Town of Orleans

MASSACHUSETTS

Technical Review and Cost Analysis of Comprehensive Wastewater Management Plan Options

Preliminary Design

Board of Selectmen's Meeting
February 15, 2012

Weston&Sampson

Introduction/Overview

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

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
  - Independent Professional Cost Estimator
- 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)

Elements of Wastewater Management

- Collection
  - Linear Construction (Cost Implications)
  - Design Concept
  - Construction Method
- Treatment
  - Level; Process; Volume
- Disposal
  - Geophysical Conditions
- Siting (Aesthetics)

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
- Subsurface Conditions
- Method of Installation
- Surface Restoration

Approach to Preliminary Engineering Design

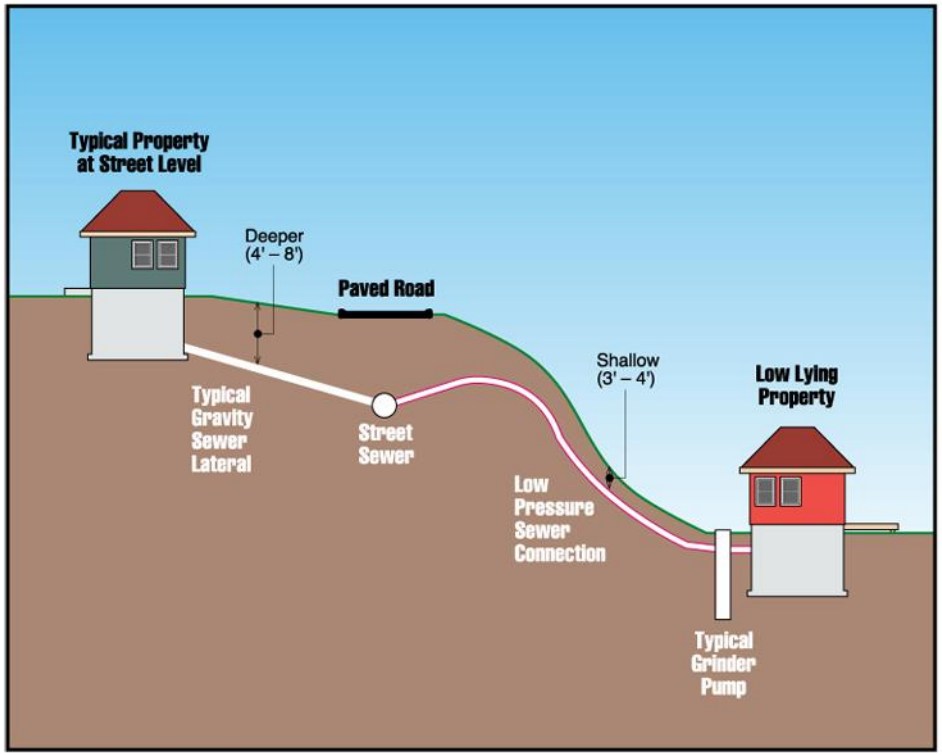
- Base Map Preparation
- Field Reconnaissance
- Generate Selected Street Profiles
- System Layouts
- Conceptual Treatment Plant Design

Centralized Sewer System

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

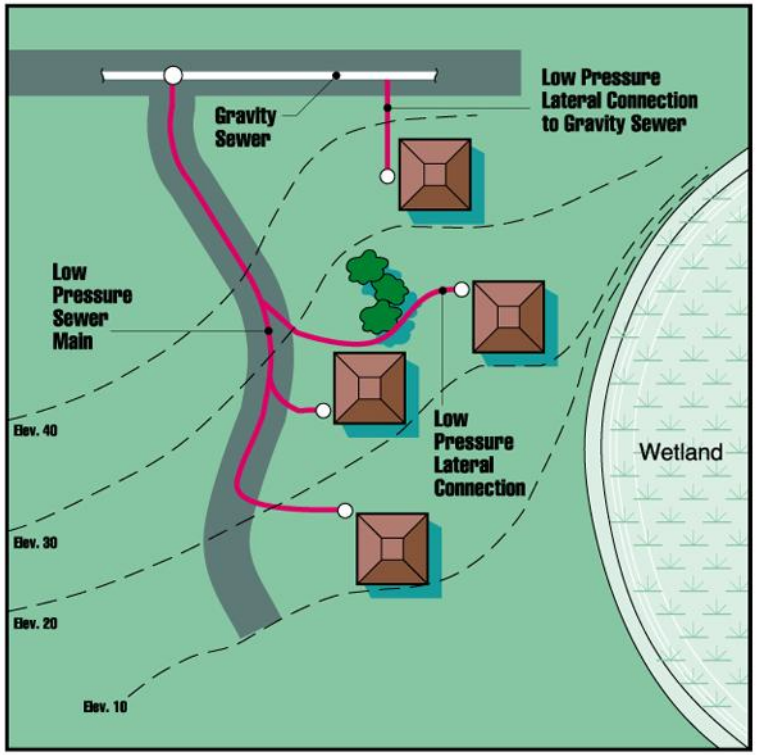
Circumstances that require the use of residential grinder pump units and/or low pressure sewers

1 Grinder pump and low pressure service connection to gravity sewer main



Required where properties are at elevations significantly lower than that of the street surface.

2 Low Pressure Sewer System



Required for roadways that fall off significantly in elevation.

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Grinder Pumps vs. Neighborhood Pump Station

Terms of Analysis = 20 years (P/A, 8%, 20) = 9.82
Interest (Discount) Rate = 8%
Equipment Replacement –
Pumps After Year – 15 (pump station); 20 (grinder pump units)

PRESENT WORTH ANALYSIS (P)

Grinder Pump Units –

1 horsepower (hp) Pump & Controls

	Cost ($)	Present Worth ($)
Capital Construction Cost	$6,000	$6,000
Operating Cost (1 hp @ ½-hr./day)	$30/year	$295 (1)
Maintenance Cost (3)	$50/year	$491 (2)
Replacement Cost (Pump after Year 20)	$1,700	$1,700
	Total Present Worth =	**$8,486**

Submersible Pump Station –

Two 5 hp Pumps, 20 kW Generator & Controls

	Cost ($)	Present Worth ($)
Capital Construction Cost	$270,000	$270,000
Operating Cost (inc. Elec., Fuel, & Misc. Spare Parts)	$2,000/year	$19,640 (1)
Maintenance Cost (150 MH/year @ $85/MH; incl. Preventative/Breakdown Maintenance)	$12,750/year	$125,205 (2)
Replacement Cost (Two Pumps after Year 15)	$8,000	$8,000
	Total Present Worth =	**$422,845**

NOTES –
(1) – Present Worth of Operating Cost = Annual Cost (A) x (P/A, 8%, 20)
(2) – Present Worth of Maintenance Cost = Annual Cost (A) x (P/A, 8%, 20)
(3) – Homeowner shall be responsible for all other maintenance costs.

