Town of Orleans

MASSACHUSETTS

Technical Review and Cost Analysis of Comprehensive Wastewater Management Plan Options

Cost Estimate Public Presentation

Board of Selectmen's Meeting
April 18, 2012

Weston&Sampson

Introduction/Overview

- Review Project Goals
- Preliminary Design
  - Hybrid Centralized System
  - Alternative System (Septic Tank Effluent)
- Cost Drivers/Criteria
- Preliminary Cost Estimates
- Schedule Update

Project Goals

- Preliminary Engineering/Detailed Cost Analysis
  - Determine Most Cost Effective Way to Address Wastewater Management Needs
- Develop/Refine Centralized System from CWMP
- Develop Alternative System
  - Septic Tank Effluent (STE) Concepts
- Develop Comprehensive Cost Estimates to Move Plan Forward
- Preliminary Design Report

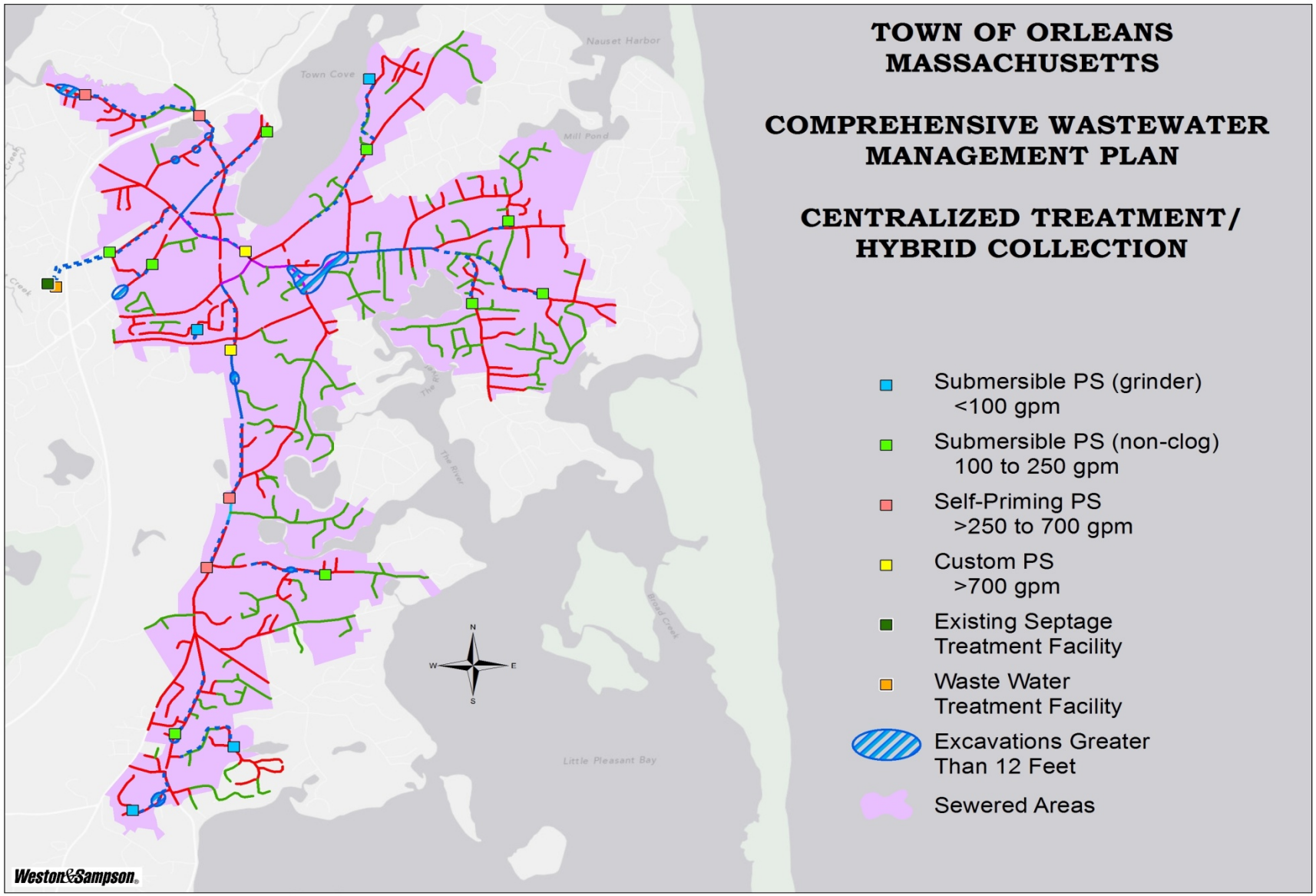
Key Issues

- Defined System Layouts
- Clear Basis of Cost Estimates
- Transparent Cost Evaluation
- ‘Apples to Apples’ Comparisons
  - TMDL Equivalence
  - Cost Analysis of Entire Systems (including Private Property)

Centralized Sewer System

- Optimize CWMP Recommended Design
- Gravity Sewer where Cost Effective
- Low-Pressure Sewer where Topography Warrants
- Reduce Capital Construction Costs

