,186,000	$204,000	$204,000	$296,000
Treatment	$14,500,000	$14,500,000	$4,680,000	$532,000	$532,000	$58,000
Disposal	$12,800,000	$9,457,000	$0	N/A[2]	N/A[2]	N/A[2]
2014 Total	$46,189,000	$42,846,000	$29,866,000	$736,000	$736,000	$354,000
2018 Total[3]	$51,986,000	$48,224,000	$33,617,000	$828,000	$828,000	$398,000

1. Local and Regional Costs based on gravity sewer collection systems for Project Area.
2. Annual Disposal and Reuse costs are included with Treatment O&M.
3. Costs escalated to 2018 at an annual inflation rate of 3%

As shown in Table 8-2, the collection system capital costs for the Regional Alternative are significantly higher than those for the Local Alternative. This is because the Regional Alternative includes pump stations, force mains, and gravity sewer needs in East Lyme and Waterford resulting from the proposed connection. However, the anticipated treatment costs are much lower for the Regional Alternative than for the Local Alternatives, since new treatment systems are not required for the Regional Alternative. Overall, the Regional alternative has an anticipated capital cost that is approximately $18M less than the Local Alternative. However, there is greater potential for major deferred capital expenses for the Regional Alternative. For example, New London has not developed a capital plan for their WPCF, of which Old Lyme would be required to contribute in the future. The same can be said about future capital needs in East Lyme and Waterford, which would also require that Old Lyme contribute to these costs.

8.2.2 Annual Operation & Maintenance Costs for Project Area

In addition to the capital costs for designing and constructing the recommended plans, there will also be an annual O&M cost for the Town to both operate and maintain the system. The operation and maintenance (O&M) cost associated with the system primarily consists of costs to operate and maintain the wastewater collection system, pump station(s), force main(s), maintenance of the mechanical pumping equipment, annual replacement costs, treatment costs, chemical addition costs, power costs, and administrative costs.

Refer to Table 8-2 above for a summary of the anticipated annual O&M costs for the Local and Regional Alternatives, including subtotals for collection and treatment (which includes disposal and reuse).

The results of the cost analysis suggest that the annual O&M costs for the Local Alternative are approximately $430,000 more expensive than that for the Regional Alternative. This cost differential could change depending in the extent of external contract operations services utilized by the Town and beaches. We also note that Old Lyme has less control over future escalations in annual O&M costs with the Regional Alternative.

8.2.3 Regional Alternative for Project Area

Following submittal of the December 2013 Draft Report, CT-DEEP provided in May 2014 information on existing potable wells adjacent to the primary subsurface disposal site that would have required relocation of the wells and/or additional testing and groundwater modeling on other available testing sites. However, based on the status of the ongoing regional sewer connection project to New London by the chartered beach associations, the Town, CT-DEEP and chartered beaches agreed to pursue the Regional Alternative together as a single recommended plan, which relies on treatment and disposal through the New London WPCF. The components of the Regional Alternative for the Project Area are shown in Figure 8-1.

8.2.4 Capital Cost Sharing and Financing for Project Area

Woodard & Curran performed an analysis on the Regional Alternative for the Project Area Sub-Areas to determine the net annual cost to the property owners in the Project Area for both capital cost and debt service. The most favorable anticipated financing terms are through the State Clean Water Fund (CWF) program which would finance the eligible capital cost, excluding the buy-in costs associated with the New London WPCF. The CWF program is a CT-DEEP financial assistance program that allows communities to receive grants and low interest loans with a payback period of up to 20 years. For the purpose of this analysis, we assumed a 25% small-community grant based on the Priority List issued by CT-DEEP, with a CWF-based 2% interest rate for a 20-year loan. Note that the Town may also be eligible to receive an additional 5% grant from CT-DEEP if the Town managed and chartered beaches agree to establish a regional WPCA. This management alternative can be explored following appropriation of project funds by the Town.

To present the capital and O&M costs to an Equivalent Uniform Annual Cost (EUAC), we calculated the Capital Recovery Factor (CRF) based on the annual interest rate (2%) and the design period (20 years). The capital EUAC was then estimated by multiplying the amount financed by the CRF. The results of this analysis are summarized in Table 8-4.

Table 8-4 includes a summary of anticipated capital and annualized capital / O&M costs for each of the Sub-Area groupings that comprise the Project Area. The Town managed Sub-Areas (Sound View and Miscellaneous Area B) are shown as one grouping. The proposed allocation of capital costs by Sub-Area is shown on an equivalent dwelling units (EDU) basis. Annual O&M cost projections are similarly shown. Figure 8-4 illustrates the net capital cost per EDU for the Project Area.

Based on the net annual capital costs, it is critical for the Town to pursue and obtain the maximum possible grant funding from CT-DEEP to reduce the financial impact on the sewer users in the Project Area.

The following debt recovery methods are options to recover the costs to finance a typical wastewater utility project:

- Betterment assessments based on the fixed uniform rate (linear foot frontage and/or property area) or the uniform unit method (number of existing/potential sewer units);
- Supplementation by special assessments such as connection charges, interest, fines, etc.;
- User charges; and
- Property taxes.

The Town will utilize benefit assessments to recover funding and financing costs for the proposed Project. Therefore, only property owners within the Project Area will be assessed Project costs. No changes to the mill rate (general taxation) are proposed as part of this Project.

8.2.5 Other Considerations

In addition to the cost benefits of the Regional Alternative, there are several other non-cost factors that should be considered by the Town in this evaluation. These include:

- <u>Deferred Downstream Capital Improvements</u>: For the Regional Alternative, future capital upgrades will be shared amongst the sewer users in New London, Waterford, East Lyme, and Old Lyme.
- <u>Implementation of New Utility</u>: Both Local and Regional Alternatives included the establishment of a new wastewater utility, and will come with challenges of implementation for facilities and additional construction in Old Lyme. Initial years for a new utility can be challenging, as connections are being made, and systems are being started up.

- Control of Flow Allocations: The Town of Old Lyme will need to manage the allocation of sewer flows, capital costs, and annual costs.

- Utilities: As we undergo efforts to provide public sewer service to the residents of the Old Lyme beach communities, it is prudent to evaluate other utility needs in the area. These other utilities potential include water supply and power.

  Water Supply: Like many of the chartered beach associations, the Town is exploring water distribution system needs in / to the Town managed parts of the High Needs Sub-Areas. The Town is working with CT-DPH, Connecticut Water, the Sanitarian, local water suppliers, and project stakeholders to evaluate these needs, develop costs, and present water improvement recommendations.

  Based upon an initial review of Hawk's Nest Beach and Sound View, it is clear that there are existing drinking water system improvement needs. At Hawk's Nest, there is a single line supplying water to a limited area of the beach community with no distribution system looping. There are also many private residential wells with seasonal water supply (piping) challenges. In Sound View, there is generally a good public water supply source however there are seasonal water piping challenges and private well concerns that require attention. In addition, Connecticut Water has developed a capital needs list for Sound View that requires outside funding to implement. Drinking water system improvements would improve public health within the project areas and will be handled on a parallel path so as to ensure they will not interfere with nor impede the Coastal Wastewater Management program.

  It should be noted that the Town may qualify for funding assistance from the CT-DPH Drinking Water State Revolving Fund program to address drinking water needs in these areas. In addition, there are likely cost savings opportunities if water and wastewater projects are designed and constructed concurrently. As water system conversations and investigations continue, recommendations will be developed and presented to the Town.

  Power: Connecticut Light & Power currently provides electricity to the Old Lyme beach communities. This power is supplied to the residents via overhead electrical lines. There are areas and residents of the beach communities that currently receive minimal power service and would likely be open to electrical system improvements. However, since electrical service is currently overhead and CL&P has no intention of implementing a costly underground electrical program, there is no cost or technical advantages of including broad-scale electrical improvements in this project.

8.3 PLAN DEVELOPMENT AND PUBLIC REVIEW PROCESS

The Town established a public workshop process as part of this Coastal Wastewater Management Plan Project to solicit input from stakeholders and partner agencies including CT-DEEP and chartered beach associations. Workshops were held during the development of this Updated Report to provide opportunities for interested parties to provide their input and/or feedback throughout the planning process.

To date, there have been more than 30 public meetings in which the Coastal Wastewater Management Plan Project was discussed. The recommended plan was presented to stakeholders during a focused public information meeting on September 30, 2014. Public comment has already helped shape the current plan, and we expect this to continue through project implementation.

8.4 RECOMMENDED PLAN

8.4.1 Proposed Project Area

Figure 8-1 shows the proposed Project Area, which comprises of five Sub-Areas. Table 8-2 includes a summary of total capital and O&M costs for the Project Area associated with the Local and Regional Alternatives, including subtotals for collection, treatment and disposal/reuse. The collection system subtotal is based on the gravity sewer option, due to its lowest capital cost compared to the other collection system alternatives. Table 8-3 summarizes the flow projections by Sub-Areas for the Project Area.

8.4.2 Proposed Alternative

The components of the Recommended Plan (the Regional Alternative) are shown in Figure 8-1. Despite the anticipated deferred capital costs associated with the Regional Alternative, the Regional Alternative capital cost projection is much lower than the Local Alternatives. This is predicated on the cooperative approach between the Town and the chartered beach association. The gravity sewer options are the best fit for the Regional and Local Alternatives. Similarly, the low pressure, STEP and STEG sewer alternatives are not the most appropriate options for either alternative, and should not be considered as part of the Regional Alternative.

The common pump station/force main sharing, and sewering across municipal boundaries, facilitates the maximization of cost sharing. If the Town and the chartered beaches decided to connect to New London with several individual pump stations and force mains, the costs for the Regional Alternative would be much higher. Therefore, based on the cooperative effort, as described, and endorsed by CT-DEEP, we recommend the Regional Alternative be implemented.

8.4.3 Coordination with Other Beach Communities

Wastewater Facilities Plans prepared for both the Old Colony Beach Club Association (OCBCA), the Old Lyme Shores Beach Club Association (OLSBCA), and the Miami Beach Association (MBA) concluded that the Regional Alternative was the preferred alternative for Sub-Areas 7, 8, and 5A. The three chartered beach associations are seeking appropriations for Project costs independent of the Town.

8.4.4 Capital Cost Allocation for Project Area

Table 8-4 includes a summary of anticipated capital and annualized capital / O&M costs for each of the Sub-Area groupings. The Town managed Sub-Areas (Sound View and Miscellaneous Area B) are shown as one grouping. The proposed allocation of capital costs by Sub-Area is shown on an equivalent dwelling units (EDU) basis. Annual O&M cost projections are similar shown.

Construction in beach communities requires close communication with project stakeholders. (Source: Town of Old Lyme, August 13, 2014)

Figure 8-2 summarizes the anticipated capital cost appropriations for each Sub-Area (Town managed and chartered beach areas) excluding the anticipated grant funds (25%) from CT-DEEP. The estimated cost sharing for the Town of Old Lyme is $9.13M, escalated to 2018. Figure 8-3 shows the net capital costs for each Sub-Area including the anticipated grant funds. Figure 8-4 illustrates the net capital cost per EDU for each of the Sub-Areas. Finally, Figure 8-5 shows the anticipated net annual cost per EDU for the project area, and Figure 8-6 highlights the projected monthly wastewater costs as compared to other household utility costs.

8.5 IMPLEMENTATION PLAN

There are four major elements of the Implementation Plan for the Coastal Wastewater Management Project. These include: (1) management planning with the Beach Communities, (2) funding/finance considerations, (3) continued public outreach and participation, and (4) management of the schedule to complete the program.

Upon CT-DEEP's review and approval of this Report, the Town will: (1) negotiate the Inter-Municipal Agreements (IMA), (2) develop and initiate a sampling program at Hawks Nest Beach, and (3) intensify public outreach in anticipation of Town referendum. However, based on the milestones for completion in the two outstanding Consent Orders Sub-Areas 7 and 8, we believe that the Town's Regional Alternative can also be concurrently implemented (upon adjustment of the Consent Order schedules) to allow not only Sub-Areas 7 and 8, but also the other Sub-Areas comprising the Project Area, to be addressed simultaneously. Figure 8-7 shows the key critical path steps for wastewater planning and implementation steps.

As aforementioned, residents in various Sub-Areas articulated a desire to expand public drinking water supply and potentially eliminate their reliance on private drinking water wells, thus eliminating a public health issue. The Town is talking to the Connecticut Water Company and the Connecticut Department of Public Health about expanding the public drinking water supply and may choose to incorporate a drinking water component into this project. This will be handled on a parallel path and will not in any way interfere nor impede the Coastal Wastewater Management program. No costs of potential drinking water improvements are quantified within this report.

8.5.1 Management Planning with the Beach Communities

The Town of Old Lyme and the Chartered Beach Communities have made tremendous progress in positioning the Coastal Wastewater Management Project for success. The parties have realized the power of collaboration and will realize significant cost savings through the implementation of a single unified program.

Going forward, the stakeholders will need to continue to work together on the design elements of the project. The team will work collaboratively throughout the Project.

8.5.2 Funding/Finance Considerations

The representatives of the Project Area understand that the Coastal Wastewater Management Project will be self-funded, meaning that the users of the system will pay their pro-rata share of the project costs (on an EDU basis). The project will be implemented utilizing CT-DEEP Clean Water Funds. These funds reimburse the participant with a grant for 55% of planning costs, and 25% of design and construction costs. The Town of Old Lyme (Sub-Areas 6 and MTA-B) will appropriate funds for their respective share of the program while Miami Beach (Sub-Area 5A), Old Colony Beach (Sub-Area 7) and Old Lyme Shores (Sub-Area 8) have each already appropriated their respective shares.

The stakeholders are also investigating other funding opportunities. For example, the Town of Old Lyme has already submitted an application for a grant under a State Resiliency Program that would have a significant positive reduction in the cost of the Project for the users in the Project Area.

8.5.3 Public Outreach & Participation

Public outreach and participation to date has been a key focus of the Town, the Old Lyme WPCA, and the chartered beaches. For example, the Town has had more than 30 public meetings and informational session on the project. 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 implemented. The potential schedule of public outreach includes (but will not be limited to):

- Public Informational Meeting – Spring 2017
- Town Meeting/Referendum – Summer 2017
- Design Public Meeting – Fall 2017
- Construction Public Meeting – Summer/Fall 2018
- Project Startup – Summer 2020

8.5.3.1 Response to CEPA Scoping Notice

CT-DEEP submitted a CEPA Scoping Notice through the Environmental Monitor in July 2014. The Scoping Notice included a project description, a map of the proposed Project Area, the proposed sewer system layout in the Project Area, as well as a figure illustrating the alignment of the existing downstream receiving sewers in East Lyme and Waterford. During the public comment period, State agencies, members of the public and other interest groups were afforded the opportunity to provide comment letters to CT-DEEP as shown in Appendix F. Following is a summary of five comment letters that were received by CT-DEEP, as well as a statement for each summarizing how these comments were considering and incorporated in this updated Report:

- *Eric Thomas of CT-DEEP submitted an email, dated August 20, 2014, inquiring as to whether the Niantic Pump Station and/or force main in East Lyme were going to be upgraded as part of the proposed project. Mr. Thomas inquired as to the current condition of the Niantic force main below the Niantic River.* There are no proposed upgrades to the Niantic Pump Station as part of this project, and the design pumping rate of the Niantic Pump Station is not expected to change as a result of the proposed Old Lyme project. Woodard & Curran did mention this comment to East Lyme Water & Sewer staff at a Fall 2014 meeting. East Lyme is in the process of considering future needs at the Niantic Pump Station, and should coordinate any potential force main evaluation tasks with CT-DEEP as part of their independent project work.

- *Marcy Balint of the State of Connecticut submitted an email on August 20, 2014, via David Fox (also of the State), to CT-DEEP. The email summarizes comments regarding the project's consistency with the State's Water Quality policies, coastal resiliency, and climate change considerations.* As a result of these comments, Woodard & Curran and CT-DEEP met in November 2014 to update the wastewater management needs analysis to ensure that it considered sea level rise, coastal resiliency, and other measures to improve coastal management and water quality goals. The proposed project is only serving existing development, and there are no allowances for future flows associated with in-fill development as part of the proposed project. CT-DEEP has stated that the future loan/grant agreement, through Connecticut Clean Water Fund funding, will include a provision stating that only existing wastewater needs from previously developed parcels can be served through the proposed wastewater infrastructure to be constructed, and funded by CT-DEEP. Additional control measures will include the implementation of an inter-municipal agreement with the "tri-town" municipalities, which will limit the amount of flow that can be discharged into the system from the Project Area. Sanitary sewers will ultimately be limited to the confines of the Associations boundaries as identified in the sewer service maps for the project.

- *Ellen Blaschinski of the Department of Public Health submitted a letter to CT-DEEP on August 22, 2014. The letter included questions relating to the sewers supporting future growth in the proposed service area. As well as statements related to confirming that existing septic systems will be properly abandoned and other sensitive environmental and public health considerations be included in the proposed project.* In response to these comments, the proposed sewer service area has been updated to eliminate undeveloped lots, include only existing development, and does not include any flow allowances for future development. Vacant lots would have to be compliant with existing local zoning regulations and demonstrate that they can sustain a fully code compliant septic system in order to be allowed to tie into the sewer system. This is consistent with the Town of Old Lyme's long-standing goal to avoid sewers, except in this case where it is the only viable and cost-effective alternative to solve existing on-site wastewater management challenges and pollution problems.

The Connecticut Coastal Management Act ("CCMA") and State Flood Management program contain regulatory tools codified in Connecticut General Statutes Sections 22a-92(b)(1)(B) and 25-68 respectively, for evaluating and restricting potential collateral impacts associated with these concerns. Based on these regulatory powers coupled with the induced-growth control measures discussed above, the state funding agreement will include restrictive language to minimize these concerns. While it is expected that environmental and public health benefits that will be achieved through the implementation of the proposed sanitary sewers will significantly offset any other collateral concerns, it is also the state's priority to minimize the exposure of lives and property to flood hazards, reduce non-point source pollution impacts and avoid potential overloading of other infrastructure in the Project Area. The Town of Old Lyme, with CT-DEEP oversight, will be responsible for implementing tools for developing a methodology for implementation of mitigation measures to address these concerns.

Construction of the proposed sewer system will be conducted in a manner that is protective of water supply infrastructure. Existing septic system will be abandoned in accordance with Public Health Code requirements once the sanitary sewer system is constructed.

- *David Potts of Killingworth, Connecticut submitted a letter to CT-DEEP on August 8, 2014. The letter advocates for solutions relying on the continued use of on-site wastewater (i.e. septic systems) with local sub-surface disposal systems.* As part of this project and updated Report, on-site systems were eliminated as a viable cost-effective alternative in the proposed Project Area. The wastewater management needs analysis in Section 2 of the CWMP summarizes these considerations as well as reasons why on-site systems are not the most appropriate alternative in the proposed Project Area. Implementation of decentralized alternatives were evaluated within the facilities plan reports for the chartered beach associations and ruled out due to the unavailability of suitable land and high density of development. In addition, more centralized on-site "Local" alternatives were considered in Section 7 of this Report, but the costs are higher than those for the Regional Alternative, and there are more significant permitting requirements for the centralized/local alternatives.

  Monitoring data clearly indicates elevated concentrations significantly above background levels of not only parameters such as ammonia, but also pathogens, both of which are strong indicators of wastewater pollution. Nitrogen and pathogenic contamination is a significant concern during the summer months when people use, very actively, the shoreline for swimming or fishing. Summer months is when people are most likely to come into contact with contaminants. Sampling results are further corroborated by monitoring records maintained by the Town sanitarian which show a prevalence of shallow groundwater conditions and ammonia pollution, especially, within the Sound View beach community.

  The proposed project is to address existing pollution concerns associated with excessive densities of development coupled with aging systems, poor soil conditions, small lots, and shallow groundwater; while minimizing to the maximum extent possible any additional development pressures that may arise associated with the project.

  Proposed infrastructure will be kept to a minimum with one pump station and force main shared by all the beach associations. Wastewater within the Project Area will be collected via gravity pipes, which will further reduce the need for additional pumping equipment within the flood zone. The project will also include, where feasible, the implementation of green infrastructure enhancements to effectively manage storm water pollution concerns in the Project Area.

With effective implementation of low impact development, green infrastructure measures and other growth control measures discussed above, secondary effects associated with the proposed project will be minimized substantially.

- *Bruce Wittchen, Connecticut Office of Policy & Management submitted a letter to CT-DEEP on August 22, 2014. The letter is requesting clarification on the rationale for the alternative selection (comparing them to historic Town committee meeting minutes), expectations for expansion of sewer service area, and how climate change considerations are being incorporated.* This Report clearly details the options and alternatives in Section 1-7 and explains the rational for recommendations in Section 8. This Report represents a culmination of numerous meetings and introduces new data; therefore, it builds upon and likely supersedes historic meeting minute items. The regional alternative has a significantly lower capital and O&M cost associated therewith and for this reason was selected to address the identified wastewater management needs in the Project Area.

  Regarding expansion of the sewer area, Section 2.7 of this Report reviews the sewer need areas consistency with the State Plan of Conservation and Development. The proposed sewer system will serve existing developed properties with the potential of serving additional vacant lots if the conditions discussed in the preceding paragraphs are met. It is envisioned that upgrades to other infrastructure within the Project Area such as stormwater and drinking water systems will be conducted concurrently with the sewer system to maximize project cost efficiency, and to increase storm resiliency and preparedness.

  Lastly, climate change is a major consideration within the Needs Assessment in Section 2 of this report and resiliency being a requirement of design of the sewer solution, has already been considered in the siting of sewer infrastructure and will continue to be incorporated into the design. Substandard septic systems, which are prone to flooding will be eliminated, which may facilitate the retrofitting of existing properties to better withstand the effects of flooding events and improve community recovery times after severe climatic events. Proposed wastewater infrastructure will be designed and constructed to meet resiliency and preparedness requirements in flood prone areas.

Upon CT-DEEP's review of this updated Report, Woodard & Curran and the Town of Old Lyme worked with CT-DEEP to develop an Environmental Impact Evaluation (EIE), as required by the CEPA Scoping Notice conclusions. After review and approval by CT-DEEP, the EIE will be subsequently advertised in the Environmental Monitor to receive any additional public comment on the proposed project. We anticipate that the EIE will be completed in December 2016

8.5.4 Schedule to Complete the Program

Old Colony Beach Club and Old Lyme Shores Beach (Sub-Areas 7 and 8) have outstanding Consent Orders requiring completion of construction by June 30, 2016. While we believe that the Town's Regional Alternative can be implemented concurrently with the Beach Association projects, there will need to be an adjustment by CT-DEEP to the current Consent Order schedules.

We propose the following schedule milestones:

- Town/Referendum Meeting (appropriation of project funds) – Summer 2017
- Design – Fall 2017 thru Summer 2018
- Construction – Fall 2018 thru Winter 2020
- Commissioning, start-up and integration – Winter 2020 thru Fall 2021

Figure 8-7 illustrates the key critical path steps for implementation plan.

Table 8-3: Summary of Gravity Flow Projections for Project Area

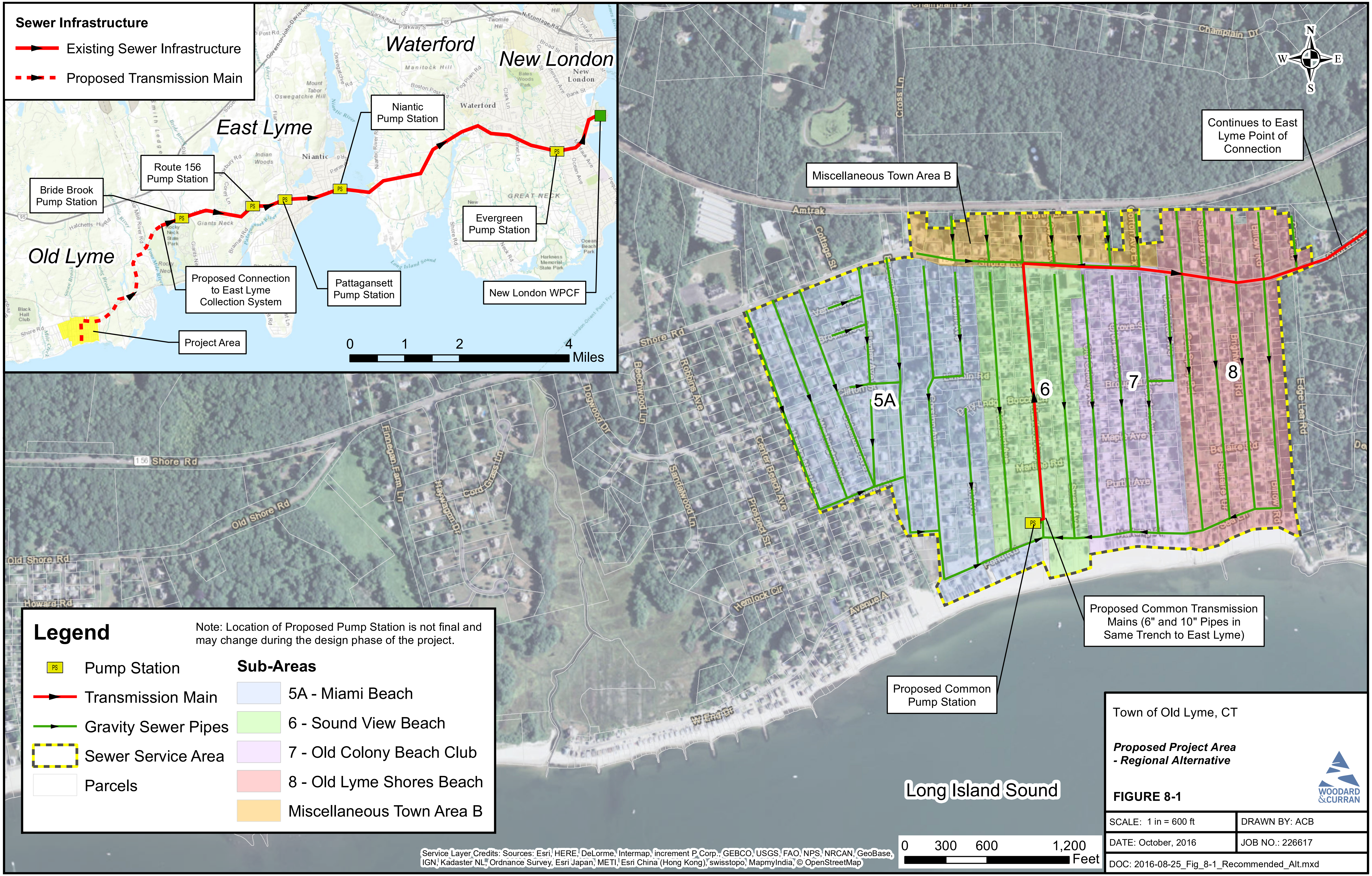
Sub-Area ID	Description	Equivalent Dwelling Units (EDU)	Average Daily Flow (GPD)			Max Daily Flow (GPD)[4]	Peak Hourly Flow (GPD)[5]
			Sanitary Flow	I/I[3]	Total		
5A[2]	Miami Beach	234	42,120	8,545	50,665	92,785	177,025
6[1]	Sound View Beach	229	41,220	2,818	44,038	85,258	167,698
7[2]	Old Colony Beach Club	236	42,480	4,727	47,207	89,687	174,647
8[2]	Old Lyme Shores Beach	196	35,280	6,545	41,825	77,105	147,665
MTA-B[1]	Miscellaneous Town Area B	41	7,380	1,697	9,077	16,457	31,217
Total		**936**	**168,480**	**24,333**	**192,813**	**361,293**	**698,253**

1. Existing EDU counts for Sub-Areas 6 and MTA-B are based on Town Sanitarian records and include assumed commercial contributions.
2. Existing EDU counts for Sub-Areas 5A, 7, and 8 are taken from CT-DEEP Beach Associations Environmental Impact Evaluation.
3. I/I estimate is based on a preliminary gravity sewer layout of 8-inch pipe, assuming 400 gpd/idm.
4. Maximum Daily Flow is the Sanitary Flow multiplied by a safety factor of 2, added to I/I.
5. Peak Hourly Flow is the Sanitary Flow multiplied by a peaking factor of 4, added to I/I.

Table 8-4: Project Area Cost Sharing Concept for Regional Alternative – Anticipated Capital and Equivalent Uniform Annual Costs (EUAC)

Sub-Area Description	Chartered Beach Associations Sub-Areas			Town Sub-Areas[4]
	5A	7	8	6, MTA-B
	Miami Beach	Old Colony Beach Club	Old Lyme Shores Beach	Sound View Beach & Misc. Town Area B
# Equivalent Dwelling Units (EDUs)	234	236	196	**270**
Cost Component				
Capital Cost Summary				
Collector Sewer	$5,083,000	$2,783,000	$3,856,000	$4,042,000
Common Transmission System	$2,128,000	$2,146,000	$1,782,000	$2,455,000
East Lyme & Waterford Upgrades	$228,000	$230,000	$191,000	$263,000
Treatment @ New London WPCF	$1,170,000	$1,180,000	$980,000	$1,350,000
Total Capital Cost Sharing (2014 Cost)	**$8,609,000**	**$6,339,000**	**$6,809,000**	**$8,110,000**
Total Capital Cost Sharing (2018 Cost)[1]	**$9,690,000**	**$7,135,000**	**$7,664,000**	**$9,128,000**
DEEP CWF Grant[2]	**$2,093,000**	**$1,452,000**	**$1,640,000**	**$1,902,000**
Net Capital Cost Sharing	**$7,597,000**	**$5,683,000**	**$6,024,000**	**$7,226,000**
EUAC Summary				
Capital EUAC[3]	**$464,600**	**$347,600**	**$368,400**	**$441,900**
Cost per EDU Summary				
Net Capital Cost Sharing per EDU	**$32,500**	**$24,100**	**$30,700**	**$26,800**
Annual Capital cost per EDU	**$1,990**	**$1,470**	**$1,880**	**$1,640**
Monthly O&M Cost per EDU	**$40**	**$40**	**$40**	**$40**
Annual O&M Cost per EDU	**$430**	**$430**	**$430**	**$430**
Net Monthly Capital Cost per EDU	**$170**	**$120**	**$160**	**$140**

1. Costs escalated to 2018 at an annual inflation rate of 3%
2. Assumes 25% small-community grant from CT-DEEP (Grant exclude New London capacity buy-in cost)
3. Assumes 2% interest for 20 years (A/P = 0.0612) ENR 9516
4. The Project Area cost sharing for the Town of Old Lyme includes the costs associated with collector sewer, a common transmission system, East Lyme & Waterford system upgrades, and treatment at the New London WPCF proportioned on an EDU basis



Legend

Note: Location of Proposed Pump Station is not final and may change during the design phase of the project.