COST COMPARISON OF PRESENT WORTHS

	Total Present Worth ($)
Grinder Pump Units	$8,486
Submersible Pump Station	$422,845
Pump Station Cost to Grinder Pump ($477,405/$7,586)	49.8

APPROXIMATELY 50 GRINDER PUMP UNITS EQUALS 1 SUMBERSIBLE PUMP STATION

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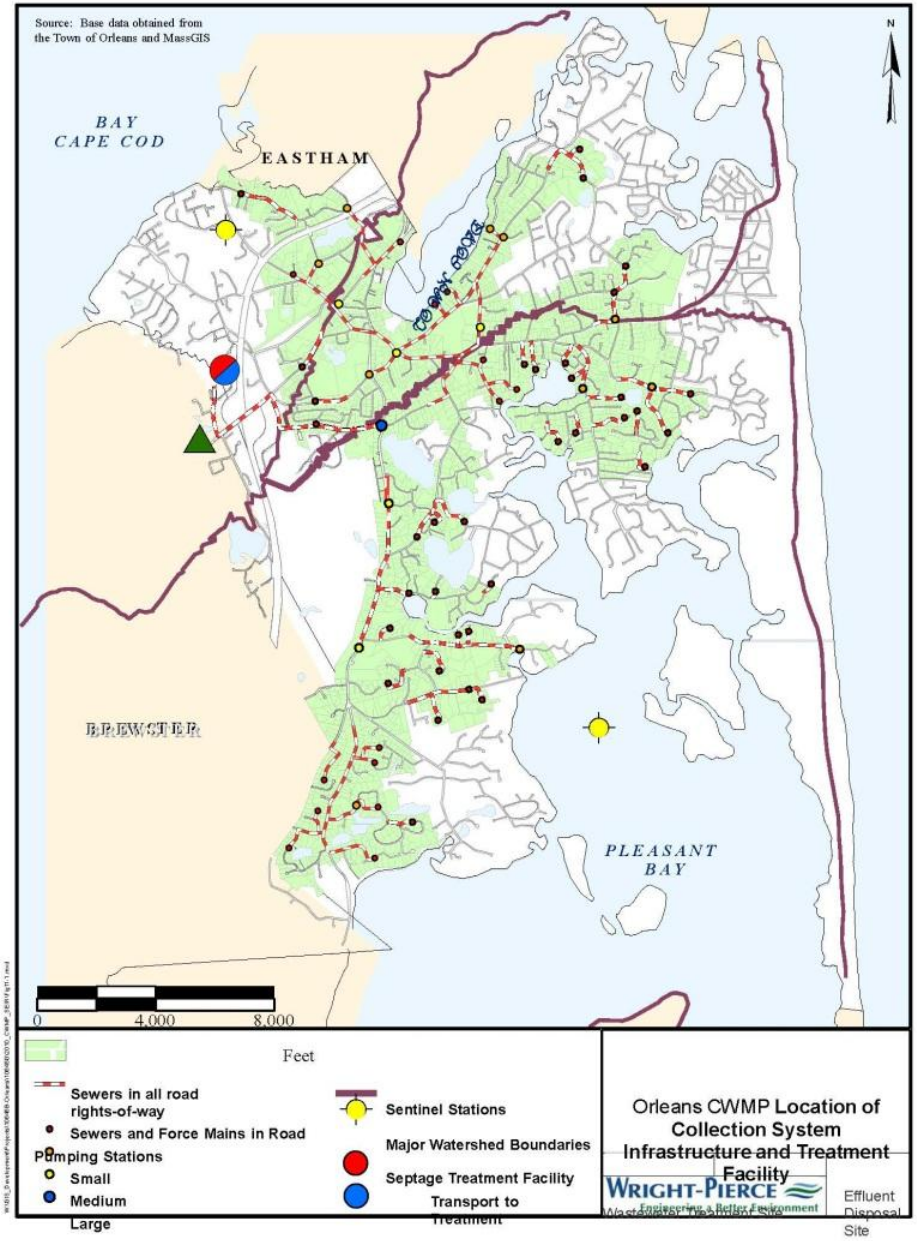
CWMP Recommended Plan



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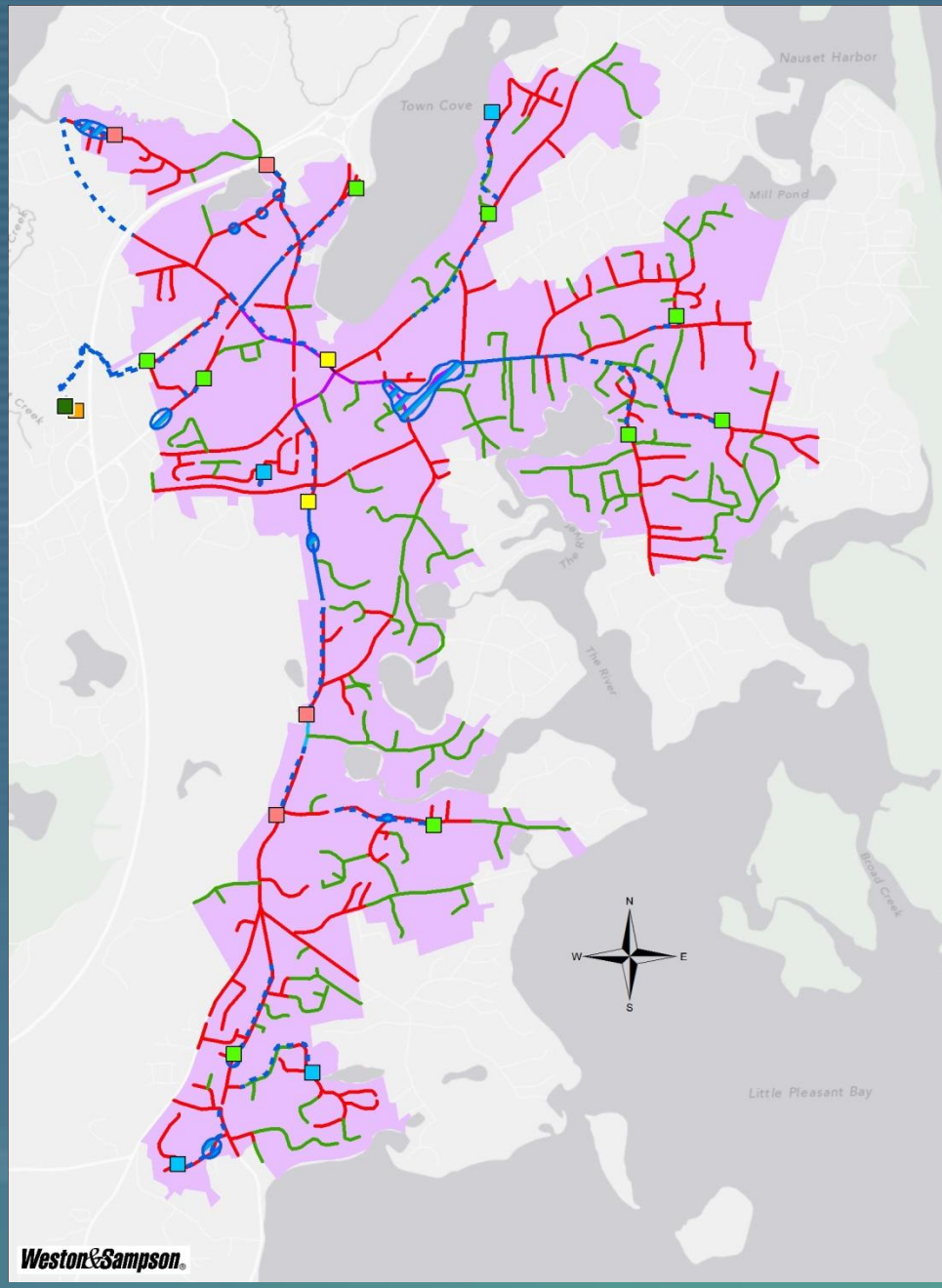
Recommended Centralized Hybrid System