Recommended Centralized Hybrid System



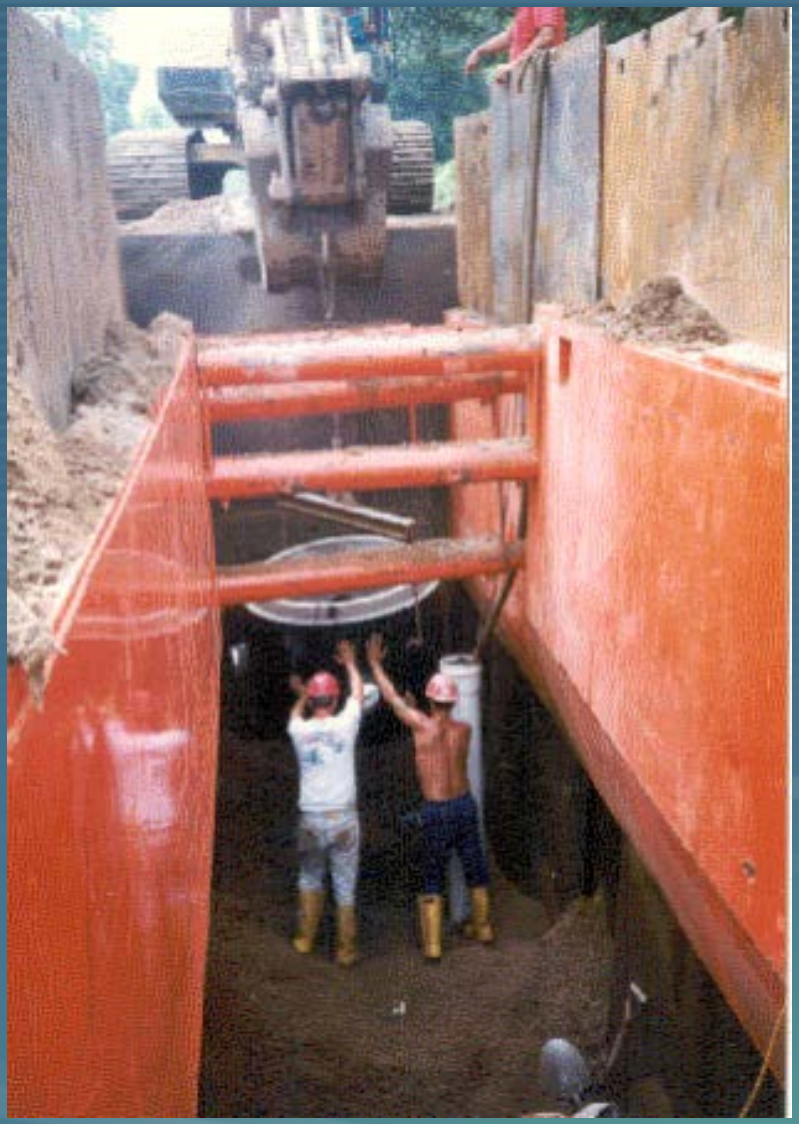
Gravity Sewers

- Least mechanical of all the pipeline alternatives
- Energy costs are free (except for pump stations)
- Easy to operate and maintain
- Dependent on existing topography of the area
- Trench depth considerations
- Pump station siting issues

Gravity Sewers (cont'd)

- 175,000 Linear Feet (l.f.)
  - 6,000 l.f. Greater than 12 Feet Deep (3%)
  - All Less than 20 Feet Deep
- Diameters Ranging from 8- to 21-inches
  - 160,000 l.f. of 8-inch
  - 15,000 l.f. Greater than 8-inch
  - 14,000 l.f. of 12- and 15-inch
- Approximately 830 Manholes
- 19 Municipal Pump Stations

Gravity Sewer Installation



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Low-Pressure Sewers

- Pressurized system, requires mechanical components
- Maintenance requirements
- Widely accepted for appropriate applications
- Generally not dependent on topography of the area
- Requires relatively shallow excavation during construction
- Requires individual grinder pump units on private properties
- Requires electrical connection on each property

Low-Pressure Sewers (cont'd)

- 116,000 l.f.
- Between 1 ½- and 3-Inch Diameter Pipe
  - Predominately 2-inch
- 290 Manhole Structures (Inline and Terminal)
- Approximately 1,100 Grinder Pumps (39%)
  - Operation & Maintenance Responsibilities
  - Grinder Pump Policy

Low-Pressure Sewer Installation

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Municipal Pump Stations

- 19 Wastewater Pump Stations
  - 1 Large Station (Greater than 700 gpm)
  - 5 Medium Stations (250 gpm to 700 gpm)
  - 13 Small Stations (50 gpm to 250 gpm)

- 50,000 l.f. of Force Main
  - Diameters Ranging from 2- to 15-inches
  - 100 Force Main Cleanout Manholes

Large (Custom) Pump Stations

Medium (Self-Priming) Pump Stations

Small (Submersible) Pump Stations

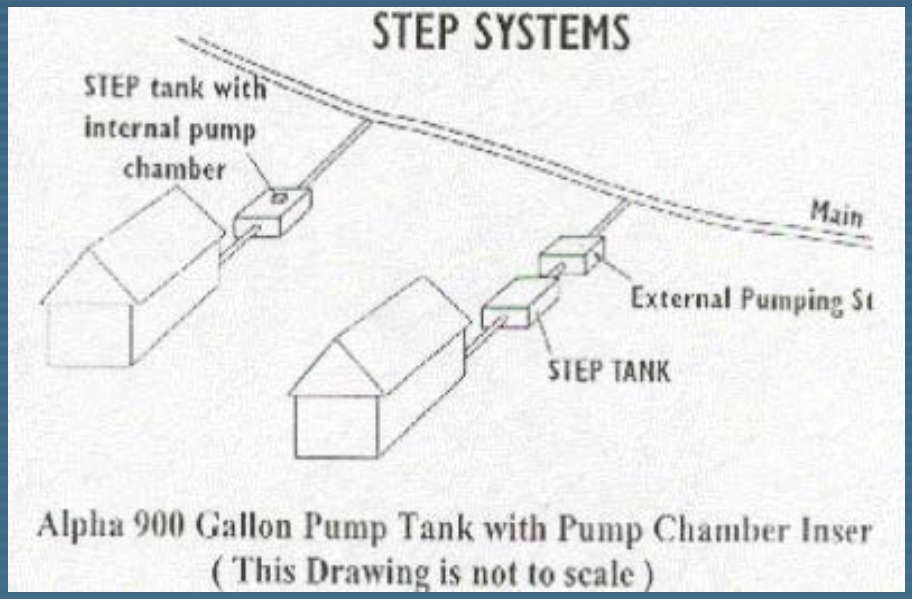
Septic Tank Effluent System

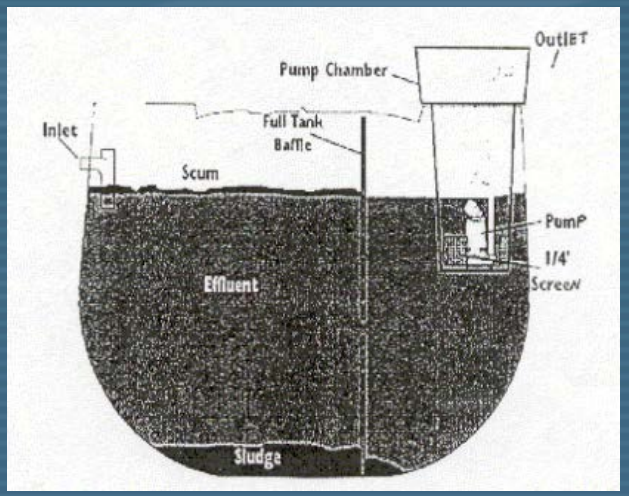
- On-site Solids Separation
- Effluent Pumping (STEP) or Gravity (STEG)
- Decentralized vs. Centralized
- Coordination with STEP Equipment Vendors
- O&M Responsibilities
  - Tank Pumping
  - Pump Maintenance

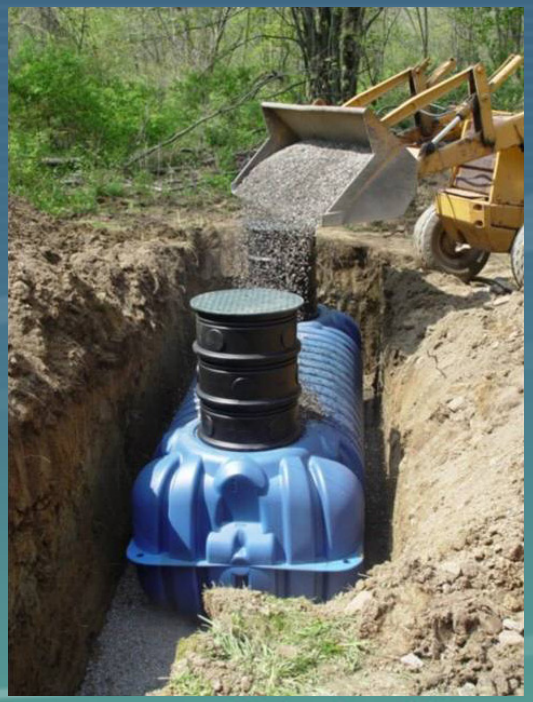
Septic Tank Effluent Pump (STEP) System

- Pressurized system, requires mechanical components
- Maintenance requirements
- Odor issues
- Not dependent on topography of the area
- Requires relatively shallow excavation
- Requires a septic tank to remove solids and individual STEP units on private properties