PS Pump Station

Transmission Main

Gravity Sewer Pipes

Sewer Service Area

Parcels

Sub-Areas

- 5A - Miami Beach
- 6 - Sound View Beach
- 7 - Old Colony Beach Club
- 8 - Old Lyme Shores Beach
- Miscellaneous Town Area B

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

Town of Old Lyme, CT

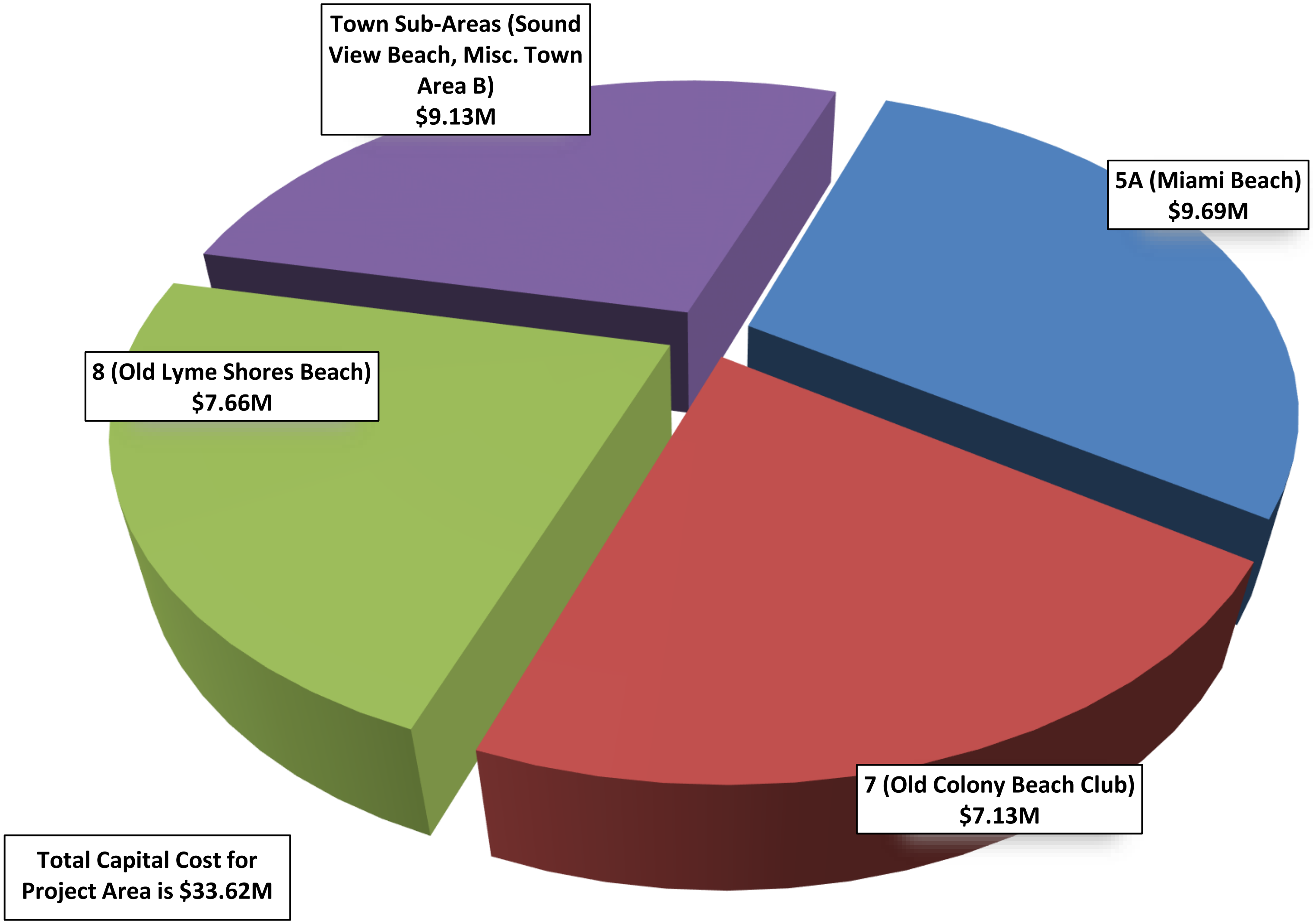
Proposed Project Area
- Regional Alternative

FIGURE 8-1

WOODARD & CURRAN

SCALE: 1 in = 600 ft	DRAWN BY: ACB
DATE: October, 2016	JOB NO.: 226617
DOC: 2016-08-25_Fig_8-1_Recommended_Alt.mxd	

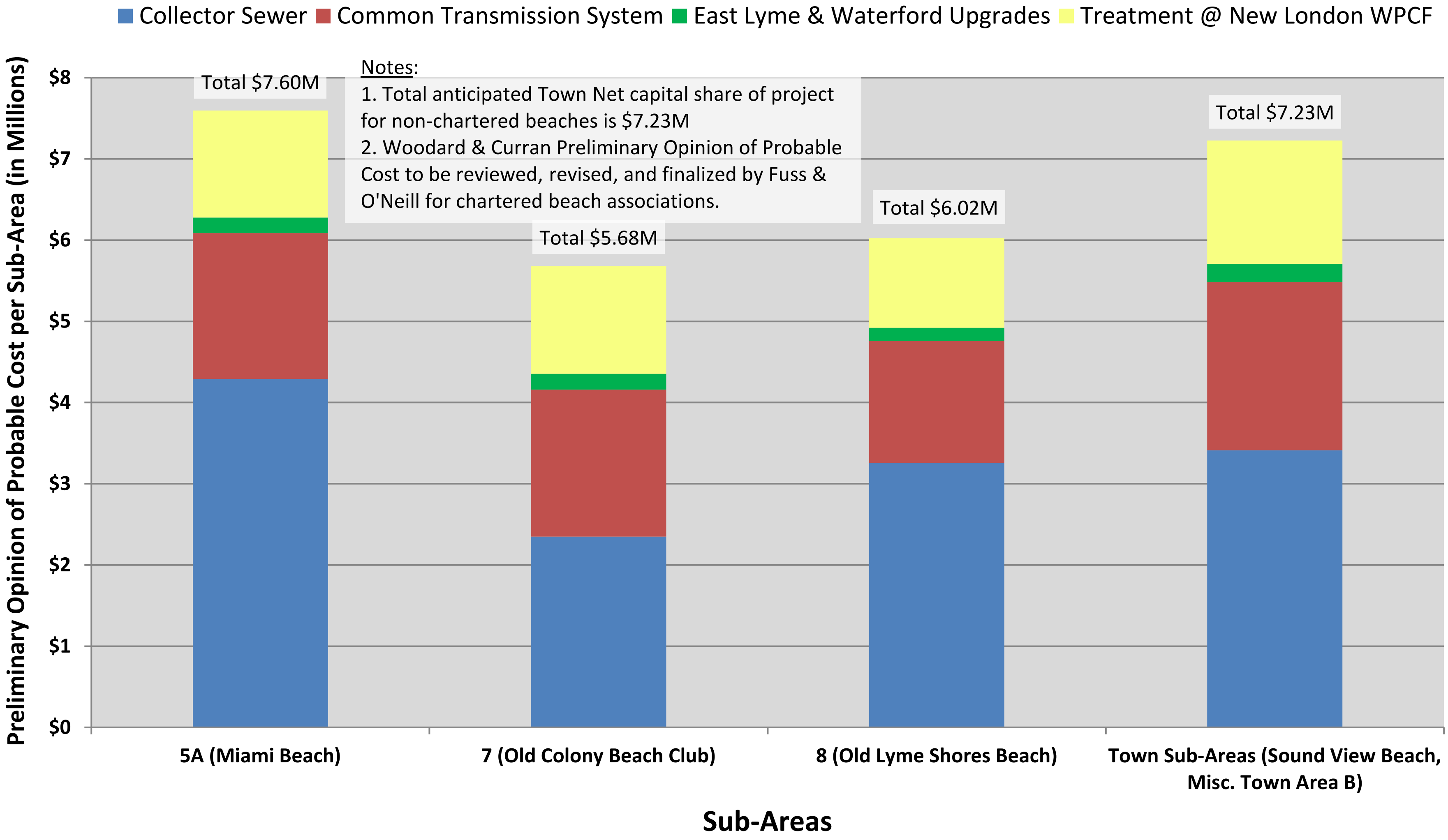
Figure 8-2: Summary of Anticipated Total Capital Cost Sharing (2018 Costs) Regional Alternative - Project Area



Total Capital Cost for Project Area is $33.62M

Figure 8-3: Summary of Anticipated Net Capital Cost Sharing Assuming 25% Grant (2018 Costs) - Regional Alternative - Project Area

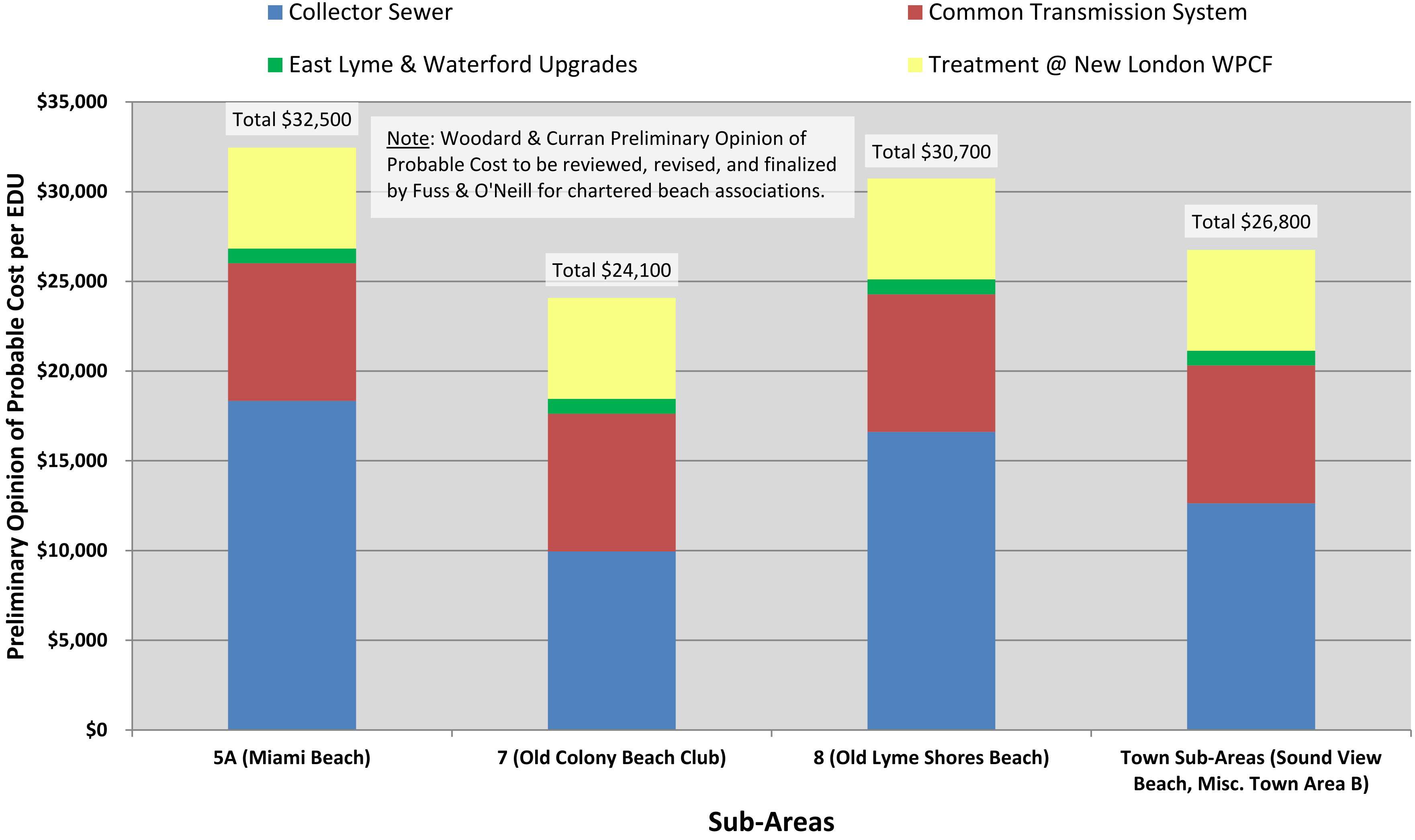
WOODARD &CURRAN



Notes:

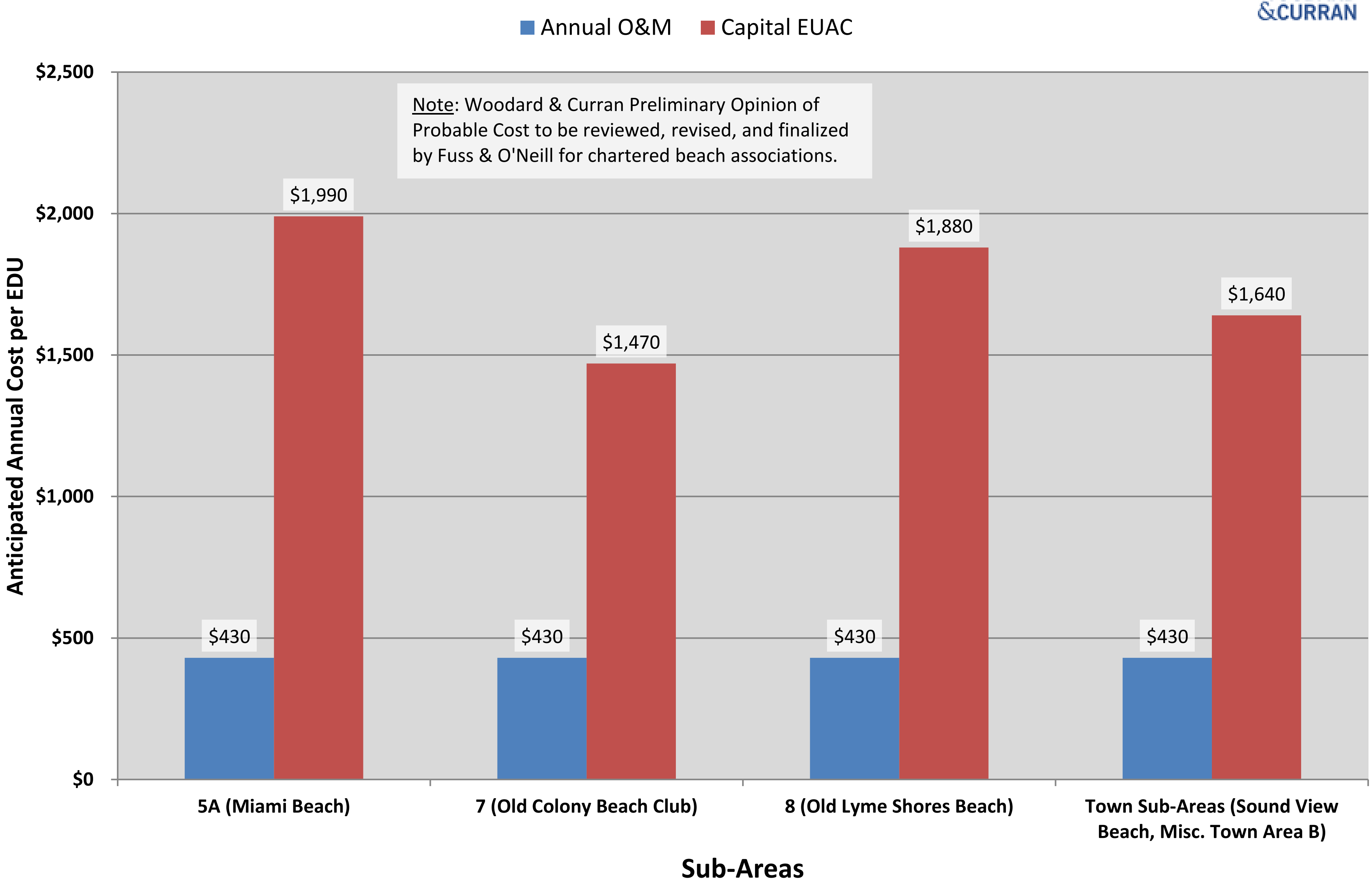
1. Total anticipated Town Net capital share of project for non-chartered beaches is $7.23M
2. Woodard & Curran Preliminary Opinion of Probable Cost to be reviewed, revised, and finalized by Fuss & O'Neill for chartered beach associations.

Figure 8-4: Summary of Anticipated Net Capital Cost Sharing per EDU Assuming 25% Grant (2018 Costs) - Regional Alternative - Project Area



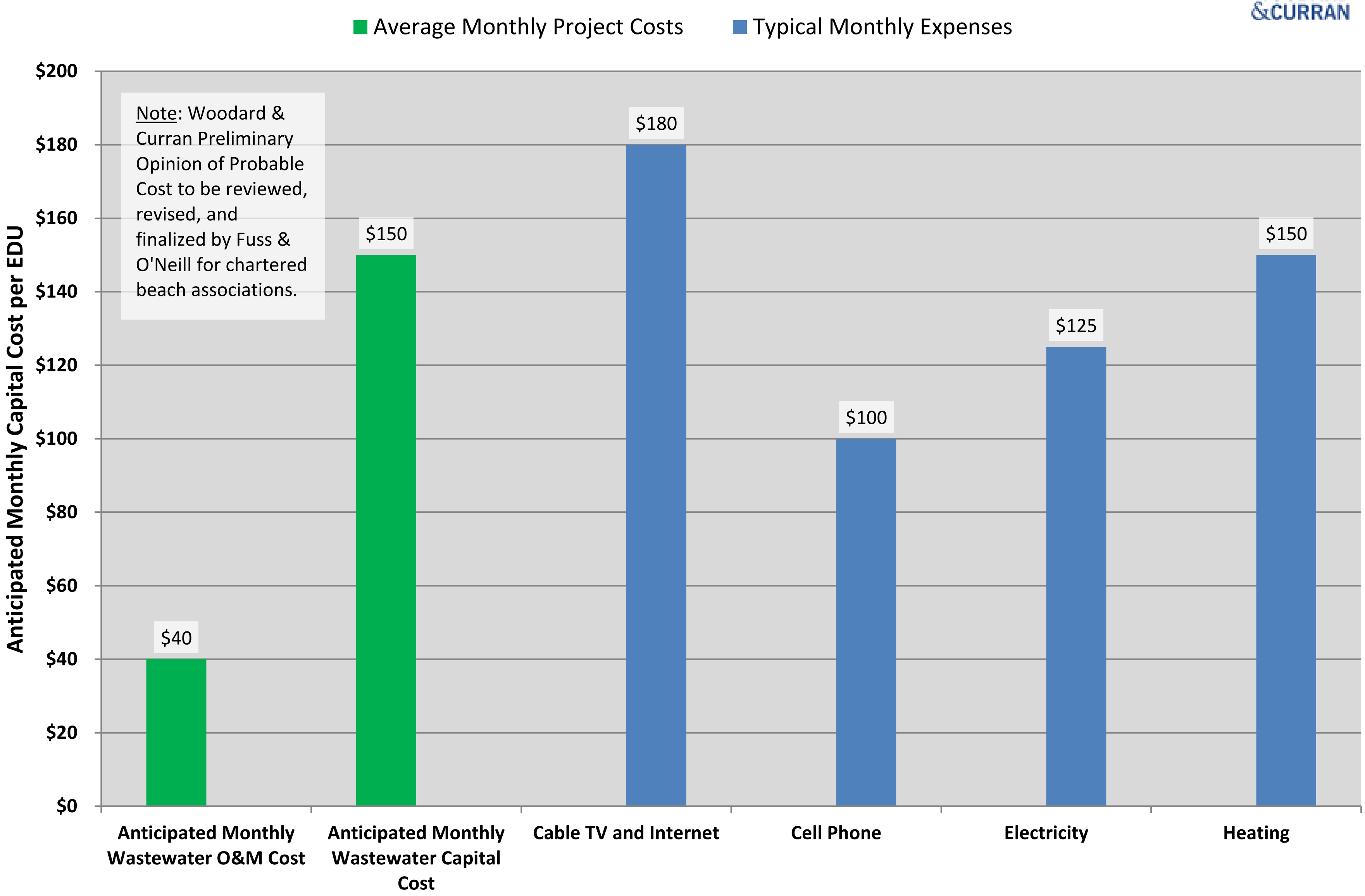
Note: Woodard & Curran Preliminary Opinion of Probable Cost to be reviewed, revised, and finalized by Fuss & O'Neill for chartered beach associations.

Figure 8-5: Summary of Anticipated Net Annual Costs per EDU (2018 Costs) - Regional Alternative - Project Area



Note: Woodard & Curran Preliminary Opinion of Probable Cost to be reviewed, revised, and finalized by Fuss & O'Neill for chartered beach associations.

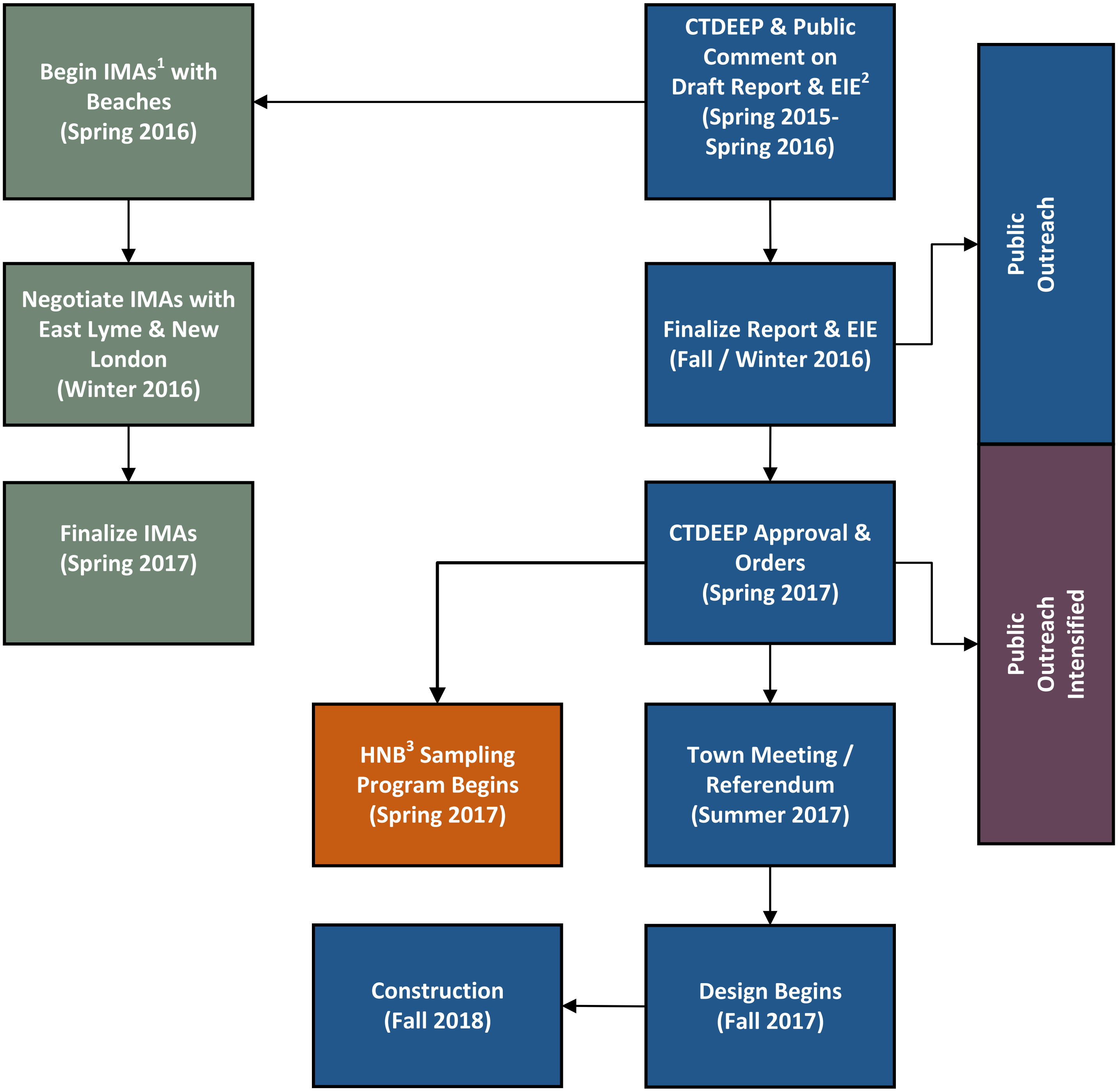
Figure 8-6: Anticipated Net Monthly Costs per EDU (2018 Costs) vs. Typical Monthly Expenses - Regional Alternative - Project Area



<u>Note</u>: Woodard & Curran Preliminary Opinion of Probable Cost to be reviewed, revised, and finalized by Fuss & O'Neill for chartered beach associations.

FIGURE 8-7: Key Critical Path Steps for Wastewater Planning and Implementation Steps
Town of Old Lyme, Connecticut

Updated October 2016



Notes:
1. IMA: Inter-Municipal Agreements
2. EIE: Environmental Impact Evaluation
3. HNB: Hawks Nest Beach

APPENDIX A: CONSENT ORDERS

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep Affirmative Action/Equal Opportunity Employer

STATE OF CONNECTICUT :
V. :
THE OLD COLONY BEACH CLUB ASSOCIATION :

Date of Issuance August 14, 2012

Order No. CO WRMU 12 001

CONSENT ORDER

A. With the agreement of The Old Colony Beach Club Association ("Old Colony"), the Commissioner of Energy and Environmental Protection ("the Commissioner") finds:

1. The Old Colony Beach Club Association is a specially chartered municipal corporation located in the Town of Old Lyme. Old Colony was incorporated in 1935 by Special Act 289. Old Colony has the power to levy and collect real estate taxes. By virtue of these powers, Old Colony qualifies for the funding of a sanitary sewer construction project from the State of Connecticut's Clean Water Fund Program.

2. Old Colony submitted for the Commissioner's review a Wastewater Management Plan for Old Colony dated October 25, 2011 and revised on January 20, 2012 (the "Plan") prepared by the consulting firm RFP Engineering and subsequently amended by the consulting firm Fuss and O'Neill, Inc on June 2012. This plan identified numerous areas within the boundaries of Old Colony that could not support onsite wastewater treatment due to the overall density of development, lack of adequate space or to adverse on-site subsurface conditions, such as shallow groundwater and rapidly draining soils. The report identified as the most technically and economically feasible alternative the conveyance of the wastewater to an offsite facility for treatment and disposal.

3. Old Colony has not implemented any structural solutions to address the wastewater disposal problems identified in the Plan.

4. After review of the Plan, staff of the DEEP concurs with the assessment of the conditions regarding wastewater disposal problems and the recommendations for conveyance of the wastewater off-site for treatment and disposal.

5. The implementation of the remedial actions specified in the Plan requires that Old Colony procure capacity in the regional sewerage system serving New London, Waterford, and East Lyme; and design and construct sanitary sewers to collect sanitary sewage within the boundaries of Old Colony through portions of the Town of Old Lyme, and convey it to the regional sewer system.

6. By virtue of the above, a community pollution problem exists and Old Colony is causing pollution of the waters of the State.

7. By agreeing to the issuance of this Consent Order, Old Colony makes no admission of fact or law except with respect to the matters addressed in paragraphs A.1 through A.6.

B. Old Colony shall undertake the following actions which the Commissioner, acting under Sections 22a-6, 22a-424, 22a-427, 22a-428 and 22a-458 of the Connecticut General Statutes, orders:

1. a. On or before sixty (60) days following the effective date of this Order, Old Colony shall retain one or more qualified consultants acceptable to the Commissioner to prepare the documents and implement or oversee the actions required by this order and shall, by that date, notify the Commissioner in writing of the identity of such consultants. Old Colony shall retain one or more qualified consultants acceptable to the Commissioner until this order is fully complied with, and, within ten days after retaining any consultant other than one originally identified under this paragraph, Old Colony shall notify the Commissioner in writing of the identity of such other consultant. The consultant(s) retained shall be a qualified professional engineer licensed to practice in Connecticut and shall be acceptable to the Commissioner. Old Colony shall submit to the Commissioner a description of a consultant's education, experience and training which is relevant to the work required by this order within ten days after a request for such a description. Nothing in this paragraph shall preclude the Commissioner from finding a previously acceptable consultant unacceptable.

   b. Unless another deadline is specified in writing by the Commissioner, on or before eight hundred and fifty (850) days after approval of the Plan, Old Colony shall (1) submit for the Commissioner's review and written approval contract plans and specifications for the approved remedial actions, a revised list of all permits and approvals required for such actions, and a revised schedule for applying for and obtaining such permits and approvals, and (2) submit applications for all permits and approvals required under the Connecticut General Statutes for such actions. Old Colony shall use best efforts to obtain all required permits and approvals.

c. Old Colony shall perform the approved remedial actions in accordance with the approved schedule(s), but in no event shall the approved remedial actions be completed by later than June 30, 2016. Within fifteen days after completing such actions, Old Colony shall certify to the Commissioner in writing that the actions have been completed as approved.

d. Old Colony may request that the Commissioner approve, in writing, revisions to any document approved hereunder in order to make such document consistent with law or for any other appropriate reason.

2. Progress reports. On or before the last day of January, April, July and October of each year after issuance of this order and continuing until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner, Old Colony shall submit a progress report to the Commissioner and the Town of Old Lyme First Selectman and Water Pollution Control Authority Chairman describing the actions which Old Colony has taken to comply with this order to date and an anticipated schedule of events to occur over the next 3 months

3. Full compliance. Old Colony shall not be considered in full compliance with this order until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner.

4. Approvals. Old Colony shall use best efforts to submit to the Commissioner all documents required by this order in a complete and approvable form. If the Commissioner notifies Old Colony that any document or other action is deficient, and does not approve it with conditions or modifications, it is deemed disapproved, and Old Colony 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 order, 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 order. Nothing in this paragraph shall excuse noncompliance or delay.

5. Definitions. As used in this order, "Commissioner" means the Commissioner or an agent of the Commissioner.

6. Dates. The date of submission to the Commissioner of any document required by this order shall be the date such document is received by the Commissioner. The date of any notice by the Commissioner under this order, 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 order, the word "day" as used in this order means calendar day. Any document or action which is required by this order to be submitted or performed by a date which falls on a 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.

7. Notification of noncompliance. In the event that Old Colony becomes aware that it did not or may not comply, or did not or may not comply on time, with any requirement of this order or of any document required hereunder, Old Colony 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, Old Colony 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 Old Colony shall comply with any dates which may be approved in writing by the Commissioner. Notification by Old Colony 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.

8. Certification of documents. Any document, including but not limited to any notice, which is required to be submitted to the Commissioner under this order shall be signed by a principal executive officer or ranking elected official or a duly authorized representative of such person, as those terms are defined in section 22a-430-3(b)(2) of the Regulations of Connecticut State Agencies and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows: "I have personally examined and am familiar with the information submitted in this document and all attachments and certify that based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief, and I understand that any false statement made in this document or its attachments may be punishable as a criminal offense."

9. Noncompliance. Failure to comply with this order may subject Old Colony to an injunction and penalties under Chapters 439, and 445 or 446k of the Connecticut General Statutes.

10. False statements. Any false statement in any information submitted pursuant to this order may be punishable as a criminal offense under Section 22a-438 or 22a-131a of the Connecticut General Statutes or, in accordance with Section 22a-6, under Section 53a-157 of the Connecticut General Statutes.

11. Notice of transfer; liability of Old Colony and others. Until Old Colony has fully complied with this order, Old Colony shall notify the Commissioner in writing no later than fifteen days after transferring all or any portion of the operations which are the subject of this order, or obtaining a new mailing or location address. Old Colony ' obligations under this order shall not be affected by the passage of title to any property to any other person or Old Colony. Any future owner of the site may be subject to the issuance of an order from the Commissioner.

12. Commissioner's powers. Nothing in this order shall affect the Commissioner's authority to institute any proceeding or take any other action to prevent or abate violations of law, prevent or abate pollution, recover costs and natural resource damages, and to impose penalties for violations of law, including but not limited to violations of any permit issued by the Commissioner. If at any time the Commissioner determines that the actions taken by Old Colony pursuant to this order have not fully characterized the extent and degree of pollution or have not successfully abated or prevented pollution, the Commissioner may institute any proceeding to require Old Colony to undertake further investigation or further action to prevent or abate pollution.

13. Old Colony's obligations under law. Nothing in this order shall relieve Old Colony of other obligations under applicable federal, state and local law.

14. No assurance by Commissioner. No provision of this order and no action or inaction by the Commissioner shall be construed to constitute an assurance by the Commissioner that the actions taken by Old Colony pursuant to this order will result in compliance or prevent or abate pollution.

15. No effect on rights of other persons. This order shall neither create nor affect any rights of persons who or municipalities which are not parties to this order. This Consent Order shall not be admissible as evidence of fact or law in any proceeding except one to enforce the terms of this Consent Order.

16. Notice to Commissioner of changes. Within fifteen days of the date Old Colony becomes aware of a change in any information submitted to the Commissioner under this order, or that any such information was inaccurate or misleading or that any relevant information was omitted, Old Colony shall submit the correct or omitted information to the Commissioner.

