Town of Orleans

MASSACHUSETTS

Technical Review and Cost Analysis of Comprehensive Wastewater Management Plan Options

Draft Preliminary Design Report Public Presentation

Board of Selectmen's Meeting
June 20, 2012

Weston&Sampson

Introduction/Overview

- Review Project Goals
- Preliminary Design
  - Hybrid Centralized System
  - Alternative System (Septic Tank Effluent)
- Preliminary Cost Estimates
- Draft Preliminary Design Report

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

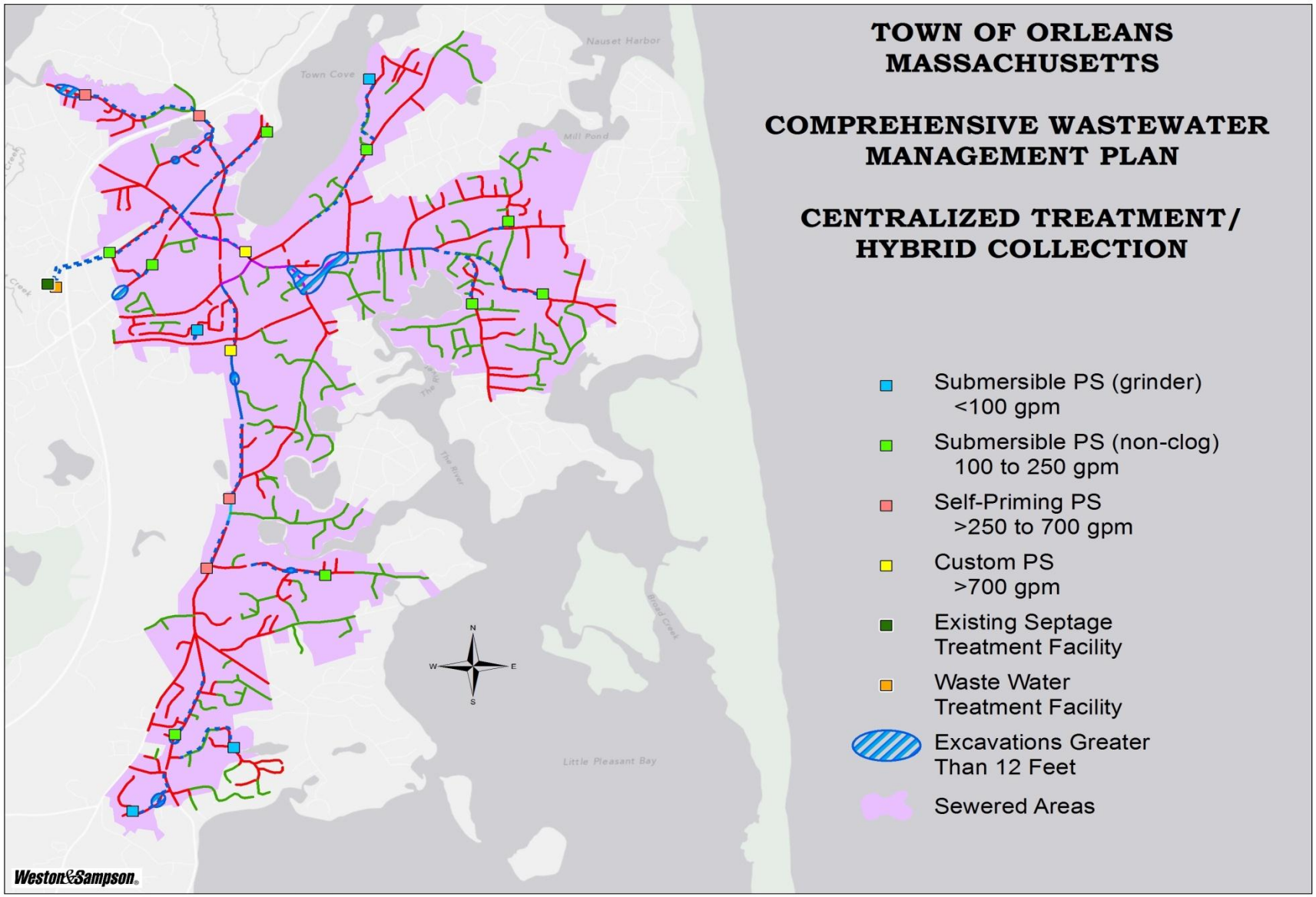
Key Issues

- 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 Sewer Summary

- 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

Low-Pressure Sewer Summary

- 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

Municipal Pump Station Summary

- 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

Septic Tank Effluent System