STEP System (cont'd)







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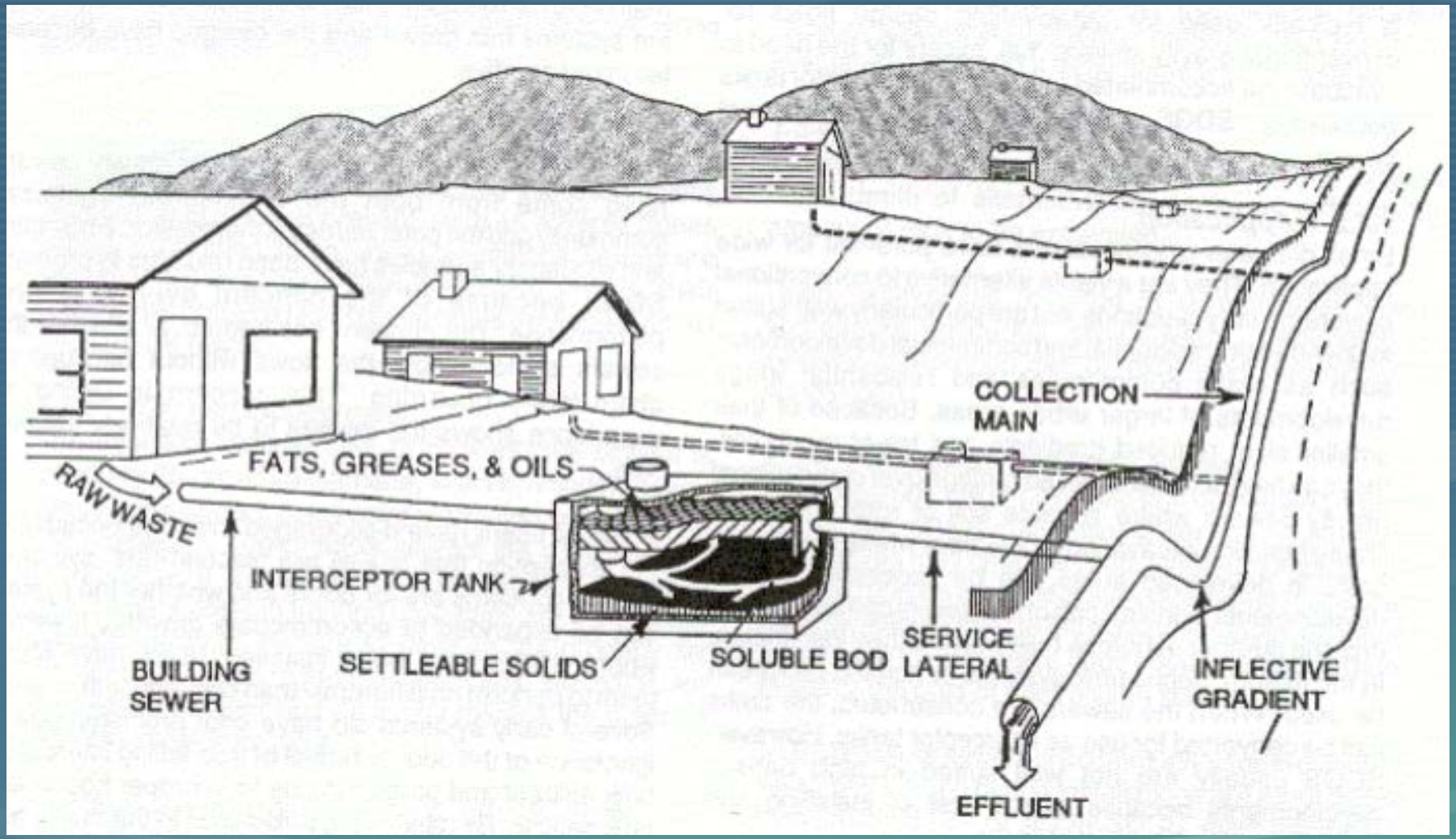
Septic Tank Effluent Gravity (STEG) System

- Gravity system, does not require mechanical components
- Maintenance requirements
- Dependent on topography of the area
  - Hydraulic Grade Line (critical)
- Requires relatively shallow excavation
- Requires septic tanks to remove solids

STEG System (cont'd)