17. Submission of documents. Any document required to be submitted to the Commissioner under this order shall, unless otherwise specified in writing by the Commissioner, be directed to:

Carlos Esguerra, Sanitary Engineer
Department of Energy and Environmental Protection
Water Management Bureau
Planning & Standards Division
79 Elm Street
Hartford, Connecticut 06106-5127

Old Colony consents to the issuance of this consent order without further notice. The undersigned certifies that he is fully authorized to enter into this consent order and to legally bind Old Colony to the terms and conditions of the consent order.

By Doug Whalen
Douglas Whalen
Chairman, Board of Governors
The Old Colony Beach Club Association
Date: July 25, 2012

Issued as a consent order of the Commissioner of Energy and Environmental Protection on 8/14, 2012.

Macky McCleary
Deputy Commissioner
Department of Energy and Environmental Protection

ORDER NO. CO WR MU 12 001
OLD COLONY

Note: This sheet is not a part of the order and is <u>only</u> attached to the original order which is retained in separate DEEP files which are accessible to the public with close supervision. The order <u>must</u> be mailed to Old Colony by certified mail, return receipt requested. If Old Colony is a business, send a certified copy of the order to the business alone and a plain copy to the attention of a person at the business.

<u>Certification of Mailing</u>

COWRMU 12 001

On July 23, 2012, at 2:00 a.m./[✓ p.m.] I mailed a certified copy of Order No. Λ to the following, by placing it in the U.S. mail:

1. Douglas Whalen
Chairman, Board of Governors
Old Colony Beach Club Association
41 Old Colony Road
Old Lyme CT 06371

Certified mail number:

[NOTE: CERTIFIED COPY
TO MUST BE SENT BY
CERTIFIED MAIL]

CO WR MU 12-001

On July 23, 2012, at 2:00 a.m./[✓ p.m.], I mailed an uncertified copy of Order No. Λ to the following, by placing it in the U.S. mail:

1. Honorable Bonnie Reemsnyder
First Selectwoman.
52 Lyme Street
Old Lyme, CT 06371

2. Dimitri Tolchisnki, Chair
Water Pollution Control Authority
52 Lyme Street
Old Lyme, CT 06371

<u>(signature)</u>
[Type name of person who did mailing]
[Type title] Patty Gilmore
[Date] Office Assistant
7/23/12

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

79 Elm Street • Hartford, CT 06106-5127 www.ct.gov/deep Affirmative Action/Equal Opportunity Employer

STATE OF CONNECTICUT :
V. :
THE OLD LYME SHORES BEACH ASSOCIATION :

Date of Issuance 10/1/12

Order No. CO WR MU 12-002

CONSENT ORDER

A. With the agreement of The Old Lyme Shores Beach Association ("OLSBA"), the Commissioner of Energy and Environmental Protection ("the Commissioner") finds:

1. OLSBA is a specially chartered municipal corporation located in the Town of Old Lyme. OLSBA was established in 1947 by Special Act of the Legislature. OLSBA has the power to levy and collect real estate taxes. By virtue of these powers, OLSBA qualifies for the funding of a sanitary sewer construction project from the State of Connecticut's Clean Water Fund Program.

2. OLSBA submitted for the Commissioner's review a Wastewater Management Plan dated January 2012 prepared by the consulting firm Fuss & O'Neill, Inc., and subsequently amended by the same firm in of June 2012. This plan identified numerous areas within the boundaries of OLSBA that could not support onsite wastewater treatment due to the overall density of development, lack of adequate space or to adverse on-site subsurface conditions, such as shallow groundwater, bedrock, and rapidly draining soils. The report identified as the most technically and economically feasible alternative the conveyance of the wastewater to an offsite facility for treatment and disposal.

3. OLSBA has not implemented any structural solutions to address the wastewater disposal problems identified in the Plan.

4. After review of the Plan, staff of the DEEP concurs with the assessment of the conditions regarding wastewater disposal problems and the recommendations for conveyance of the wastewater off-site for treatment and disposal.

5. The implementation of the remedial actions specified in the Plan requires that OLSBA procure capacity in the regional sewerage system serving New London, Waterford, and East Lyme; and design and construct sanitary sewers to collect sanitary sewage within the boundaries of OLSBA and convey it through portions of the Town of Old Lyme, to the regional sewer system.

6. By virtue of the above, a community pollution problem exists and OLSBA is causing pollution of the waters of the State.

7. By agreeing to the issuance of this Consent Order, OLSBA makes no admission of fact or law except with respect to the matters addressed in paragraphs A.1 through A.6.

B. OLSBA shall undertake the following actions which the Commissioner, acting under Sections 22a-6, 22a-424, 22a-427, 22a-428 and 22a-458 of the Connecticut General Statutes, orders:

1. a. On or before sixty (60) days following the effective date of this Order, OLSBA shall retain one or more qualified consultants acceptable to the Commissioner to prepare the documents and implement or oversee the actions required by this order and shall, by that date, notify the Commissioner in writing of the identity of such consultants. OLSBA shall retain one or more qualified consultants acceptable to the Commissioner until this order is fully complied with, and, within ten days after retaining any consultant other than one originally identified under this paragraph, OLSBA shall notify the Commissioner in writing of the identity of such other consultant. The consultant(s) retained shall be a qualified professional engineer licensed to practice in Connecticut and shall be acceptable to the Commissioner. OLSBA shall submit to the Commissioner a description of a consultant's education, experience and training which is relevant to the work required by this order within ten days after a request for such a description. Nothing in this paragraph shall preclude the Commissioner from finding a previously acceptable consultant unacceptable.

b. Unless another deadline is specified in writing by the Commissioner, on or before eight hundred and fifty (850) days after approval of the Plan, OLSBA shall (1) submit for the Commissioner's review and written approval contract plans and specifications for the approved remedial actions, a revised list of all permits and approvals required for such actions, and a revised schedule for applying for and obtaining such permits and approvals, and (2) submit applications for all permits and approvals required under the Connecticut General Statutes for such actions. OLSBA shall use best efforts to obtain all required permits and approvals.

c. OLSBA shall perform the approved remedial actions in accordance with the approved schedule(s), but in no event shall the approved remedial actions be completed by later than June 30, 2016. Within fifteen days after completing such actions, OLSBA shall certify to the Commissioner in writing that the actions have been completed as approved.

d. OLSBA may request that the Commissioner approve, in writing, revisions to any document approved hereunder in order to make such document consistent with law or for any other appropriate reason.

2. Progress reports. On or before the last day of January, April, July and October of each year after issuance of this order and continuing until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner, OLSBA shall submit a progress report to the Commissioner and the Town of Old Lyme First Selectman and Water Pollution Control Authority Chairman describing the actions which OLSBA has taken to comply with this order to date and an anticipated schedule of events to occur over the next 3 months.

3. Full compliance. OLSBA shall not be considered in full compliance with this order until all actions required by this order have been completed as approved and to the satisfaction of the Commissioner.

4. Approvals. OLSBA shall use best efforts to submit to the Commissioner all documents required by this order in a complete and approvable form. If the Commissioner notifies OLSBA that any document or other action is deficient, and does not approve it with conditions or modifications, it is deemed disapproved, and OLSBA 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 order, 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 order. Nothing in this paragraph shall excuse noncompliance or delay.

5. Definitions. As used in this order, "Commissioner" means the Commissioner or an agent of the Commissioner.

6. Dates. The date of submission to the Commissioner of any document required by this order shall be the date such document is received by the Commissioner. The date of any notice by the Commissioner under this order, 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 order, the word "day" as used in this order means calendar day. Any document or action which is required by this order to be submitted or performed by a date which falls on a 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.

7. Notification of noncompliance. In the event that OLSBA becomes aware that it did not or may not comply, or did not or may not comply on time, with any requirement of this order or of any document required hereunder, OLSBA 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, OLSBA 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 OLSBA shall comply with any dates which may be approved in writing by the Commissioner. Notification by OLSBA 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.

8. Certification of documents. Any document, including but not limited to any notice, which is required to be submitted to the Commissioner under this order shall be signed by a principal executive officer or ranking elected official or a duly authorized representative of such person, as those terms are defined in section 22a-430-3(b)(2) of the Regulations of Connecticut State Agencies and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows: "I have personally examined and am familiar with the information submitted in this document and all attachments and certify that based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief, and I understand that any false statement made in this document or its attachments may be punishable as a criminal offense."

9. Noncompliance. Failure to comply with this order may subject OLSBA to an injunction and penalties under Chapters 439, and 445 or 446k of the Connecticut General Statutes.

10. False statements. Any false statement in any information submitted pursuant to this order may be punishable as a criminal offense under Section 22a-438 or 22a-131a of the Connecticut General Statutes or, in accordance with Section 22a-6, under Section 53a-157 of the Connecticut General Statutes.

11. Notice of transfer; liability of OLSBA and others. Until OLSBA has fully complied with this order, OLSBA shall notify the Commissioner in writing no later than fifteen days after transferring all or any portion of the operations which are the subject of this order, or obtaining a new mailing or location address. OLSBA's obligations under this order shall not be affected by the passage of title to any property to any other person or OLSBA. Any future owner of the site may be subject to the issuance of an order from the Commissioner.

12. Commissioner's powers. Nothing in this order shall affect the Commissioner's authority to institute any proceeding or take any other action to prevent or abate violations of law, prevent or abate pollution, recover costs and natural resource damages, and to impose penalties for violations of law, including but not limited to violations of any permit issued by the Commissioner. If at any time the Commissioner determines that the actions taken by OLSBA pursuant to this order have not fully characterized the extent and degree of pollution or have not successfully abated or prevented pollution, the Commissioner may institute any proceeding to require OLSBA to undertake further investigation or further action to prevent or abate pollution.

13. OLSBA's obligations under law. Nothing in this order shall relieve OLSBA of other obligations under applicable federal, state and local law.

14. No assurance by Commissioner. No provision of this order and no action or inaction by the Commissioner shall be construed to constitute an assurance by the Commissioner that the actions taken by OLSBA pursuant to this order will result in compliance or prevent or abate pollution.

15. No effect on rights of other persons. This order shall neither create nor affect any rights of persons who or municipalities which are not parties to this order. This Consent Order shall not be admissible as evidence of fact or law in any proceeding except one to enforce the terms of this Consent Order.

16. Notice to Commissioner of changes. Within fifteen days of the date OLSBA becomes aware of a change in any information submitted to the Commissioner under this order, or that any such information was inaccurate or misleading or that any relevant information was omitted, OLSBA shall submit the correct or omitted information to the Commissioner.

17. Submission of documents. Any document required to be submitted to the Commissioner under this order shall, unless otherwise specified in writing by the Commissioner, be directed to:

Carlos Esguerra, Sanitary Engineer
Department of Energy and Environmental Protection
Water Management Bureau
Planning & Standards Division
79 Elm Street
Hartford, Connecticut 06106-5127

OLSBA consents to the issuance of this consent order without further notice. The undersigned certifies that he is fully authorized to enter into this consent order and to legally bind OLSBA to the terms and conditions of the consent order.

By Paul J. Rowean
Paul Rowean
President
The Old Lyme Shores Beach Association
Date: 9/24/12

Issued as a consent order of the Commissioner of Energy and Environmental Protection on 10/1, 2012.

Macky McCleary
Deputy Commissioner
Department of Energy and Environmental Protection

ORDER NO. CO WR MU 12-002
OLSBA

Note: This sheet is not a part of the order and is <u>only</u> attached to the original order which is retained in separate DEEP files which are accessible to the public with close supervision. The order <u>must</u> be mailed to OLSBA by certified mail, return receipt requested. If OLSBA is a business, send a certified copy of the order to the business alone and a plain copy to the attention of a person at the business.

<u>Certification of Mailing</u>

CO WRMU 12-002

On Oct 9, 2012, at 2:00 a.m./[✓ p.m.] I mailed a certified copy of Order No. A to the following, by placing it in the U.S. mail:

1. Paul Rowean
   President
   The Old Lyme Shores Beach Association
   29 Billow Road
   Old Lyme, CT 06371

Certified mail number:

[NOTE: CERTIFIED COPY
TO MUST BE SENT BY
CERTIFIED MAIL]

Co WRMU 12-002

On Oct 9, 2012, at 2:00 a.m./[✓ p.m.] I mailed an uncertified copy of Order No. A to the following, by placing it in the U.S. mail:

1. Honorable Bonnie Reemsnyder
   First Selectwoman.
   52 Lyme Street
   Old Lyme, CT 06371

2. Dimitri Tolchisnki, Chair
   Water Pollution Control Authority
   52 Lyme Street
   Old Lyme, CT 06371

(signature)
[Type name of person who did mailing]
[Type title] Patty Gilmore
[Date] Office Assistant
10/9/12

APPENDIX B: SUBSURFACE INVESTIGATION (FIGURES & TABLES)

TABLE B-1
SUMMARY OF SUBSURFACE EXPLORATION

SITE	LOCATION	MEASURING POINT (MP)	MP ELEVATION (FT AMSL)	X (FT)	Y (FT)	DEPTH OF EXPLORATION (FEET)	REFUSAL
BLACK HALL	BH-1	GROUND SURFACE	32.08	1125369.81	667901.20	23.5	YES
	BH-2	GROUND SURFACE	45.74	1125238.76	667622.50	29.5	YES
	BH-4	GROUND SURFACE	33.06	1125282.69	666534.62	13.5	YES
	BH-5	GROUND SURFACE	54.69	1124281.05	666784.70	6.5	YES
	MW-3D	TOP OF PVC	56.12	1124714.24	667392.97	35.5	YES
		TOP OF CASING	56.23	1124714.39	667392.89		
		GROUND SURFACE	53.13	1124714.56	667393.27		
	MW-3S	TOP OF PVC	56.19	1124714.09	667391.35	35.5	YES
		TOP OF CASING	56.33	1124714.52	667391.26		
		GROUND SURFACE	53.12	1124714.64	667391.62		
	MW-A	TOP OF CASING	32.90	1124242.67	668150.61	16.4	UNKNOWN
		GROUND SURFACE	29.10	1124242.96	668150.56		
	MW-E	TOP OF CASING	26.76	1123522.72	668471.61	28.8	UNKNOWN
	MW-H	TOP OF CASING	31.01	1122927.21	668165.41	13.8	UNKNOWN
		GROUND SURFACE	29.29	1122927.05	668165.69		
	MW-I	TOP OF CASING	27.15	1123590.28	667862.59	5.4	UNKNOWN
		GROUND SURFACE	25.95	1123590.56	667862.66		
CHERRYSTONE	TH 5-06	GROUND SURFACE	19.22	1126433.33	667015.58	16.0	YES
	TH-1	GROUND SURFACE	19.12	1126600.71	666489.18	8.8	NO
	TH-10	GROUND SURFACE	23.60	1126558.22	666960.14	8.3	YES
	TH-11	GROUND SURFACE	21.76	1126745.29	666862.38	6.2	YES
	TH-12	GROUND SURFACE	23.08	1126788.81	666998.48	5.5	YES
	TH-13	GROUND SURFACE	18.07	1126432.36	667067.56	8.1	NO
	TH-2	GROUND SURFACE	21.17	1126840.41	666519.08	8.2	NO
	TH-20	GROUND SURFACE	18.94	1126406.10	666736.01	16.0	NO
	TH-21	GROUND SURFACE	13.02	1126389.26	666994.87	10.1	NO
	TH-22	GROUND SURFACE	14.27	1126343.04	666826.85	12.7	NO
	TH-4	GROUND SURFACE	21.91	1126822.45	666749.54	9.0	YES
	TH-5	GROUND SURFACE	23.10	1126628.31	666721.74	8.2	NO
	TH-6	GROUND SURFACE	19.92	1126448.84	666602.58	8.7	NO
	TH-7	GROUND SURFACE	16.87	1126313.62	666703.04	8.5	NO
	TH-8	GROUND SURFACE	13.31	1126374.60	666912.60	8.5	NO
	TH-9	GROUND SURFACE	22.75	1126483.39	666832.92	9.3	NO
	TP-01	GROUND SURFACE	21.24	1126718.82	666496.31	10.0	YES
	TP-02	GROUND SURFACE	19.57	1126481.04	666597.19	10.0	NO
	TP-03	GROUND SURFACE	19.34	1126369.07	666710.74	10.2	NO
	TP-04	GROUND SURFACE	23.13	1126551.57	666749.74	10.0	YES
	TP-05	GROUND SURFACE	21.83	1126742.36	666777.53	3.5	YES
	TP-07	GROUND SURFACE	23.17	1126610.43	666878.15	10.0	NO
	TP-08	GROUND SURFACE	19.95	1126432.60	666955.07	8.7	NO
	WC-1	TOP OF PVC	24.21	1126574.01	666585.57	20.3	YES
		TOP OF CASING	24.33	1126574.05	666585.56		
		GROUND SURFACE	21.14	1126574.54	666585.47		
	WC-2	TOP OF PVC	23.70	1126445.39	666751.55	30.0	NO
		TOP OF CASING	23.82	1126445.65	666751.60		
		GROUND SURFACE	20.55	1126444.96	666751.96		
	WC-3	TOP OF PVC	15.54	1126359.22	666912.24	30.0	NO
		TOP OF CASING	15.67	1126359.33	666912.22		
		GROUND SURFACE	12.45	1126359.91	666912.51		
	WC-4	TOP OF PVC	25.30	1126782.41	666721.12	11.5	YES
		TOP OF CASING	25.41	1126782.26	666721.00		
		GROUND SURFACE	22.35	1126782.71	666721.59		

NOTES:
X, Y expressed in Connecticut State Plane coordinates, North American Datum (NAD) 1983
Ft AMSL = feet above mean sea level

TABLE B-2
SEASONAL HIGH WATER TABLE CALCULATIONS
CHERRYSTONE

USGS Well	$DTW_{SHWT,USGS}$	$DTW_{T,USGS}$
412916073121701	10.79	11.17
412825072410501	6.22	8.38

Cherrystone Well	$DTW_{T,SITE}$	$DTW_{SHWT,SITE}$ using USGS Well:		
		412916073121701	412825072410501	AVERAGE
WC-1	17.06	16.48	12.66	14.57
WC-2	17.31	16.72	12.85	14.78
WC-3	9.56	9.23	7.10	8.17

Black Hall Well	$DTW_{T,SITE}$	$DTW_{SHWT,SITE}$ using USGS Well:		
		412916073121701	412825072410501	AVERAGE
MW-3S	16.06	15.51	11.92	13.72
MW-3D	21.78	21.04	16.17	18.60

NOTES:

$DTW_{SHWT,USGS}$ = Depth to water at seasonal high water table, USGS sentinel wells (feet below ground)

$DTW_{T,USGS}$ = Depth to water during 2013 monitoring period, USGS sentinel wells (feet below ground)

$DTW_{T,SITE}$ = Depth to water during 2013 monitoring period, site wells (feet below ground)

$DTW_{SHWT,SITE}$ = Depth to water at seasonal high water table, site wells (feet below ground)

$DTW_{T,USGS}$ and $DTW_{T,SITE}$ data were obtained at 00:00 on June 16, 2013, when the water table was relatively shallow throughout the study area

WC-4 not used in SHWT calculations because it does not represent the Cherrystone aquifer

*The water level in MW-A is above the ground surface due to localized hydrologic conditions, resulting in a depth to water less than zero

MW-A, MW-E, MW-H, and MW-I are not used in SHWT calculations because of inaccessibility to potential future designs and prohibitively low hydraulic conductivity

TABLE B-3
SUMMARY OF HYDRAULIC CONDUCTIVITY

SITE	WELL	K (ft/day)
CHERRYSTONE	WC-2	250
	WC-3	80
	WC-4	20
BLACK HALL	MW-A	0.13
	MW-E	12.5
	MW-I	0.11
	MW-3S	2.2
	MW-3D	16

NOTES:
K = Saturated hydraulic conductivity
*WC-4 likely does not represent Cherrystone aquifer conditions
WC-1 and MW-H did not have adequate water depth to perform slug testing

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

Legend

☐ PARCEL

0 250 500 1,000 Feet

WOODARD & CURRAN
980 WASHINGTON STREET | SUITE 325
DEDHAM, MA 02026
800.446.5518 | www.woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

SITE PLAN

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-1

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

Legend

●	TEST PIT, 2013
●	TEST PIT, HISTORICAL
⯐	MONITOR WELL, 2013

RECEPTORS

▨	CHERRYSTONE WETLAND
☐	PARCEL BOUNDARY

0 50 100 200
Feet

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SUBSURFACE - CHERRYSTONE

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-2

SUBSURFACE - BLACK HALL

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

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

Legend

- ⊙ SOIL BORING, 2013
- ⊕ MONITOR WELL, 2013
- ⊕ MONITOR WELL, HISTORICAL
- ☐ PARCEL BOUNDARY

0 150 300 600 Feet

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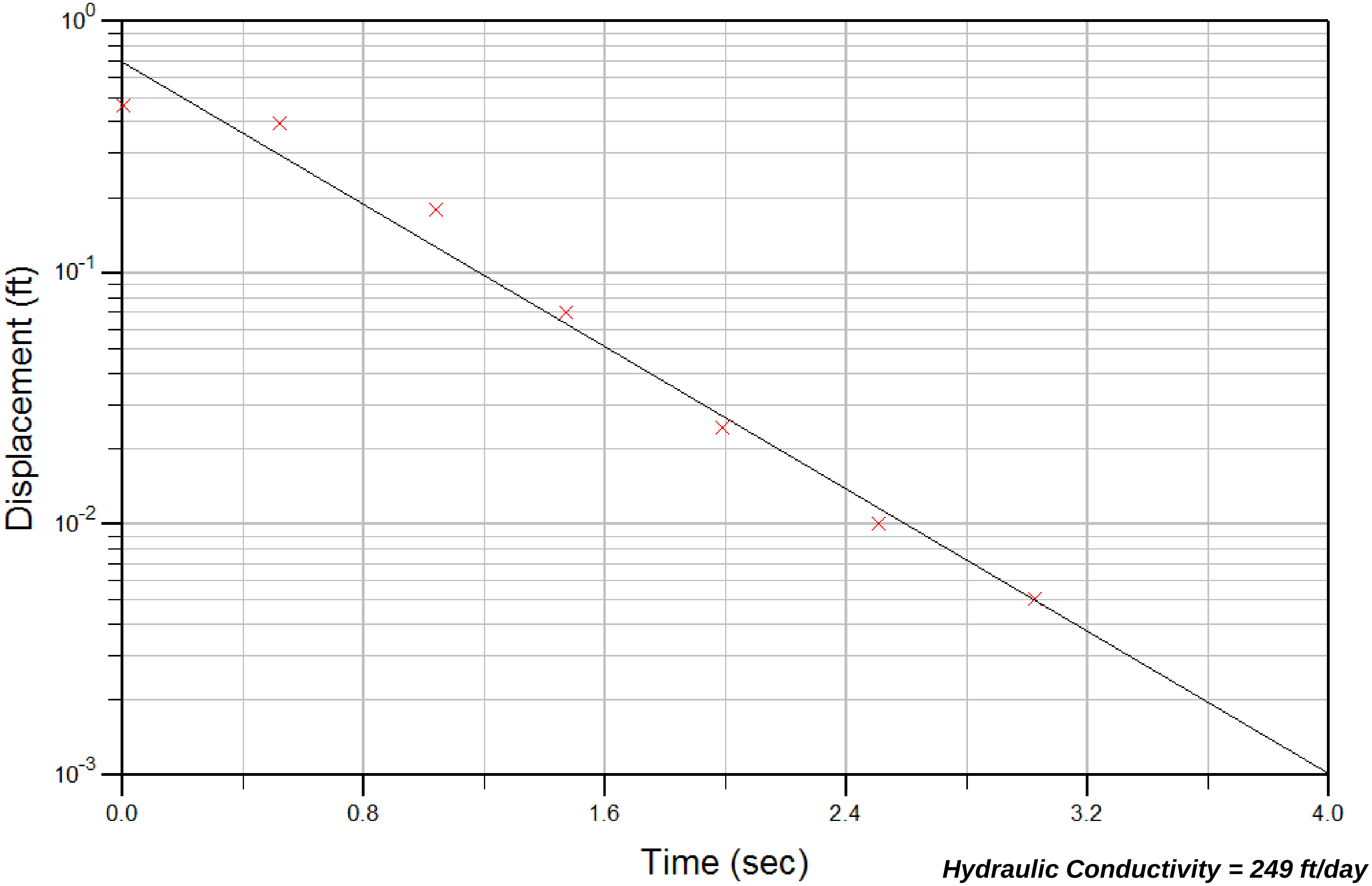
PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-3



Hydraulic Conductivity = 249 ft/day

COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN
980 Washington St, Suite 325
Dedham, MA 02026
T: 800.446.5518

SLUG TEST ANALYSIS: WC-2

DESIGNED BY: BVA
CHECKED BY: DP
DRAWN BY: BVA

Town of Old Lyme
Old Lyme, Connecticut

JOB NO.: 226617.00
DATE: OCTOBER 2013
SCALE: NA

FIGURE B-4

NOTE: GROUNDWATER ELEVATIONS MEASURED JUNE 25, 2013

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

Legend

- ▨ CHERRYSTONE WETLAND
- ☐ PARCEL BOUNDARY
- ⌖ MONITOR WELL AND GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- ━ GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)

0 50 100 200 Feet

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GROUNDWATER - CHERRYSTONE

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-5

NOTE: GROUNDWATER ELEVATIONS MEASURED JUNE 25, 2013

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

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DEDHAM, MA 02026
800.446.5518 | www.woodardcurran.com

GROUNDWATER - BLACK HALL

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-6

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

Legend

- ⊙ TEST PIT, 2013
- ● TEST PIT, HISTORICAL
- ⌖ MONITOR WELL, 2013

RECEPTORS

- ▨ CHERRYSTONE WETLAND
- 🟩 55 FOOT WETLAND BUFFER
- ☐ PARCEL BOUNDARY
- 🟧 55 FOOT PARCEL BUFFER

SAS FACILITY

- ☐ SMALL
- ☐ LARGE

0 50 100 200 Feet

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DEDHAM, MA 02026
800.446.5518 | www.woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

SAS FACILITY - CHERRYSTONE

OLD LYME, CONNECTICUT

TOWN OF OLD LYME, CONNECTICUT

PN: 226617

BY: BVA

DATE: OCTOBER 2013

FIGURE B-7

APPENDIX C: SUBSURFACE INVESTIGATION - GROUNDWATER DATA AND BORING LOGS

Woodard & Curran
980 Washington St | Suite 325
Dedham, MA 02026
Telephone: 781.251.0200
Fax: 781.251.0847

TEST PIT NUMBER TP-01

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

DATE STARTED 5/30/13 **COMPLETED** 5/30/13

GROUND ELEVATION 21.24 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR Town of Old Lyme

GROUND WATER LEVELS:

EXCAVATION METHOD Test Pit

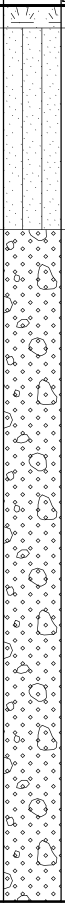
AT TIME OF EXCAVATION ---

LOGGED BY Brent V Aigler **CHECKED BY** David Prickett

AT END OF EXCAVATION ---

NOTES

AFTER EXCAVATION ---



DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
0		0.3	Dark brown, silty topsoil	21.0
	SM	2.5	Light brown, damp, silty SAND loam; cohesive, roots, upward fining	18.7
2				
4				
6	SW	10.0	Light brown, dry, F-C SAND, Some F-C Gravel; cobbles, unconsolidated	11.2
8				
10				

Refusal at 10.0 feet.
Bottom of test pit at 10.0 feet.

Woodard & Curran
980 Washington St | Suite 325
Dedham, MA 02026
Telephone: 781.251.0200
Fax: 781.251.0847

TEST PIT NUMBER TP-02

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

DATE STARTED 5/30/13 **COMPLETED** 5/30/13

GROUND ELEVATION 19.57 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR Town of Old Lyme

GROUND WATER LEVELS:

EXCAVATION METHOD Test Pit

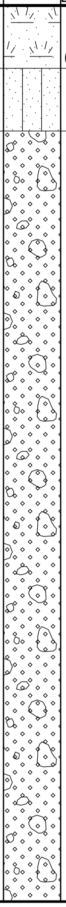
AT TIME OF EXCAVATION ---

LOGGED BY Brent V Aigler **CHECKED BY** David Prickett

AT END OF EXCAVATION ---

NOTES

AFTER EXCAVATION ---



DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0			0.7	Dark brown, silty topsoil	18.9
	SM		1.4	Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	18.2
2 4 6 8 10	SW		10.0	Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders, unconsolidated	9.6

Bottom of test pit at 10.0 feet.

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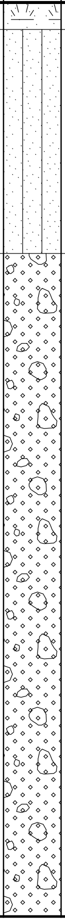
TEST PIT NUMBER TP-03

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 19.34 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---



DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0			0.3	Dark brown, silty topsoil	19.0
2	SM		2.8	Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	16.5
4 6 8 10	SW		10.2	Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders, inch-scale layering from 6-10 feet	9.1

Bottom of test pit at 10.2 feet.

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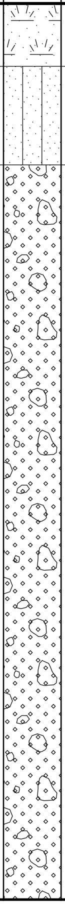
TEST PIT NUMBER TP-04

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 23.13 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---



DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
0		0.7	Dark brown, silty topsoil	22.4
	SM	1.8	Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	21.3
2 4 6 8 10	SW	10.0	Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders	13.1

Visual confirmation of granitic rock surface

Refusal at 10.0 feet.
Bottom of test pit at 10.0 feet.

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TEST PIT NUMBER TP-05

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

DATE STARTED 5/30/13 **COMPLETED** 5/30/13

GROUND ELEVATION 21.83 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR Town of Old Lyme

GROUND WATER LEVELS:

EXCAVATION METHOD Test Pit

AT TIME OF EXCAVATION ---

LOGGED BY Brent V Aigler **CHECKED BY** David Prickett

AT END OF EXCAVATION ---

NOTES

AFTER EXCAVATION ---

DEPTH (ft)	REMARKS	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0					Dark brown, damp, F SAND, Some Silt; roots	
				1.0		20.8
2	Boulder noted at 1-2 ft depth in sidewall Orange mottling	SM			Light brown, damp, F SAND, Some Silt	
				3.5		18.3

Visual confirmation of granitic rock surface

Refusal at 3.5 feet.
Bottom of test pit at 3.5 feet.

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TEST PIT NUMBER TP-07

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

DATE STARTED 5/30/13 **COMPLETED** 5/30/13

GROUND ELEVATION 23.17 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR Town of Old Lyme

GROUND WATER LEVELS:

EXCAVATION METHOD Test Pit

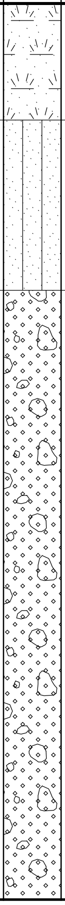
AT TIME OF EXCAVATION ---

LOGGED BY Brent V Aigler **CHECKED BY** David Prickett

AT END OF EXCAVATION ---

NOTES

AFTER EXCAVATION ---



DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
0			Dark brown, silty topsoil	
		1.3		21.9
2	SM		Brown, damp, silty SAND loam; cohesive	
		3.2		20.0
4			Light brown, dry, F-C SAND, Some F-C Gravel and Cobbles	
6	SW			
8			Light brown-gray, damp, F-C SAND, Some Boulders	
	SW			
10		10.0		13.2

Bottom of test pit at 10.0 feet.

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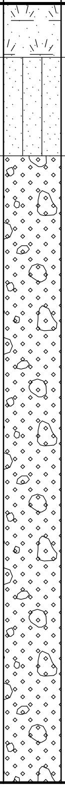
TEST PIT NUMBER TP-08

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/30/13 **COMPLETED** 5/30/13
GROUND ELEVATION 19.95 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Town of Old Lyme
GROUND WATER LEVELS:
EXCAVATION METHOD Test Pit
AT TIME OF EXCAVATION ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0			0.6	Dark brown, silty topsoil	19.4
	SM		1.7	Light brown, damp, silty SAND loam; cohesive, roots, little cobbles	18.3
2 4 6 8	SW		8.7	Light brown, dry, F-C SAND, Some F-C Gravel; little cobbles and boulders, unconsolidated	11.3

Bottom of test pit at 8.7 feet.