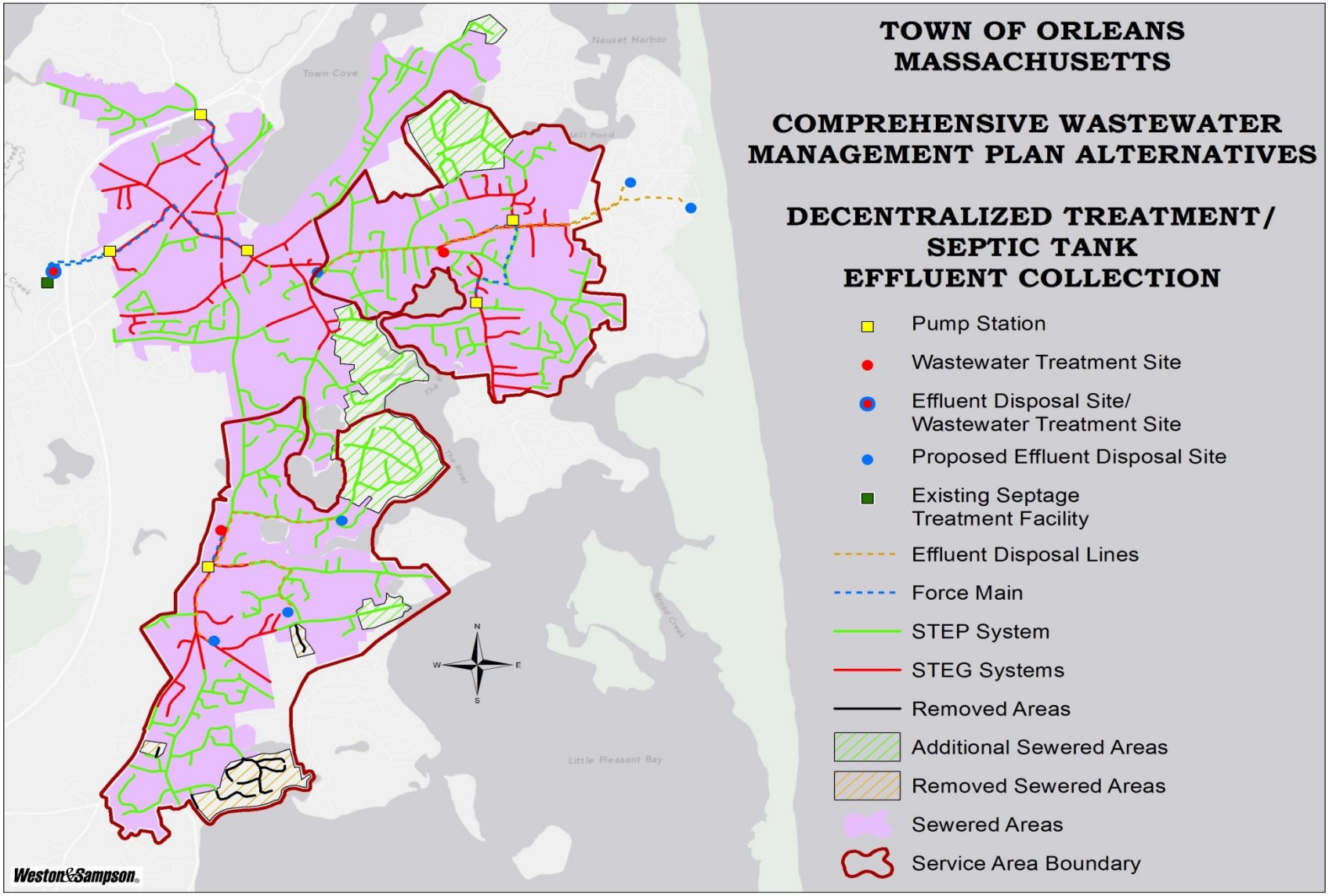
- On-site Solids Separation
- Effluent Pumping (STEP) or Gravity (STEG)
- Decentralized vs. Centralized
- Odor and Corrosion Issues
- Septic Tank Considerations
- O&M Responsibilities
  - Tank Pumping
  - Pump Maintenance

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

WEF Manual of Practice No. FD-12 (1)

- "The use of existing septic tanks has seldom been successful. Because of age, poor construction, poor installation, or homeowner abuse, existing septic tanks have proven to be one of the most significant sources of infiltration and inflow in effluent sewer systems. Unless a particular tank is known to be well-designed and manufactured, installed by a reputable installer, and effectively tested for water-tightness, it is better to replace the tank than risk it becoming a significant source of infiltration and inflow."

