Water Resource and Wastewater Planning

Collection System Working Group

March 9, 2017

Agenda

- Regulatory Documents
- FY18 - Funding Request Rationale for Traditional Technologies
- Downtown Area PDR (25% Design) – Status
- Wastewater Treatment Facility Process Evaluation
- Septage
- Effluent Disposal Investigations
- Collection System Basis of Design
- Costs

Regulatory Documents

- “TR16, Guides for the Design of Wastewater Treatment Works” by New England Interstate Water Pollution Control Commission
- “Wastewater Engineering: Treatment, Disposal, and Reuse” by AECOM (Metcalf & Eddy)
- “Water Reuse: issues, Technologies, and Applications” by AECOM (Metcalf & Eddy)
- “Biological Wastewater Treatment” by Grady, Daigger, & Lim
- “Wastewater Treatment Plant Design: Manual of Practice (MOP 8)” by Water Environment Federation
- “Process Design Manual: Land Treatment of Municipal Wastewater – Supplement on Rapid Infiltration and Overland Flow” by United States EPA (EPA 625/1-81-013a)

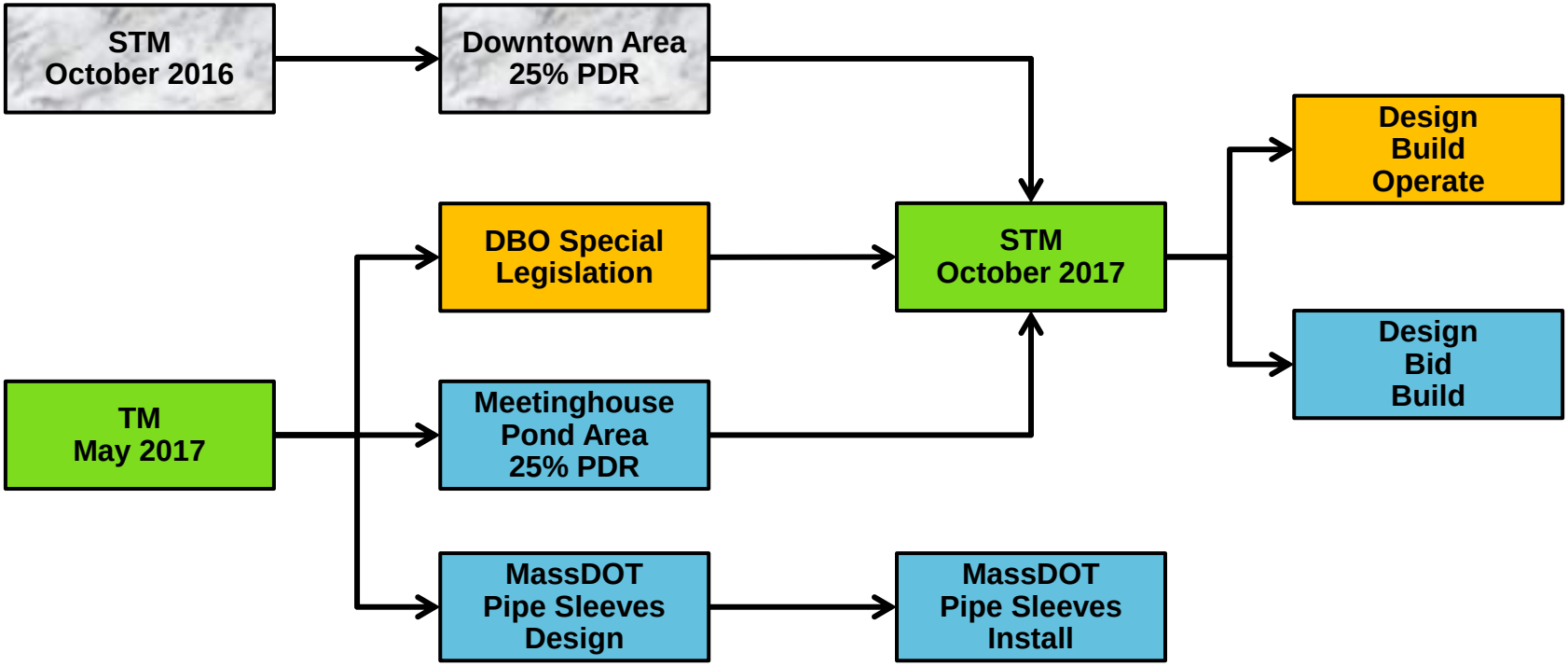
Regulatory Documents (cont.)