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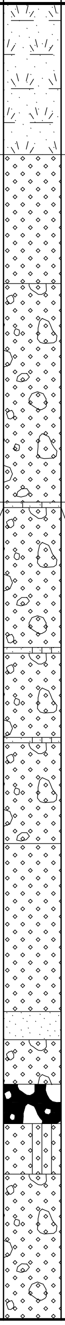
BORING NUMBER BH-1

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/20/13 **COMPLETED** 5/20/13
GROUND ELEVATION 32.08 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---



DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
0			Dark brown, dry, F SAND & SILT; roots Light brown, dry, F SAND, Some Silt, trace f. gravel and roots	
2		2.7		29.4
4	SW		Light brown-gray, dry, F-M SAND, trace f. gravel	
6	SW		Light brown, dry, F-C SAND, Little F-C Gravel	
8		8.9		23.2
	SM	9.0	Light brown, dry, F-C SAND, Some Silt	23.1
10	SW		Light brown, dry, F-C SAND, Little F-C Gravel	
12	SP-SM		Dark brown, damp, F SAND, Little Silt and Roots	
	SW		Light brown, dry, F-C SAND, Little F-C Gravel	
	SP-SM		Light brown, damp, F SAND, Little Silt and Roots	
14	SW		Light brown, dry, F-C SAND, Little F-C Gravel	
16	SW		Light brown, damp, F-C SAND, trace f-c gravel	
18	SP		Light brown, damp, F SAND	
	SP-SM		Olive-gray, damp, F-M SAND, Little Silt and F Gravel	
			White rock fragments	
20	SW-SM		Olive-gray, damp, F-M SAND, Little Silt and F Gravel	
22	SW		Light brown-gray, damp, F-C SAND, Little F-C Gravel	
	SW	23.5	Brown-gray, damp, F-C SAND, Little F-C Gravel, trace silt	8.6

Refusal at 23.5 feet.
Bottom of borehole at 23.5 feet.

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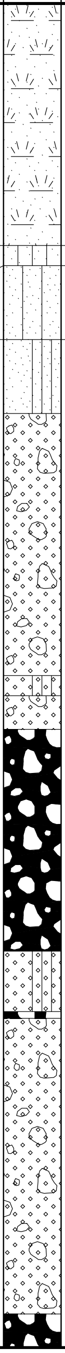
BORING NUMBER BH-2

PAGE 1 OF 2

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/20/13 **COMPLETED** 5/20/13
GROUND ELEVATION 45.74 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---



DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
0			Brown, dry, F-M SAND, Some Silt, little f. gravel and roots	
2		3.6	Light brown, dry, F-C SAND, Little Silt and F Gravel, roots	42.1
4	MH	3.9	Dark brown, damp, SILT, Some F SAND	41.8
	SM	5.0	Light brown, dry, F SAND, Some Silt, trace f. gravel	40.7
6	SP-SM		Light brown, dry, F SAND, Little Silt and F Gravel	
8	SW		Light gray, dry, F-C SAND, Some F-C Gravel	
10	SW-SM		Dark brown, damp, F-M SAND, Little Silt and F Gravel; red/gray mottling, cohesive	
	SW		Light gray, dry, F-C SAND, Little F Gravel	
12			Dry fragments of gneissic rock	
14	SW-SM		Dark brown, damp, F-M SAND, Little Silt and F Gravel; red/gray mottling, cohesive	
			Brown, dry, weathered granitic rock	
16	SW		Light brown, dry, F-M SAND, Little F-C Gravel	
18				
20			Dry fragments of gneissic rock	

(Continued Next Page)

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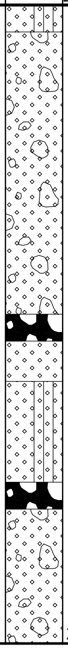
BORING NUMBER BH-2

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT



DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
20	SW-SM			Brown, dry, F-M SAND, Little Silt	
	SW			Brown-yellow, dry, F-C SAND, Little F-C Gravel	
22					
24					
				Dry fragments of gneissic rock	
	SW			Light brown-gray, dry, F-M SAND, trace f. gravel and silt	
26	SW-SM			Olive-gray, damp, F-M SAND, Little Silt, trace c. sand; cohesive	
				Rock fragments	
28	SW			Brown, damp, F-C SAND, Little F-C Gravel, trace silt; granitic rock fragment in spoon tip	
			29.5		16.2

Refusal at 29.5 feet.
Bottom of borehole at 29.5 feet.

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BORING NUMBER BH-4

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT

PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

DATE STARTED 5/21/13 **COMPLETED** 5/21/13

GROUND ELEVATION 33.06 ft **HOLE SIZE** 4"

DRILLING CONTRACTOR New England Geotech

GROUND WATER LEVELS:

DRILLING METHOD GeoProbe

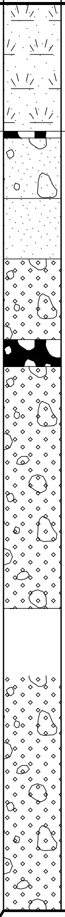
AT TIME OF DRILLING ---

LOGGED BY Brent V Aigler **CHECKED BY** David Prickett

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---



DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0				Dark brown, damp, F SAND, Some Silt, trace f. gravel and roots	
				Light brown, damp, F-M SAND, Little Silt, trace f. gravel and roots	
2			1.9		31.2
				Rock fragments	
	SP			Light brown, damp, F SAND, Little F Gravel, trace silt	
	SP			Light gray, damp, F SAND, trace c. sand and roots	
4	SW			Orange-red, damp, F-C SAND, Some F-C Gravel, Little Silt	
	SW			Light brown-gray, damp, F-C SAND, Some F-C Gravel	
				Rock fragments	
6	SW			Olive-gray, damp, F-M SAND, Little F Gravel; cohesive	
				Brown-gray-white, damp, F-C SAND, Some F-C Gravel	
8	SW				
10				Light brown-gray, damp, F-C SAND, Some F-C Gravel, trace silt	
12	SW				
	SW		13.5	Black, damp, F-C SAND, Some F-C Gravel, trace silt	19.6

Refusal at 13.5 feet.
Bottom of borehole at 13.5 feet.

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BORING NUMBER BH-5

PAGE 1 OF 1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/21/13 **COMPLETED** 5/21/13
GROUND ELEVATION 54.69 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
0			Dark brown, damp, F SAND, Some Silt, roots and leaves	
2		2.4	Light brown, damp, F SAND, Some Silt, roots; cohesive	52.3
	SW	2.5	Yellow-orange, damp, F-C SAND	52.2
	SM	2.7	Light brown, damp, F SAND, Some Silt, roots; cohesive	52.0
			Pulverized rock fragments	
4	SW-SM		Light brown, damp, F-M SAND, Little Silt, trace f. gravel; cohesive, light gray mottling	
	SW		Light brown, damp, F-M SAND, trace f. gravel and silt	
6			Pulverized rock fragments	
	SW	6.5	Light brown, damp, F-M SAND, trace f. gravel and silt	48.2
	SW		Light brown, damp, F-M SAND, trace f. gravel; not cohesive	

Refusal at 6.5 feet.
Bottom of borehole at 6.5 feet.

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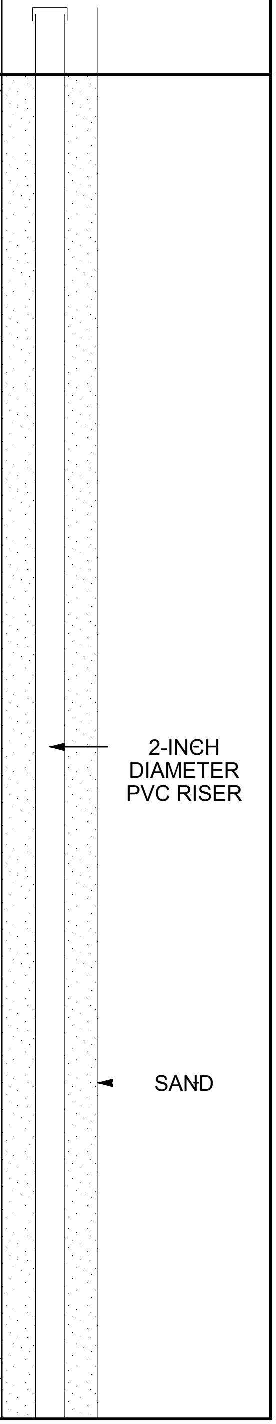
WELL NUMBER MW-3D

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/21/13 **COMPLETED** 5/21/13
GROUND ELEVATION 53.13 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
▽ **AFTER DRILLING** 22.99 ft / Elev 30.14 ft

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0			0.2	Brown topsoil, roots	52.9
	SW			Light brown, dry, F-C SAND, Some F-C Gravel, little silt and roots	
2					
	SP-SM			Light brown-gray, dry, F SAND, Little Silt and Roots	
4			3.9		49.2
	SW			Brown-gray, dry, F-C SAND	
				Granitic rock fragments	
				Brown-white-gray, dry, F-C SAND, Some F-C Gravel, rock fragments	
6					
	SW				
8					
10					
	SW			Light brown, damp, F-M SAND, Little F-C Gravel, trace silt	
				Brown, damp, F-C SAND, Little F-C Gravel	
	SW				
12					
	SW			Brown, moist, F-M SAND, trace f. gravel	
14				Brown, moist, F-C SAND, Some F-C Gravel	
	SW				
				Cave-in material	
				Brown-gray, dry, F-C SAND, Little F-C Gravel, trace silt	
16	SW				
				Yellow-orange, damp, F-M SAND, trace f. gravel	
	SW				
				Yellow-orange, moist, F-C SAND, trace f. gravel	
	SW				
18					
				Olive-gray, wet, F SAND	
			19.1		34.0
	SM		19.4	Olive-gray, wet, F SAND, Some Silt	33.7
20	SP		20.0	Olive-gray, wet, F SAND	33.1

WELL DIAGRAM



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WELL NUMBER MW-3D

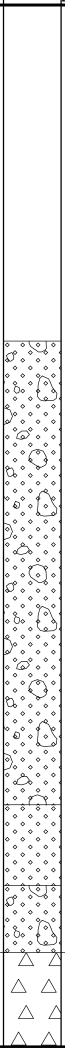
CLIENT Town of Old Lyme, CT

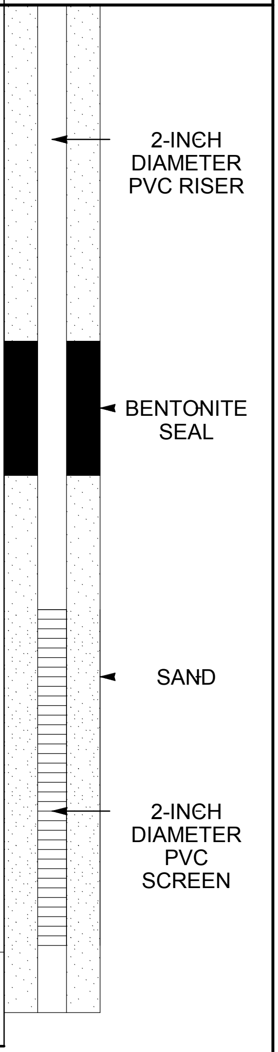
PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

U.S.C.S.	MATERIAL DESCRIPTION	Feet BGS	
	Granitic rock fragments		
	Soils preserved for laboratory sampling		
SW	Olive-gray, moist, F-M SAND, Little F-C Gravel and Silt; cohesive		
SW	Olive-gray, wet, F-M SAND, Little F-C Gravel and Silt; cohesive		
SW	Brown, wet, F-C SAND		
SW	Brown, wet, F-M SAND, Some F-C Gravel, trace silt	34.1	19.0
	Rock fragments: gneissic banding, secondary clay minerals	35.5	17.6





Refusal at 35.5 feet.
Bottom of borehole at 35.5 feet.

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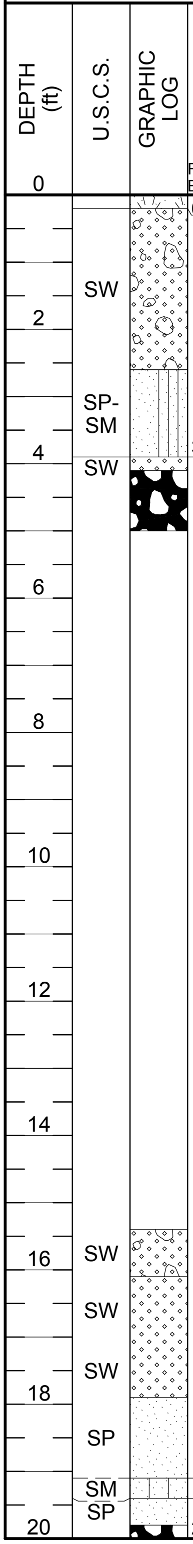
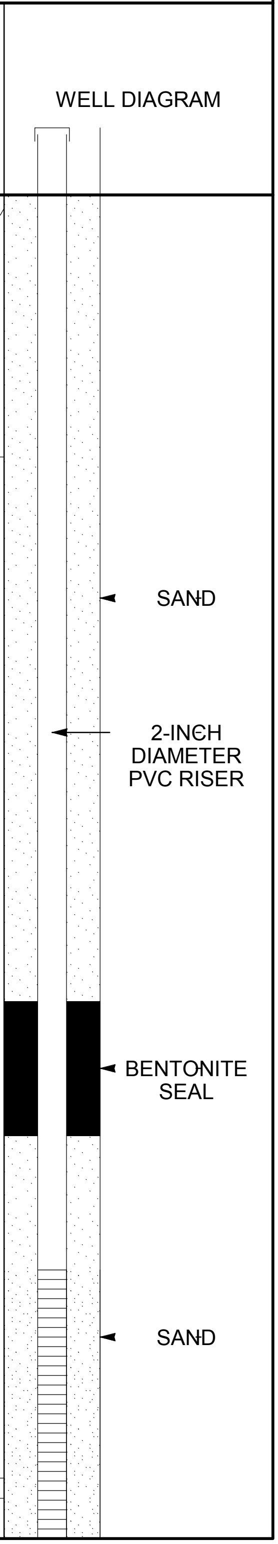
WELL NUMBER MW-3S

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/20/13 **COMPLETED** 5/20/13
GROUND ELEVATION 53.12 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
AFTER DRILLING 17.89 ft / Elev 35.23 ft

Feet BGS	U.S.C.S.	MATERIAL DESCRIPTION	
0.2		Brown topsoil, roots	52.9
	SW	Light brown, dry, F-C SAND, Some F-C Gravel, little silt and roots	
3.9	SP-SM	Light brown-gray, dry, F SAND, Little Silt and Roots	49.2
	SW	Brown-gray, dry, F-C SAND Granitic rock fragments Soils preserved for laboratory sampling	
		Cave-in material	
	SW	Brown-gray, dry, F-C SAND, Little F-C Gravel, trace silt	
	SW	Yellow-orange, damp, F-M SAND, trace f. gravel	
	SW	Yellow-orange, moist, F-C SAND, trace f. gravel	
19.1	SP	Olive-gray, wet, F SAND	34.0
19.4	SM	Olive-gray, wet, F SAND, Some Silt	33.7
20.0	SP	Olive-gray, wet, F SAND	33.1





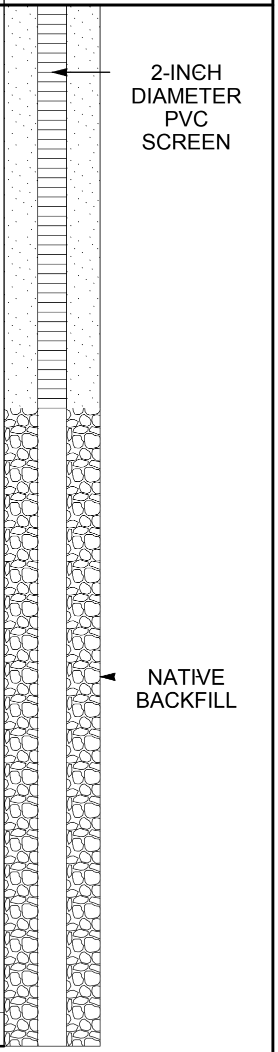
(Continued Next Page)

WELL NUMBER MW-3S

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
20				Granitic rock fragments	
	SM			Olive-gray, saturated, F-M SAND, Some Silt, little f. gravel; cohesive	
22					
24					
				Soils preserved for laboratory sampling	
26					
28					
30					
32					
34					
			35.0		18.1
			35.5	Black, micaceous weathered rock	17.6

WELL DIAGRAM



Refusal at 35.5 feet.
Bottom of borehole at 35.5 feet.

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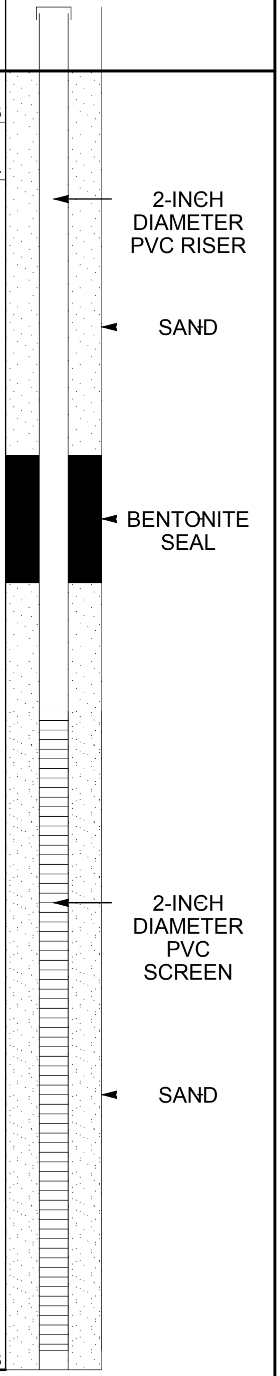
WELL NUMBER WC-1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 21.14 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
▼ **AFTER DRILLING** 18.90 ft / Elev 2.24 ft

U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
	0.8	Brown, damp, F SAND, Some Silt, trace f. gravel and roots	20.3
SP	1.7	Light brown, damp, F SAND, Some Gravel, little silt	19.4
SW		Light brown-gray, dry, F-C SAND, Some Gravel	
SW		Light brown-gray, moist, F-M SAND, trace f. gravel; cm-scale laminae	
SW	20.3	▼ Light brown-gray, wet, F-C SAND, Some F-C Gravel	0.8

WELL DIAGRAM



Refusal at 20.3 feet.
Bottom of borehole at 20.3 feet.

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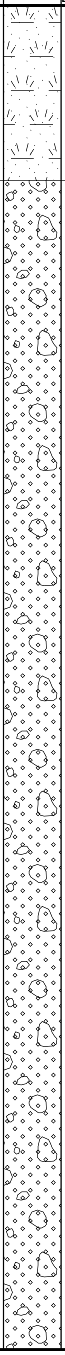
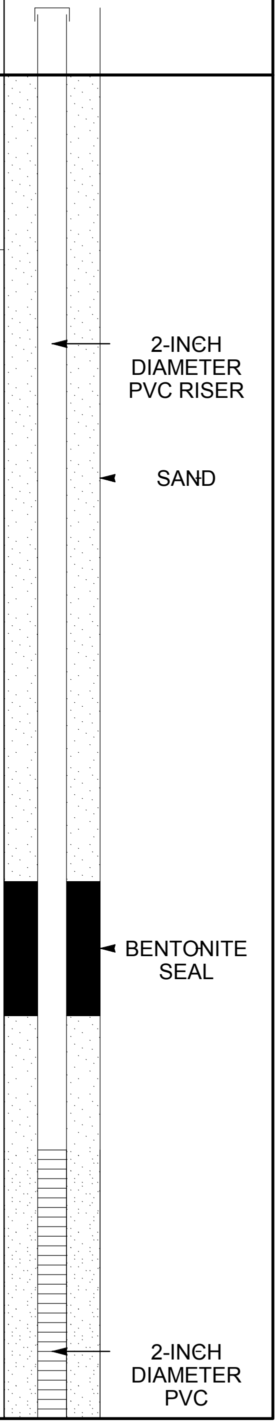
WELL NUMBER WC-2

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 20.55 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
▽ **AFTER DRILLING** 18.57 ft / Elev 1.98 ft

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	Elevation
0			Brown, damp, F SAND, Some Silt, trace f. gravel and roots	
2			Light brown, damp, F SAND, Little Silt, trace f. gravel and roots	
		2.6	Light brown-gray, dry, F-C SAND, Some F-C Gravel	18.0
6	SW			
10			Light brown-gray, damp, F-C SAND, Some F-C Gravel	
12	SW			
16			Light gray-brown, damp, F-C SAND, Little F Gravel	
18	SW		▽	
20	SW		Light gray-brown, wet, F-C SAND, Little F Gravel	



WELL DIAGRAM



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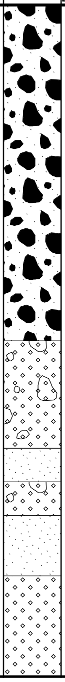
WELL NUMBER WC-2

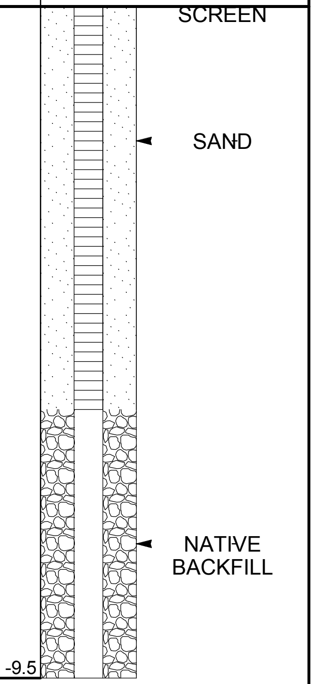
CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION
20 22 24	GW		Light brown-gray, wet, F-C GRAVEL, Some F-C Sand
	SW		Blue-gray, wet, F-M SAND, Little F Gravel, trace silt
26	SW		Light brown-gray, wet, F-C SAND, Little F Gravel
	SP		Light brown-gray, wet, F SAND; inch-scale laminae
	SW		Light brown-gray, wet, F-C SAND, Little F Gravel
28	SP		Light brown-gray, wet, F SAND; inch-scale laminae
	SW		Light brown-gray, wet, F-M SAND; inch-scale laminae
30	SW	30.0	Light brown-gray, wet, F-C SAND

GRAPHIC LOG



WELL DIAGRAM



Bottom of borehole at 30.0 feet.

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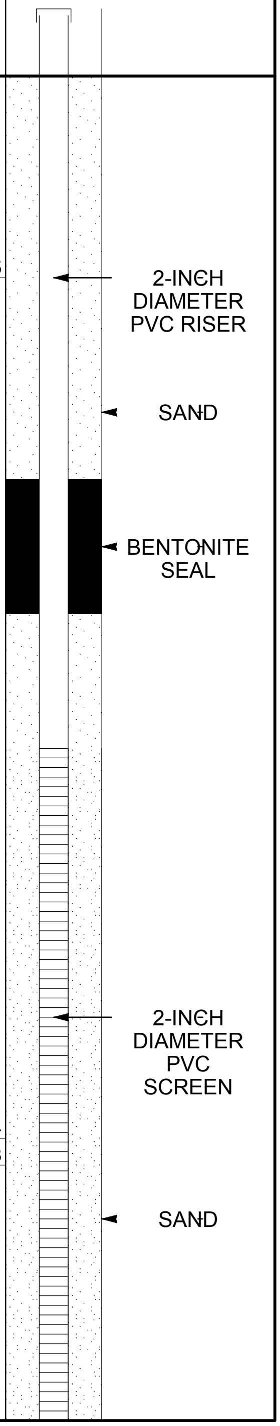
WELL NUMBER WC-3

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 12.45 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
▼ **AFTER DRILLING** 10.55 ft / Elev 1.90 ft

U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	
		Dark brown, damp, F SAND, Some Silt, trace c. sand and roots	
		Brown, damp, F SAND, Little Silt, trace f-c gravel and roots	
SW	3.0	Yellow-orange-light gray, dry, F-C SAND, Little F-C Gravel	9.5
SW		▼ Light brown-gray, damp, F-C SAND, Little F-C Gravel	
SW		Light brown-gray, wet, F-C SAND, Little F-C Gravel	
SW		Light brown-gray, wet, F-C SAND, Some F-C Gravel	
SW		Light brown-gray, wet, F-M SAND	
SM	15.8	Light brown-gray, wet, F-M SAND, Some Silt	-3.4
SW	16.2	Light brown-gray, wet, F-M SAND	-3.8
SW		Light brown-gray, wet, F-M SAND, Some F-C Gravel	
SP		Light brown-gray, wet, F SAND, Little Silt	
SW		Light brown-gray, wet, F-M SAND, Some F-C Gravel	

DEPTH (ft): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

WELL DIAGRAM



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WELL NUMBER WC-3

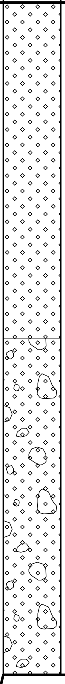
CLIENT Town of Old Lyme, CT

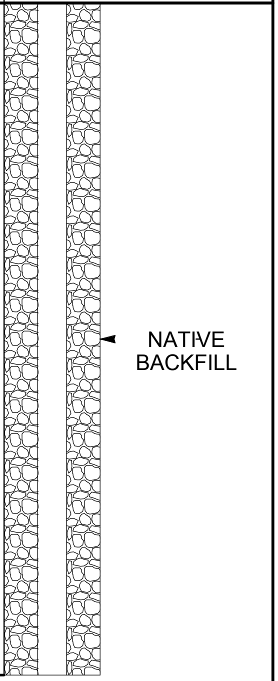
PROJECT NAME Old Lyme Wastewater Management

PROJECT NUMBER 226617

PROJECT LOCATION Old Lyme, CT

DEPTH (ft)	U.S.C.S.	Feet BGS	MATERIAL DESCRIPTION	WELL DIAGRAM
20			Light brown-gray, wet, F-M SAND, trace f. gravel	
22				
	SW			
24				
			Light brown-gray, wet, F-C SAND, Some F-C Gravel	NATIVE BACKFILL
26	SW			
			Light brown-gray, wet, F-M SAND, Some F-C Gravel; millimeter-scale laminae	
28	SW			
	SW		Light brown-gray, wet, F-C SAND, Some F-C Gravel	
	SW		Light brown-gray, wet, F-M SAND, Some F-C Gravel; millimeter-scale laminae	
30	SW	30.0	Light brown-gray, wet, F-C SAND, Some F-C Gravel	-17.6
	SW		Light brown-gray, wet, F-M SAND, Some F-C Gravel; millimeter-scale laminae	





Bottom of borehole at 30.0 feet.

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WELL NUMBER WC-4

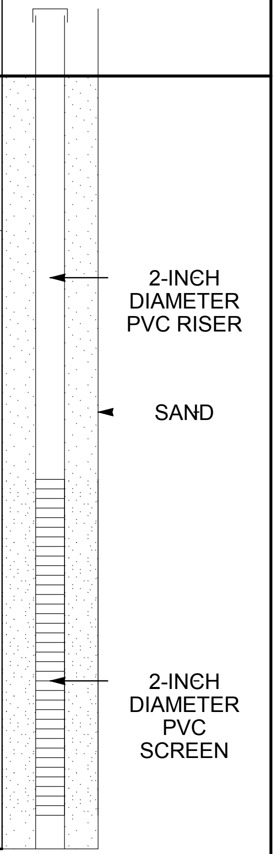
PAGE 1 OF 1

CLIENT Town of Old Lyme, CT
PROJECT NAME Old Lyme Wastewater Management
PROJECT NUMBER 226617
PROJECT LOCATION Old Lyme, CT
DATE STARTED 5/22/13 **COMPLETED** 5/22/13
GROUND ELEVATION 22.35 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR New England Geotech
GROUND WATER LEVELS:
DRILLING METHOD GeoProbe
AT TIME OF DRILLING ---
LOGGED BY Brent V Aigler **CHECKED BY** David Prickett
AT END OF DRILLING ---
NOTES
▽ **AFTER DRILLING** 9.24 ft / Elev 13.11 ft

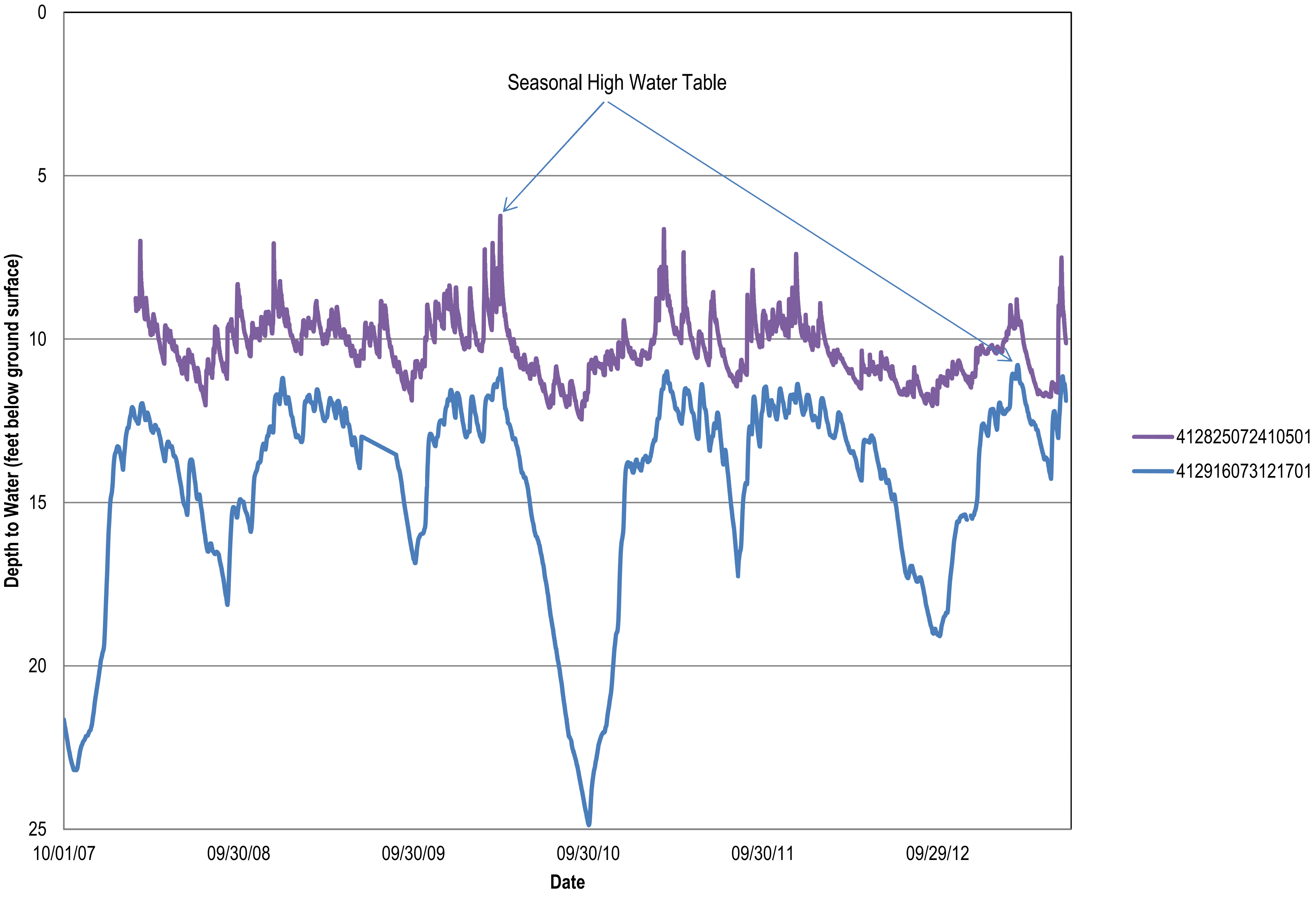
DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	Feet BGS	MATERIAL DESCRIPTION	
0				Brown, damp, F SAND, Some Silt, trace f. gravel	
				Light brown, damp, F SAND, Little Silt, trace f. gravel and c. sand	
2			2.3		20.1
	SW			Light brown-gray, dry, F-C SAND, Some F-C Gravel	
4	SW			Light brown-gray, dry, F-M SAND; cm-scale laminae	
6	SW			Brown, damp, F-M SAND, trace f. gravel	
8	SW			Light brown-gray, damp, F-M SAND, Some F-C Gravel	
	SW		▽	Light brown-gray, wet, F-C SAND, trace f. gravel	
10	SW			Olive-gray, wet, F-C SAND, Little F Gravel, trace silt	
	SW		11.5	Orange-brown, damp, F-C SAND, Little Silt	10.9

Refusal at 11.5 feet.
Bottom of borehole at 11.5 feet.