(1) Source: Water Environment Federation, Alternative Sewer Systems, 2nd Edition, 2008

Estimated Cost of Total Replacement

- STEP – $18,400,000
- STEG – $4,680,000
- Total – $23,080,000

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Board of Health Files

- 338 Files Reviewed
- 49 Cesspools Identified
- 157 tanks – 1978 Title 5 Code (pre-1995)
- 125 tanks – 1995 Title 5 Code (1,500 gallon tanks)
- 37% of Existing Tanks Considered for Reuse

Estimated Cost of Tank Reuse

- 3,080 Total Tanks x 37% = 1,140 Tanks
- Tank Inspections = 1,140 x $500/tank = $570,000
- Assume 75% Acceptable for Reuse = 855 Tanks
- 75 % STEP = 641 x $3,000/tank (retrofit) = $1,923,000
- 25% STEG = 214 x $700/tank (retrofit) = $149,800

Estimated Cost of Tank Reuse (cont'd)

- 1,659 New STEP Tanks = $13,272,000
- 566 New STEG Tanks = $3,396,000
- Inspections = $570,000
- 641 Retrofitted STEP Tanks = $1,923,000
- 214 Retrofitted STEG Tanks = $149,800
- Total Estimated Cost = $19,310,800
- Potential Savings = $3,769,200
- Future Replacement Costs

Collection System Capital Cost

	Centralized Hybrid	Decentralized STE
Public Way	$58,145,000	$36,070,000
On-Lot Costs	$18,125,000	$33,078,000
Construction Contingency (25%)	$19,067,000	$17,287,000
Engineering (25%)	$19,067,000	$17,287,000
Public Safety	$4,100,000	$3,100,000
Land & Legal	$540,000	$700,000
Total	**$119,044,000**	**$107,522,000**

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Road 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 (Road 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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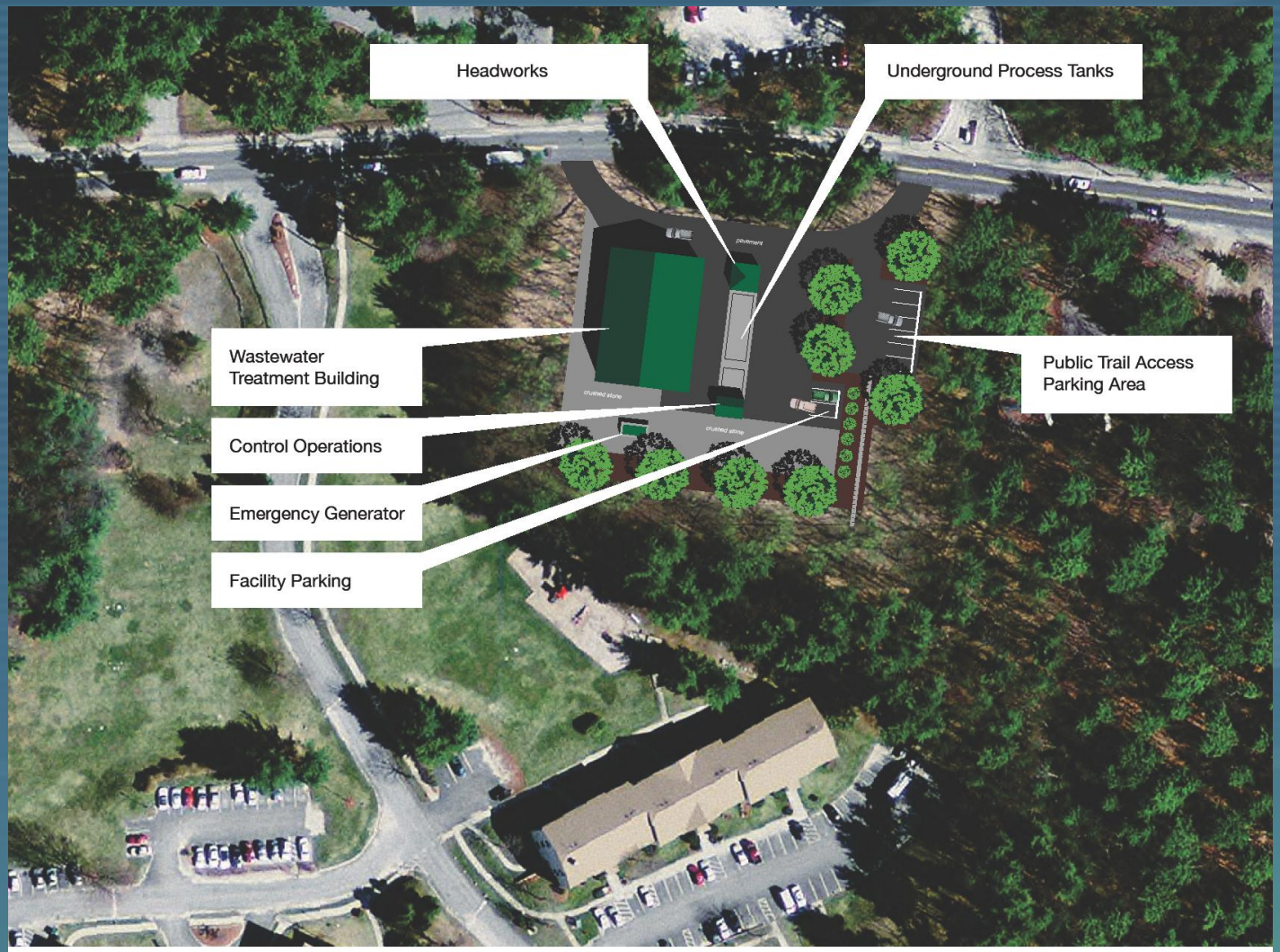
On-Lot (Private Property) Infrastructure Cost