- "Process Design Manual: Land Treatment of Municipal Wastewater" by United States EPA (EPA 625/1-81-013)
- "310 CMR 15.00: The State Environmental Code Regulating Septic Systems (Title 5)" by MassDEP
- "Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants" by the New England Interstate Water Pollution Control Commission
- "Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal" by MassDEP

Words such as "should" and "recommended" used in the Documents are interpreted by MassDEP as "required" during their Review and approval of Contract Documents

Acknowledgement

FY18 - Funding Request Rationale for Traditional Technologies

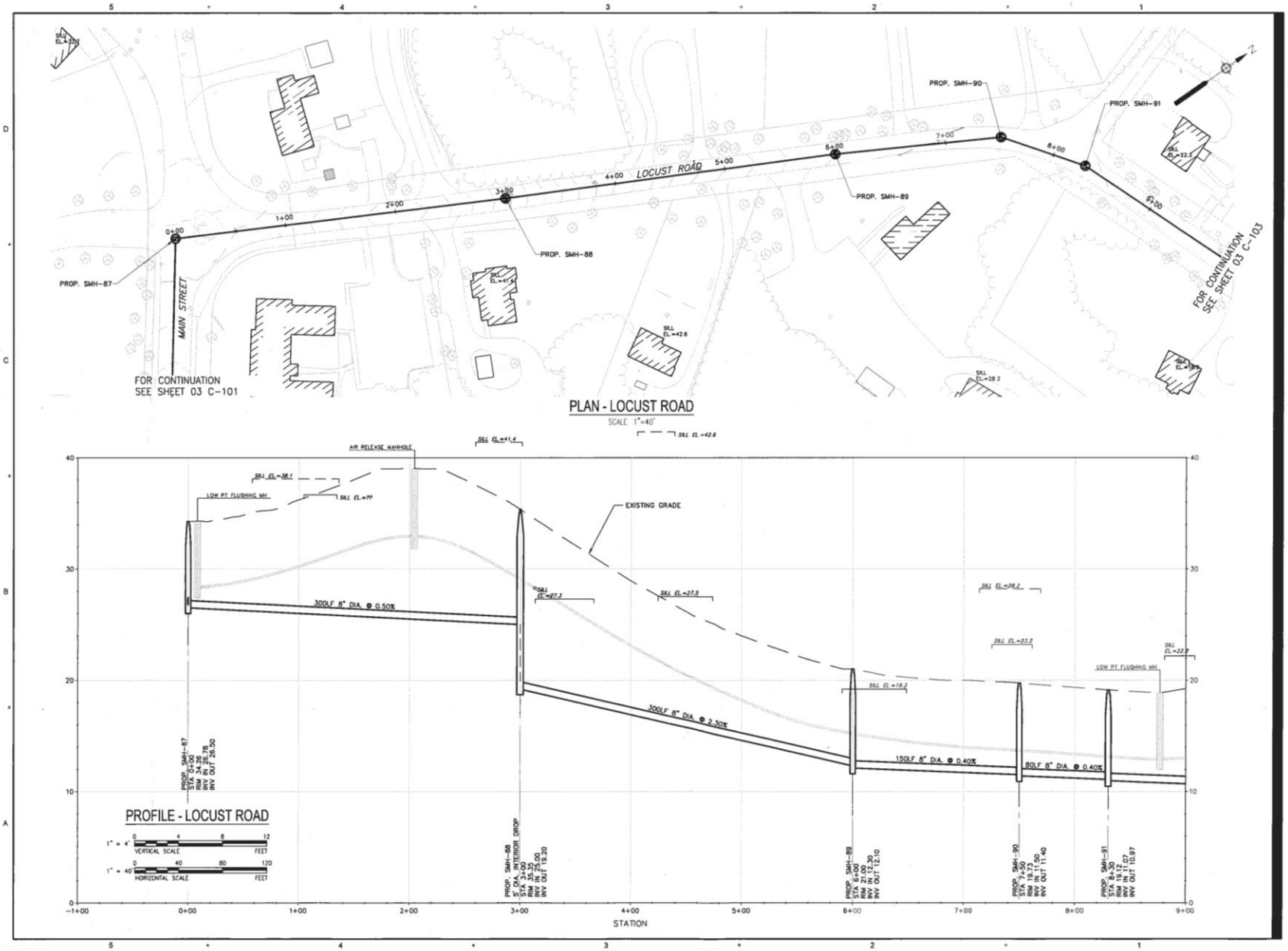


Downtown Area PDR (25% Design) – Status

- Topographic Survey
  - Ground Survey
    - Survey at the Route 6A/Route 28/Canal Road Roundabout Has Been Completed
    - Differential Leveling for Benchmarks and Plan Check is on Going
    - Acquiring Sill Elevations in the Downtown Area Has Been Completed
  - Aerial Survey
    - Ground Control Survey Has Been Completed
    - Aerial Flight Completed on 2/27/17
    - Data Processing Scheduled to be Completed by 3/17/17
- Subsurface Investigation
  - 125 Locations
    - Over 50% Complete (66 Borings)
    - Scheduled to Complete by 3/24/17
  - Nothing Unexpected Observed/Discovered to Date
    - Groundwater: Locus Road and Canal Road Area
    - Bike Path (Old Railroad) Bed Material: Old Pavement

Downtown Area PDR (25% Design) – Status (cont.)

- Cultural Resource Evaluation
  - Received Draft Report from PAL
    - Not Recommending Conducting Any Intensive Level Testing
    - Recommending Development of an Unanticipated Discoveries Plan and Monitoring During Construction
  - Preparing Draft Technical Memorandum
- Update Collection System Type Evaluation and Preliminary System Configuration
  - Added Sills
  - Updated Profiles Showing Gravity Sewer and Pressure Sewer
  - Updated Quantities
  - Reviewing Impacts from Existing Utilities



AECOM

PROJECT
Downtown Area Plans and Profiles

25% Preliminary Design Report

CLIENT
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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION

PROJECT NUMBER
60476644

Designed By:	M. CURRAN
Drawn By:	M. CURRAN
Dept Check:	T. PARECE
Proj Check:	M. DONOGHUE
Date:	----
Scale:	AS NOTED