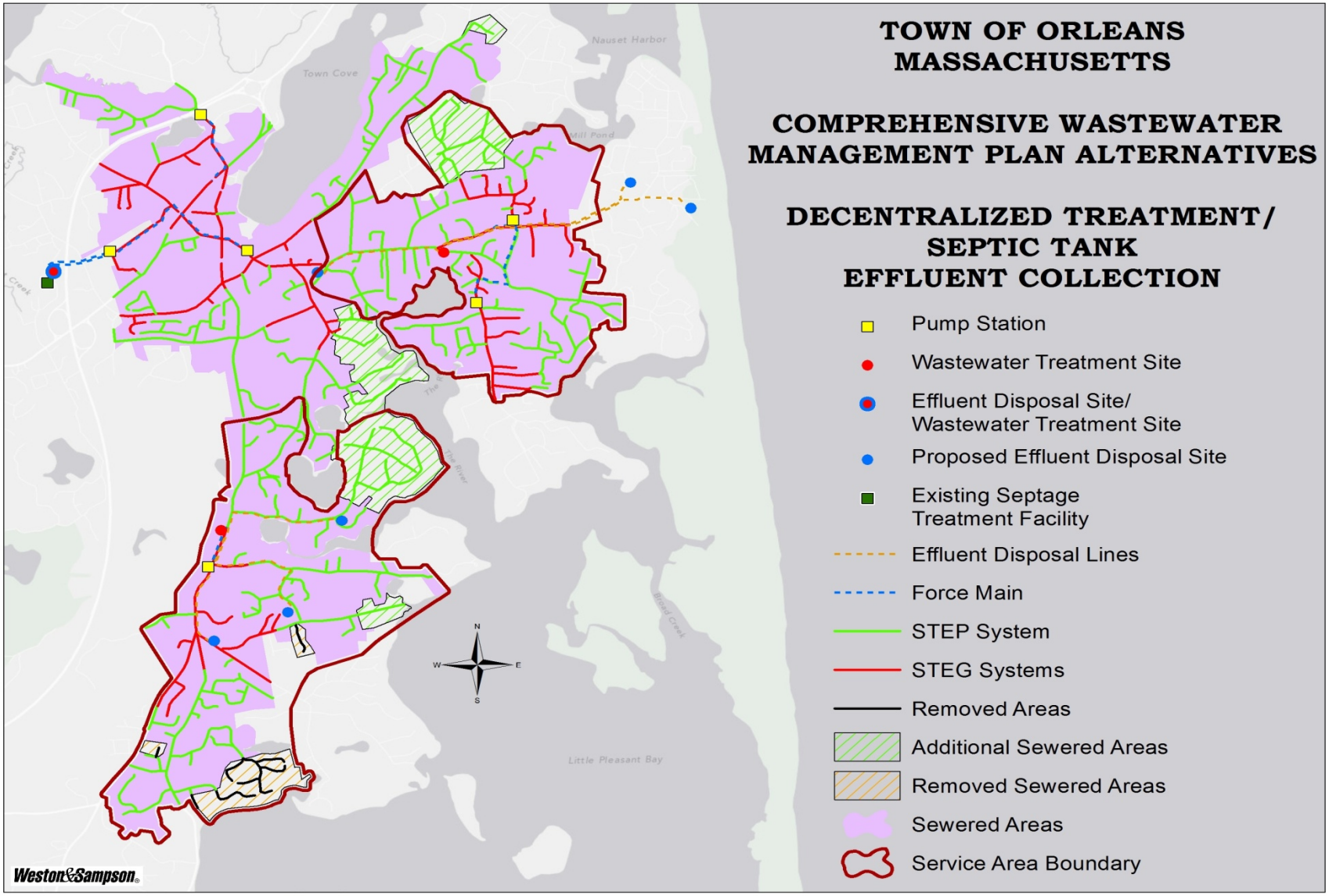


STE - Centralized vs. Decentralized

- STE Technology
  - Typically Small Systems – More Manageable
  - Small Diameter, Shallow Pipes
  - Uniform Effluent Pump Sizes (½-hp)
  - Limited Municipal Pump Stations

- Septic Waste vs. Raw Sewage
  - Odor
  - Corrosion
  - Shorter Transmission Lines

Proposed STE Layout



Summary of STE Collection System Components

- Modified Service Area (Nitrogen Balance)
- 338,000 l.f. of Pipe
  - 80,000 l.f. of STEG System
  - 237,000 of STEP System
  - 21,000 l.f. of Force Main
- 2,300 STEP Pumps (75%)
- 6 Pump Stations
  - 1 Large Station (>700 gpm)
  - 3 Medium Stations (>250 gpm to 700 gpm)
  - 2 Small Stations (50 gpm to 250 gpm)

Collection System Comparison

Centralized Hybrid

- 2,830 Properties
- 341,000 l.f. of Pipe
- 19 Pump Stations
  - 1 Large Station
  - 5 Medium Stations
  - 13 Small Stations
- 1,100 Grinder Pumps

Decentralized STE

- 3,080 Properties
- 338,000 l.f. of Pipe
- 6 Pump Stations
  - 1 Large Station
  - 3 Medium Stations
  - 2 Small Stations
- 2,300 STEP Pumps

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Collection System Cost Drivers

- Size and Depth of Pipe
  - Number of Manholes and Other Structures
  - Number and Size of Municipal Pump Stations
  - Number of Individual On-Lot Pumps/ STE Systems
- Subsurface Conditions
- Method of Installation
- Surface Restoration
- Public Safety
- Land and Legal

Subsurface Conditions

- Geotechnical Investigations Not Performed
  - Required during Final Design
- Soil Conservation Service Maps
- Local Knowledge
  - Meeting with Water Foreman, Highway Manager, and Health Agent
- Unsuitable Materials, Rock, High Groundwater, etc.
- Existing Utilities (Available Corridors)

Surface Restoration

- Trenchless Technology vs. Open Cut
  - Subsurface Conditions
  - Existing Utilities
  - Number of Connections Required
- Paved Road vs. Gravel Road
- State Highway vs. Local Road
  - CDF
- Gravity Trenches vs. LP/STE Trenches

Public Safety (Traffic Details)

- Assumed Construction Production Rates
  - Pipe and Appurtenances
    - Gravity vs. Pressure
  - Surface Restoration
  - Auxiliary Work
- Number of Officers Required
  - State Highway vs. Local Road
  - Meeting with Deputy Chief of Police

STEP & STEG Tanks

- New vs. Existing
  - Age, Size, Condition
  - Evaluations Required
  - Industry Practice
- Material of Construction
  - Concrete vs. PE vs. Fiberglass
- Frequency of Pumping

Collection System Capital Cost

	Centralized Hybrid	Decentralized STE
Public Way	$58,145,000	$36,070,000
On-Lot Costs	$18,125,000	$33,138,000
Construction Contingency (25%)	$19,067,000	$17,302,000
Engineering (25%)	$19,067,000	$17,302,000
Public Safety	$4,100,000	$3,100,000
Land & Legal	$330,000	$100,000
Total	**$118,834,000**	**$107,012,000**

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Public Way Infrastructure Costs

	Centralized Hybrid	Decentralized STE
Pipe & Appurtenances	$24,545,000	$16,096,000
Pump Stations & Force Mains	$12,605,000	$5,366,000
Subsurface Conditions	$3,861,000	$2,757,000
Surface Restoration	$14,365,000	$10,134,000
Mobilization	$2,769,000	$1,718,000
Subtotal	**$58,145,000**	**$36,070,000**

Average Cost per Property Served (Public Way Infrastructure)

	Centralized Hybrid	**Decentralized STE**
Total Cost	$58,145,000	$36,070,000
Number of Properties	2,830	3,080
Cost per Property	$20,546	$11,711

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On-Lot (Private Property) Infrastructure Cost

	Centralized Hybrid	Decentralized STE
Pipe	$10,200,000	$9,825,000
Pumps/Tanks	$7,925,000	$23,313,000
Subtotal	**$18,125,000**	**$33,138,000**

Average Cost per Property Served (On-Lot Infrastructure Cost)

	Centralized Hybrid	Decentralized STE
Total Cost	$18,125,000	$33,138,000
Number of Properties	2,830	3,080
Cost per Property	$6,404	$10,759