	Centralized Hybrid	Decentralized STE
Pipe	$10,200,000	$9,825,000
Pumps/Tanks	$7,925,000	$23,253,000
Subtotal	**$18,125,000**	**$33,078,000**

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

	Centralized Hybrid	**Decentralized STE**
Total Cost	$18,125,000	$33,078,000
Number of Properties	2,830	3,080
Cost per Property	$6,404	$10,740

Wastewater Treatment Facility



DECENTRALIZED WASTEWATER TREATMENT FACILITY — CONCEPTUAL SITE PLAN

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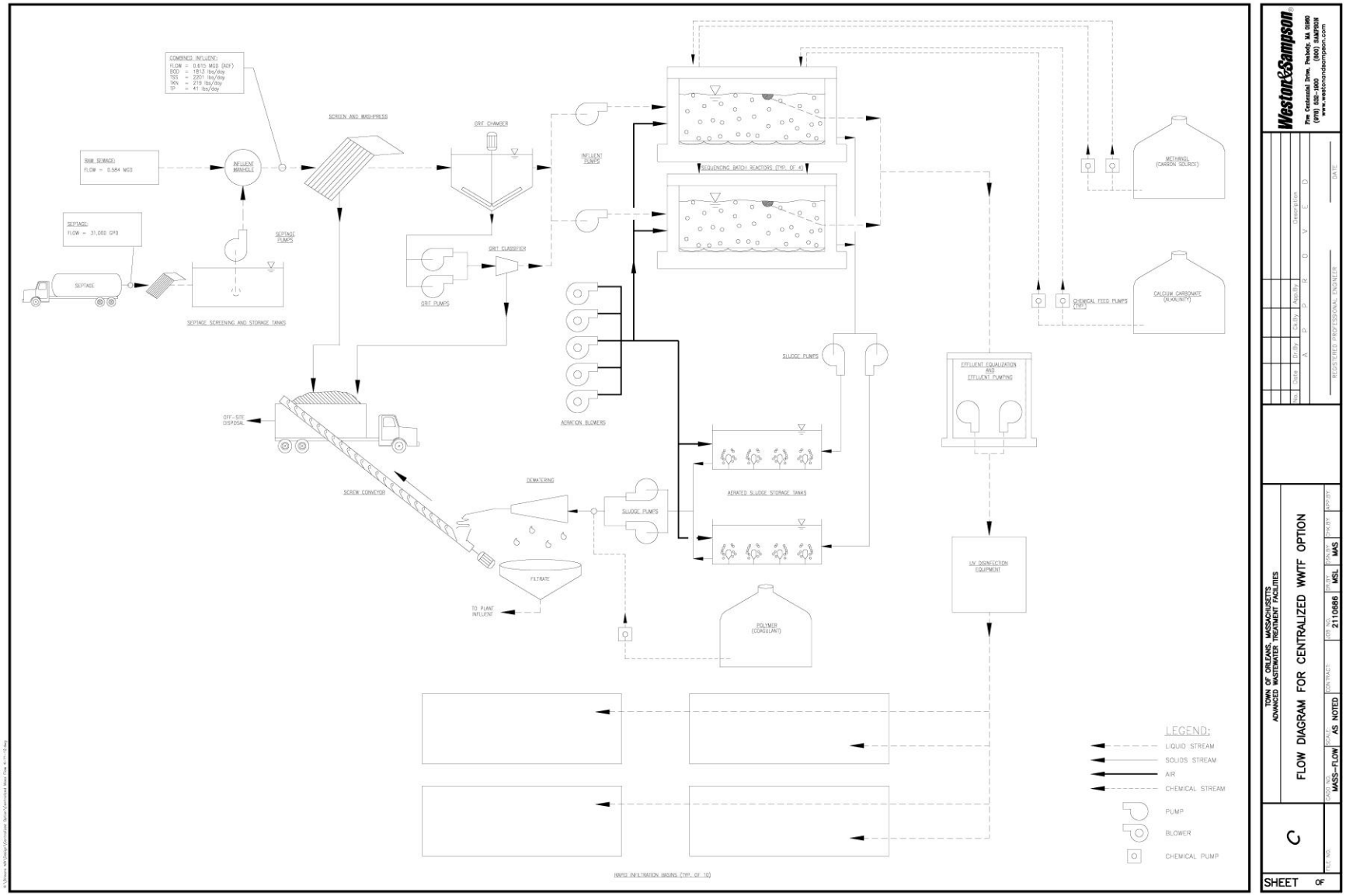
Centralized Treatment Plant