DISCIPLINE
CIVIL
SHEET TITLE
PLAN AND PROFILE SEWER LOCUST ROAD I

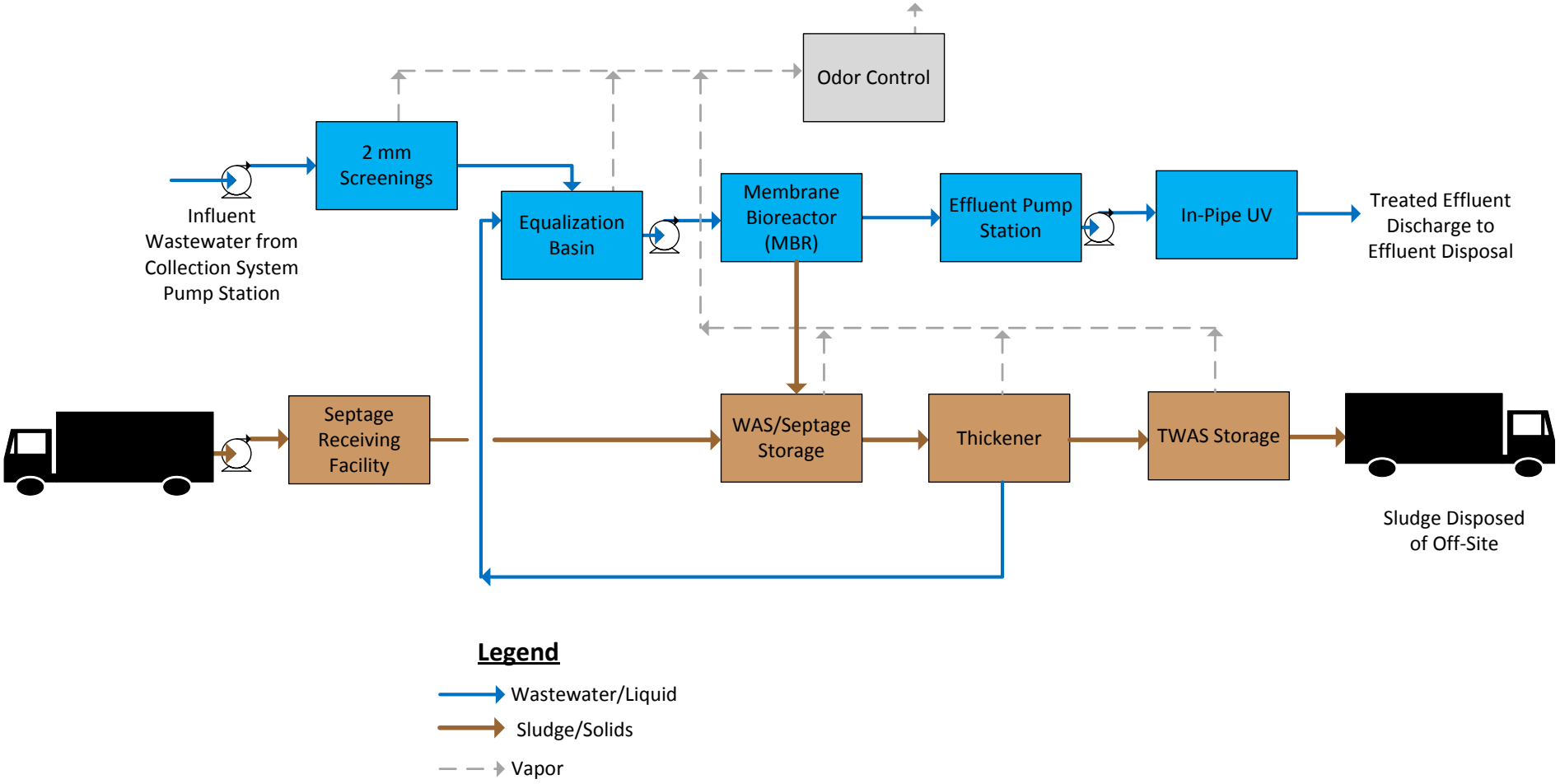