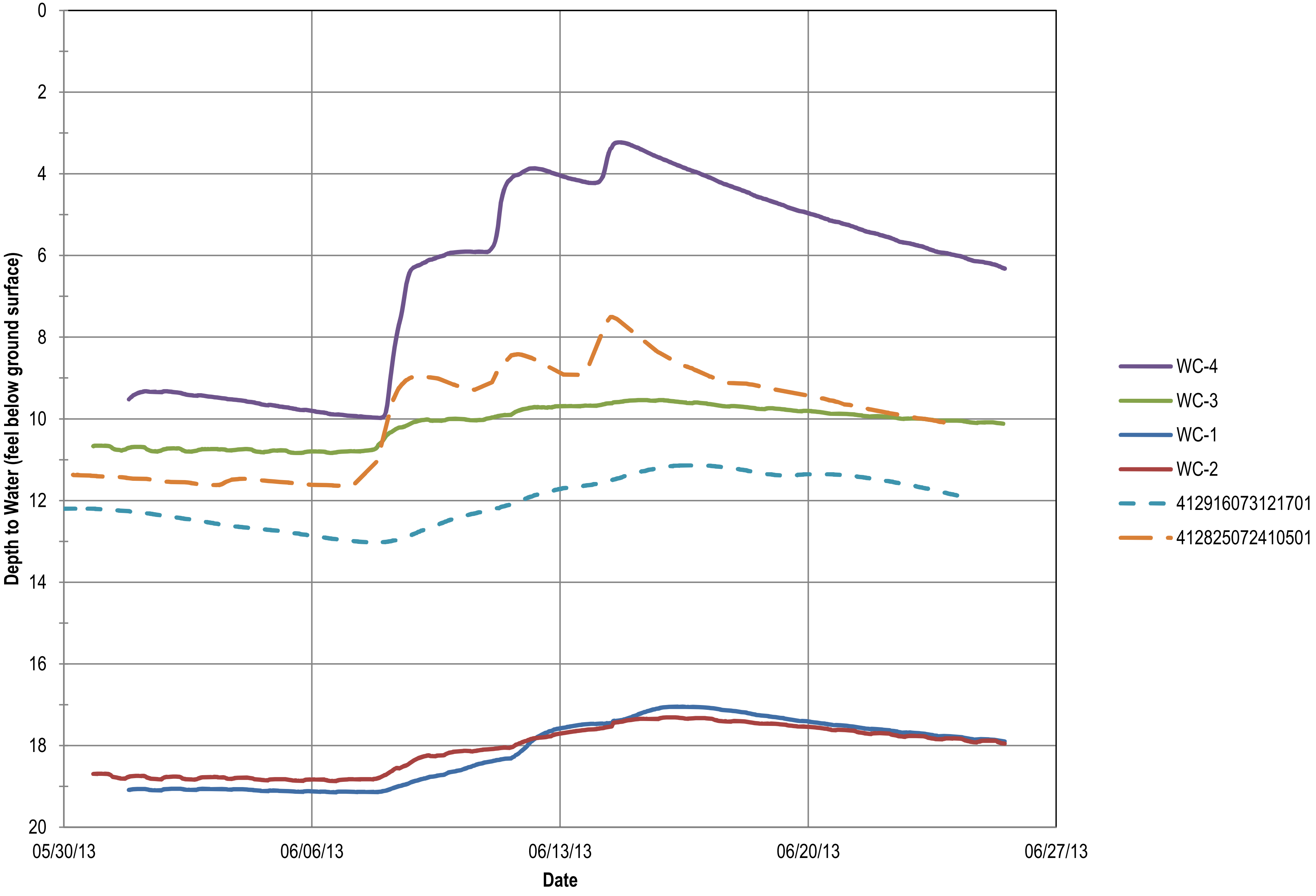
WELL DIAGRAM



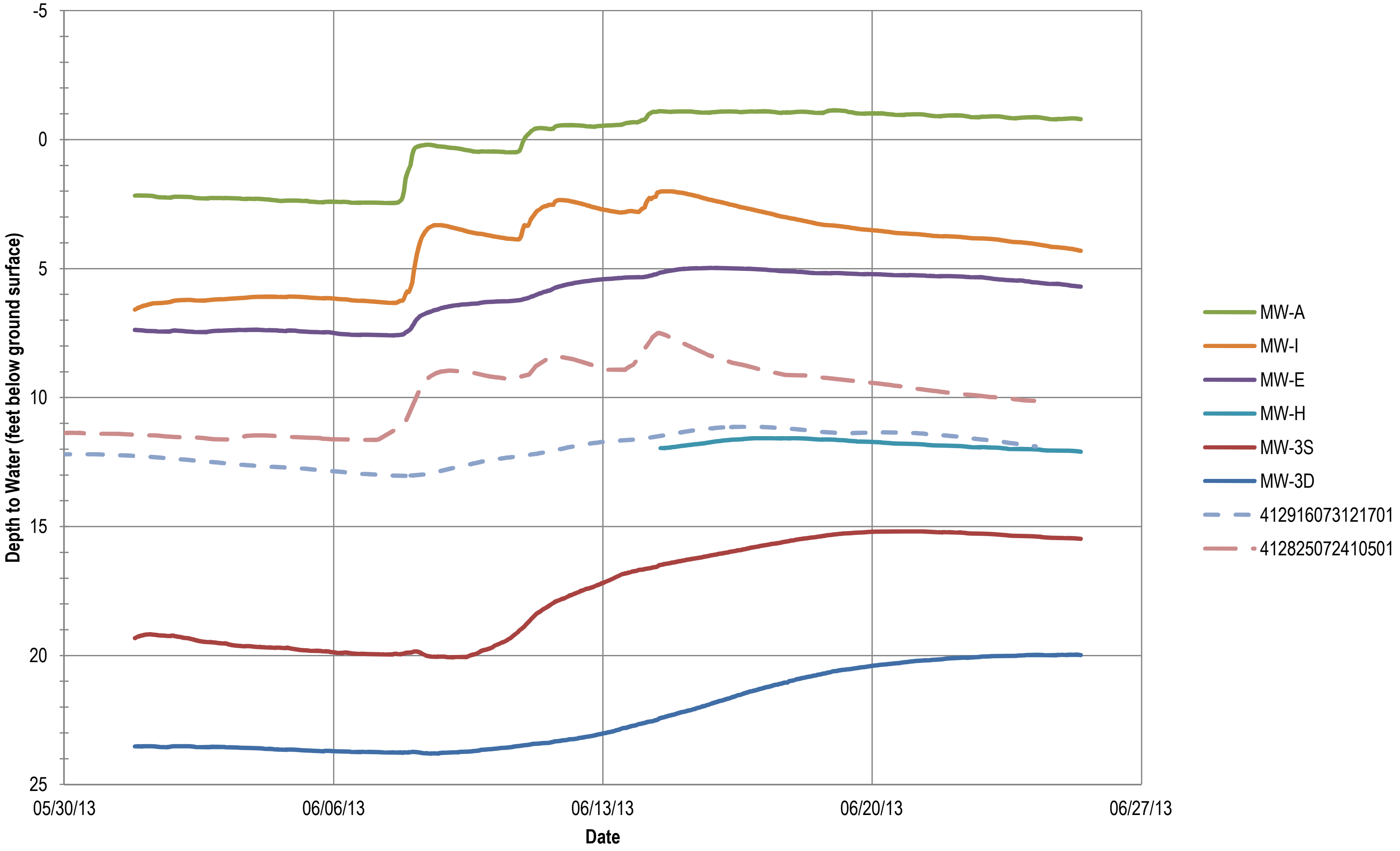
Appendix C.2: Depth to Groundwater - USGS Sentinel Wells



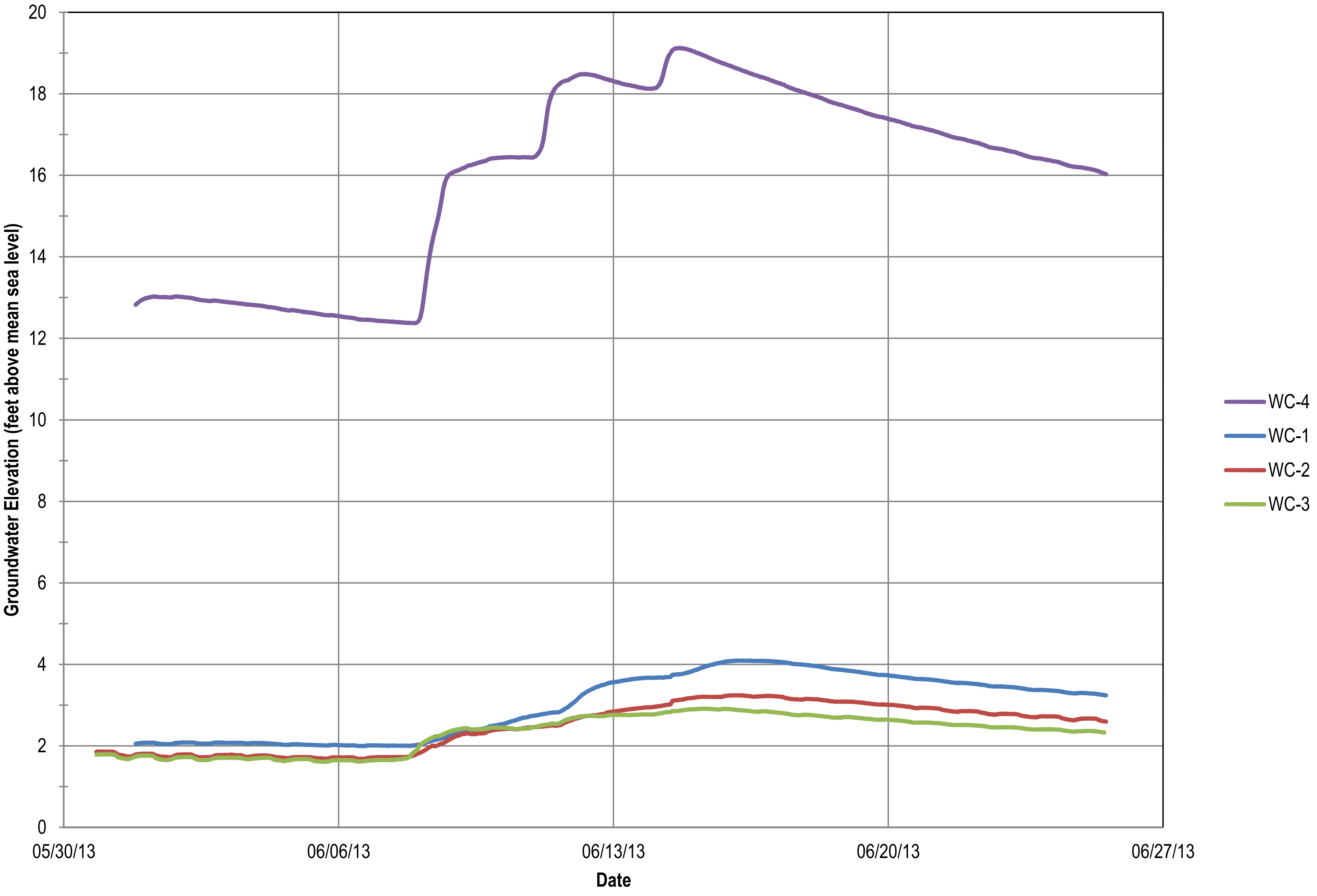
Appendix C.3: Depth to Groundwater - Cherrystone



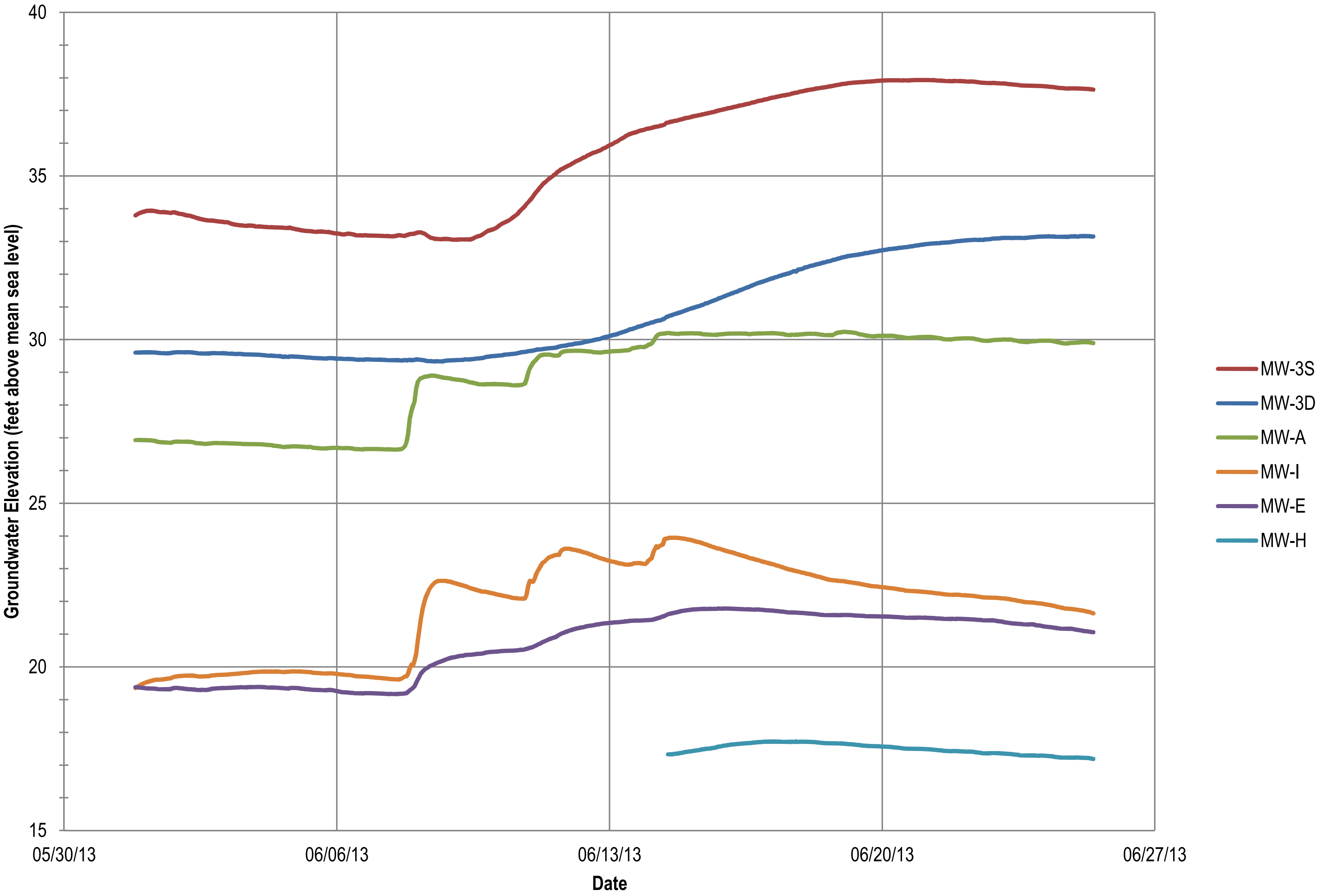
Appendix C.4: Depth to Groundwater - Black Hall



Appendix C.5: Groundwater Elevations - Cherrystone



Appendix C.6: Groundwater Elevations - Black Hall



APPENDIX C.7
CHERRYSTONE FACILITY - 1.67 AC.

Saturated Thickness = 20 feet	
Simulation 1: R = 1.2 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	2.8
K = 150 ft/day	2.0
K = 200 ft/day	1.6
Total Flow = 87,600 gal/day	
Simulation 2: R = 2.0 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	4.6
K = 150 ft/day	3.3
K = 200 ft/day	2.6
Total Flow = 146,000 gal/day	
Simulation 3: R = 3.0 gallons/ft^2/day	
	Mound (ft)
K = 100 ft/day	6.5
K = 150 ft/day	4.8
K = 200 ft/day	3.8
Total Flow = 219,000 gal/day	

NOTES:

K = Horizontal hydraulic conductivity
vertical conductivity is 1/10 of horizontal K

R = Infiltration rate

Mound heights are maximum, at center of facility

APPENDIX C.8
CHERRYSTONE FACILITY - 3.52 AC.

Saturated Thickness = 20 feet

Simulation 1: R = 1.2 gallons/ft^2/day

	Mound (ft)
K = 100 ft/day	5.1
K = 150 ft/day	3.8
K = 200 ft/day	3.0

Total Flow = 190,000 gal/day

Simulation 2: R = 2.0 gallons/ft^2/day

	Mound (ft)
K = 100 ft/day	8.2
K = 150 ft/day	6.1
K = 200 ft/day	4.9

Total Flow = 316,000 gal/day

Saturated Thickness = 15 feet

Simulation 1: R = 1.2 gallons/ft^2/day

	Mound (ft)
K = 100 ft/day	6.2
K = 150 ft/day	4.6
K = 200 ft/day	3.7

Total Flow = 190,000 gal/day

Simulation 2: R = 2.0 gallons/ft^2/day

	Mound (ft)
K = 100 ft/day	9.6
K = 150 ft/day	7.3
K = 200 ft/day	5.9

Total Flow = 316,000 gal/day

NOTES:

K = Horizontal hydraulic conductivity; vertical conductivity taken as 1/10 of horizontal

R = Infiltration rate

Mound heights are maximum, at center of facility

Highlighted cells indicate mounds exceeding eight feet

APPENDIX D: GROUNDWATER QUALITY DATA FROM 2012 NLJ REPORT

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

HN-1-98	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
6/25/1998	81	18	3.10	0.006	0.28	0.28	3.4	***2***	***2***	***2***	nt
9/23/1998	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
10/1/1998	154	16	4.90	***0.005***	0.10	***0.05***	5.0	***2***	***2***	***2***	nt
5/12/1999	197	20	10.00	***0.005***	0.43	***0.05***	10.4	0	***2***	***2***	nt
10/19/1999	184	18	11.00	***0.005***	***0.10***	0.07	11.1	0	***2***	0	nt
6/21/2000	209	32	4.60	***0.005***	2.80	***0.05***	7.4	0	***2***	0	nt
9/12/2000	173	23	3.20	***0.005***	2.40	***0.05***	5.6	nt	48	***2***	nt
4/25/2001	192	25	5.30	***0.005***	0.26	***0.05***	5.6	nt	***2***	***2***	nt
9/26/2001	150	17	4.80	***0.010***	0.43	***0.03***	5.2	nt	***10***	***10***	nt
5/30/2002	210	24	7.60	***0.010***	0.40	0.05	8.0	nt	***10***	***10***	nt
8/23/2002	190	22	6.30	***0.010***	0.72	0.25	7.0	***10***	***10***	30	nt
5/7/2003	210	33	5.50	***0.010***	0.54	0.07	6.1	30	***10***	***10***	nt
9/9/2003	130	17	4.10	***0.010***	0.27	***0.02***	4.4	60	60	***20***	nt
6/10/2004	190	27	4.90	0.020	0.48	0.10	5.4	***10***	***10***	***10***	***10***
8/17/2004	140	14	3.60	0.020	0.11	***0.02***	3.7	***10***	***10***	***10***	nt
5/10/2005	200	29	5.30	***0.010***	0.33	0.04	5.6	***10***	***10***	***10***	nt
9/14/2005	150	13	4.90	***0.010***	0.32	0.07	5.2	***20***	***20***	***20***	***20***
8/9/2006	150	13	5.90	***0.010***	0.99	0.10	6.9	***20***	***20***	***20***	***20***
5/8/2007	160	21	3.80	***0.010***	***0.10***	0.03	3.9	***20***	***20***	***20***	***20***
8/29/2007	130	15	2.70	***0.010***	0.56	***0.02***	3.3	***10***	***10***	***10***	***10***
4/16/2008	189	22	4.90	***0.010***	0.78	***0.02***	5.7	***10***	***10***	***10***	***10***
9/3/2008	170	17	6.50	***0.010***	0.73	0.06	7.2	10	***10***	***10***	***10***
5/19/2009	nt	20	4.60	***0.010***	0.83	0.12	5.4	10	***10***	***10***	***10***
8/28/2009	191	28	3.70	***0.010***	0.26	0.05	4.0	***10***	***10***	***10***	***10***
5/21/2010	172	18	8.00	***nt***	1.00	0.06	9.0	***10***	***10***	***10***	***10***
11/8/2011	161	19	7.80	***0.010***	0.60	0.02	8.4	***10***	***10***	***10***	***10***
6/19/2012	161	18.2	6.42	***0.010***	0.74	0.10	7.2	***10***	***10***	***10***	***10***
Minimum	81	13	2.70	***0.005***	***0.10***	***0.02***	3.3	0	***2***	0	***10***
Maximum	210	33	11.00	0.020	2.80	0.28	11.1	60	60	30	***20***
Average	170	21	5.52	0.009	0.64	0.07	6.2	na	na	na	na

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

5/2/13

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

HN-2-98	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
6/25/1998	97	25	2.40	0.010	0.84	0.28	3.3	***2***	10	***2***	nt
9/23/1998	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
10/1/1998	160	25	2.30	0.017	0.27	0.15	2.6	***2***	***2***	***2***	nt
5/12/1999	233	39	4.80	0.057	0.72	0.73	5.6	0	***2***	***2***	nt
10/19/1999	157	21	3.60	***0.005***	0.39	0.08	4.0	0	***2***	0	nt
6/21/2000	174	24	2.00	0.005	0.91	0.15	2.9	2	2	4	nt
9/12/2000	217	41	2.30	0.017	1.30	0.21	3.6	nt	2	***2***	nt
4/25/2001	187	27	2.40	0.022	0.60	0.09	3.0	nt	***2***	***2***	nt
9/26/2001	170	22	3.70	***0.010***	1.40	0.21	5.1	nt	***10***	***10***	nt
5/30/2002	150	16	5.10	***0.010***	0.44	0.33	5.6	nt	***10***	10	nt
8/23/2002	190	23	5.40	***0.010***	0.88	0.50	6.3	***10***	***10***	300	nt
5/7/2003	200	26	5.10	***0.010***	0.61	0.15	5.7	***10***	***10***	***10***	nt
9/9/2003	140	22	2.30	***0.010***	0.34	0.09	2.7	40	***20***	***20***	nt
6/10/2004	170	20	2.80	***0.010***	0.37	0.11	3.2	***10***	***10***	***10***	***10***
8/17/2004	150	14	2.60	0.010	0.24	0.06	2.9	***10***	***10***	***10***	***10***
5/10/2005	180	17	4.60	***0.010***	0.35	0.03	5.0	***10***	***10***	***10***	nt
9/13/2005	180	21	3.50	***0.010***	0.63	0.09	4.1	***20***	***20***	***20***	***20***
8/9/2006	170	19	3.00	***0.010***	0.72	0.04	3.7	***20***	***20***	***20***	***20***
5/8/2007	160	21	1.80	***0.010***	***0.10***	0.03	1.9	20	***20***	***20***	***20***
8/29/2007	150	15	1.70	***0.010***	0.28	0.02	2.0	***10***	***10***	***10***	***10***
4/16/2008	180	17	2.90	***0.010***	0.38	***0.02***	3.3	***10***	***10***	***10***	***10***
9/3/2008	199	19	6.20	***0.010***	0.42	0.04	6.6	***10***	***10***	***10***	***10***
5/19/2009	nt	19	5.00	***0.010***	0.71	0.10	5.7	***10***	***10***	***10***	***10***
8/28/2009	170	17	3.40	0.010	0.89	0.06	4.3	***10***	***10***	***10***	***10***
5/21/2010	161	18	3.30	nt	0.73	0.09	4.0	10	***10***	***10***	***10***
11/8/2011	147	19	3.30	***0.010***	0.81	0.10	4.1	10	***10***	***10***	***10***
6/19/2012	170	16	5.20	***0.010***	1.06	0.32	6.3	20	10	***10***	10
Minimum	97	14	1.70	***0.005***	0.10	0.02	1.9	0	***2***	0	***10***
Maximum	233	41	6.20	0.057	1.40	0.73	6.6	40	20	300	***20***
Average	170	22	3.49	0.013	0.63	0.16	4.1	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

HN-3-98	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
6/25/1998	183	55	0.05	***0.005***	0.98	0.70	1.0	360	8	26	nt
9/23/1998	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
10/1/1998	324	66	***0.01***	0.019	1.60	0.94	1.6	6	***2***	***2***	nt
5/12/1999	285	58	***0.01***	0.006	1.30	0.87	1.3	0	***2***	***2***	nt
10/19/1999	172	27	0.05	***0.005***	3.80	0.18	3.9	57	4	20	nt
6/21/2000	218	44	0.15	0.006	2.40	0.41	2.6	580	***2***	8	nt
9/12/2000	309	80	0.05	0.012	1.60	0.34	1.7	nt	***2***	***2***	nt
4/25/2001	284	68	0.01	0.007	1.20	0.13	1.2	nt	***2***	***2***	nt
5/30/2002	250	43	0.19	***0.010***	0.86	0.15	1.1	nt	***10***	120	nt
8/23/2002	290	54	0.08	***0.010***	1.90	0.79	2.0	***10***	***10***	170	nt
5/7/2003	160	21	0.26	***0.010***	0.90	0.23	1.2	30	***10***	10	nt
9/9/2003	140	8	0.14	***0.010***	1.80	0.74	2.0	40	***20***	***20***	nt
6/10/2004	180	22	0.22	***0.010***	0.70	0.24	0.9	***10***	***10***	***10***	***10***
8/17/2004	130	10	1.30	0.010	0.48	0.11	1.8	100	***10***	10	10
5/10/2005	160	17	1.40	***0.010***	0.57	0.06	2.0	100	70	***10***	nt
9/14/2005	270	47	0.08	***0.010***	1.50	0.78	1.6	480	360	***20***	300
8/9/2006	190	22	0.06	***0.010***	1.30	0.46	1.4	320	40	20	20
5/8/2007	180	23	1.90	0.020	0.40	0.07	2.3	60	***20***	***20***	***20***
8/29/2007	250	27	0.04	***0.010***	2.70	1.40	2.7	***10***	***10***	640	***10***
4/16/2008	199	22	0.99	0.010	1.10	0.06	2.1	50	***10***	***10***	***10***
9/3/2008	234	20	0.22	***0.010***	1.90	0.84	2.1	20	***10***	***10***	***10***
5/19/2009	nt	14	2.00	***0.010***	1.70	0.22	3.7	***10***	***10***	***10***	***10***
8/28/2009	258	52	0.02	***0.010***	1.30	0.24	1.3	200	10	220	20
5/21/2010	130	8	3.80	nt	1.40	0.11	4.2	50	20	***10***	20
11/8/2011	1680	670	4.70	0.030	2.40	0.86	7.1	90	***10***	***10***	***10***
6/19/2012	628	144	0.99	***0.010***	3.33	0.77	4.3	100	40	100	30
Minimum	130	8	***0.01***	*0.005*	0.40	0.06	0.9	0	***2***	***2***	***10***
Maximum	1680	670	4.70	0.030	3.80	1.40	7.1	580	360	640	300
Average	296	65	0.75	0.011	1.56	0.47	2.3	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

HN-4	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/12/2000	157	29	1.40	***0.005***	1.40	0.06	2.8	nt	16	4	nt
4/25/2001	174	33	2.50	***0.005***	0.30	***0.05***	2.8	nt	***2***	***2***	nt
9/26/2001	50	4	0.87	***0.010***	0.17	0.05	1.1	nt	400	***100***	nt
5/30/2002	170	25	3.40	***0.010***	0.25	0.02	3.7	nt	***10***	***10***	nt
8/23/2002	180	30	3.90	***0.010***	0.85	0.31	4.8	***10***	***10***	***10***	nt
5/7/2003	210	46	2.20	***0.010***	0.39	0.09	2.6	***10***	***10***	***10***	nt
9/9/2003	150	31	1.50	***0.010***	0.45	0.04	2.0	280	40	120	nt
6/10/2004	220	43	2.70	***0.010***	0.44	0.08	3.2	10	***10***	***10***	***10***
8/17/2004	78	8	1.10	0.010	0.26	0.04	1.4	1200	400	700	500
5/10/2005	240	47	2.40	***0.010***	0.25	***0.02***	2.7	***10***	***10***	***10***	nt
9/14/2005	300	66	1.90	***0.010***	0.52	0.09	2.4	20	***20***	20	20
8/9/2006	220	45	1.90	***0.010***	0.50	0.05	2.4	***1000***	***20***	20	***20***
5/8/2007	220	42	1.50	***0.010***	***0.10***	0.04	1.6	40	***20***	***20***	***20***
8/29/2007	210	42	1.30	***0.010***	0.44	0.07	1.8	20	***10***	***10***	***10***
4/16/2008	212	41	1.30	***0.010***	1.50	0.06	2.8	30	***10***	***10***	***10***
9/3/2008	217	41	2.50	***0.010***	0.48	0.03	3.0	10	***10***	***10***	***10***
5/19/2009	nt	36	1.60	***0.010***	0.40	0.11	2.0	***10***	10	***10***	***10***
8/28/2009	267	61	0.80	0.020	0.77	0.05	1.6	***10***	***10***	***10***	***10***
5/21/2010	179.0	33	3.00	nt	0.86	0.06	3.9	***10***	10	***10***	***10***
11/8/2011	153.0	30	0.70	***0.010***	0.34	***0.02***	1.1	30	***10***	***10***	***10***
6/19/2012	264.0	65.9	1.03	***0.010***	0.42	0.10	1.46	***10***	***10***	10	***10***
Minimum	50	4	0.70	***0.005***	0.10	***0.02***	1.1	***10***	***2***	***2***	***10***
Maximum	300	66	3.90	0.020	1.50	0.31	4.8	1200	400	700	500
Average	194	38	1.88	0.010	0.53	0.07	2.4	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

HN-5D	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/13/2000	195	21	3.30	***0.005***	1.30	***0.05***	4.6	nt	***2***	***2***	nt
4/25/2001	194	22	3.40	***0.005***	0.23	***0.05***	3.6	nt	***2***	***2***	nt
5/31/2002	220	28	6.90	***0.010***	0.24	***0.02***	7.2	nt	***10***	***10***	nt
8/23/2002	230	27	7.40	***0.010***	0.73	0.28	8.1	***10***	***10***	10	nt
5/7/2003	230	28	7.10	***0.010***	0.80	0.07	7.9	***10***	***10***	***10***	nt
9/9/2003	200	23	7.20	***0.010***	0.31	0.02	7.5	60	***20***	20	nt
6/10/2004	200	22	5.60	***0.010***	0.69	0.09	6.3	***10***	***10***	***10***	***10***
8/17/2004	210	21	6.10	***0.010***	0.36	0.06	6.5	***10***	***10***	***10***	***10***
5/10/2005	210	20	6.40	***0.010***	0.37	0.04	6.8	***10***	***10***	***10***	nt
9/14/2005	230	24	7.20	0.010	0.51	0.08	7.7	***20***	***20***	***20***	***20***
8/9/2006	230	22	7.70	0.010	0.16	0.05	7.9	***20***	***20***	***20***	***20***
5/8/2007	220	22	6.20	***0.010***	***0.10***	0.02	6.3	***20***	***20***	***20***	***20***
4/16/2008	197	22	3.40	***0.010***	***0.10***	***0.02***	3.5	***10***	***10***	***10***	***10***
9/3/2008	190	18	5.90	***0.010***	0.39	0.04	6.3	***10***	***10***	***10***	***10***
5/19/2009	nt	19	5.50	***0.010***	0.61	0.12	6.1	***10***	***10***	***10***	***10***
8/28/2009	199	21	6.40	***0.010***	0.19	0.04	6.6	10	***10***	***10***	***10***
5/21/2010	201	24	6.00	nt	0.98	0.06	7.0	***10***	***10***	***10***	***10***
11/8/2011	310	81	5.20	***0.010***	0.86	0.09	6.1	***10***	***10***	***10***	***10***
6/19/2012	254	42.2	5.55	***0.010***	0.65	0.05	6.2	***10***	***10***	***10***	***10***
Minimum	190	18	3.30	***0.005***	0.10	***0.02***	3.5	***10***	***2***	***2***	***10***
Maximum	310	81	7.70	0.010	1.30	0.28	8.1	60	20	20	***20***
Average	218	27	5.92	0.009	0.50	0.07	6.4	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