- 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

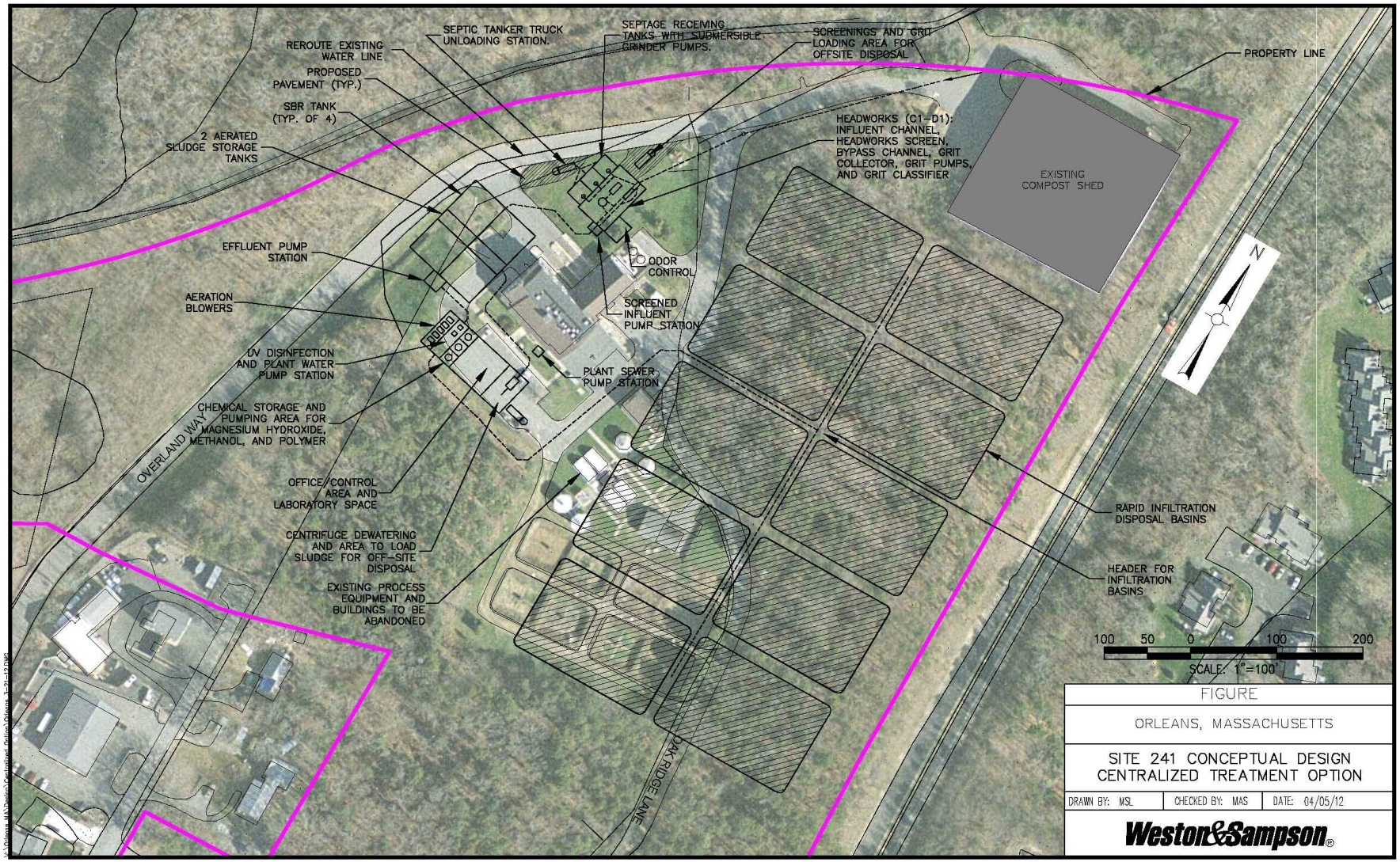
Conceptual Flow Diagram - Centralized



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