SHEET NUMBER
03 C-102

AECOM

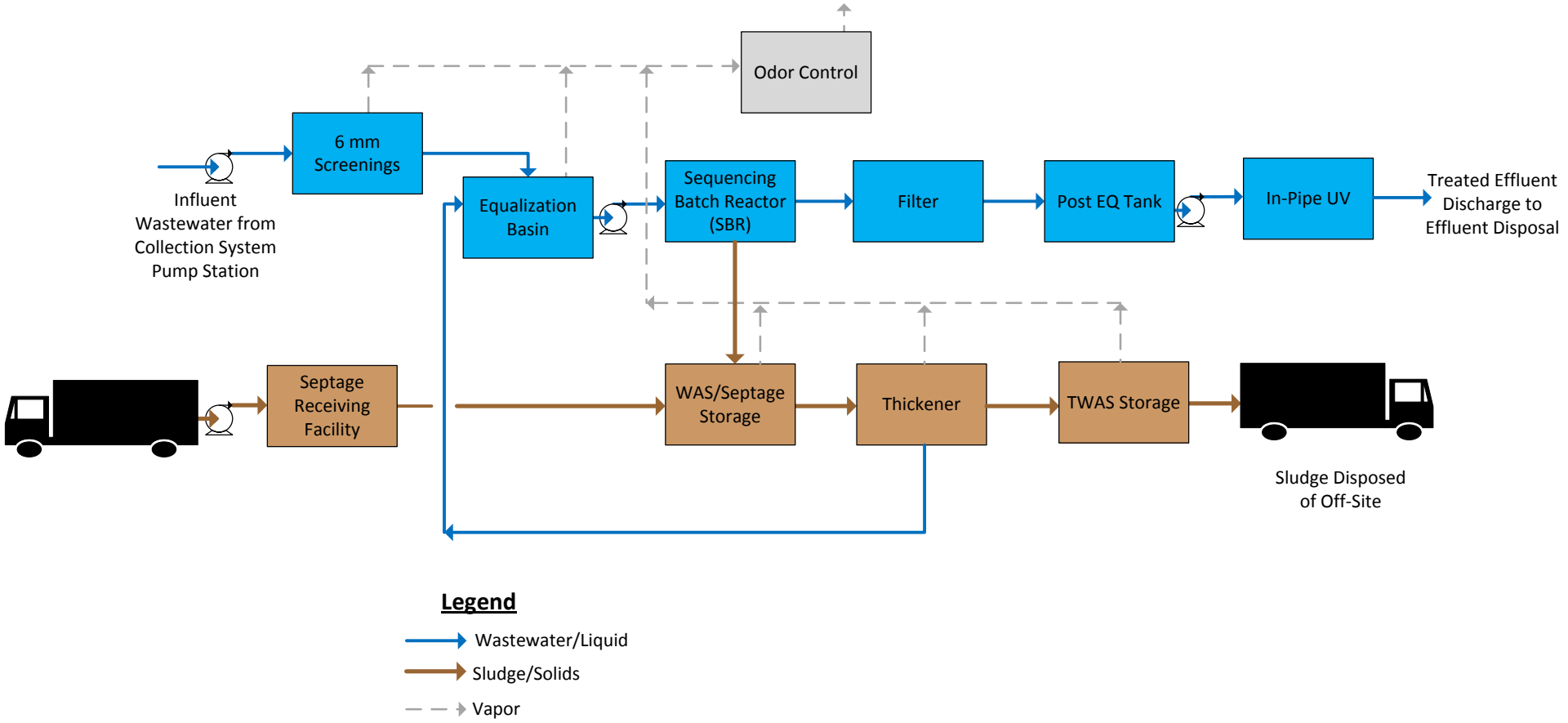
Downtown Area PDR (25% Design) – Status (cont.)