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MASSACHUSETTS

COMPREHENSIVE WASTEWATER MANAGEMENT PLAN

CENTRALIZED TREATMENT/ HYBRID COLLECTION

- Submersible PS (grinder) <100 gpm
- Submersible PS (non-clog) 100 to 250 gpm
- Self-Priming PS >250 to 700 gpm
- Custom PS >700 gpm
- Existing Septage Treatment Facility
- Waste Water Treatment Facility
- Excavations Greater Than 12 Feet
- Sewered Areas

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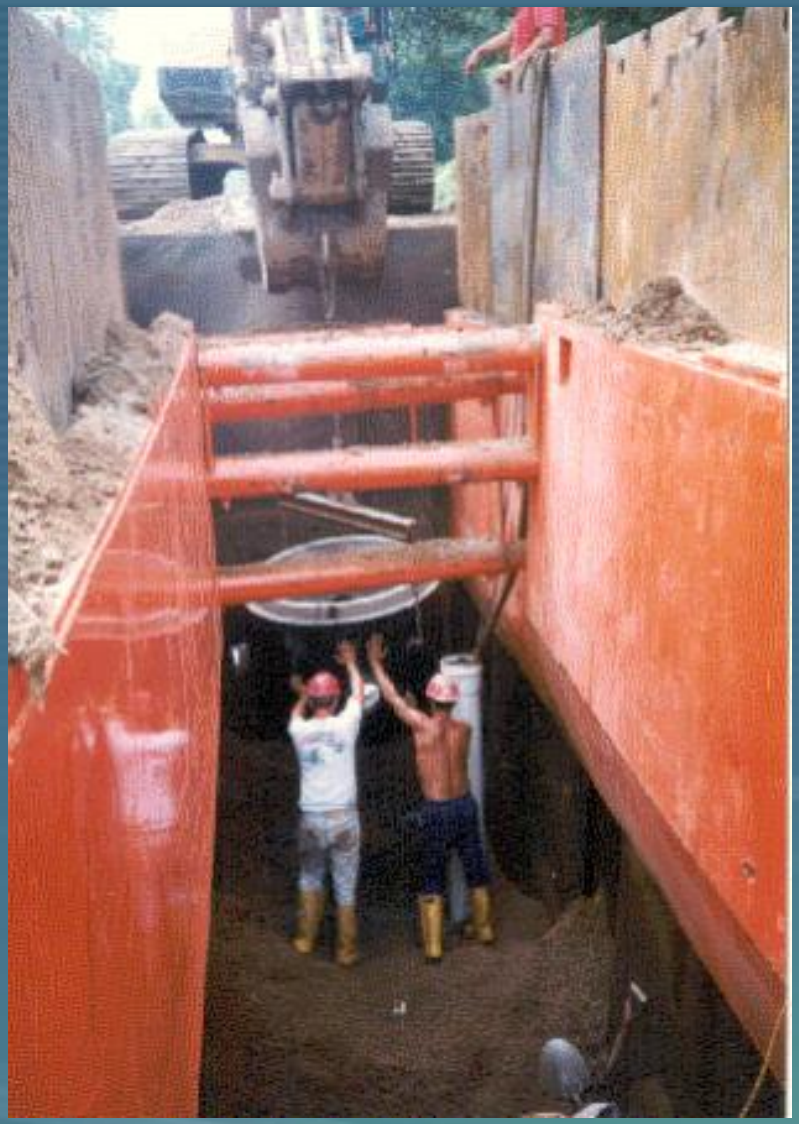
Gravity Sewers

- 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.)
  - 5,000 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
  - 13,500 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 2 and 4 Inches Diameter Pipe
  - Predominately 2 inch
- 285 Manhole Structures (Inline and Terminal)
- Approximately 1,000 Grinder Pumps (36%)
  - Operation & Maintenance Responsibilities
  - Grinder Pump Policy

Low-Pressure Sewer Installation

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Municipal Pump Stations

- 19 Wastewater Pump Stations
  - 2 Large Stations (Greater than 700 gpm)
  - 4 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

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Medium (Self-Priming) Pump Stations

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Small (Submersible) Pump Stations