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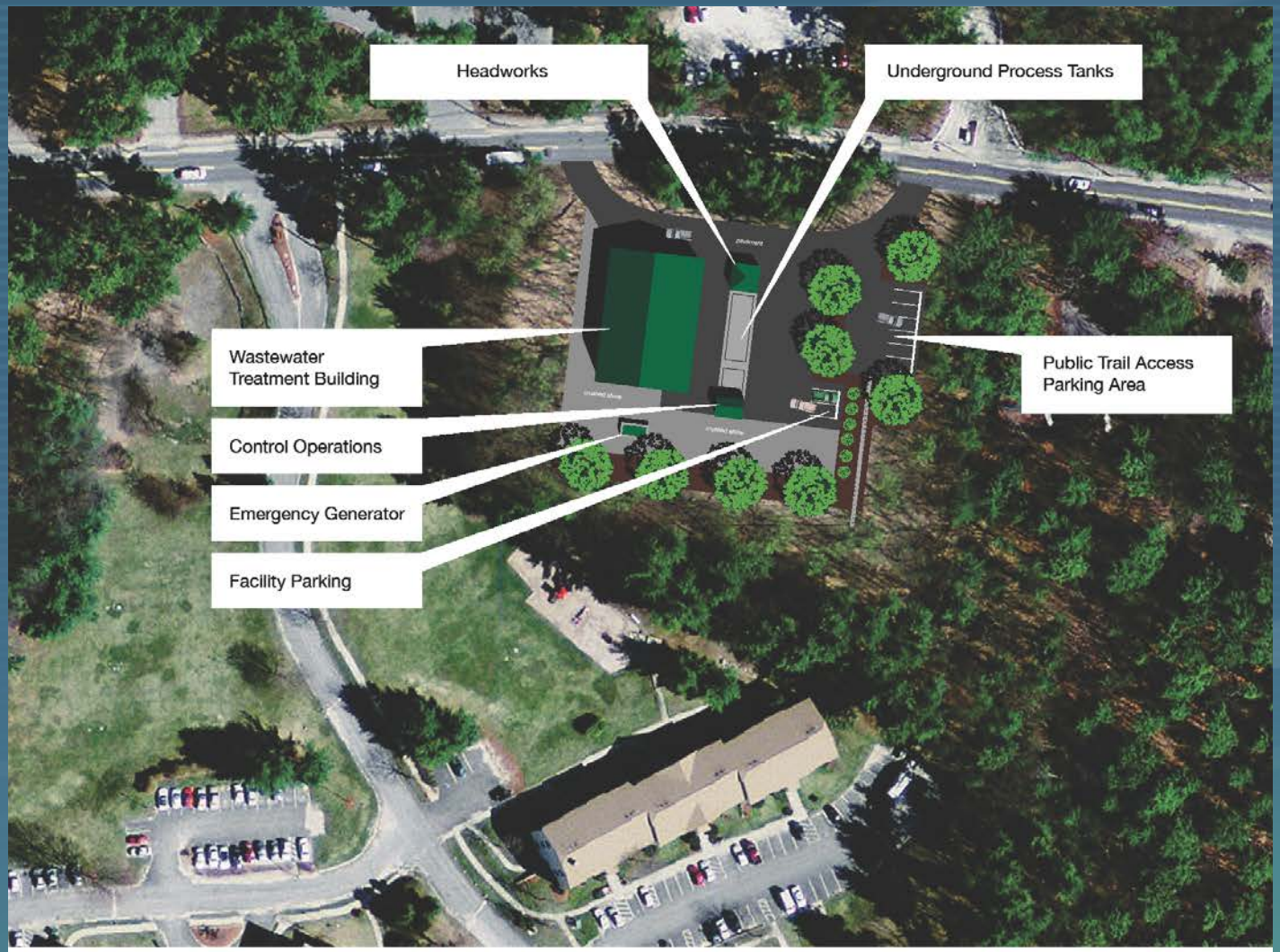
Wastewater Treatment Facility



DECENTRALIZED WASTEWATER TREATMENT FACILITY — CONCEPTUAL SITE PLAN

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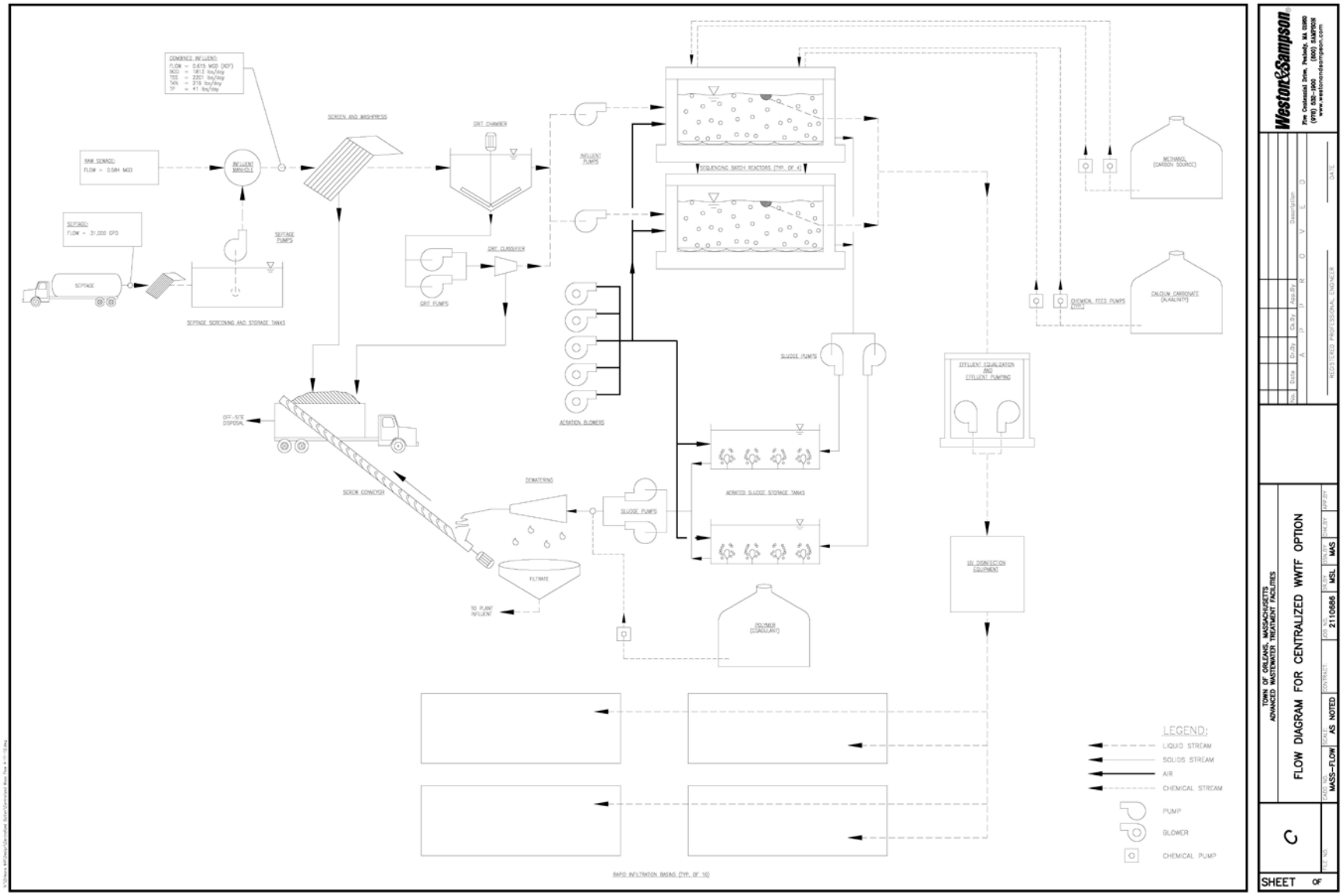
Centralized Treatment Plant

- Approximate Volume to be Treated:
  - Average Daily Flow – 640,000 gpd
  - Maximum Daily Flow – 1,440,000 gpd
- Sequencing Batch Reactor (SBR) vs. Membrane BioReactor (MBR) Technology
- SBR Technology Recommended
  - Lower Life Cycle Cost
  - Greater Operational Flexibility
- Anticipated Effluent Nitrogen Limits – 3 mg/l
  - Rapid Infiltration