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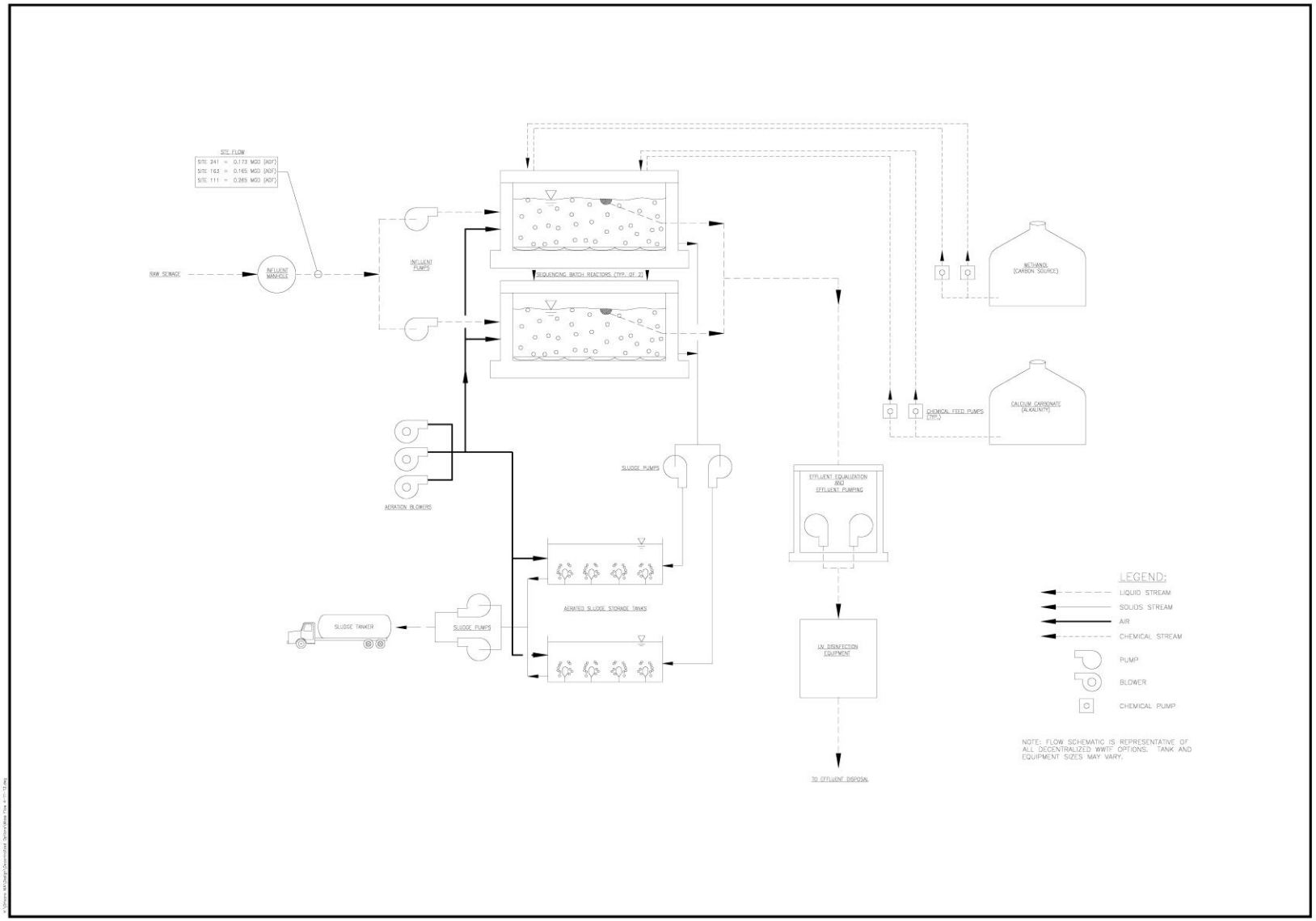
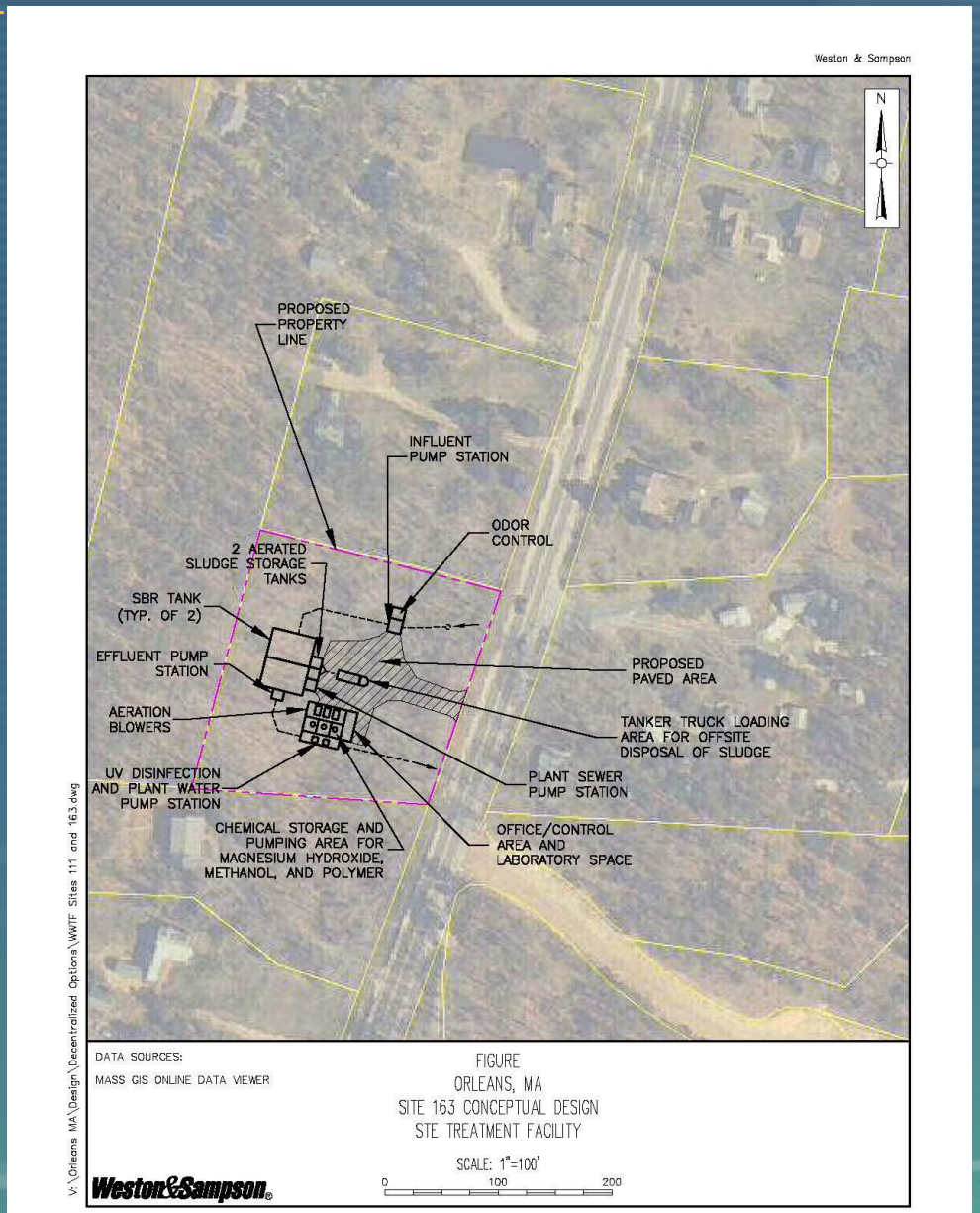
Conceptual Flow Diagram - Decentralized



Conceptual Treatment Process - Decentralized

- SBR (Biological Treatment)
- Methanol Addition (Biological Nutrient Removal)
- Effluent Equalization
- Pressurized UV Disinfection