CWMP Option #2 vs. Proposed System

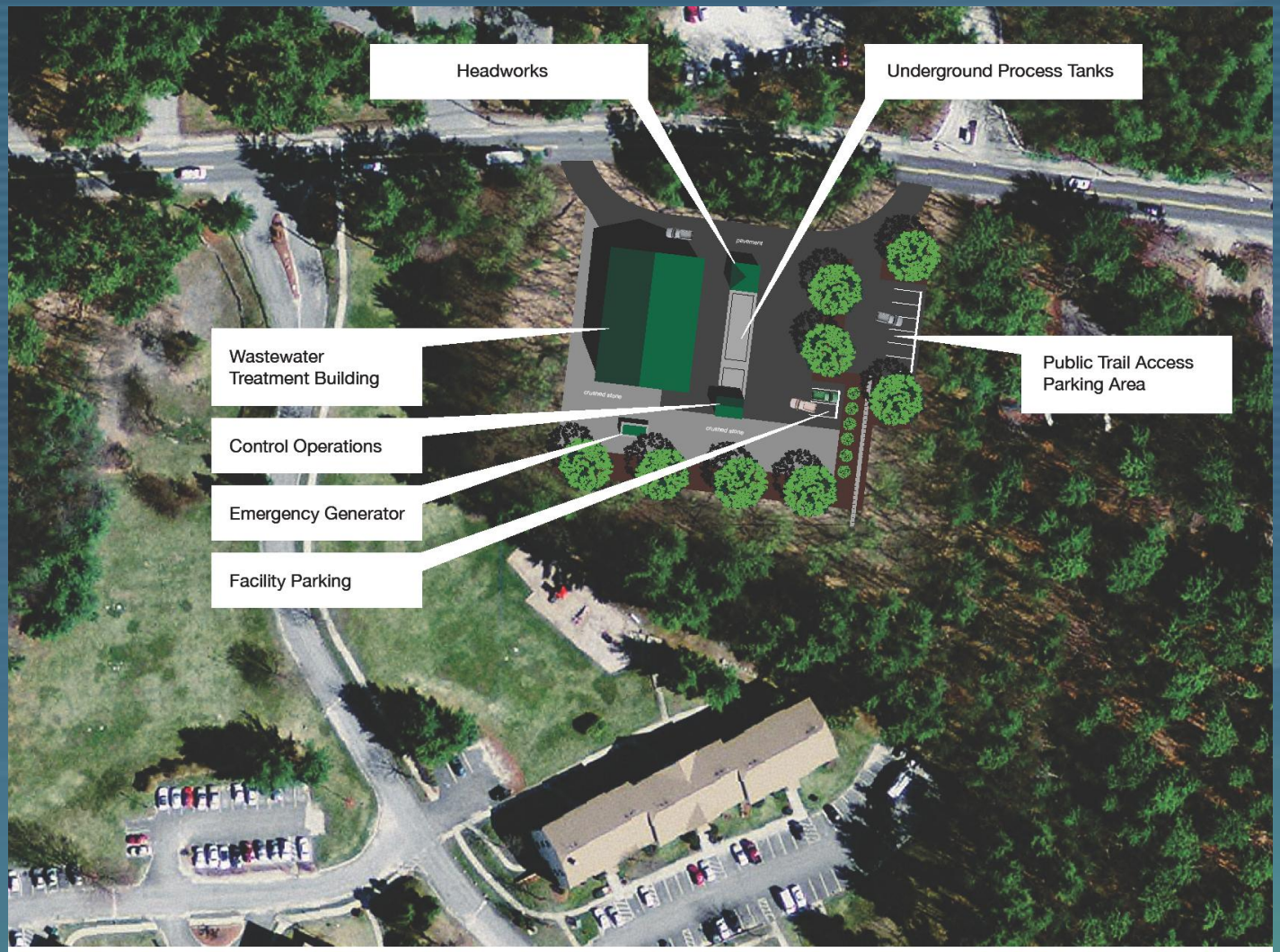
CWMP Recommended Plan

- 2,830 Properties
- 390,000 l.f. of Pipe
- 61 Pump Stations
- 78 Grinder Pumps

Proposed Hybrid System

- 2,830 Properties
- 341,000 l.f. of Pipe
- 19 Pump Stations
- 1,050 Grinder Pumps

Wastewater Treatment Facility



DECENTRALIZED WASTEWATER TREATMENT FACILITY — CONCEPTUAL SITE PLAN

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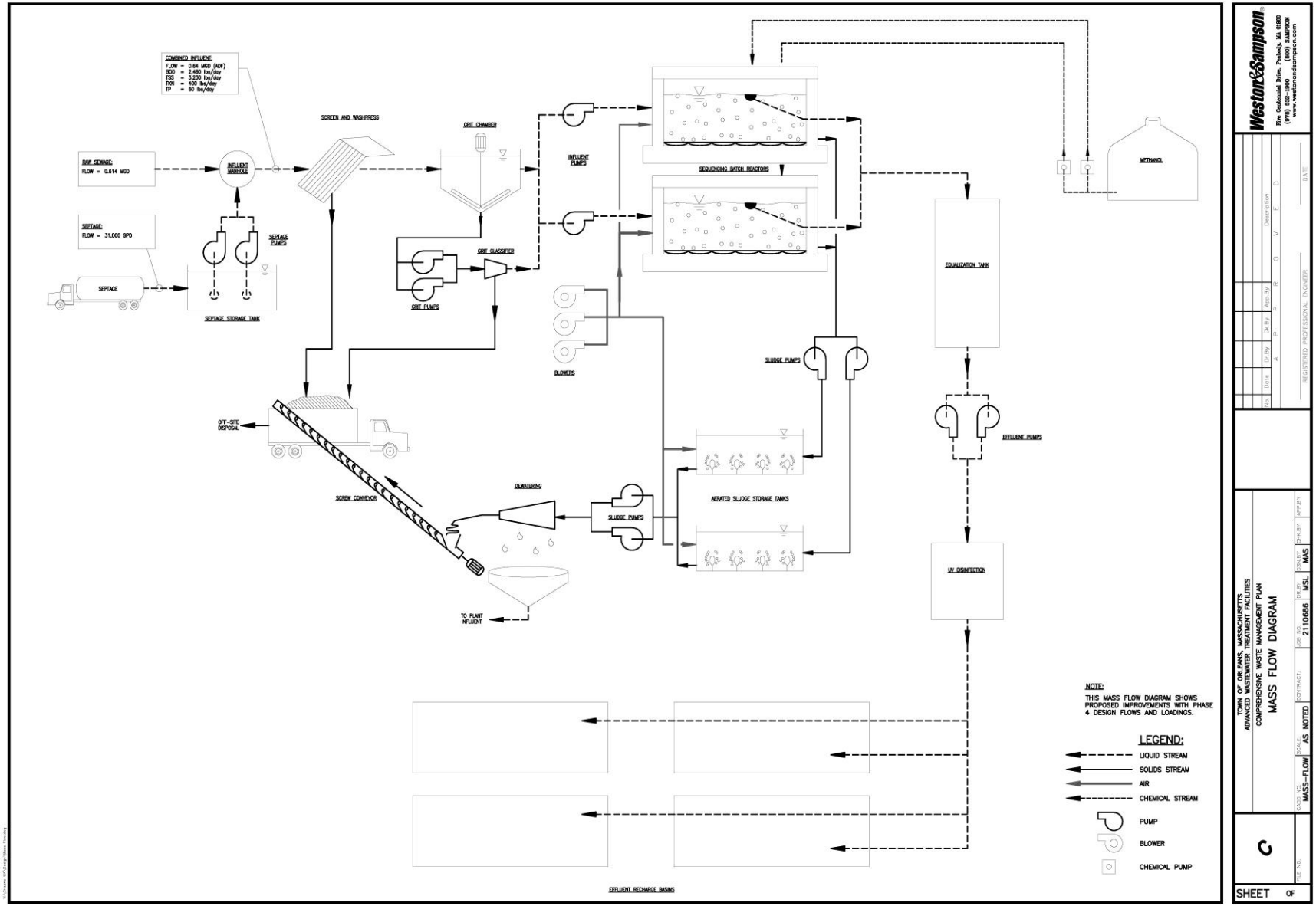
Centralized Treatment Plant