HN-5S	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/13/2000	177	17	3.30	***0.005***	1.50	***0.05***	4.8	nt	***2***	***2***	nt
4/25/2001	180	22	2.70	***0.005***	0.54	***0.05***	3.2	nt	***2***	***2***	nt
5/31/2002	170	12	7.70	***0.010***	0.58	0.02	8.3	nt	***10***	***10***	nt
8/23/2002	170	18	6.40	***0.010***	0.63	0.25	7.0	***10***	***10***	***10***	nt
5/7/2003	200	29	5.60	***0.010***	0.53	0.09	6.1	***10***	***10***	***10***	nt
9/9/2003	150	10	5.40	***0.010***	0.30	0.03	5.7	75	***20***	***20***	nt
6/10/2004	210	20	7.80	0.010	1.00	0.11	8.8	***10***	***10***	***10***	***10***
8/17/2004	200	16	6.90	0.010	0.29	0.06	7.2	***10***	***10***	***10***	***10***
5/10/2005	210	22	7.00	***0.010***	0.42	0.04	7.4	***10***	***10***	***10***	nt
9/14/2005	220	16	7.20	***0.010***	0.63	0.07	7.8	***20***	***20***	***20***	***20***
8/9/2006	180	13	5.30	***0.010***	1.50	0.02	6.8	***20***	***20***	20	***20***
5/8/2007	170	18	3.40	***0.010***	***0.10***	0.04	3.5	***20***	***20***	20	***20***
4/16/2008	180	19	3.80	***0.010***	0.79	***0.02***	4.6	***10***	***10***	***10***	***10***
9/3/2008	215	17	10.00	***0.010***	0.60	0.07	10.6	***10***	***10***	***10***	***10***
5/19/2009	nt	21	6.60	***0.010***	0.91	0.12	7.5	***10***	***10***	***10***	***10***
8/28/2009	191	17	6.40	***0.010***	0.23	0.08	6.6	***10***	***10***	***10***	***10***
5/21/2010	193	22	6.10	nt	0.99	0.06	7.0	***10***	***10***	***10***	***10***
11/8/2011	1100	270	22.00	***0.010***	2.30	0.09	24.3	20	***10***	***10***	***10***
6/19/2012	226	26.8	9.13	0.010	0.87	0.04	10.0	***10***	***10***	***10***	***10***
Minimum	150	10	2.70	***0.005***	0.10	0.02	3.2	***10***	***2***	***2***	***10***
Maximum	1100	270	22.00	0.010	2.30	0.25	24.3	75	20	20	***20***
Average	241	32	6.99	0.009	0.77	0.07	7.8	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

HN-6	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/12/2000	220	43	2.40	***0.005***	1.50	0.07	3.9	nt	***2***	***2***	nt
4/25/2001	180	33	0.40	0.005	0.46	***0.05***	0.9	nt	***2***	***2***	nt
5/31/2002	240	51	1.00	***0.010***	0.38	0.03	1.4	nt	***10***	***10***	nt
8/23/2002	190	31	2.40	***0.010***	0.82	0.26	3.2	***10***	***10***	***10***	nt
5/7/2003	190	39	1.70	***0.010***	0.38	0.08	2.1	100	***10***	***10***	nt
9/9/2003	190	38	1.50	***0.010***	0.36	0.03	1.9	***20***	***20***	***20***	nt
6/10/2004	200	35	2.10	***0.010***	0.73	0.10	2.8	***10***	***10***	***10***	***10***
8/17/2004	210	37	1.80	0.010	0.31	0.07	2.1	***10***	***10***	***10***	***10***
5/10/2005	220	36	1.90	***0.010***	0.34	0.03	2.3	***10***	***10***	***10***	nt
9/14/2005	200	30	2.40	0.020	3.50	0.46	5.9	***20***	***20***	***20***	***20***
8/10/2006	210	30	3.20	0.010	0.54	0.04	3.8	***20***	***20***	***20***	***20***
5/8/2007	180	25	2.10	0.010	***0.10***	0.03	2.2	***20***	***20***	***20***	***20***
4/18/2008	153	25	0.72	***0.010***	0.34	0.04	1.1	***10***	***10***	***10***	***10***
9/3/2008	204	31	3.60	***0.010***	1.00	***0.10***	4.6	***10***	***10***	***10***	***10***
5/19/2009	nt	38	2.20	***0.010***	0.45	0.09	2.7	***10***	***10***	***10***	***10***
8/28/2009	255	49	1.80	0.020	0.43	0.06	2.3	***10***	***10***	***10***	***10***
5/21/2010	189	31	2.50	nt	0.54	0.05	3.0	***10***	***10***	***10***	***10***
11/9/2011	244	55	1.20	***0.010***	0.34	0.04	1.6	***10***	***10***	***10***	***10***
6/19/2012	200	34.9	2.03	***0.010***	0.34	0.06	2.4	***10***	***10***	***10***	***10***
Minimum	153	25	0.40	***0.005***	0.10	0.03	0.9	***10***	***2***	***2***	***10***
Maximum	255	55	3.60	0.020	3.50	0.46	5.9	100	***20***	***20***	***20***
Average	204	36	1.94	0.011	0.68	0.09	2.6	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

SV-1	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
6/25/1998	125	26	2.90	0.015	0.42	0.14	3.3	10	20	0	nt
9/23/1998	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
10/1/1998	1770	43	3.20	0.005	0.23	***0.05***	3.4	***2***	***2***	***2***	nt
4/6/1999	198	33	4.00	***0.005***	***0.01***	***0.05***	4.0	0	***2***	***2***	nt
5/11/1999	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
10/19/1999	212	32	4.60	***0.005***	***0.01***	***0.05***	4.6	0	***2***	0	nt
6/21/2000	202	30	2.30	***0.005***	2.00	0.05	4.3	0	***2***	0	nt
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/13/2000	274	52	2.70	***0.005***	2.00	***0.05***	4.7	nt	***2***	***2***	nt
5/4/2001	180	27	0.95	***0.005***	1.30	***0.05***	2.3	nt	***4***	***4***	nt
9/26/2001	280	51	4.00	***0.010***	0.39	0.11	4.4	nt	***100***	***100***	nt
5/31/2002	200	31	5.50	***0.010***	0.88	0.06	6.4	nt	***10***	***10***	nt
8/22/2002	260	44	4.70	***0.010***	0.85	0.14	5.6	***10***	***10***	40	nt
5/7/2003	210	33	5.00	***0.010***	1.90	0.18	6.9	***10***	***10***	***10***	nt
9/10/2003	260	43	3.20	***0.010***	0.43	***0.05***	3.6	80	***20***	40	nt
6/10/2004	230	39	3.70	***0.010***	0.74	0.12	4.5	***10***	***10***	***10***	***10***
8/17/2004	270	45	3.40	0.010	0.43	0.03	3.8	***10***	***10***	***10***	nt
5/11/2005	210	31	3.30	***0.010***	1.20	0.14	4.5	***10***	***10***	***10***	nt
9/13/2005	280	48	3.80	***0.010***	1.90	0.74	5.7	***20***	***20***	100	***20***
8/10/2006	240	37	2.80	***0.010***	0.67	0.06	3.5	***20***	***20***	***20***	***20***
5/9/2007	160	22	2.10	***0.010***	1.20	0.08	3.3	***20***	***20***	***20***	***20***
8/29/2007	220	36	2.00	***0.010***	0.49	0.04	2.5	***10***	***10***	***10***	***10***
4/17/2008	210	41	2.10	***0.010***	0.92	0.04	3.0	***10***	***10***	***10***	***10***
9/3/2008	251	41	4.90	***0.010***	0.94	0.05	5.9	***10***	***10***	***10***	***10***
5/21/2009	nt	29	3.10	***0.010***	1.10	0.08	4.2	***10***	***10***	***10***	***10***
8/18/2009	229	42	3.30	0.020	0.74	0.05	4.1	***10***	***10***	***10***	***10***
5/24/2010	214	36	3.60	nt	0.56	0.02	4.1	***10***	***10***	***10***	***10***
11/9/2011	345	55	2.50	0.010	0.54	***0.04***	3.1	***10***	***10***	***10***	***10***
6/19/2012	210	35	2.88	***0.010***	0.62	***0.02***	3.5	***10***	***10***	***10***	***10***
Minimum	125	22	0.95	***0.005***	***0.01***	0.02	2.3	0	***2***	0	***10***
Maximum	1770	55	5.50	0.020	2.00	0.74	6.9	80	100	100	***20***
Average	290	38	3.33	0.009	0.86	0.10	4.2	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

SV-2	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
6/25/1998	596	117	0.06	0.041	5.90	4.50	6.0	***2***	***2***	***2***	nt
9/23/1998	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
10/1/1998	254	450	***0.01***	***0.005***	3.70	4.20	3.7	18	20	***2***	nt
4/6/1999	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
5/12/1999	994	160	***0.01***	0.017	4.50	4.00	4.5	0	***2***	***2***	nt
10/19/1999	3140	900	0.04	0.017	9.60	5.80	9.7	0	***2***	0	nt
6/21/2000	875	120	***0.01***	0.011	4.30	2.50	4.3	9	***2***	0	nt
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/13/2000	1970	460	0.01	0.019	10.00	5.50	10.0	nt	250	12	nt
5/4/2001	1300	220	0.01	0.045	7.50	4.40	7.6	nt	***4***	***4***	nt
9/26/2001	1200	190	0.18	***0.010***	7.80	4.20	8.0	nt	100	***100***	nt
5/31/2002	970	88	***0.01***	***0.010***	5.80	3.90	5.8	nt	***10***	160	nt
8/22/2002	1300	210	0.08	***0.010***	13.00	6.80	13.1	***10***	***10***	50	nt
5/7/2003	880	110	0.13	***0.010***	5.10	3.40	5.2	***10***	***10***	***10***	nt
9/9/2003	1000	180	***0.05***	***0.010***	7.80	4.90	7.9	***20***	***20***	***20***	nt
6/10/2004	1000	160	***0.05***	***0.010***	4.00	3.10	4.1	***10***	***10***	***10***	***10***
8/18/2004	1300	200	***0.05***	***0.010***	6.30	5.10	6.4	***10***	***10***	***10***	nt
5/11/2005	750	110	0.06	***0.010***	5.90	3.30	6.0	***10***	***10***	***10***	nt
9/13/2005	1100	130	***0.05***	***0.010***	9.40	7.20	9.5	***20***	***20***	20	***20***
8/10/2006	1700	330	***0.05***	***0.010***	7.60	5.10	7.7	***20***	***20***	***20***	***20***
5/8/2007	1100	220	***0.01***	0.090	4.10	2.90	4.2	20	***20***	***20***	***20***
8/29/2007	1200	200	0.03	0.012	8.90	6.90	8.9	***10***	***10***	***10***	***10***
4/16/2008	886	180	0.10	0.010	4.80	2.30	4.9	***10***	***10***	***10***	***10***
9/4/2008	1640	320	***0.01***	***0.010***	9.20	6.40	9.2	***10***	***10***	***10***	***10***
5/21/2009	nt	120	***0.01***	0.060	4.90	3.70	5.0	***10***	***10***	***10***	***10***
8/18/2009	1320	230	***0.01***	0.010	7.60	6.20	7.6	***10***	***10***	***10***	***10***
5/24/2010	783	110	***0.01***	nt	4.40	3.60	4.4	***10***	***10***	40	***10***
11/9/2011	1470	420	***0.01***	0.080	8.90	4.40	9.0	10	10	***10***	10
6/19/2012	1350	322	***0.01***	0.080	4.59	3.62	4.7	***10***	***10***	***10***	***10***
Minimum	254	88	***0.01***	***0.005***	3.70	2.30	3.7	0	***2***	0	***10***
Maximum	3140	900	0.18	0.090	13.00	7.20	13.1	20	250	160	***20***
Average	1203	241	0.04	0.024	6.75	4.54	6.8	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

SV-3	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/13/2000	164	17	2.40	0.005	1.30	***0.05***	3.7	nt	***2***	***2***	nt
5/4/2001	150	17	0.43	***0.050***	1.60	0.05	2.1	nt	***4***	***4***	nt
9/26/2001	200	22	4.60	***0.010***	1.40	0.23	6.0	nt	***100***	***100***	nt
5/31/2002	160	20	6.50	***0.010***	1.00	0.06	7.5	nt	***10***	30	nt
8/22/2002	260	22	2.70	***0.010***	12.00	1.60	14.7	***100***	***50***	***100***	nt
5/7/2003	150	18	4.40	***0.010***	0.67	0.11	5.1	***10***	***10***	***10***	nt
9/10/2003	150	14	2.80	***0.010***	0.39	0.06	3.2	120	***20***	***20***	nt
6/10/2004	170	16	5.80	***0.010***	0.62	0.15	6.4	***10***	***10***	***10***	***10***
Duplicate	170	15	5.60	***0.010***	0.68	0.14	6.3	***10***	***10***	***10***	***10***
8/17/2004	170	16	4.90	0.010	0.44	0.08	5.4	***10***	***10***	***10***	nt
5/12/2005	170	18	4.60	***0.010***	0.48	0.05	5.1	***10***	***10***	***10***	nt
9/13/2005	240	22	2.50	0.020	2.20	0.76	4.7	***20***	***20***	40	***20***
8/9/2006	140	13	2.80	0.010	0.84	0.06	3.7	***20***	***20***	***20***	***20***
5/8/2007	130	12	2.80	***0.010***	***0.10***	0.03	2.9	***20***	***20***	***20***	***20***
8/29/2007	190	50	2.10	0.890	1.50	0.11	4.5	***10***	***10***	***10***	***10***
4/16/2008	144	13	4.20	0.020	1.30	***0.10***	5.5	***10***	***10***	***10***	***10***
9/3/2008	213	22	7.80	0.140	1.10	0.04	9.0	***10***	***10***	***10***	***10***
5/21/2009	nt	17	5.00	***0.010***	0.80	0.06	5.8	***10***	***10***	***10***	***10***
8/18/2009	156	14	4.50	0.030	0.63	0.07	5.2	***10***	***10***	***10***	***10***
5/24/2010	151	16	3.70	nt	0.41	***0.02***	4.1	***10***	***10***	***10***	***10***
11/9/2011	159	15	5.50	***0.010***	0.82	0.04	6.3	***10***	***10***	***10***	***10***
6/19/2012	162	17	3.97	***0.010***	0.76	0.02	4.7	***10***	***10***	***10***	***10***
Minimum	130	12	0.43	***0.005***	0.10	***0.02***	2.1	***10***	***2***	***2***	***10***
Maximum	260	50	7.80	0.890	12.00	1.60	14.7	120	***100***	***100***	***20***
Average	171	18	4.07	0.062	1.41	0.18	5.5	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

SV-4	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/13/2000	478	52	***0.01***	***0.005***	12.00	9.80	12.0	nt	***2***	***2***	nt
5/4/2001	360	24	0.01	0.017	8.90	7.70	8.9	nt	***4***	***4***	nt
9/26/2001	320	46	0.18	***0.010***	11.00	10.00	11.2	nt	***100***	***100***	nt
5/31/2002	460	36	***0.01***	***0.010***	12.00	11.00	12.0	nt	***10***	450	nt
8/22/2002	460	38	0.08	***0.010***	1.70	1.20	1.8	***10***	***10***	>600	nt
5/7/2003	410	27	0.28	***0.010***	11.00	9.40	11.3	***10***	***10***	***10***	nt
9/10/2003	500	34	***0.05***	***0.010***	11.00	10.00	11.1	100	***20***	***20***	nt
6/10/2004	460	24	***0.05***	***0.010***	8.30	7.60	8.4	***10***	***10***	***10***	***10***
8/17/2004	500	28	***0.05***	***0.010***	8.30	7.80	8.4	***10***	***10***	***10***	***10***
5/11/2005	330	10	***0.05***	***0.010***	6.60	5.90	6.7	***10***	***10***	***10***	nt
9/13/2005	420	29	0.06	***0.010***	11.00	10.00	11.1	***20***	***20***	***20***	***20***
8/9/2006	370	19	0.06	***0.010***	8.20	7.30	8.3	***20***	***20***	***20***	***20***
5/8/2007	340	17	***0.01***	0.040	7.00	6.00	7.1	***20***	***20***	***20***	***20***
8/29/2007	380	28	***0.01***	0.050	7.40	6.70	7.5	***10***	***10***	***10***	***10***
4/16/2008	231	15	***0.03***	***0.010***	6.50	5.60	6.5	***10***	***10***	***10***	***10***
9/4/2008	323	19	***0.01***	0.060	5.60	5.60	5.7	***10***	***10***	***10***	***10***
5/21/2009	nt	13	***0.01***	0.040	6.20	5.70	6.3	***10***	***10***	***10***	***10***
8/18/2009	265	17	***0.01***	0.080	6.00	5.00	6.1	***10***	***10***	***10***	***10***
5/24/2010	264	10	***0.01***	nt	5.00	4.70	5.0	***10***	***10***	***10***	***10***
11/9/2011	287	17	***0.01***	0.060	5.50	5.10	5.6	***10***	***10***	***10***	***10***
6/19/2012	476	100	***0.01***	0.060	5.97	5.55	6.0	***10***	***10***	***10***	***10***
Minimum	231	10	***0.01***	***0.005***	1.70	1.20	1.8	***10***	***10***	***10***	***10***
Maximum	500	100	0.28	0.080	12.00	11.00	12.0	100	***100***	>600	***20***
Average	382	26	0.05	0.022	8.09	7.21	8.2	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

SV-6	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
9/8/2000	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
9/13/2000	688	160	***0.01***	***0.005***	2.80	0.70	2.8	nt	***2***	16	nt
5/4/2001	580	110	***0.01***	***0.005***	2.00	0.77	2.0	nt	***4***	4	nt
9/26/2001	510	110	0.22	***0.010***	1.20	0.67	1.4	nt	***100***	***100***	nt
5/31/2002	540	100	***0.01***	***0.010***	2.00	1.30	2.0	nt	***10***	70	nt
8/22/2002	510	94	0.08	***0.010***	6.00	1.60	6.1	***10***	***10***	>600	nt
5/7/2003	460	82	0.23	***0.010***	1.40	0.72	1.6	***10***	***10***	***10***	nt
9/9/2003	420	80	***0.05***	***0.010***	1.70	0.46	1.8	180	160	200	nt
6/10/2004	600	120	***0.05***	***0.010***	3.40	0.87	3.5	***10***	***10***	***10***	***10***
8/17/2004	460	80	***0.05***	***0.010***	1.40	0.54	1.5	200	1000	50	nt
5/11/2005	430	73	***0.05***	***0.010***	1.30	0.73	1.4	***10***	***10***	***10***	nt
9/13/2005	460	76	***0.05***	***0.010***	5.40	2.50	5.5	20	***20***	300	***20***
8/10/2006	490	86	***0.05***	***0.010***	3.90	0.71	4.0	***20***	***20***	20	***20***
5/9/2007	360	56	0.01	***0.010***	0.73	0.23	0.8	20	***20***	***20***	***20***
8/29/2007	370	63	***0.01***	***0.010***	1.00	0.34	1.0	60	50	***10***	60
4/17/2008	311	46	***0.01***	***0.010***	2.00	1.00	2.0	***10***	***10***	***10***	***10***
9/4/2008	361	57	***0.01***	***0.010***	2.20	***0.40***	2.2	40	***10***	10	***10***
5/21/2009	nt	55	***0.01***	***0.010***	1.70	0.92	1.7	300	40	20	300
8/18/2009	398	65	***0.01***	***0.010***	2.00	0.91	2.0	***10***	10	***10***	***10***
5/24/2010	356	59	***0.01***	nt	***0.50***	***0.10***	***0.5***	120	***10***	***10***	***10***
11/9/2011	350	63	***0.01***	***0.010***	0.61	0.19	0.6	50	***10***	***10***	***10***
6/19/2012	405	54	***0.05***	***0.05***	0.90	0.31	1.0	***10***	***10***	***10***	***10***
Minimum	311	46	***0.01***	***0.005***	0.50	0.10	0.5	***10***	***10***	***10***	***10***
Maximum	688	160	0.23	0.010	6.00	2.50	6.1	300	1000	>600	***20***
Average	453	80	0.05	0.012	2.10	0.76	2.2	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

OC-1	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
5/7/2003	280	20	0.45	***0.010***	9.40	8.40	9.9	***10***	***10***	***10***	nt
9/10/2003	360	34	***0.05***	***0.010***	8.40	7.60	8.5	80	***20***	***20***	nt
6/16/2004	260	19	***0.05***	***0.010***	6.10	5.60	6.2	***10***	***10***	***10***	nt
8/17/2004	370	29	0.20	***0.010***	7.90	7.20	8.1	210	***10***	***10***	nt
5/12/2005	240	17	0.12	***0.010***	6.00	5.10	6.1	***10***	***10***	***10***	nt
9/14/2005	310	25	0.09	***0.010***	2.60	2.20	2.7	***20***	***20***	***20***	***20***
8/15/2006	290	18	***0.05***	***0.010***	5.70	5.30	5.8	100	***20***	***20***	***20***
5/9/2007	270	23	0.02	***0.010***	6.10	6.00	6.1	***20***	***20***	***20***	***20***
4/17/2008	307	25	***0.01***	***0.010***	6.80	6.10	6.8	***10***	***10***	***10***	***10***
9/4/2008	238	17	***0.01***	***0.010***	6.20	4.10	6.2	***10***	***10***	***10***	***10***
5/21/2009	nt	16	***0.01***	***0.010***	3.90	3.60	3.9	***10***	***10***	***10***	***10***
8/19/2009	241	15	***0.01***	***0.010***	5.50	4.30	5.5	***10***	***10***	***10***	***10***
5/24/2010	198	12	***0.01***	nt	5.80	5.50	5.8	***10***	***10***	***10***	***10***
11/9/2011	433	21	***0.01***	***0.010***	10.00	9.20	10.0	***10***	***10***	***10***	***10***
6/20/2012	303	24.1	***0.01***	***0.010***	7.24	6.68	7.3	***10***	***10***	***10***	***10***
Minimum	198	12	***0.01***	***0.010***	2.60	2.20	2.7	***20***	***10***	***10***	***20***
Maximum	433	34	0.45	0.010	10.00	9.20	10.0	210	***20***	***20***	***20***
Average	293	21	0.07	0.010	6.51	5.79	6.6	na	na	na	na

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TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

OC-2	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
5/7/2003	230	25	5.40	0.370	30.00	5.10	35.8	***10***	***10***	***10***	nt
9/18/2003	230	23	5.10	***0.010***	2.10	1.40	7.2	***20***	***20***	20	nt
6/16/2004	220	24	5.60	0.010	1.30	1.10	6.9	***10***	***10***	***10***	nt
8/17/2004	230	23	5.00	0.050	1.60	1.00	6.7	***10***	***10***	***10***	nt
5/12/2005	230	24	5.90	***0.010***	2.30	1.10	8.2	***10***	10	***10***	nt
9/14/2005	210	22	2.00	0.020	2.90	1.10	4.9	20	20	***20***	20
8/15/2006	210	23	5.90	0.010	1.70	1.10	7.6	180	***20***	20	***20***
5/9/2007	220	28	5.30	0.100	0.72	0.68	6.1	***20***	***20***	***20***	***20***
4/17/2008	215	23	3.00	0.020	1.20	0.70	4.2	***10***	***10***	***10***	***10***
9/4/2008	218	22	6.60	0.030	2.00	0.82	8.6	***10***	***10***	***10***	***10***
5/21/2009	nt	22	6.10	0.020	1.50	0.80	7.6	***10***	***10***	***10***	***10***
8/19/2009	221	34	6.20	0.050	0.88	0.73	7.1	10	10	10	***10***
5/24/2010	221	26	6.50	nt	1.30	0.53	6.5	>1000	240	***10***	200
11/9/2011	214	24	6.90	0.010	1.40	0.63	8.3	***10***	***10***	***10***	***10***
6/20/2012	217	25.5	6.14	***0.010***	1.05	0.55	7.2	***10***	***10***	***10***	***10***
Minimum	210	22	2.00	***0.010***	0.72	0.53	4.2	***10***	***10***	***10***	***20***
Maximum	230	34	6.90	0.370	30.00	5.10	35.8	>1000	240	20	200
Average	220	25	5.44	0.051	3.46	1.16	8.9	na	na	na	na

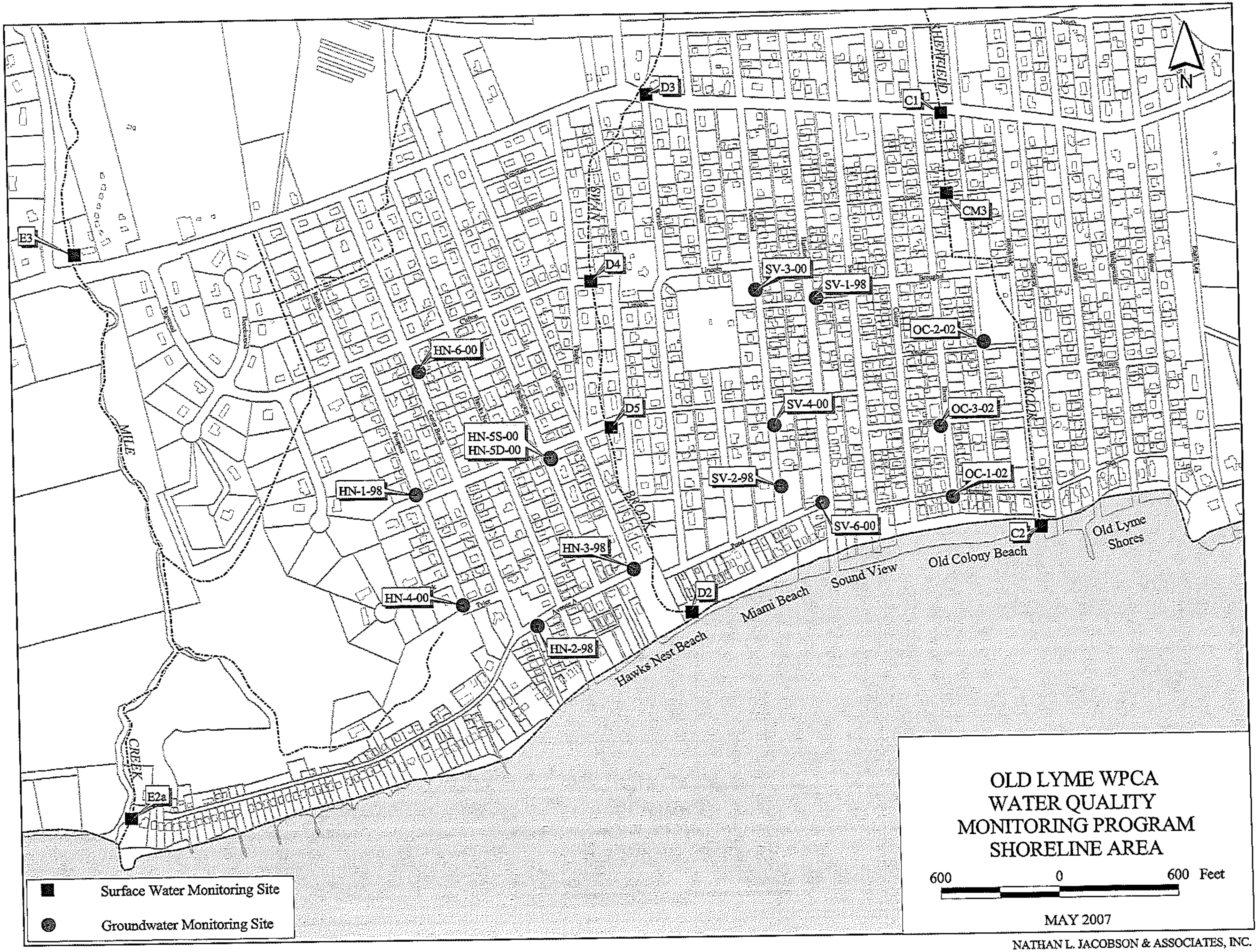
Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.

TOWN OF OLD LYME
WATER POLLUTION CONTROL AUTHORITY

GROUNDWATER QUALITY DATA

OC-3	Spec Cond. umhos/cm	Chloride mg/l	Nitrate mg/l	Nitrite mg/l	TKN mg/l	Ammonia mg/l	Total Nitrogen mg/l	Tl Coli. Bact #/100 ml	Fecal Coli #/100 ml	Fecal Strepto. #/100 ml	Escheri. Coli #/100 ml
5/7/2003	110	6	0.39	***0.010***	0.65	0.30	1.1	***10***	***10***	***10***	nt
9/10/2003	170	5	0.05	***0.010***	0.75	0.32	0.8	120	***20***	***20***	nt
6/16/2004	170	5	0.08	***0.010***	1.60	0.26	1.7	10	***10***	***10***	nt
8/17/2004	300	7	0.80	0.040	0.69	0.24	1.5	1200	>600	570	nt
5/12/2005	130	4	0.34	***0.010***	0.57	0.14	0.9	40	***10***	20	nt
9/14/2005	180	9	0.71	***0.010***	3.70	0.59	4.4	160	340	80	160
8/15/2006	170	10	1.50	***0.020***	0.25	0.19	1.8	240	***20***	***20***	***20***
5/9/2007	130	10	0.24	***0.010***	0.21	0.21	0.5	280	***20***	***20***	***20***
4/17/2008	117	8	0.16	0.010	0.99	0.14	1.2	80	***10***	***10***	***10***
9/4/2008	191	7	***0.01***	***0.010***	0.76	0.18	0.8	380	***10***	40	***10***
5/21/2009	nt	5	0.67	***0.010***	1.30	0.16	2.0	***10***	30	40	***10***
8/19/2009	185	15	0.82	***0.010***	0.32	0.20	1.2	40	60	50	40
5/24/2010	133	5.5	1.20	nt	0.45	0.06	0.5	>1000	180	60	160
11/9/2011	352	88.0	0.27	***0.010***	1.40	0.08	1.7	90	***10***	***10***	***10***
6/20/2012	174	14.3	0.21	***0.010***	0.85	0.15	1.1	250	320	30	130
Minimum	110	4	0.01	***0.010***	0.21	0.06	0.5	10	***10***	***10***	***20***
Maximum	352	88	1.50	0.040	3.70	0.59	4.4	1200	>600	570	160
Average	179	13	0.50	0.013	0.97	0.21	1.4	na	na	na	na

Bold/Italic Represents minimum detection limit for that parameter. The testing laboratory reported the value as being less than minimum detection limit (mdl). The mdl is reported to allow for computation of averages. The actual average value is less than computed and is shown as bold/italic.



OLD LYME WPCA WATER QUALITY MONITORING PROGRAM SHORELINE AREA

NATHAN L. JACOBSON & ASSOCIATES, INC.