- Update WWTF Process Selection
  - Design for Sewage and Septage Receiving/Treatment
  - Two Top Candidates Identified in Concept Design Phase Being Further Explored (SBR and MBR)
  - Design to Include Biosolids Thickening but Not Dewatering
- Design Data
  - Flows Derived from Collection System Evaluation
  - Sewage Strength (Assumed medium to strong)
    - Provincetown and Chatham Used as a Reference
  - Tri-town Septage Treatment Facility Data Used for Septage Characteristics
  - Anticipated Effluent Requirements
    - BOD & TSS <= 30 mg/l
    - TN <= 10 mg/l
    - Designing for Lower Limits

Wastewater Treatment Facility Process Evaluation
MBR Conceptual Design



Wastewater Treatment Facility Process Evaluation (cont.)
SBR Conceptual Design



Wastewater Treatment Facility Process Evaluation (cont.)
Process Component Caparison

	Option – 1 SBR Treating Sewage/Septage	Option – 2 MBR Treating Sewage/Septage	MBR Treating STEP Effluent
Screening	X (6 mm)	X (2 mm)	X (2 mm)
Pre-Equalization	X	X	X
Biological Process	X	X (smaller than Opt–1)	X (smaller than Opt-2)
Post Filtration	X		
Post-Equalization	X		
Disinfection	X	X	X
Septage Receiving	X	X	X
Biosolids Storage	X	X	X (slightly smaller than Opt-2)
Biosolids Thickening/Storage	X	X	X
Supplemental Carbon Addition			X

Wastewater Treatment Facility Process Evaluation (cont.)
Comparison of Wastewater Characteristics

	Sewage[1]	Septage[2]	Sewage/Septage Blend[3]	STEP Effluent[4]	Comments
BOD, mg/l	270	2,300	275	270	
TSS, mg/l	310	3,600	300	75	
TN, mg/l	55	1,600	60	120	Achieving Effluent TN of 10 mg/l or less with STEP Effluent Could Prove Difficult

Notes:

1. Sewage characteristics based on “medium to strong” typical values, cross checked with Provincetown and Chatham data where available.
2. Septage characteristics based on Tri-town Septage Treatment Facility supplemented with EPA guidelines as needed.
3. Sewage/septage blend characteristics assume blending after septage thickening.
4. STEP effluent characteristics based on Septage Characteristics, but assuming 98% solids capture in septic tank.