- 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

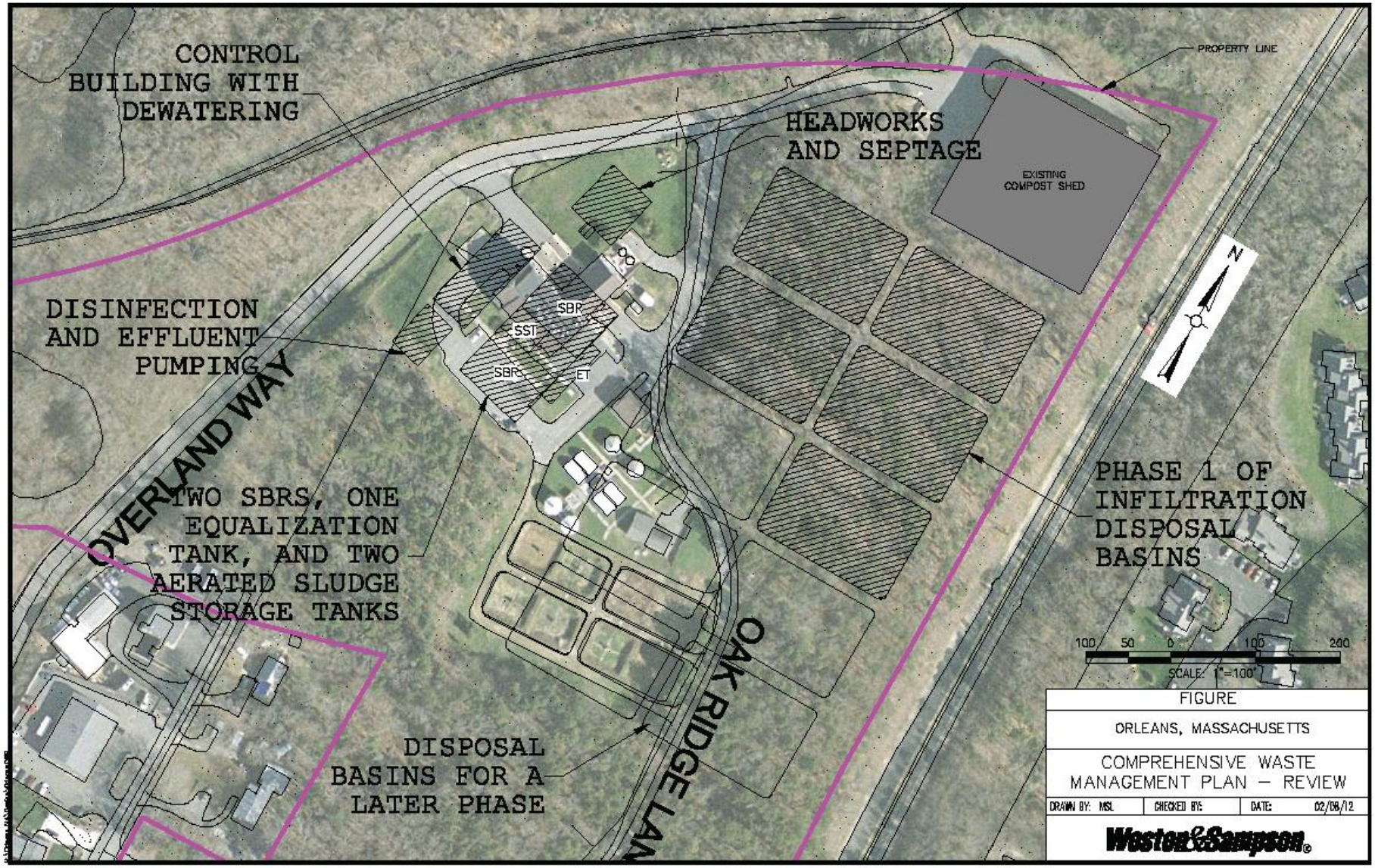
Conceptual Flow Diagram



Conceptual Treatment Process

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

Conceptual Site Plan



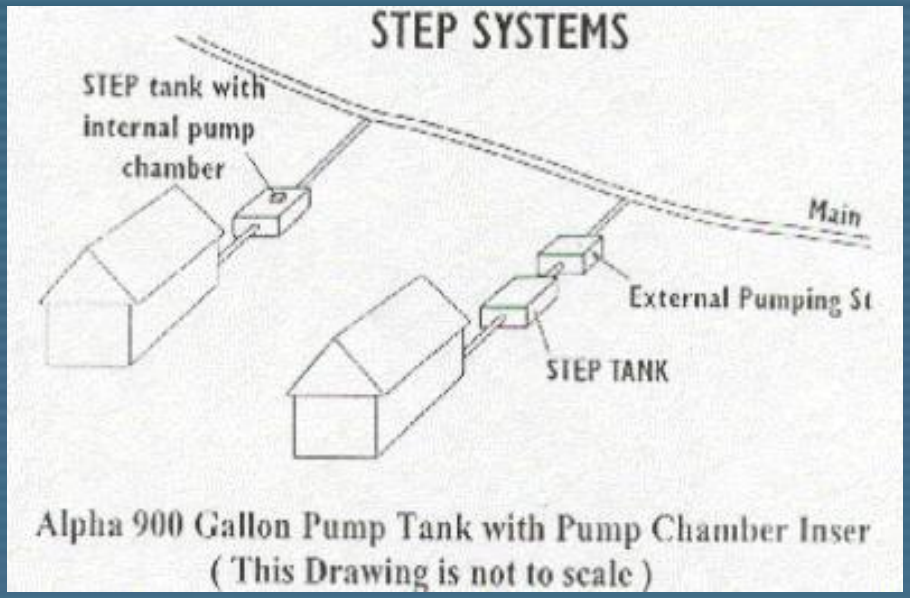
Septic Tank Effluent System

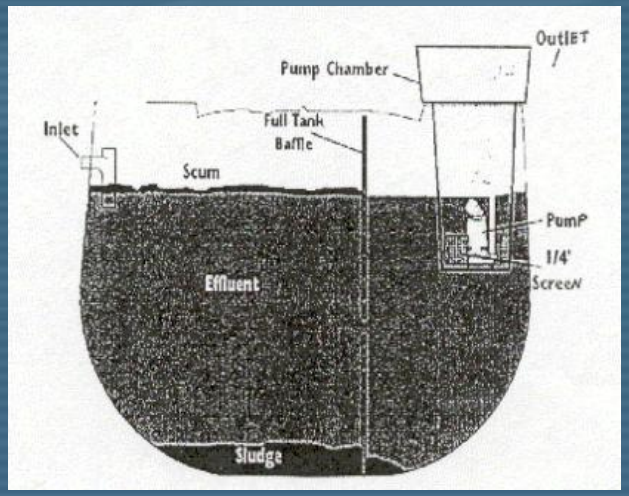
- On-site Solids Separation
- Effluent Pumping (STEP) or Gravity (STEG)
- Decentralized vs. Centralized
- Coordination with STEP Equipment Vendors
- O&M Responsibilities
  - Tank Pumping
  - Pump Maintenance