APPENDIX E: MARINE BACTERIAL COUNT DATA

ACH NAME	DATE	CRITERIA/TEST	COL/100 ML
White Sands (Marine Water)	5/22/2014	Enterococci	24
White Sands (Marine Water)	5/28/2014	Enterococci	4
White Sands (Marine Water)	6/2/2014	Enterococci	4
White Sands (Marine Water)	6/10/2014	Enterococci	14
White Sands (Marine Water)	6/18/2014	Enterococci	0
White Sands (Marine Water)	6/24/2014	Enterococci	0
White Sands (Marine Water)	7/1/2014	Enterococci	0
White Sands (Marine Water)	7/9/2014	Enterococci	44
White Sands (Marine Water)	7/15/2014	Enterococci	40
White Sands (Marine Water)	7/21/2014	Enterococci	0
White Sands (Marine Water)	7/30/2014	Enterococci	0
White Sands (Marine Water)	8/5/2014	Enterococci	0
White Sands (Marine Water)	8/12/2014	Enterococci	0
White Sands (Marine Water)	8/18/2014	Enterococci	0
White Sands (Marine Water)	8/26/2014	Enterococci	6
White Sands (Marine Water)	9/3/2014	Enterococci	0
White Sands (Marine Water)	9/9/2014	Enterococci	0
White Sands (Marine Water)	9/17/2014	Enterococci	6
Hawk's Nest (Marine Water)	5/22/2014	Enterococci	12
Hawk's Nest (Marine Water)	5/28/2014	Enterococci	4
Hawk's Nest (Marine Water)	6/2/2014	Enterococci	6
Hawk's Nest (Marine Water)	6/10/2014	Enterococci	24
Hawk's Nest (Marine Water)	6/18/2014	Enterococci	2
Hawk's Nest (Marine Water)	6/24/2014	Enterococci	0
Hawk's Nest (Marine Water)	7/1/2014	Enterococci	4
Hawk's Nest (Marine Water)	7/9/2014	Enterococci	32
Hawk's Nest (Marine Water)	7/15/2014	Enterococci	16
Hawk's Nest (Marine Water)	7/21/2014	Enterococci	4
Hawk's Nest (Marine Water)	7/30/2014	Enterococci	0
Hawk's Nest (Marine Water)	8/5/2014	Enterococci	72
Hawk's Nest (Marine Water)	8/12/2014	Enterococci	0
Hawk's Nest (Marine Water)	8/18/2014	Enterococci	12
Hawk's Nest (Marine Water)	8/26/2014	Enterococci	4
Hawk's Nest (Marine Water)	9/3/2014	Enterococci	40
Hawk's Nest (Marine Water)	9/9/2014	Enterococci	46
Hawk's Nest (Marine Water)	9/17/2014	Enterococci	8

Sound View (Marine Water)	5/22/2014	Enterococci	16
Sound View (Marine Water)	5/28/2014	Enterococci	12
Sound View (Marine Water)	6/2/2014	Enterococci	2
Sound View (Marine Water)	6/10/2014	Enterococci	24
Sound View (Marine Water)	6/18/2014	Enterococci	6
Sound View (Marine Water)	6/24/2014	Enterococci	2
Sound View (Marine Water)	7/1/2014	Enterococci	4
Sound View (Marine Water)	7/9/2014	Enterococci	20
Sound View (Marine Water)	7/15/2014	Enterococci	60
Sound View (Marine Water)	7/21/2014	Enterococci	0
Sound View (Marine Water)	7/30/2014	Enterococci	8
Sound View (Marine Water)	8/5/2014	Enterococci	8
Sound View (Marine Water)	8/12/2014	Enterococci	4
Sound View (Marine Water)	8/18/2014	Enterococci	0
Sound View (Marine Water)	8/26/2014	Enterococci	4
Sound View (Marine Water)	9/3/2014	Enterococci	0
Sound View (Marine Water)	9/9/2014	Enterococci	10
Sound View (Marine Water)	9/17/2014	Enterococci	0
Point O' Woods	5/22/2014	Enterococci	2
Point O' Woods	5/28/2014	Enterococci	2
Point O' Woods	6/2/2014	Enterococci	4
Point O' Woods	6/10/2014	Enterococci	2
Point O' Woods	6/18/2014	Enterococci	2
Point O' Woods	6/24/2014	Enterococci	18
Point O' Woods	7/1/2014	Enterococci	4
Point O' Woods	7/9/2014	Enterococci	24
Point O' Woods	7/15/2014	Enterococci	88
Point O' Woods	7/21/2014	Enterococci	16
Point O' Woods	7/30/2014	Enterococci	88
Point O' Woods	8/5/2014	Enterococci	12
Point O' Woods	8/12/2014	Enterococci	100
Point O' Woods	8/18/2014	Enterococci	0
Point O' Woods	8/26/2014	Enterococci	96
Point O' Woods	9/3/2014	Enterococci	24
Point O' Woods	9/9/2014	Enterococci	4
Point O' Woods	9/17/2014	Enterococci	0
Miami Beach (Marine Water)	5/22/2014	Enterococci	0
Miami Beach (Marine Water)	5/28/2014	Enterococci	18

Miami Beach (Marine Water)	6/2/2014	Enterococci	2
mi Beach (Marine Water)	6/10/2014	Enterococci	40
Miami Beach (Marine Water)	6/24/2014	Enterococci	2
Miami Beach (Marine Water)	6/18/2014	Enterococci	16
Miami Beach (Marine Water)	7/1/2014	Enterococci	88
Miami Beach (Marine Water)	7/9/2014	Enterococci	36
Miami Beach (Marine Water)	7/15/2014	Enterococci	16
Miami Beach (Marine Water)	7/21/2014	Enterococci	8
Miami Beach (Marine Water)	7/30/2014	Enterococci	4
Miami Beach (Marine Water)	8/5/2014	Enterococci	100
Miami Beach (Marine Water)	8/12/2014	Enterococci	0
Miami Beach (Marine Water)	8/18/2014	Enterococci	0
Miami Beach (Marine Water)	8/26/2014	Enterococci	0
Miami Beach (Marine Water)	9/3/2014	Enterococci	0
Miami Beach (Marine Water)	9/9/2014	Enterococci	2
Miami Beach (Marine Water)	9/17/2014	Enterococci	4
Old Colony (Marine Water)	5/22/2014	Enterococci	22
Old Colony (Marine Water)	5/28/2014	Enterococci	6
Old Colony (Marine Water)	6/2/2014	Enterococci	2
Colony (Marine Water)	6/10/2014	Enterococci	34
Old Colony (Marine Water)	6/18/2014	Enterococci	6
Old Colony (Marine Water)	6/24/2014	Enterococci	8
Old Colony (Marine Water)	7/1/2014	Enterococci	4
Old Colony (Marine Water)	7/9/2014	Enterococci	32
Old Colony (Marine Water)	7/15/2014	Enterococci	16
Old Colony (Marine Water)	7/21/2014	Enterococci	0
Old Colony (Marine Water)	7/30/2014	Enterococci	0
Old Colony (Marine Water)	8/5/2014	Enterococci	8
Old Colony (Marine Water)	8/12/2014	Enterococci	4
Old Colony (Marine Water)	8/18/2014	Enterococci	0
Old Colony (Marine Water)	8/26/2014	Enterococci	0
Old Colony (Marine Water)	9/3/2014	Enterococci	2
Old Colony (Marine Water)	9/9/2014	Enterococci	2
Old Colony (Marine Water)	9/17/2014	Enterococci	0
Old Lyme Shores (Marine Water)	5/22/2014	Enterococci	22
Old Lyme Shores (Marine Water)	5/28/2014	Enterococci	24
Old Lyme Shores (Marine Water)	6/2/2014	Enterococci	6
Lyme Shores (Marine Water)	6/10/2014	Enterococci	16

Old Lyme Shores (Marine Water)	6/18/2014	Enterococci	2
Old Lyme Shores (Marine Water)	6/24/2014	Enterococci	0
Old Lyme Shores (Marine Water)	7/1/2014	Enterococci	0
Old Lyme Shores (Marine Water)	7/9/2014	Enterococci	8
Old Lyme Shores (Marine Water)	7/15/2014	Enterococci	0
Old Lyme Shores (Marine Water)	7/21/2014	Enterococci	8
Old Lyme Shores (Marine Water)	7/30/2014	Enterococci	80
Old Lyme Shores (Marine Water)	8/5/2014	Enterococci	8
Old Lyme Shores (Marine Water)	8/12/2014	Enterococci	0
Old Lyme Shores (Marine Water)	8/18/2014	Enterococci	4
Old Lyme Shores (Marine Water)	8/26/2014	Enterococci	2
Old Lyme Shores (Marine Water)	9/3/2014	Enterococci	4
Old Lyme Shores (Marine Water)	9/9/2014	Enterococci	6
Old Lyme Shores (Marine Water)	9/17/2014	Enterococci	0

MARINE WATER COMMENTS:

A concentration of enterococcal organisms less than or equal to 104 per 100ml is generally considered satisfactory for a single sample from a bathing area. .

A single sample with a concentration of enterococcal organisms greater than 104 per 100 ml is in excess of that which is considered acceptable for bathing.
(Reference CT Dept. of Health Services Guidelines)

APPENDIX F: CEPA SCOPING NOTICE & COMMENT DOCUMENTS


Susan D. Merrow
Chair

Environmental Monitor
Meeting Information
- Schedule
- Agenda
- Minutes
- Participation

Internships

Scoping Notice

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Scoping Notice

Project Title: Old Lyme Coastal Wastewater Management Plan

Municipality where proposed project might be located: Old Lyme

Addresses of Possible Project Locations: Shoreline communities located south of and along Route 156 between White Sand Beach Association and Old Lyme Shores Beach Association, and the Route 156 corridor to East Lyme

Project Description: The Town of Old Lyme, and Old Lyme Shores, Old Colony Beach and Miami Beach Associations have conducted independent engineering studies showing that the prevalent conditions in the project area such as the age and location of existing onsite wastewater treatment systems, high density of development, lack of adequate space and overall challenging subsurface conditions, such as shallow groundwater, have rendered the onsite wastewater treatment systems economically and technically unfeasible for long term wastewater renovation. For this reason, the Town of Old Lyme is joining efforts with three chartered beach associations (Miami Beach, Old Colony Beach and Old Lyme Shores) to implement a holistic and long term solution that addresses identified wastewater management concerns within the boundaries of the described shoreline area.

The proposed solution would incorporate the installation of sanitary sewers within the following beach communities: White Sand Beach Association, Hawks Nest, Miami Beach Association, Sound View, Old Colony Beach Association and Old Lyme Shores Beach Association. It would also incorporate the installation of pump station(s) and transmission line to collect wastewater from the mentioned communities and transport it eastward along Route 156 to the town of East Lyme where it would be discharged into existing regional conveyance infrastructure for final treatment at the Piacenti Wastewater Treatment Facility in the City of New London. Once all connections into the proposed sanitary sewer system are completed, it is estimated that 1,350 existing dwelling units will be served by the proposed infrastructure generating approximately 300,000 gallons of wastewater on an average daily basis.

Project Maps: Click here to view the areas to be sewered.
Click here to view the sewer route in Old Lyme.
Click here to view the existing conveyance system.

Written comments from the public are welcomed and will be accepted until the close of business on *August 22, 2014*.

Any person can ask the sponsoring agency to hold a Public Scoping Meeting by sending such a request to the address below. If a meeting is requested by 25 or more individuals, or by an association that represents 25 or more members, the sponsoring agency shall schedule a Public Scoping Meeting. Such requests must be made by *August 1, 2014*.

Written comments and/or requests for a Public Scoping Meeting should be sent to:

Name: Carlos Esguerra
Agency: Department of Energy & Environmental Protection
Bureau of Water Protection & Land Reuse
Address: 79 Elm Street
Hartford, CT 06106-5127
Phone: 860-424-3756
Fax: 860-424-4067
E-Mail: carlos.esguerra@ct.gov

If you have questions about the public meeting, or other questions about the scoping for this project, contact Mr. Esguerra, as directed above.

The Connecticut Department of Energy and Environmental Protection is an Affirmative Action/Equal Opportunity Employer that is committed to complying with the requirements of the Americans with Disabilities Act. Any person with a disability who may need a communication aid or service may contact the agency's ADA Coordinator at 860-424-3194 or at deep.hrmed@ct.gov. Any person with limited proficiency in English, who may need information in another language, may contact the agency's Title VI Coordinator at 860-424-3035 or at deep.aaoffice@ct.gov. ADA or Title VI discrimination complaints may be filed with DEEP's EEO Manager at (860) 424-3035 or at deep.aaoffice@ct.gov.

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79 Elm Street Hartford, CT 06106 / Phone: 860-424-4000

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From: Esguerra, Carlos <Carlos.Esguerra@ct.gov>
Sent: Wednesday, August 27, 2014 8:10 AM
To: Dave Prickett; 'Kurt A. Mailman'
Cc: 'Jim Zanavich'; 'Kurt J Zemba RMB (kjzrmb@msn.com)'; 'FRANK NOE (fnoe@freedomchoice.com)'; 'breemsnyder@oldlyme-ct.gov'; 'Paul J Rowean'; 'Douglas Whalen'; 'Scott Boulanger'; 'Gary@dditech.com'
Subject: CEPA comments
Attachments: David Potts.pdf; DPH.pdf; Old Lyme Coastal Wastewater Management Plan; FW: Projects Being Reviewed; OPM.pdf

Good morning everyone,

Attached are three comment letters and two internal DEEP emails that were received as a result of the initial CEPA scoping notice. Responses addressing these comments need to be incorporated in the planning report and final CEPA document.
Dave, I will coordinate with you and Kurt Mailman on the responses and updates to the report.

Thank you,

Carlos
CTDEEP
Municipal Facilities Section
860-424-3756
carlos.esguerra@ct.gov

From: Esguerra, Carlos
Sent: Tuesday, August 19, 2014 1:40 PM
To: 'Dave Prickett'; 'Kurt A. Mailman'
Cc: 'Jim Zanavich'; 'Kurt J Zemba RMB (kjzrmb@msn.com)'; 'FRANK NOE (fnoe@freedomchoice.com)'; 'breemsnyder@oldlyme-ct.gov'; 'Paul J Rowean'; 'Douglas Whalen'; 'Scott Boulanger'; 'Gary@dditech.com'
Subject: David Potts comment letter

Good afternoon, Dave and Kurt,

The attached comment letter was received from Mr. David Potts on the proposed sewer extension project. I am forwarding this letter to you so that his comments can be documented and addressed in Town's report and associated CEPA documentation. Since DEEP is utilizing the town's scoping notice process to suffice MBA's CEPA requirements, Mr. Potts' comments will also pertain to the MBA study. Please review attached letter and I will be in touch regarding a coordinated response.

Thank you,

Carlos
CTDEEP
860-424-3756

Dave Prickett

From: Thomas, Eric <Eric.Thomas@ct.gov>
Sent: Wednesday, August 20, 2014 7:51 AM
To: Esguerra, Carlos
Subject: Old Lyme Coastal Wastewater Management Plan

Hi Carlos,

Upon reviewing the maps posted on the CEQ Environmental Monitor website, is that a new pump station proposed for the Niantic pump station location?

I am reviewing for the addition of a potential source of nutrients and pathogens in close proximity to the Niantic River, which is chronically assessed as impaired for Aquatic Life and for Recreation use. I would like to see what measures are to be included in the planning and post-construction O&M phases to monitor, detect and correct leaks through this pump station and transmission line crossing the Niantic River. Who would be responsible for the Niantic portion of this regional system?

I have a Niantic River Watershed Committee board meeting coming up and plan to share this information with the local committee (and town staff/commission representatives).

http://www.ct.gov/ceq/lib/ceq/RegionalSewer.pdf

Eric

Eric D. Thomas
Watershed Manager
Watershed and Nonpoint Source Management Program
Planning and Standards Division
Water Protection and Land Reuse
Connecticut Department of Energy and Environmental Protection
79 Elm Street, Hartford, CT 06106-5127
P: 860.424.3548 | F: 860.424.4055 | E: Eric.Thomas@ct.gov

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Ensuring a clean, affordable, reliable, and sustainable energy supply.

From: Esguerra, Carlos <Carlos.Esguerra@ct.gov>
Sent: Wednesday, August 20, 2014 10:51 AM
To: Greci, Dennis
Subject: FW: Projects Being Reviewed

Importance: Low

fyi

From: Balint, Marcy
Sent: Wednesday, August 20, 2014 10:11 AM
To: Fox, David
Cc: Esguerra, Carlos
Subject: RE: Projects Being Reviewed
Importance: Low

Hi, Dave,

Some general OLISP comments on OL project. Carlos E has been doing a great job keeping me up to date on OL Sewer project over time. I was not able to access the link and am now leaving on a long vacation so won't be able to respond by this Friday. (I return Sept 15th). OLISP is supportive of this project as a means to treat long-standing water quality issues consistent with our CCMA policies to reduce adverse impacts to WQ

In terms of sewers and the CCMA notes " To disapprove extension of sewer and water services into developed and undeveloped beaches, barrier beaches and tidal wetlands except that, when necessary to abate existing sources of pollution, sewers that will accommodate existing uses with limited exces capacity may be used" (CGS Sec. 22a-92(b)(1)(B)).

Consistent with the above, Carlos and I have spoken about carefully implementing a growth management policy whereby lots that were not formerly approvable for septic would continue to not be eligible for sewer tie in, (or similar). Carlos understands this more and Dennis G first alerted to me this tool they have. Implementiing this policy will be very important in this process. Perhaps Carlos can give you more information on this as required for your comprehensive review. In other words, CCMA is not looking to increase overall and sudden building in Coastal resource sensitive areas which are often flood prone as well. This seems especially important now in age of increased climate change threats and increased storm events. See www.ctclimatechange.com for more information regarding this.

.As an aside, we understand the town's concerns(over many years) regarding the need for growth management. One observation is that given the generally small lots in these beach areas, and existing zoning requirements, the town may wish to tighten their zoning to disallow significant housing expansions, which would help significantly to address their issues. I am not aware of them getting this zoning help but perhaps they are already thinking of this by now. I am available to brainstorm with the town or others as need be.

Hope this is useful.
Marcy Balint

From: Fox, David
Sent: Wednesday, August 20, 2014 9:35 AM
To: Aarrestad, Peter; Applefield, Dean; Babbidge, Tracy; Balint, Marcy; Barrett, Kevin; Bell, Robert E. (DEEP); Blais, Melissa; Blatt, David; Bolton, Yvonne; Bowe, Patrick; Brothers, Elizabeth; Caiola, Jeff; Chase, Cheryl; Christian, Art; Cimochowski, John; Colon, Carmen; Creighton, James; Czapla, Kim; Czeczotka, Jan; Dawley, Scott; DeCaprio, Mark; Decker, Melinda; DeRosa, Pat; Deshais, Janice; Dickson, Jenny; Duva, Diane; Emmerthal, Douglas; Farrell, Paul;

Firsick, Michael; Fitting, Corinne; Francis, Peter; Frigon, Gabrielle; Gaucher, John; Gephard, Steve; Giannotti, Laurie; Gilbert, Jacques; Gilmore, Robert; Girard, Robert; Gobin, Anne; Golembiewski, Brian; Gordon, Dahlia; Greci, Dennis; Hannon, Robert; Hart, Michael; Hudak, Kim; Hust, Robert; Hyatt, William; Inglese, Oswald; Isner, Robert; Jacobson, Rick; Johnson, Mark; Kaliszewski, Bob; Kallenberg, Kristal; Klee, Robert; Kozak, David; Lacas, Christine; LaFrance, Robert; Latham, Mark; Lee, Charles; Levere, Alan; Lugli, Nicole; Malik, Christopher; Mariani, Eleanor; Martin, Christopher; Mauger, Art; McCleary, Macky; McKay, Dawn; Monroe, Albert; Morgillo, Mary; Murphy, Brian; Murray, Nancy; Mysling, Donald; Whalen, Susan; Nosal, Thomas; Patel, Nisha; Pestana, Edith; Peterson, Susan; Pierce, Ellen; Pirolli, Ric; Ploch, Peter; Ringquist, David; RisCassi, Thomas; Robinson, Bradford; Robinson, Robert; Rose, Gary; Ruzicka, Denise; Saliby, Lori; Sarabia, Edward; Schain, Dennis; Schiavone, Joseph; Schnoor, Terri; Sherwin, Mary; Simpson, David; Stevens, Graham; Stratton, Jessie; Szymanski, Carol; Talbot, Tammy; Thomas, Eric; Thompson, Brian; Trella, Kim; Tyler, Tom; Warzecha, William; Williams, Neal; Wingfield, Betsey; Winther, Darcy; Zack, Peter
Subject: Projects Being Reviewed

See attached

David J. Fox
Senior Environmental Analyst
Office of Environmental Review
Connecticut Department of Energy and Environmental Protection
79 Elm Street, Hartford, CT 06106-5127
P: 860.424.4111 | E: david.fox@ct.gov

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STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH

Jewel Mullen, M.D., M.P.H., M.P.A.
Commissioner

Dannel P. Malloy
Governor
Nancy Wyman
Lt. Governor

August 22, 2014

Carlos Esguerra
Bureau of Water Protection & Land Reuse
Department of Energy & Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

Re: Old Lyme Coastal Wastewater Management Plan

Dear Mr. Esguerra:

The Department of Public Health DPH) has reviewed the Notice of Scoping for the Old Lyme Coastal Waste Water Management Plan. The Town of Old Lyme is collaborating with three chartered beach associations (Miami Beach, Old Colony Beach and Old Lyme Shores) to implement a comprehensive, long term solution that addresses identified wastewater management concerns within the boundaries of the described shoreline area. The proposed solution would incorporate the installation of sanitary sewers within the following beach communities: White Sand Beach Association, Hawks Nest, Miami Beach Association, Sound View, Old Colony Beach Association and Old Lyme Shores Beach Association. It would also incorporate the installation of pump station(s) and transmission line to collect wastewater from the mentioned communities and transport it eastward along Route 156 to the town of East Lyme where it would be discharged into existing regional conveyance infrastructure for final treatment at the Piacenti Wastewater Treatment Facility in the City of New London.

It is not clear from the proposed solution whether the provision of sewers to the existing development is also intended to allow for induced growth of the residential and commercial uses within the project area. The majority of the buildings in the six beach communities that will benefit from public sewers are primarily seasonal cottages on small lots that cannot support code complying septic systems. Since the 1970s 19-13-B100 & B100a of the Regulations of CT State Agencies has prevented the cottages from being converted to year round. The regulations governing intensification of use activities in areas relying on septic systems ensures development does not expand beyond the capacity of the land to renovate and dispose of wastewater. The regulations often have significant impact in shoreline and lake area developments where there is significant development pressure; the regulations often serve as growth management.

The Old Lyme beach communities are located in environmentally sensitive areas that also face resiliency challenges associated with climate change. Recent revisions to the clean water state revolving fund statutes cite climate change in project funding considerations. It is recommended that induced growth controls be considered for state financing of this project so that it is clear that sewers are being introduced to provide a long term means of wastewater disposal for the beach communities, rather than a subsidization of a project for the benefit of property owners seeking to expand the use of their properties that are located in this sensitive shoreline area. The State of CT's Conservation and Development Plan includes policies about sewering of areas to address health and safety concerns, and it notes such projects should be done at a scale that responds to existing needs to prevent more

Connecticut Department of Public Health

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extensive development. The Environmental Health Section is available to further discuss induced control measures, and sewer need assessments.

As the public sewer project moves ahead, all existing sewage disposal systems (septic systems, cesspools, holding tanks) must be located prior to commencement of construction. The Old Lyme Health Department maintains sewage disposal system records, including as-built record drawings that locate sewage systems relative to fixed reference points. Sewage system areas should be identified in the field, and care must be taken to ensure the systems aren't damaged by construction equipment/work since the systems will need to remain functional until the sewer system is operational.

Existing sewage disposal systems must also be formally abandoned once public sewers are operational. Sewage system abandonment must be completed in accordance with the provisions of Section II D of the Department's *Technical Standards for Subsurface Sewage Disposal Systems*. Abandonment of the sewage disposal systems must be approved by the Old Lyme Health Department, and abandonment records must be kept on file in accordance with the record keeping provisions of the Public Health Code.

Pursuant to Section 19-13-B51d of the Regulations of Connecticut State Agencies, the location of all wells in the area where sewers are to be installed need to be located to meet adequate separation distances between the wells and the lateral sewer connections to houses and sewer pipes/manholes in the roads. The Department is aware that many of the houses in the area to be served by sewers are supplied by the Connecticut Water Company; however there may be houses that retained their private wells for irrigation use. In situations when the minimal separation distance between future connections to sewer piping and any existing irrigation wells cannot be met, the well should be abandoned in accordance with the well abandonment procedures outlined in the Connecticut Well Drilling Code. Under the authority of Section 19a-36(d)(2), the Local Director of Health has authority to require abandonment of an irrigation well when there is an unacceptable risk of injury to the health or safety of persons using the water, to the general public, or to any public water supply. The Department recommends the existing construction of the well and the separation distance to existing and future sources of pollution be evaluated in the determination if irrigation well poses an unacceptable risk of injury to the health and safety of anybody using the water or to the public.

The proposed project area includes areas that are served by the following public water systems:

Public Water System	PWSID Number	Administrative Contact	Phone Number
Miami Beach Water Company	CT1051021	Michael Girard	860-434-7562
Connecticut Water Company, Shoreline Region Sound View Water	CT1050732	Robert F. Ross	860-664-6120
Connecticut Water Company, Shoreline Region, Point O Woods	CT1050752	Robert F. Ross	860-664-6120
Old Lyme Pizza Palace	CT1050264	Theodore Anastasiou	860-434-1517
South Shore Landing	CT1050344	Kelly Angelini	860-434-0222
Camp Niantic by the Atlantic	CT0450024	Carol Rice	860-739-9308

There are numerous bedrock wells that supply water for the customers of these systems that are located within and near the area proposed to be sewered and along the conveyance route. In order minimize the potential impacts to the purity and adequacy of these public drinking water supply wells, the Town of Old Lyme must locate the active and inactive public water supply wells for these systems and ensure that the sewer collection and conveyance system design is consistent with the applicable requirements of the Regulations of Connecticut State Agencies Section 19-13-B51d for the separating distances from systems for the disposal of sewage.

The Notice of Scoping indicates that the area proposed to be sewered will generate an average of 300,000 gallons of waste water per day. The basis for determining the average daily discharge should be clarified. The majority of the area proposed to be sewered is also served by public water with water production and use data available. A review of DPH records indicates that this estimate is more consistent with maximum day demands that are currently experienced within the areas served by public water.

Installation of this sewage collection and conveyance system in the vicinity of the public water supply wells must adhere to the recommendations offered in the "General Construction Best Management Practices for Sites within a Public Drinking Water Supply Source Area" attached to this letter.

If you have any questions regarding these comments, please contact Bob Scully or Ryan Tetreault of the Environmental Health Section at 860-509-7296 or Eric McPhee of the Drinking Water Section at 860-509-7333.

Sincerely,

Ellen Blaschinski, RS, MBA
Public Health Branch Chief
Regulatory Services Branch

EB/sm
attachment

c: Suzanne Blancaflor, MS, MPH ,Environmental Health Section
Lori Mathieu, DPH Drinking Water Section
Sonia Marino, Old Lyme Health Department
Michael Girard, Miami Beach Water Company
Robert F. Ross, Connecticut Water Company
Theodore Anastasiou, Old Lyme Pizza Palace
Kelly Angelini, South Shore Landing
Carol Rice, Camp Niantic by the Atlantic
David Radka, Connecticut Water Company

General Construction Best Management Practices for Sites within a Public Drinking Water Supply Area

DRINKING WATER SECTION • JULY 2014

Emergency Response Plan

A response plan should be written for actions to be taken for the containment of accidental fuel or chemical spills or the failure of temporary erosion and sedimentation controls that may occur during construction. Spill response equipment should be available on-site at all times along with personnel trained in the proper use of such equipment. A person or persons should be designated by the contractor for emergency response coordination on a 24/7 basis.

Vehicles and Machinery

Designate one area for auto parking, vehicle refueling and routine equipment maintenance. The designated area should be well away from exposed surfaces or storm drains. Methods and locations of refueling, servicing, and storage of vehicles and machinery should be addressed and included as notes on the final site plans. Minor servicing and refueling of machinery should be completed on a fueling pad with containment. All major equipment repairs must be made off site. Onsite fuel storage should be discouraged.

General Site Conditions

Keep pollutants off exposed surfaces. The burying of stumps or construction debris must not be allowed on the job site. Sediment fences and hay bales must be strategically placed, inspected and maintained to prevent sedimentation and erosion. Temporary storm water ponds and basins must be routinely inspected and maintained. If unexpected conditions occur, additional fences and hay bales should be available for use as needed to prevent runoff. Protect exposed stockpiles of soil to prevent runoff. Use as little water as possible for dust control. Clean up leaks, drips and other spills immediately to prevent or minimize soil contamination. Never hose down "dirty" pavement or surfaces where materials have spilled. Use dry cleanup methods whenever possible.

Hazardous Materials Storage

Paints, paint products and other hazardous materials should be removed from the site during non-work hours or otherwise stored in a secure area to prevent vandalism. Place covered trashcans and recycling receptacles around the site. Cover and maintain dumpsters, check frequently for leaks, and never clean a dumpster by hosing it down on site.

Connecticut Department of Public Health
410 Capitol Avenue, Hartford, CT 06134
www.ct.gov/dph/publicdrinkingwater

Sanitation

Make sure portable toilets are in good working order. Check frequently for leaks.

Notification

Notification of the project start date should be sent to the Public Water System as soon as it has been determined. Public Water System personnel should be granted daily site access to review compliance with site best management practices. The Public Water System, DPH Drinking Water Section (860-509-7333 OR after hours at 860-509-8000), and appropriate sections of the Department of Energy and Environmental Protection must be notified immediately of any chemical/fuel spill or any major failure of an erosion and sedimentation control at the construction site. Emergency telephone numbers and a statement identifying the construction site as a sensitive public water supply area should be posted where they are readily visible to contractors and other on-site personnel. A note should be added to the construction documents stating the sensitivity of the area.

DAVID A. POTTS
385 Roast Meat Hill Road
Killingworth, CT 06419

PLANNING & [illegible] LAND [illegible] DIVISION
AUG [illegible] 2014

August 8, 2014

Mr. Carlos Esguerra
Department of Energy and Environmental Protection
Bureau of Water Protection and Land Reuse
79 Elm Street
Hartford, Connecticut 06106-5127

Re: Scoping Notice - Old Lyme Coastal Wastewater Management Plan

Dear Mr. Esguerra:

I have reviewed the above-referenced Department of Energy and Environmental Protection's ("DEEP") Scoping Notice for the Old Lyme Coastal Wastewater Management Plan. As stated in the Scoping Notice, the Town of Old Lyme and the Old Lyme Shores, Old Colony Beach and Miami Beach Associations have conducted independent engineering studies that conclude that on-site wastewater treatment systems are not a feasible solution for long-term wastewater renovation. We have reviewed these reports and have several concerns regarding the conclusions and the proposed solution of a centralized sanitary sewerage system, ultimately discharging to the wastewater treatment facility in New London.

By way of background, I am an environmental scientist and I have spent my professional career working in the field of soil and groundwater remediation and wastewater treatment. I am an avid outdoorsman and truly appreciate the need for, and the value of, clean water. I have lived on and around Long Island Sound for many years. As a result of my environmental expertise and involvement in the wastewater industry, I have been contacted by many people: environmentalists, local residents and even environmental regulators, who are concerned that the Old Lyme Coastal Wastewater Management Plan (the "Project") will set a dangerous precedent for Connecticut's shoreline and lake front communities. Based on the concerns that my friends and colleagues have raised, I am compelled to provide you with the following comments for your consideration.