Conceptual Site Plan - Decentralized



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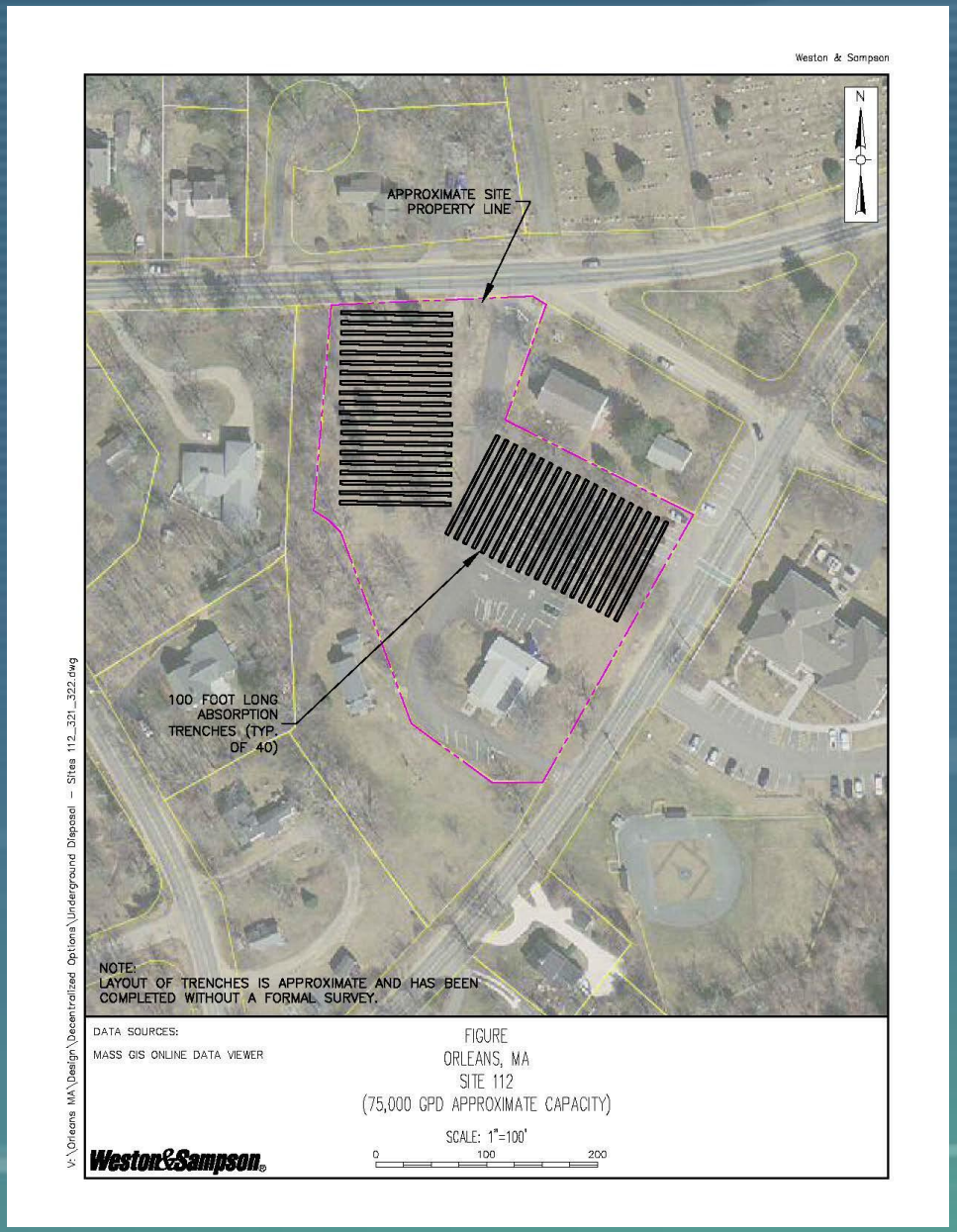
Sample Subsurface Disposal Field



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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	$119,044,000	$107,522,000
Treatment Plant(s)	$24,240,000	$34,540,000
Total	**$143,284,000**	**$142,062,000**
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	$8,762,000	$7,914,000
Treatment Plant(s)	$1,790,000	$2,560,000
Operation & Maintenance	$1,960,000	$3,210,000
Total	**$12,512,000**	**$13,684,000**

Next Steps

- Review/Comment on Draft Report
  - Town Officials
  - Independent Cost Estimator
- Final Letter Report
  - Final Public Presentation – July 18th

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Questions & Discussion