Septic Tank Effluent Pump (STEP) System

- Pressurized system, requires mechanical components
- Maintenance requirements
- Odors 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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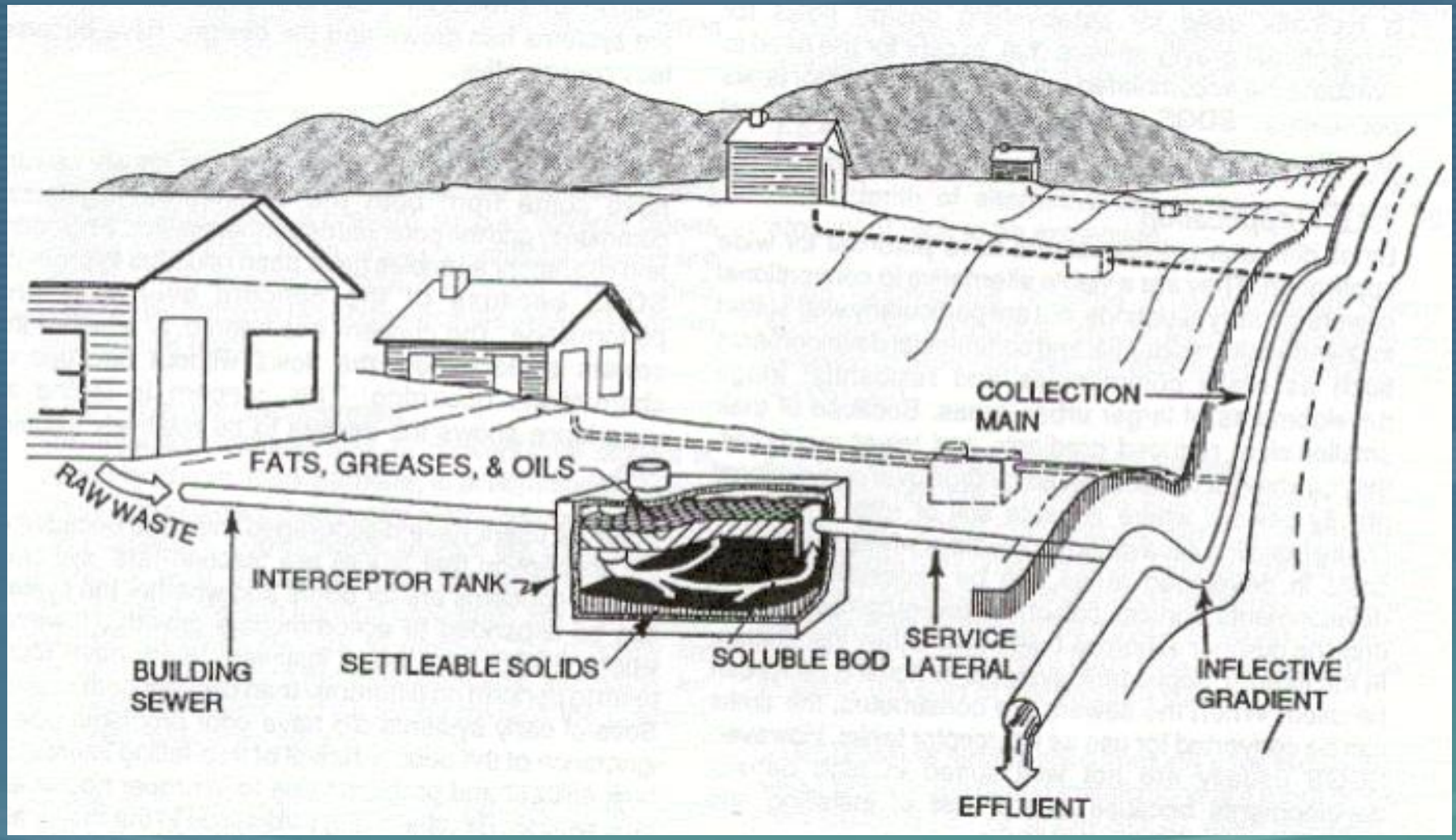
Septic Tank Effluent Gravity (STEG) System

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

STEG System (cont'd)



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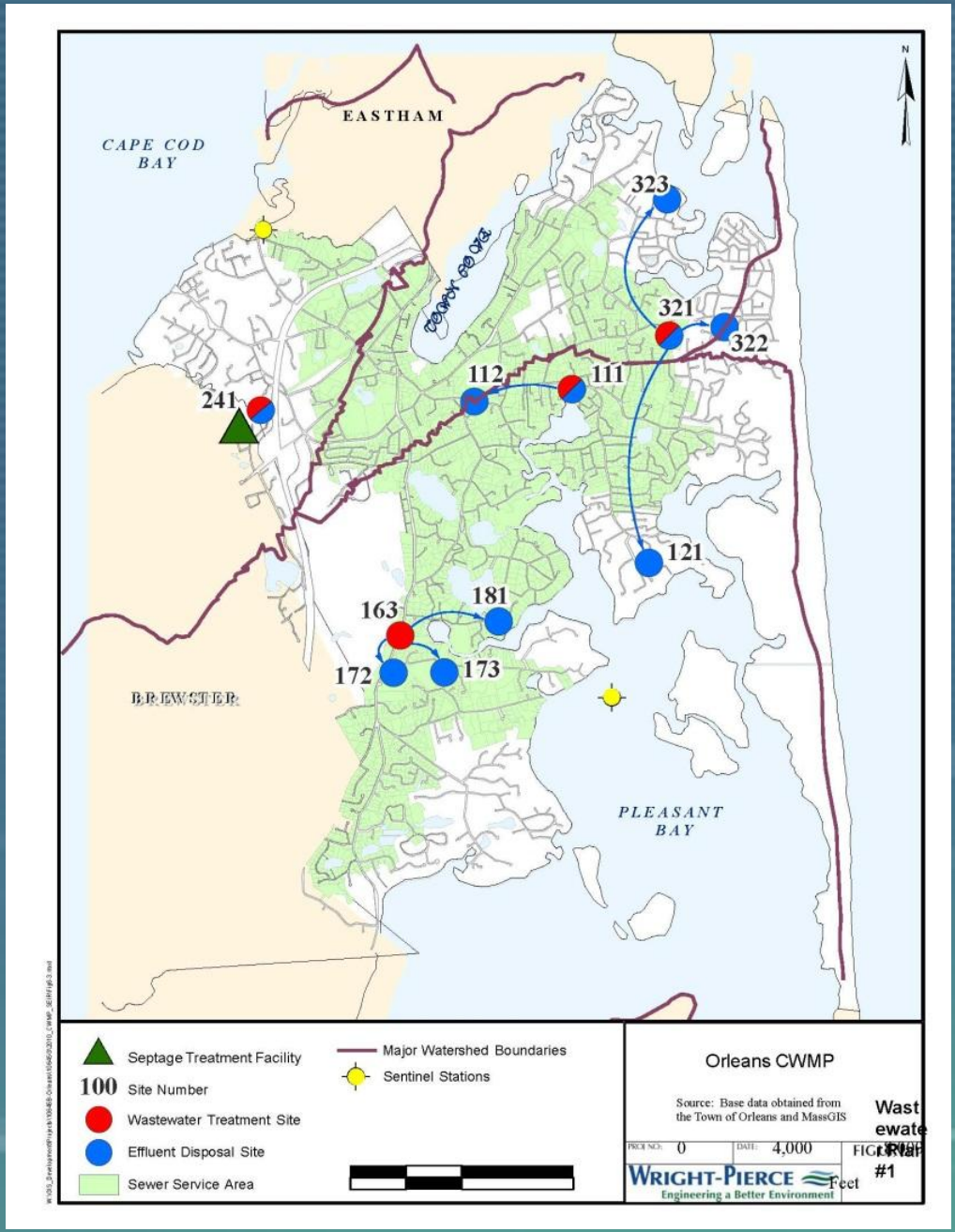
STE - Centralized vs. Decentralized

- STE Technology
  - Typically Small Systems – More Manageable
  - Small Diameter, Shallow Pipes
  - Limited Municipal Pump Stations

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

CWMP Plan #1



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Treatment and Disposal Capacities from CWMP

Treatment Sites –

- Site 163 –
  - 165,000 gpd ADF
  - 330,000 gpd Maximum Daily Flow
- Site 321 –
  - 175,000 gpd ADF
  - 350,000 gpd Maximum Daily Flow
- Site 111 –
  - 55,000 gpd ADF
  - 110,000 gpd Maximum Daily Flow
- Site 241 –
  - 150,000 gpd ADF
  - 300,000 gpd Maximum Daily Flow