Septage

- Septage Processing was Previously Evaluated (Ref Task 1.c TM Dated April 4, 2016)
- Incremental Capital Costs Estimated at $500,000
- Incremental O&M Costs Estimated at $225,000/year
- Break-even Tipping Fee Using Annual O&M and Amortized Capital Costs = $0.05/gallon
- Market Price Conservative at $0.10/gallon
- Delta Represents Revenue Opportunity for Town

Table 2-2. Characteristics of Septage: Conventional Parameters (1)

Parameter	Concentration (mg/L)		
	Average	Minimum	Maximum
Total solids	34,106	1,132	130,475
Total volatile solids	23,100	353	71,402
Total suspended solids	12,862	310	93,378
Volatile suspended solids	9,027	95	51,500
Biochemical oxygen demand	6,480	440	78,600
Chemical oxygen demand	31,900	1,500	703,000
Total Kjeldahl nitrogen	588	66	1,060
Ammonia nitrogen	97	3	116
Total phosphorus	210	20	760
Alkalinity	970	522	4,190
Grease	5,600	208	23,368
pH	—	1.5	12.6

Effluent Disposal Investigations

- MassDEP Approved Hydrogeology Evaluations
  - Orleans Market Place – 140,000 gpd
  - 223 Beach Road – 200,000 gpd
- Ongoing / Planned Hydrogeology Evaluations
  - Site 1/1A
  - Route 6 – Exit 12 Cloverleaf
  - Nauset Regional School District Pending FY18 Town Meeting Funding

The Town of Orleans Has Not Decided on the Location(s) for Effluent Disposal

Collection System Basis of Design
General

- Sizing of a Wastewater Collection System (Initial, Design and Future)
  - Minimum Flows
  - Maximum Daily Flows
  - Maximum Hourly Flows
  - Seasonal Flows
  - Required Peaking Factors
- Flow Types Impact the Sizing of Collection Lines including Gravity Sewers, Pressure Sewers and Force Mains
- Some Other Considerations
  - Expansion
  - Change in Use
  - Zoning Changes
  - Utilities
  - Environmental
  - Historical

Collection System Basis of Design (cont.)
General

- Impacts of Improperly Designed Collection System
  - Odors
  - Sewer Overflows
  - Excessive Operating Costs
  - Short Equipment Life and Excess Energy Costs Due to Equipment Operating Outside of their Normal Operating Range
  - Lack of Flexibility for Future Conditions

Collection System Basis of Design (cont.)
Gravity Sewers

- Design Criteria
  - Velocity: 2 to 12 Feet per Second
  - I/I Allowance: 200 to 500 gpd/inch diameter/mile
  - Minimum Cover: 4 feet
  - Minimum Size: Building Sewer 4-inch; and Municipal Sewer = 8-inch
  - Materials: PVC, Ductile Iron, Reinforced Concrete or Other Material Approved by MassDEP
  - Location to Water Supplies: 10 feet Horizontally and 18-inches Vertically (Unless cased piping is used for necessary crossings)
- Components
  - Manholes
  - Drop Manholes
  - Chimneys
  - Cleanout/Check Valve at Property Line

Collection System Basis of Design (cont.)
Pressure Sewers (LPS and STEP)

- Design Criteria
  - Minimum Velocity: 3 Feet per Second
  - Minimum Cover: 4 feet
  - Minimum Size: 1-1/4-inch
  - Materials: Class 200 PVC, Ductile Iron, HDPE
  - Location to Water Supplies: 10 feet Horizontally and 18-inches Vertically (Unless cased piping is used for necessary crossings)
- Components
  - Isolation Valves
  - Air Release Valves
  - Cleanouts
  - Check Valve at Property Line
  - Electrical – Pumps, Control Panels, Transfer Switches
  - Septic Tank (1,500 gallon) - STEP

Collection System Basis of Design (cont.)
Force Mains

- Design Criteria
  - Minimum Velocity: 3 Feet per Second
  - Minimum Cover: 4 feet
  - Minimum Size: 3-inch
  - Materials: PVC, Ductile Iron, HDPE
  - Location to Water Supplies: 10 feet Horizontally and 18-inches Vertically (Unless cased piping is used for necessary crossings)
- Components
  - Isolation Valves
  - Air Release Valves
  - Cleanouts