Conceptual Flow Diagram - Centralized



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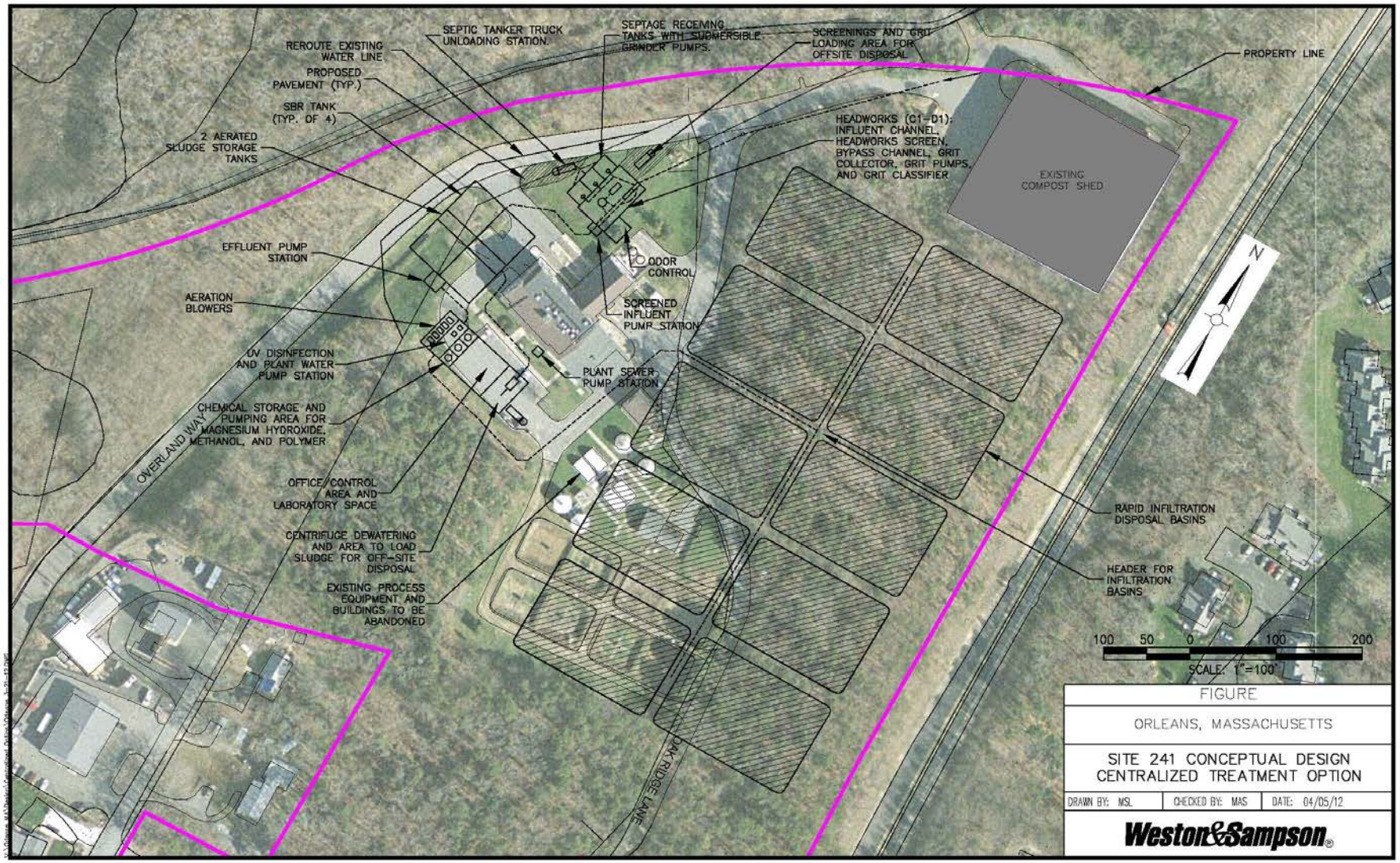
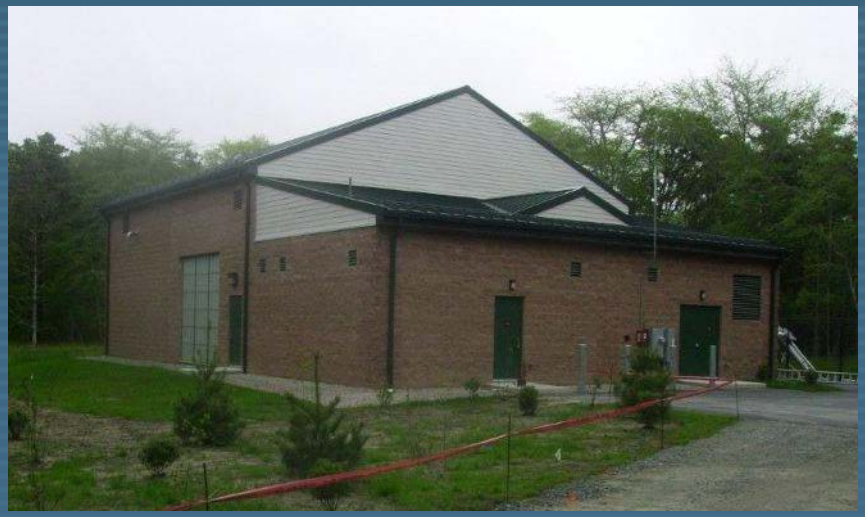
Conceptual Treatment Process - Centralized

- Primary Treatment (Screening & Grit Removal)
- SBR (Biological Treatment)
- Methanol Addition (Biological Nutrient Removal)
- Effluent Equalization
- Pressurized UV Disinfection
- Sludge Dewatering

Conceptual Site Plan - Centralized



Decentralized Wastewater Treatment



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Proposed Treatment and Disposal

Treatment Sites –

- Site 163 –
  - 165,000 gpd ADF
  - 330,000 gpd Maximum Daily Flow
- Site 111 –
  - 230,000 gpd ADF
  - 460,000 gpd Maximum Daily Flow
- Site 241 –
  - 150,000 gpd ADF
  - 300,000 gpd Maximum Daily Flow

Disposal Sites –

- Site 172 – 140,000 gpd
- Site 173 – 50,000 gpd
- Site 181 – 140,000 gpd
- Site 321 – 235,000 gpd
- Site 322 – 150,000 gpd
- Site 112 – 75,000 gpd
- Site 241 – 300,000 gpd