First, with regard to public policy, the Project should be evaluated for consistency under the new State Plan of Conservation and Development (the "Plan") and the associated statutes. It is my understanding, and I have heard it often repeated, that the Plan does not allow an agency to provide funding for a growth related project unless the project is in a priority funding area. At a minimum there should be an explanation of how the use of Clean Water Funds for this Project is or is not "funding for a growth related project" and whether and how it can be funded. If it can be funded in accordance with the Plan, then an explanation is due for how the funding of the Project is consistent with the following statements from the Plan:

- Cluster development techniques, when combined with properly installed and maintained decentralized water, wastewater and/or stormwater systems can accommodate growth without the need for publicly subsidized expansions of infrastructure.
- Rely upon the capacity of the land, to the extent possible, to provide drinking water and wastewater disposal needs beyond the limits of the existing service area. Support the introduction or expansion of public water and or sewer services or advanced wastewater treatment systems only when there is a demonstrated environmental, public health, public safety, economic, social or general welfare concern, and then introduce such services only at a scale which responds to the existing need without serving as an attraction to more extensive development.
- Minimize the siting of new infrastructure and development in coastal areas prone to erosion and inundation from sea level rise or storms, encourage the preservation of undeveloped areas into which coastal wetlands can migrate and undertake any development activities within coastal areas in an environmentally sensitive manner consistent with statutory goals and policies set forth in the Connecticut Coastal Management Act.

It would also be beneficial to the public to offer a detailed justification of the scoring of the Project for the Clean Water fund Priority List:

- 15 points -the Project is necessary for attainment of water quality standards where the impacted resource is a coastal area.
- 3 points - the Project will lower coliform bacteria levels in the waters of shellfish beds.
- 3 points – the project will enhance existing swimming opportunities.
- 2 points – the population served by the Project is less than 5,000.
- 6 points – the Project will eliminate ponding of sewage from failing septic systems, backup of sewage into basements, or overflow of sewage in streets.

Second, with regard to science, I have previously reviewed the above-referenced engineering reports and based on the testing data included in those, it has never been clear to me that the results demonstrated that the wastewater from the beach communities is actually causing a pollution problem. Specifically, there is no conclusive proof that nitrogen from these neighborhoods is polluting Long Island Sound. In fact, the test data show that nitrogen levels in groundwater are not significantly elevated. This may be the result of natural attenuation processes, dilution, and denitrification from organics in soils or a combination of these factors. Without a clearly understood or defined problem, it is premature to design a solution.

I believe that the reports overlook the latest science regarding the natural attenuation process for nitrogen and other pollutants from on-site systems. In particular, recent studies have shown that with conditions similar to those present in these communities, anaerobic ammonium oxidation can result in up to an 80 % reduction in nitrogen levels. These and other natural abilities of the site conditions to effectively renovate nitrogen are not described in any scientific detail in the engineering reports. The fact that the nitrogen levels in groundwater are not elevated is likely the result of these factors. It is not prudent to conclude that the existing balance of conditions that results in low nitrogen concentrations will be further improved by constructing sewers in these areas. Until the balanced site conditions are more clearly understood, any change could negatively upset this balance.

Further, the engineering studies have not adequately demonstrated that the proposed solution will actually reduce nutrient loading to Long Island Sound. Under the current conditions, the properties in the project area are largely occupied by seasonal homes. These properties cannot be expanded or converted to year-round use, unless the property owner can demonstrate that an on-site system could be constructed to meet the requirements of Section 19-13-B100a of the Department of Public Health regulations. Given that many of these properties cannot meet these standards, the communities maintain a mostly seasonal status, which significantly limits the annual nutrient loading. When the restrictions of the health code are removed through the construction of sanitary sewers, properties can more easily be expanded or converted to year-round use. This intensification can lead to unexpected secondary consequences effecting water quality. Increased impervious surfaces, increased use of fertilizers and winter road treatments contribute to increased surface water runoff that flows directly to receiving waters, without the benefit of treatment.

The unfortunate example of this condition is Lake Pocotopaug in East Hampton, Connecticut. Sewers were constructed in this seasonal lakeside community to solve a "community pollution problem." The sewers promoted a phase of rapid development and conversions to year-round use. Despite the replacement of the septic systems with sewers, the lake has had repeated problems with algal plumes and a sizeable fish kill. Studies of these problems strongly suggest that the cause is the increased nutrient loads in storm water from the developed shorelines of the lake. Certainly, with such a stark example, any studies should account for the substitution of nutrient loads from on-site wastewater systems with untreated flows of contaminated storm water.

Finally, the Clean Water Act requires that any waste treatment and management project undertaken with Federal or State financial assistance must be the waste treatment and management system that constitutes the most economical and cost effective project. While the engineering reports have purportedly analyzed the available alternatives and identified the most cost-effective solution, it is quite possible that the most cost-effective solution, natural attenuation, already exists and any disruption of the existing conditions could lead to more pollution, not less. The sampling data contained in the above-referenced reports serve as a benchmark. If sewers were to be constructed and concentrations at the sampling locations increase, then it will be clear that DEEP's solution has caused the additional pollution.

As a final point, it is no surprise that the engineering reports identify sewers as the most cost-effective solution. I am not aware of any sanitary survey that has reached a different conclusion that has been initially accepted by the DEEP. The only exception that I am aware of is the Old Saybrook Decentralized project, but as you know, that has a history of its own.

Thank you for your consideration of these comments. If you have any questions, comments or suggestions, please feel free to contact me.

Sincerely,

David Potts
Environmental Scientist

Cc: Ms. Margaret Miner, Rivers Alliance of Connecticut
Ms. Sally Harold, The Nature Conservancy
Roger Reynolds, Esq., Connecticut Fund for the Environment/Save the Sound
Other Interested Parties

STATE OF CONNECTICUT
OFFICE OF POLICY AND MANAGEMENT
INTERGOVERNMENTAL POLICY DIVISION

August 22, 2014

Carlos Esguerra
Department of Energy & Environmental Protection
Bureau of Water Protection & Land Reuse
79 Elm Street
Hartford, CT 06106-5127

Re: Notice of Scoping:
Old Lyme Coastal Wastewater Management Plan

Dear Carlos:

The Office of Policy and Management (OPM) has reviewed the Notice of Scoping for the Old Lyme Coastal Wastewater Management Plan and submits the following comments:

- Old Lyme's 12/20/2013 Draft Coastal Wastewater Management Plan had recommended an approach other than that shown in the Notice of Scoping and described various environmental and financial advantages to that approach. There appeared to be strong local support for that approach, but minutes of the Old Lyme WPCA's 5/13/2014 meeting, available at http://www.oldlyme-ct.gov/Pages/OldLymeCT_WPCAMin/I0482FFC7, mention feedback from DEEP that led to the town changing its approach. Please describe the rationale for the change in approach since December and what opportunity there was for public review and comment regarding that rationale and the resulting change. The circumstances would appear to call for a greater than usual level of detail in explaining the comparison of these alternatives and the ultimate decision.

- The project description and mapping provided in the Notice of Scoping do not show whether there is an expectation for expansion of sewer service outside of the highlighted neighborhoods. DEEP should clarify whether or not there are plans for any expansion of sewer service outside those areas and, if there might be such an expansion, DEEP's determination of the proposed action's consistency with the State Plan of Conservation & Development should also consider the consistency of such expansion.

- The WPCA's 7/8/2014 WPCA minutes, available at http://www.oldlyme-ct.gov/Pages/OldLymeCT_WPCAMin/I04986C92, includes the following:

> **New Business**
> *Sanitarian's Report*
> She has been in contact with the State's Drinking Water section and private wells department, as well as Ct Water Company, and will be scheduling a meeting so that the Town's water needs can be coordinated on a townwide basis. It is important to consider drinking water now in conjunction with the Wastewater project so cost efficiencies can be realized.

Any change in water service area beyond the sewer service area that is induced or stimulated by the proposed wastewater project must be considered as an indirect effect of the proposed action.

- Some dwellings in the area proposed to be served by sanitary sewers were heavily damaged by the state's recent tropical storms. Recognizing such threats, the 2011 CT Climate Change Preparedness Plan recommends the following best management practice:

> **Develop decision tools to evaluate replacement, modification, and design life for infrastructure**
> Decision support tools are needed for analysis of alternatives, trade-offs, costs and benefits of adaptation approaches. Technical support will be needed to develop decision tools that provide for consideration of economic, societal and environmental effects of climate change impacts and potential adaptation approaches. The decision tools should be created for engineers and planners to determine if replacement or modification of infrastructure is warranted and to guide selection of the most appropriate alternatives. The decision tools also will include information to determine the appropriate design life for future infrastructure components. For existing infrastructure, the vulnerability database should be used, in conjunction with these decision tools to assign priorities for action that could include re-engineering, relocation, and/or removal, based on social, economic and environmental considerations of the infrastructure value and cost/benefits of various actions.

What if anything has DEEP done to incorporate such an evaluation into its technical and financial review of the wastewater management plan, given the considerable cost and design life of the expected wastewater system?

Thank you for the opportunity to respond to this Notice of Scoping and please feel free to contact me if you have any questions.

Sincerely:

Bruce Wittchen
Office of Policy & Management
450 Capitol Ave, MS# 54ORG
Hartford, CT 06106
(860) 418-6323
bruce.wittchen@ct.gov

APPENDIX G: CONNECTICUT DPH CIRCULAR LETTER 2000-01

STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH

DEH Circular Letter 2000-01

TO:
Directors of Health
Chief Sanitarians
Professional Engineers
Licensed Installers/Cleaners

FM:
Frank A. Schaub FaS
Supervising Sanitary Engineer
Environmental Engineering Section

DATE: January 13, 2000

RE: Sewage Updates

1. Year 2000 Revisions to Technical Standards
2. Code Training and Discussions
3. Installation of Pump Vaults in Septic Tanks
4. The Density of Developments
5. Septic Tank Outlet Filter Letter

1. **Revision to Technical Standards:** Our section has completed revisions to the Technical Standands and the publications are now available to health departments and the public. *Although the changes made to the Technical Standards become effective January 1, 2000, new requirements in Section V, Septic Tanks will not be required until July 1, 2000.* Septic tank changes include compliance with ASTM C1227, installation of outlet filters, and installation of manhole extensions on existing deep tanks. Even though all of our state septic tank manufacturers have been aware of these forthcoming changes, they still have many tanks in stock and the next six months will give them an opportunity to eliminate that stock and comply with the new requirements for septic tank construction. We have delivered many of the Technical Standards to local health departments already and will be mailing a few more in the near future. Engineers and installers may purchase the document for $3.00 by mailing a check made out to Treasurer, State of Connecticut, and mailing it to the address below. Please mark the envelope "Attention – Joseph Mitchell" so that your document can be quickly mailed.

2. **Code Training and Discussions:** As with past changes to regulations or Technical Standards, our staff will be assisting local health departments in conducting meetings locally to review the changes and discuss other items of concern to health departments, engineers installers, and cleaners. Several of these meetings have already been scheduled and a few have been successfully completed. In addition to reviewing the new changes, we have various samples of septic tank effluent filters so all can review and inspect first hand. We are requesting health departments locate suitable sites for training of their area engineers,

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installers and cleaners. We would prefer a minimum of 40 individuals at each session and further suggest small health departments contact adjacent health agencies to coordinate training and the selection of the best site. We would like to do the training during normal working hours but are also willing to conduct evening sessions if the demand is there. A three-hour minimum is necessary to review all the changes, discuss filter inspections and respond to questions from the attendees. The format which brings regulators, engineers, installers and cleaners to the same meeting has been preferred by the local health departments. The months of January and February are preferable for conducting these training sessions. Please contact us so we can lock in the dates and make preparations for your area. We can bring copies of the new regulation for sale at these meetings.

3. **In-Tank Pump Vaults:** Attached please find a copy of a letter which was recently written to address installation of pump vaults within a septic tank. We believe the letter is self-explanatory and provides the names of three companies that have requested approval for use of these vaults. You will note that each company utilizes a screened (filter like) pump vault in the second chamber of the tank that allows effluent at mid depth to enter the vault. These screened vaults would meet the requirements for installation of an outlet filter in a septic tank.

4. **Density of Development:** Over the past two years, we have been working with our sister agency, the Department of Environmental Protection (DEP) to address groundwater pollution in several densely developed residential areas in our state. Some of these involve inland watercourses and others are coastal developments with both year round and seasonal use homes. We are all familiar with densely developed residential subdivisions and the typical problems of small system failures, pollution of storm drainage systems and tidal flush systems which may have been constructed in or close to the seasonal high ground water levels.

   Some municipalities and DEP have identified groundwater pollution problems involving high ammonia, nitrogen and bacteria/viruses on properties with lots as small as 1/8th or 1/10th of an acre. Even lots with "good soils" that do not suffer from hydraulic limitations can create pollution problems in dense developments. High-density developments with these soils will not pollute storm drainage systems, cause surface breakouts, or backup into the houses. They will however, adversely affect groundwater quality due to increased nitrogen loading. One can easily imagine the impact of eight three-bedroom homes constructed on a single 1-acre parcel.

   Section 19-13-B103e (a)(4) states that no permits shall be issued "for any new subsurface sewage disposal system where the naturally surrounding soil cannot adequately absorb or disperse expected volume of sewage effluent without overflow, breakout or detrimental effect on ground or surface water". Several years ago, we addressed the absorption and dispersal of effluent by naturally occurring soils with Minimum Leaching System Spread

(MLSS). We would now like to bring forth our concerns with respect to high-density development. Recent modifications to our Technical Standards include a system, that compresses a large amount of leaching area into a small area. Due to its compact size, previously non-buildable parcels underlain by well-drained sand and gravel soils may now be reconsidered for development in light of this change. With that in mind, we are recommending that any reconsideration for lot development also include scruitinization with respect to nitrogen pollution. Use of DEP's 1982 pollution renovation criteria could be utilized for this calculation. If any existing or proposed lots were being considered for new construction, we would recommend local health departments require nitrogen analysis for all parcels where the density of development exceeds one bedroom per 0.167 acre. If more than a two-bedroom house was proposed on a third acre parcel or less, we would recommend the analysis be performed. If more than a three-bedroom home were proposed on a one half-acre parcel, we would recommend nitrogen analysis be performed. Please note that these guidelines are consistent with the existing Public Health Code, which is intended to protect both public health and the environment. They should be applied to all new construction (and not include repairs) no matter what kind of leaching system is being proposed.

5. **Septic Tank Effluent Letter:** Enclosed please find a five page informational letter on tank outlet filters. This document should provide answers to many frequently asked questions. Please feel free to reproduce this document for local distribution as needed.

Enclosure (1) Pump Vault Letter
(2) Septic Tank Filter Letter
(3) Technical Standards Training Sessions - Listing

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STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH

TO: **Directors of Health**
Chief Sanitarians
Professional Engineers
Licensed Installers

FROM: **Frank A. Schaub**
Supervising Sanitary Engineer
Environmental Engineering Section

DATE: **January 13, 2000**

RE: **APPROVAL OF IN-TANK FILTER/PUMP UNITS**

Over the past several years, several manufacturers of filtered pump vaults have requested approval of their products for installation in a septic tank where pumping to the leach field was required. Typically, the vault is installed in the second compartment of a specially modified septic tank with an opening large enough to facilitate the circular filter/pump vault unit that normally extends above the top of the tank. The extensions come with an access manhole that is extended to grade. The filtered units draw effluent from the mid-section of the tank and the filter not only provides a better quality effluent for discharge to the system but also protects the pump.

In our Technical Standards under Section VI, Distribution of Sewage Effluent, the second paragraph of subsection A clearly requires 24 hour emergency storage capacity above the alarm when a single pump is used, or dual alternating pumps with no required emergency storage. The most common design typically incorporates a septic tank followed by a pump chamber that ranges from 1,000 to 1,500 gallons in size. The pump is installed in the pump chamber with controls set low to maintain adequate storage capacity above the alarm. This criterion could also be achieved with a single tank if the designer specified a somewhat oversized septic tank. For example, assume a three-bedroom home is to be built requiring a minimum 1,000-gallon capacity septic tank. The designer seeks approval for installation of a 2,000 - gallon capacity septic tank with an oversized access manhole on the second compartment to facilitate the pump vault. Controls on the pump unit are set such that the pump on float occurs at the 1,400- gallon capacity level. The pump off float could perhaps be set at the 1,250- gallon mark thereby providing a 150- gallon per cycle dose. If the alarm were set at 1,500 gallons, the difference in elevation between the 1,500-gallon mark and the 2,000- gallon sewer inlet pipe would provide a 500 gallon, 24 hour emergency storage above the alarm float.

What is critical about this example is that the liquid level within the tank must always be maintained above the opening in the 1/3-2/3 tank compartment wall to prevent floating scum in the first chamber from getting into the second chamber. The filtered pump vault would most likely not allow scum to be discharged to the system but we would still prefer the second chamber effluent to remain relatively clear of solids or floating material.

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The single unit septic tank/pump chamber option maybe beneficial for use on repairs where little room is available for both septic tank and separate pump chamber installations. In addition, the pump unit within the tank may address concerns for flotation of empty chambers in wet areas and would reduce the potential for groundwater infiltration when essentially large empty tanks are installed on wet parcels. If dual alternating pumps are installed in a single pump vault, the emergency storage capacity is not required and septic tank sizing would most likely increase only 250 gallons to facilitate the expected pump dose.

If you desire additional information on these in-tank filter/pump units, you may contact the manufacturers directly. The companies, which have submitted requests and have received approvals, include Orenco Systems, Inc. (OSI), (800) 718-4699, Zabel Environmental Technology, (800) 221-5742 and the Zoeller Pump Company, (800) 928-7867. Please feel free to contact these manufacturers directly for more information.

Please note that use of any in-tank filter pump vault manufactured by the companies above does not constitute an endorsement of any of their products and this information is being provided to you at this time as an option to the standard separate septic tank/pump chamber installations. Regulators, engineers and installers must carefully review the Technical Standards to assure pump settings and emergency storage capacities are provided in compliance with the regulations. Prior to specifying use of any in-tank filter/pump, you should check with your local precast concrete tank manufacturer to confirm tank manhole openings suitable for vault installations.

If you have any questions or would like to further discuss these units, please contact our staff at 860-509-7296.

n/sewage/memos/in-tank

STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC HEALTH

SEPTIC TANK OUTLET FILTERS

JANUARY 13, 2000

Frank A. Schaub
Supervising Sanitary Engineer

The installation of septic tank outlet filters is not a new concept but will be new to Connecticut starting July 1, 2000 when Connecticut regulations will require installation of an outlet filter for every new tank installed in our state. Some septic tank manufacturers will elect to provide the filter as part of the tank sales. Other septic tank manufacturers may provide an outlet filter for installation by a license installer, or licensed installers may elect to purchase and install the filters on their own. The Department of Public Health (DPH) first approved installation of tank outlet filters back in 1983. Over the years, several filter manufacturers have applied for and received approval for installation of their filter products in septic tanks. Unfortunately, relatively few installers or property owners elected to use tank outlet filters. The year 2000 changes made to our Technical Standards (TS) will now make installation a requirement after July 1st.

Other states, counties, and local municipalities have required installation of tank outlet filters increasingly over the past 5 years. Florida, a state that installs 30 to 40 thousand septic systems each year, has gained much information concerning the installation and benefit of septic tank filters over the past five years. Initially, filters were installed as an option to construction of a two-compartment septic tank. Current regulations require filter installation on all septic tanks, one and two compartment. North Carolina was the latest state to recently require installation of tank outlet filters for all new construction. Reports from these regulators have been positive.

What is an outlet filter? - A septic outlet filter is a device which is installed in place of an outlet baffle and is designed to reduce the amount of suspended solids which are discharged into the leaching system. Organic pollutants from our toilets, sinks, tubs and washing machines discharge large quantities of water together with these organic chemicals for primary treatment by a septic tank. Some heavier pollutants settle to the bottom of the tank in the first compartment and form a stable biological sludge after time. Some lighter pollutants such as soap scum and grease rise up to the top of the tank forming a scum layer. The septic tank contains large quantities of bacteria, which help digest some of the organic pollutants in an environment devoid of oxygen. The dynamic processes of settlement organic digestion by bacteria and hydraulic flow through the tank tend to carry suspended solids through the tank and out the outlet piping. This organic matter combined with other organic pollutants with specific gravities close to that of water and inorganic pollutants such as fibers from washing machines might pass through the septic tank without achieving the benefit of settlement or digestion by bacteria. The purpose of the tank outlet filter is to reduce some of the suspended solids discharged to the leaching system.

Most outlet filters achieve this goal by providing a grid or mesh type interface were floating particles may be temporarily trapped, digested in place or sloughed off to the bottom of the tank. A second method of providing quiet settlement zones within a plate type filter can also reduce suspended solid discharge by providing large flat surface areas for particles to settle on and still rely upon narrow slots for effluent passage. The screen and settlement type filters are normally made of plastic and range from 4 to 18 inches in diameter, 12" to 3 feet in length. They allow septic tank effluent to enter into the filter from below the scum line and above the sludge layer.

What is happening to the suspended solids in tanks with no filters? - A large percentage of all septic systems that exist in Connecticut will continue to operate without the benefit of a septic tank outlet filter. The particles that are discharged into the leaching system will be trapped along the perimeter of the leaching system where the sewage meets the soil. An organic slime layer builds up at this point and further effluent treatment is achieved by the slime

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layer as liquid effluent slowly percolates through the slime into the surrounding soils. Unfortunately, many systems which are subjected to high loads of biological pollutants or which have received continual loading of suspended solids over many years tend to build up a thick biological layer that ultimately becomes very slowly permeable. This restrictive barrier prevents effluent from getting into the soil and may cause a backup or overflow at the weakest link in the sewage disposal system. It is conceivable that on sites where the sewage flows generated do not exceed the hydraulic capacity of the soil, the reduction in suspended solids resulting from filter installation could reduce the cause of the majority of infiltrative clogging within septic systems.

Why are tank outlet filters beneficial? - By reducing the quantity of suspended solids discharged to any leaching system, the probability of clogging at the soils/stone interface is reduced. If the biological mat does not thicken to a point of becoming excessively restrictive, treatment via passing through the biological mat infiltration/detention by the aerated soils found beyond the leaching system can provide for excellent effluent treatment. In addition, tank outlet filters can help prevent major leaching system failure by property owners who abuse a sewage disposal system or discharge too many pollutants to the septic tank. Like all operating systems, septic tanks require regular service to provide long term effective effluent treatment. In general, the range of pumping frequency is from two to five years depending upon the size of the tank and the occupant loading. Failure to pump a septic tank on a routine basis will result in an accumulation of sludge and scum which, in turn, reduces the efficiency of tank function. This reduction in efficiency will result in a higher percentage of suspended solids passing to the leaching system. Installation of a tank outlet filter will most likely result in plugging of the filter if the tank is not serviced on a regular interval.

In addition, tank outlet filters will also help detect the excessive buildup of organic pollutants caused by over use of household garbage grinders which unnecessarily increase the septic tank loading by grinding up kitchen wastes. Excessive use of a garbage grinder combined with failure to pump the tank on a regular interval could result in premature filter clogging. When this occurs, it provides an educational opportunity for regulatory officials, installers and cleaners to review household water practices and discuss options with the homeowner to reduce the frequency of filter servicing. Over the past several years, we have advised local municipalities of the dangers related to installation of central vacuum systems or portable vacuum systems that use water as a means of eliminating or reducing dust while vacuuming. These small quantities of water are discharged to the septic tank and contain large amounts of organic and inorganic fiber that can quickly pass through a septic tank and plug a leaching system. It is likely that fibrous material will be trapped in the tank effluent filters before doing excessive damage to the leaching system once again providing an opportunity to educate the system user as to the perils of continued water vacuum discharge.

Do tank outlet filters have to be cleaned frequently? - The ideal situation would result in the tank outlet filter remaining functional until the required time for tank servicing. For that reason, it would be desirable for filters not to plug more frequently than every two to five years. The variability of sewage generation and organic loading by the user combined with improper selection of tank outlet filter may result in filters being cleaned more frequently. For example, if a tank manufacturer or installer elects to use a filter product with minimal infiltrate surface area, it is probable that that filter will plug sooner than a filter with a larger infiltrate surface area. If a homeowner elects to grind up all kitchen waste, that household will obviously generate a stronger sewage discharge with more suspended solids as compared to a household without a garbage grinder. It would be preferable for providers of tank outlet filters to make a careful selection and choose an outlet filter with flow capacity and projected time between servicing suitable for the intended client.

Who can clean filters? - Reports from other states indicate licensed installers and septic tank cleaners typically provide servicing of tank outlet filters. We anticipate similar results and remind all that only individuals licensed to install and/or clean subsurface sewage disposal systems can offer these services to the public. Homeowners may elect to clean their own filter. However, we do not recommend this unless the homeowner is educated on the proper procedures and on safety/health concerns. Changes made to the technical standards which become effective July 1, 2000 will require a standard septic tank top configuration with service access holes in only three choices. All tanks will have a single outlet access hole over the outlet filter. There are two choices for inlet manholes to facilitate inlet piping from the building to the tank. For this reason, servicing septic tanks after July 1, 2000 will require cleaners and installers to open both the inlet and outlet access covers to clean and inspect both the inlet baffle and outlet filter. Previously, some tanks were manufactured to provide cleaning from a central hole with inspection of inlet and outlet baffles performed via use of mirrors and flashlights. Cleaning of the outlet filter is required each time the tank is serviced. Failure to provide this service by a licensed individual during cleaning could result in disciplinary action against that individual.

Property owners could elect to clean septic tank outlet filters but, precautions must be taken to assure the protection of their and adjacent residents health. Effluent discharged from a tank contains high numbers of harmful bacteria and potentially harmful viruses. For this reason, all water used to rinse filters must be discharged back into the tank. The ground must also be disinfected with chlorinated lime if a spill does occur. Licensed individuals are familiar with the hazards involved with coming into contact with domestic sewage and take necessary precautions using gloves and disinfectants when required. For example, hoses used by the property owner or licensed cleaner should not come into contact with septic tank effluent. If such an event does occur, rinsing and disinfecting of the nozzle and all associated contaminating surfaces would be required. Servicing of filter elements during the winter months may result in a licensed installer or cleaner removing the element and installing a replacement element of same kind. The removed unit could be taken back to the place of business and cleaned in a sanitary manner. Where a hose or water supply is not available during cleaning, licensed individuals may elect to use a hand type garden spray pump to flush trapped particles off the filter back into the tank.

What should a homeowner or licensed individual do if a filter plugs prematurely? - It is possible that some filters may plug more frequently than every two to five years and these occurrences should be used by regulatory and licensed individuals as an opportunity to review water use habits in the house or make changes to the filter in order to provide extended service intervals. The licensed installer or cleaner should interview the property owner to determine if a garbage grinder is actively used. Are vacuum cleaners that use water being used in the residence? Is water softening equipment discharging to the sewage disposal system? Are the occupants disposing unused medication (that may adversely effect the biological activity inside the tank) into the septic tank? Does the clothes washing machine have a self cleaning lint filter which in turn could be discharging all the lint to the septic tank? Has the occupancy of the house recently changed in any way that would result in a greater loading on the septic tank? Is there a home business or are day care services for children being provided? Adult homes for the handicapped have a history of premature system failures due to large quantities of water used and high sewage strengths. These and other questions can be helpful in determining whether more frequent servicing of the septic tank and outlet filter are necessary or whether an outlet filter with increased capacity should be provided.

Some manufacturers of septic tank filters provide several different models of filter units to increase filtering capacity. Other manufacturers provide for easy addition of filter units in series or by multiple installation of units at the same outlet piping. If property owners are reluctant or unwilling to change habits inside the house, installers and cleaners can respond by providing a product that meets their needs for extending service intervals.

What are the drawbacks with respect to installing tank outlet filters? - For the vast majority of property owners utilizing on-site sewage disposal systems, the drawbacks to tank outlet filter installation should be minimal. It will be necessary to uncover two manholes each time a tank is serviced. By providing two access manholes, property owners can be assured of effective and efficient cleaning of both chambers within the septic tank. Currently, servicing some tanks with a central cleaning manhole does not promote complete cleaning of both chamber compartments. There may be drawbacks for some individuals who generate large quantities of organic and inorganic pollutants that discharge to a septic tank. The initial clogging of the outlet filter could result in an artificially high liquid level in the tank that would first be identified by a property owner as gurgling in the household plumbing at the lowest water fixtures being used. Tank outlet filters approved for use in Connecticut must continue to function even when the liquid level in the tank is artificially high or overflows the top of the filtering element. In our regulation, we refer to this as a non- bypass outlet filter. Continued rising of the liquid level in the tank could result in a plugging of the inlet piping or a surface discharge at the septic tank itself. If the septic tank was installed on a relatively level grade with minimal pitch back to the building served, it is possible that effluent could continue to back up in the piping and discharge at the lowest fixture inside the structure. The typical warning signs of slow draining fixtures or gurgling in the piping are apt to alert the property owner long before discharge occurs in the lowest plumbing fixture.

If concern for prevention of sewage discharge at the lowest fixture is a primary item, installation of a high liquid alarm within the septic tank can be made. One filter manufacturer offers an alarm as in intricate accessory to the filter installation. Standard high-level alarm floats similar to those installed in an effluent pump chamber could also be installed in a septic tank.

Does the effluent filter have to be installed inside the septic tank? - The answer is no. Several products are available on the market for installation of separate filter units that are housed in vaults installed on the outlet side of the septic tank. Access to these separate filter vaults must be the same as that to a septic tank and location of the vault must be clearly identified on the as-built plans so that installers, cleaners and regulators can be made aware vault location. It would be beneficial if the septic tank outlet cover was provided with a permanent tag noting the location and existence of the separate filter vault.

Are there any National Standards governing septic tank outlet filters? - At the present time, the National Sanitation Foundation (NSF) is developing Standard 46, Section 10 to address a class of products referred to as septic tank effluent filters. This standard will test filters for flow capacity when clean, flow when partially plugged solids reduction, by-pass protection and general structural suitability. While not a true test of each product's ability to effectively trap organic and inorganic pollutants, the standard is a good start to provide comparison for different products.

What would happen if a property owner, installer, or cleaner removed the filter element from its housing? – Removal of a filter element by a licensed installer or cleaner would be a violation of our Code and Technical Standards. For those filter elements installed in a standard 4 inch. Diameter sanitary tee, septic tank function would essentially revert back to the pre year 2000 regulation and an increased suspended solid loading would be placed back on the leaching system. One product manufacturer has a built in shut off feature that prevents unfiltered effluent from escaping to the leaching system when the element is removed from the housing. The shut off feature would remain functional until the liquid level raises above that of the filter housing, approximately 6 inches above the normal tank operating level. At that point, any liquid build up above the top of the filter housing would discharge to the leaching system.

Can you install a tank outlet filter in both single and two compartment septic tanks? - The likelihood of tank outlet filter clogging in a two-compartment tank is less than for one installed in a single compartment tank. The benefits in providing filtered effluent would remain equal for both situations. For that reason, installers, cleaners and property owners should consider the possibility of more frequent servicing if installed in a single compartment tank and the benefits to providing added filtration interface to extend the interval between pumping. One other consideration for retrofitting existing tanks is access to the filter element itself. The manhole over the tank outlet piping must be adequate in size to facilitate retrofitting for filter installation and removing the filter element during cleaning.

Conclusion - Installation of septic tank outlet filters should provide a long-term benefit to the health and protection of the residents in the State of Connecticut. The filters will obviously promote servicing of septic tanks on routine intervals. By reducing the pollutant loading to leaching systems, effluent filters should prolong the effective life of those leaching systems. Many systems, which receive consistent qualities and quantities of sewage effluent over many years, fail due to bio-mat build-up. This clogging failure is observed occasionally with new and recently repaired systems constructed in excellent quality sand fill. When evaluating these premature failures, the breaching of the organic layer along the side wall of the leaching system frequently results in the entire leaching system being drained into the unsaturated adjacent sandy soils. This observation is of a clogged system constructed in highly permeable soils. Reduction of pollutant loading to the leaching system can help reduce this occurrence. Reduction of suspended solids discharged to the leaching system can help extend the function of septic systems constructed in naturally occurring fine sandy soils that tend to build up a biological crust at a faster rate than other course sandy soils.

One Connecticut septic tank manufacturer has elected to provide outlet filters with each new tank installed since August of 1998. Other tank manufacturers who sell tanks beyond our borders have also provided outlet filters with their tanks for some of these out of state deliveries. The reports have been very favorable with respect to minimal problems from servicing or creation of nuisance conditions. This next year will be a learning period for our licensed installers and cleaners, regulators and engineers, as well as property owners as we adjust to the installation and maintenance of septic tank outlet filters.