Disposal Sites –

- Site 172 – 150,000 gpd
- Site 173 – 60,000 gpd
- Site 181 – 150,000 gpd
- Site 321 – 200,000 gpd
- Site 322 – 150,000 gpd
- Site 111 – 60,000 gpd
- Site 112 – 75,000 gpd
- Site 241 – 650,000 gpd

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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 – 150,000 gpd
- Site 173 – 60,000 gpd
- Site 181 – 150,000 gpd
- Site 321 – 200,000 gpd
- Site 322 – 150,000 gpd
- Site 111 – 60,000 gpd
- Site 112 – 75,000 gpd
- Site 241 – 650,000 gpd

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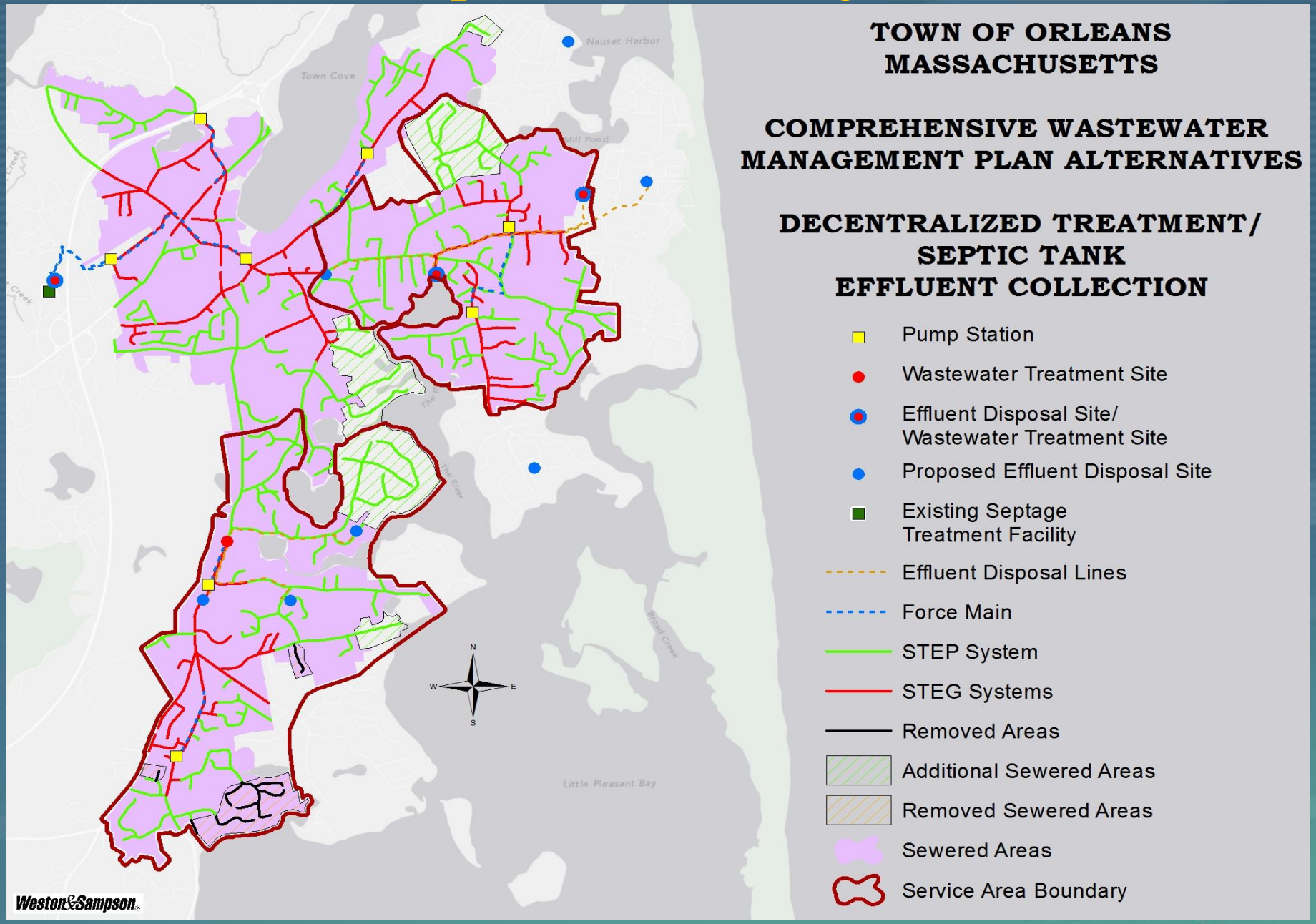
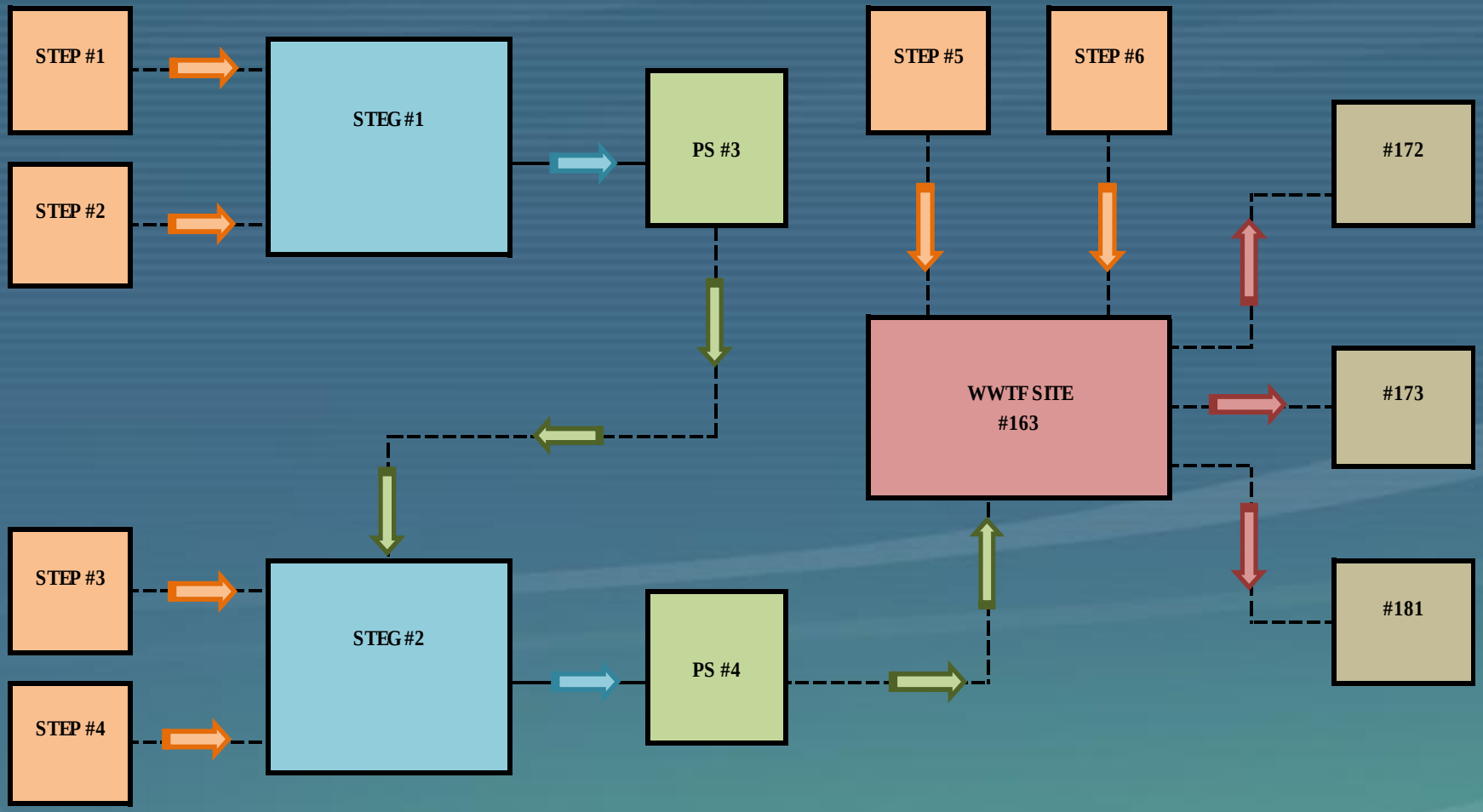
Proposed STE Layout