Collection System
Operation and Maintenance – Septic Systems

- Regular Maintenance
  - Single Most Important Consideration To Make Sure the System Works Well Over Time
  - While Pumping Frequency is a Function of Use, MassDEP Recommends that Systems be Pumped at Least Once Every Three Years for Properties Not Having a Garbage Disposal and Every Year for Properties with a Garbage Disposal

- Cost Estimate
  - Survey by Committee Member: $380 per 1,500 Gallon Tank
  - Using Cost of $450 Average Cost for Residential and Non-residential Properties (Pump-out and Inspection) Every Three Years. Higher Cost Accounts for Significant Number of Non-Residential Properties

The Town of Orleans has not Decided What Entity will be Responsible for the Management of the System (Public and/or Private Property Components)

Comparison of On-Site Estimated Unit Prices
STEP and LPS

Description	STEP Simplex	STEP Duplex	LPS
Pump Out and Abandon Septic Tank	$750	$750	$750
Access Equipment (2 ft and 4 ft Burial Depth)	$382	$382	$0
New Septic Tank (1,500 gallons)	$1,750	$1,750	$0
STEP Pumping Equipment	$1,433	$2,363	$2,750
10-Year Warranty	$25	$50	$50
Control Panel (Non-Telemetry)	$450	$1,266	$750
Connection (Ball Valve and Check Valve)	$250	$250	$250
Piping (75 LF at $25)	$1,875	$1,875	$1,875
Electrical (Service Upgrade Not Included)	$750	$750	$750
Installation Estimate (60% of Materials)	$4,149	$5,212	$3,855
Shipping Estimate (10% of Materials)	$767	$944	$718
Site Restoration	$1,000	$1,000	$750
Totals	**$13,581**	**$16,591**	**$12,498**
Unit Price Used	**$13,600**	**$16,600**	**$12,500**

Estimated Capital Costs
STEP and LPS – Downtown Area

Description	STEP Simplex	STEP Duplex	LPS
Pressure Pipe (29,600 lf at $100/lf)	$2,960,000	$2,960,000	$2,960,000
Pump Equipment and Controls	$4,596,800	$5,610,800	$4,225,000
Pump Station (1) *	$585,000	$585,000	$585,000
Force Main (2,200 lf at $125/lf) *	$264,000	$264,000	$264,000
Subtotals	$8,405,800	$9,419,800	$8,034,000
Mobilization and Demobilization (5%)	$420,290	$470,990	$401,700
Subtotals	$8,826,090	$9,890,790	$8,435,700
Overhead and Profit (22%)	$1,941,700	$2,176,000	$1,855,900
Subtotals	$10,767,790	$12,066,790	$10,291,600
Contingency (15%)	$1,615,200	$1,810,000	$1,543,700
Town Administration/Engineering (35%)	$4,583,900	$5,106,800	$4,392,400
Totals	$16,966,890	$18,983,590	$16,227,700

* Increased Process Flexibility at the WWTF

On-Site Estimated Annual Costs
STEP and LPS – Downtown Area

Description	STEP Simplex	STEP Duplex	LPS
Operation and Maintenance Costs			
Operations	$152,100	$152,100	$152,100
Utilities, Chemicals, etc.	$40,000	$40,000	$40,000
Clean and TV - Pressure Pipes (25% per year)	$15,900	$15,900	$15,900
Private Property - Pumps/Valves	$42,250	$42,250	$42,250
On-Site System Pump Out ($450 per 3 years)	$50,700	$50,700	$0
Replacement Costs			
Allowance - Pump Stations	$14,625	$14,625	$14,625
Private Property - Pumps/Valves	$42,250	$42,250	$42,250
Monitoring Costs			
Allowance - Pump Stations	$2,500	$2,500	$2,500
Private Property - Pumps/Valves	$21,970	$21,970	$21,970
Totals	$382,295	$382,295	$331,595

Estimated Present Worth
STEP and LPS – Downtown Area

Description	STEP Simplex	STEP Duplex	LPS
Estimated Capital Cost	$16,996,890	$18,983,590	$16,227,700
Estimated Annual Operation and Maintenance Cost	$382,295	$382,295	$331,595
Estimated Present Value (20 years at 3%)	$22,655,000	$24,672,000	$21,161,000

Thank You