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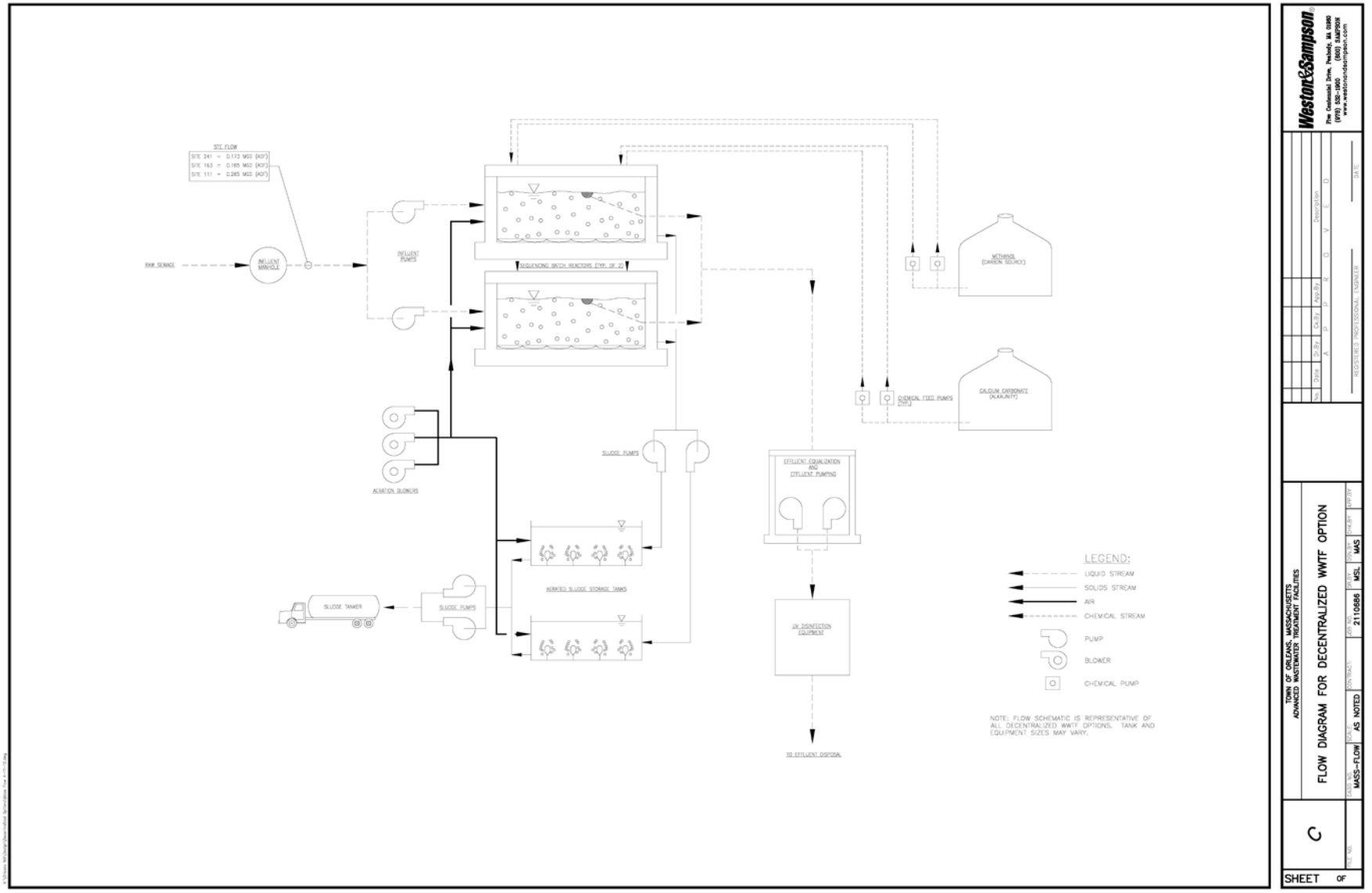
Conceptual Flow Diagram - Decentralized



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Conceptual Treatment Process - Decentralized

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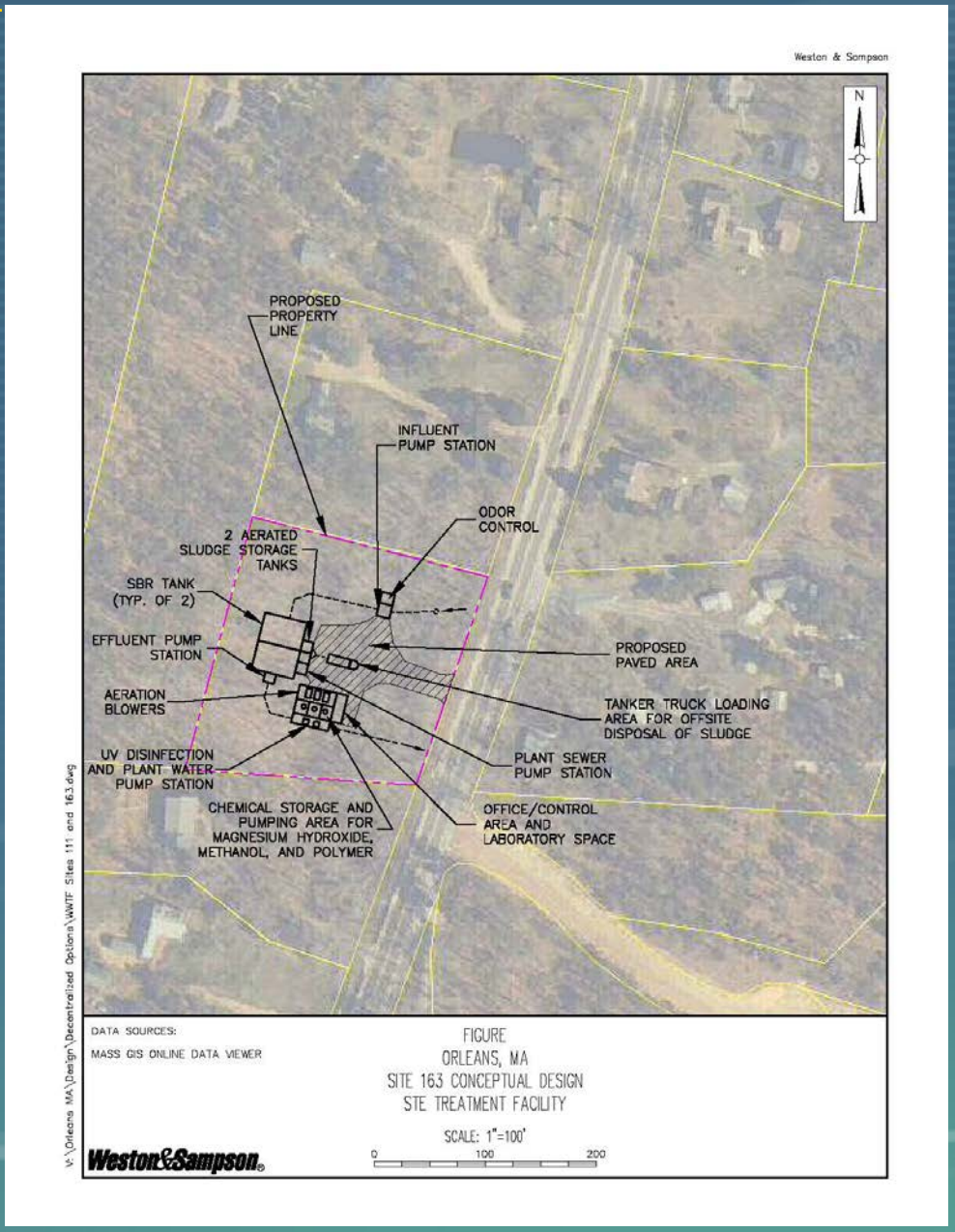
- Effluent Equalization
- Pressurized UV Disinfection