Site #163 Flow Diagram



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Overall Summary of STE System Components

- Modified Service Area (Nitrogen Balance)
- 370,000 l.f. of Pipe
  - 93,000 l.f. of STEG System
  - 223,000 of STEP System
  - 24,000 l.f. of Force Main
  - 29,000 l.f. of Effluent Disposal Pipe
- 2,275 STEP Pumps
- 8 Pump Stations
- 3 WWTFs
- 8 Effluent Disposal Sites
  - Rapid Infiltration and Subsurface Leaching

Centralized Hybrid vs. Decentralized STE

Centralized Hybrid

- 2,830 Properties
- 341,000 l.f. of Pipe
- 19 Pump Stations
- 1,050 Grinder Pumps

Decentralized STE

- 3,080 Properties
- 370,000 l.f. of Pipe
- 8 Pump Stations
- 2,275 STEP Pumps

Decentralized Wastewater Treatment

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Effluent Disposal

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Cost Estimates

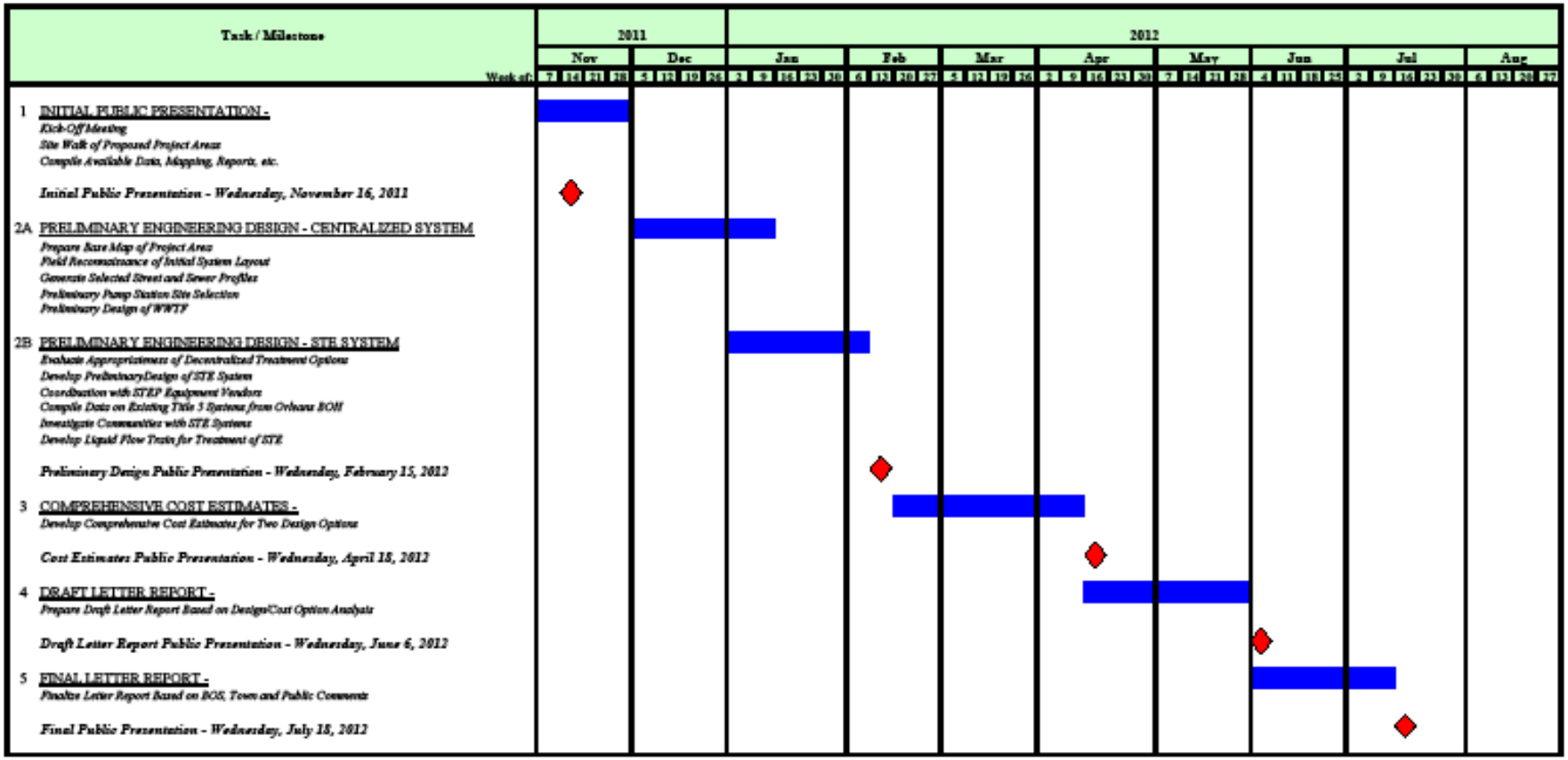
- Develop Useful and Appropriate Cost Information
- Construction Costs
  - Extensive Design & Construction Estimates
  - Data From Publicly Bid Projects
  - Weston & Sampson CMR (Construction Bidding)
  - Professional Estimating - A.M. Fogarty
- Operation & Maintenance Costs
  - Weston & Sampson Services O&M
- Life Cycle Costs (Present Worth Analysis)
- Consider All Costs (Public & Private)

Cost Considerations

- Open Cut vs. Trenchless Technologies
- Surface Restoration
  - Paved vs. Unpaved Surfaces
  - Shoulder of Road vs. Centerline
  - Trench-Width vs. Full-Width Paving
- Traffic Details
- Control Density Fill (CDF) – State Highway
- Re-use of Existing Septic Tanks
- Grinder Pumps vs. STEP Pumps

TECHNICAL REVIEW & COST ANALYSIS OF CWMP OPTIONS
TOWN OF ORLEANS, MASSACHUSETTS

REVISED PROJECT SCHEDULE (February 2012)



Results for the Town

- Support the Public Decision Making Process
- Provide Answers to Key Questions
- Emphasize Public Understanding of Issues

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Questions & Discussion