Conceptual Site Plan - Decentralized



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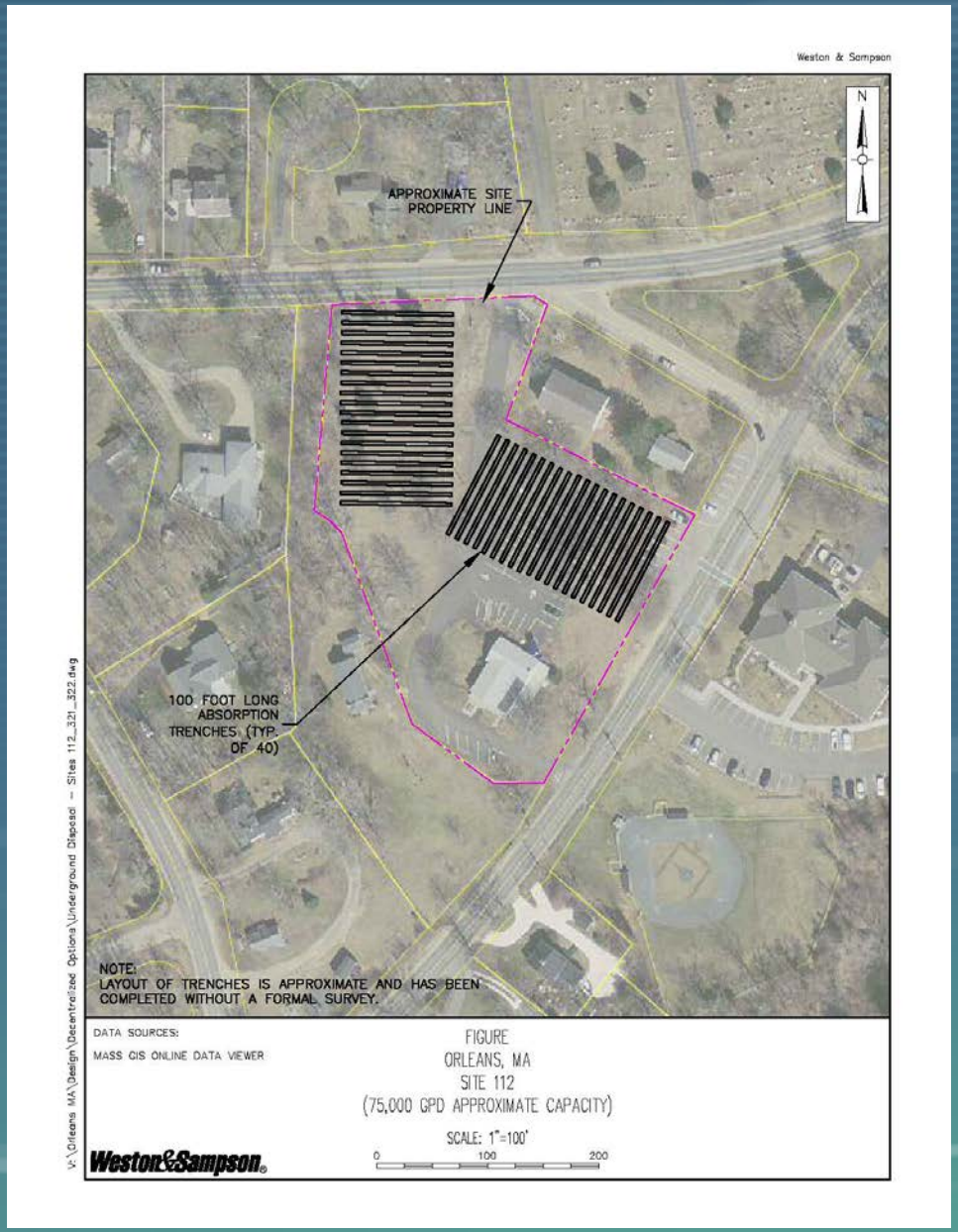
Sample Subsurface Disposal Field



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Effluent Disposal

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Wastewater Treatment Cost Summary

	Centralized	Decentralized			
		Site 163	Site 111	Site 241	Total
Construction Subtotal	$16,155,000	$5,673,000	$6,321,000	$8,824,000	$20,818,000
Engineering, Permitting, Project Development	$4,039,000	$1,418,000	$1,580,000	$2,206,000	$5,204,000
Construction Contingencies	$4,039,000	$1,418,000	$1,580,000	$2,206,000	$5,204,000
Land and Legal	N/A	$800,000	$2,500,000	N/A	$3,300,000
Total	**$24,240,000**	**$9,310,000**	**$11,990,000**	**$13,240,000**	**$34,540,000**

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Construction Cost Breakdown

	Centralized	Decentralized		
		Site 163	Site 111	Site 241
Primary Treatment	$1,283,000	N/A	N/A	N/A
Septage Receiving	$693,000	N/A	N/A	N/A
Biological Treatment	$2,777,000	$1,548,000	$1,688,000	$1,548,000
Chemical Addition	$65,000	$35,000	$35,000	$35,000
Solids Handling	$424,000	$25,000	$25,000	$25,000
Disinfection	$260,000	$131,000	$131,000	$131,000
Pumping	$235,000	$321,000	$321,000	$321,000
Odor Control	$340,000	$50,000	$50,000	$50,000
Wastewater Effluent Disposal	$767,000	$1,013,000	$1,400,000	$270,000
Site Work	$2,588,000	$163,000	$163,000	$968,000
Miscellaneous Work	$3,702,000	$1,326,000	$1,326,000	$1,326,000
Update Septage Treatment Plant	N/A	N/A	N/A	$2,500,000
General	$3,021,000	$1,061,000	$1,182,000	$1,650,000

Total Estimated System Capital Costs

	Centralized Hybrid	Decentralized STE
Collection System	$118,840,000	$107,020,000
Treatment Plant(s)	$24,240,000	$34,540,000
Total	**$143,080,000**	**$141,560,000**
Number of Properties	2,830	3,080
Capital Cost per Property	$51,000	$46,000

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Annual Operation & Maintenance Costs

	Centralized Hybrid	Decentralized STE
Collection System	$736,000	$654,000
Treatment Plant(s)		
Site 241	$1,216,000	$1,447,700
Site 163	N/A	$548,700
Site 111	N/A	$556,500
Total	**$1,960,000**	**$3,210,000**

Equivalent Uniform Annual Cost (EUAC)

	Centralized Hybrid	Decentralized STE
Collection System	$8,750,000	$7,880,000
Treatment Plant(s)	$1,790,000	$2,560,000
Operation & Maintenance	$1,960,000	$3,210,000
Total	**$12,500,000**	**$13,650,000**

Next Steps

- Refine Costs
  - Independent Cost Estimator
- Draft Letter Report
  - Public Presentation – June 6th
- Final Letter Report
  - Final Public Presentation – July 18th

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Questions & Discussion