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Memorandum

To	George Meservey, Director of Planning & Community Development
CC	Betsy Shreve, AICP, AECOM Project Director Martin "Reggie" Donoghue, P.E., AECOM Project Engineer
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Task Number 10.1.C – Facilities Preliminary Design** **Task 10.1.C.4 - Collection System Preliminary Design Report (25% Design)** **Downtown Area**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	06/17/17 (Revised 08/22/17 and 04/13/18)

Approvals	Date	Signature / Initials
George Meservey, Orleans, MA Director of Planning & Community Development		

1. Background

The purpose of this Collection System Preliminary Design Report (25% Design) Downtown Area is to identify the types of collection system technologies and to evaluate each of the technologies in order to develop a cost-effective alternative for the proposed Downtown Area wastewater collection area of Orleans. The Collection System Technologies include: (a) Gravity Sewers (GS); (b) Low Pressure Sewers (LPS); (c) Septic Tank Effluent Gravity (STEG); (d) Septic Tank Effluent Pumping (STEP); and (e) Vacuum Sewers (VS). This Technical Memorandum updates previous documents based on supplemental information obtain including topography survey, subsurface investigations and cultural resource evaluations as well as input from the Collection System Working Group.

2. Introduction

A. General

The Orleans Water Quality Advisory Panel (OWQAP) was convened to achieve consensus and build widespread community support for a customized, affordable water quality management plan for the Town of Orleans. The panel consisted of stakeholder representatives (Orleans Selectmen and representatives of engaged citizen constituencies), and liaisons from key town boards and commissions, organizations, neighboring towns, and regional, state, and federal partners. The OWQAP met for twelve half-day meetings starting in July 2014, all of which were open to public attendance and comment. The Project is necessary in order to reduce excessive nitrogen discharges to the Town's ponds, estuaries and embayments. The Project represents the first to implement a "Hybrid" approach under the Cape Cod 208 Water Quality Plan, recently approved by both USEPA and MassDEP.

The Project consists of conceptual and preliminary design to update the Comprehensive Wastewater Management Plan (CWMP) completed by the Town in 2011 to reflect the Consensus Plan (Water Quality Management Plan) developed by the Town in 2015. The Project goal is to minimize the proposed sewered footprint (area of Town and number of properties to be sewered) to the greatest extent possible by maximizing the use of several non-traditional technologies (Coastal Habitat Restoration, Aquaculture, Layered Soil Treatment Areas, and Permeable Reactive Barriers).

The resulting map (Figure. 1), entitled Conceptual Approach to Meet Orleans Water Quality Goals (March 2015) shows the agreed upon water quality management plan and indicates the two proposed areas to be sewered. This map also indicates the number of properties and associated wastewater flows associated with the respective Downtown Area and Meetinghouse Pond Area wastewater collection systems.

The current Project includes two areas proposed for sewering: (1) about 350 parcels encompassing Downtown Area (Average Design Flow of about 234,000 gpd) and (2) about 375 parcels within the Meetinghouse Pond Area (Average Design Flow of about 110,000 gpd) to be treated at a new wastewater treatment facility located on Overland Way and aquifer recharge.

B. Definitions

1) Gravity Sewers (GS)

A Gravity Sewer system two major components: (a) collection system; and (b) a conveyance system. Gravity Sewers have historically been the most popular method used for the collection and conveyance of wastewater in the United States. The pipes are installed on a slope to enable the wastewater to flow by gravity from each property through a series of gravity collector pipes, often to a pumping station, for conveyance to a wastewater treatment facility for treatment and disposal. Pipes are generally 8 inches and larger and they typically are installed at a minimum depth with 5 feet of cover and a maximum depth of about 25 feet. Manholes are located a maximum of 400 feet apart and/or at changes of direction or slope.

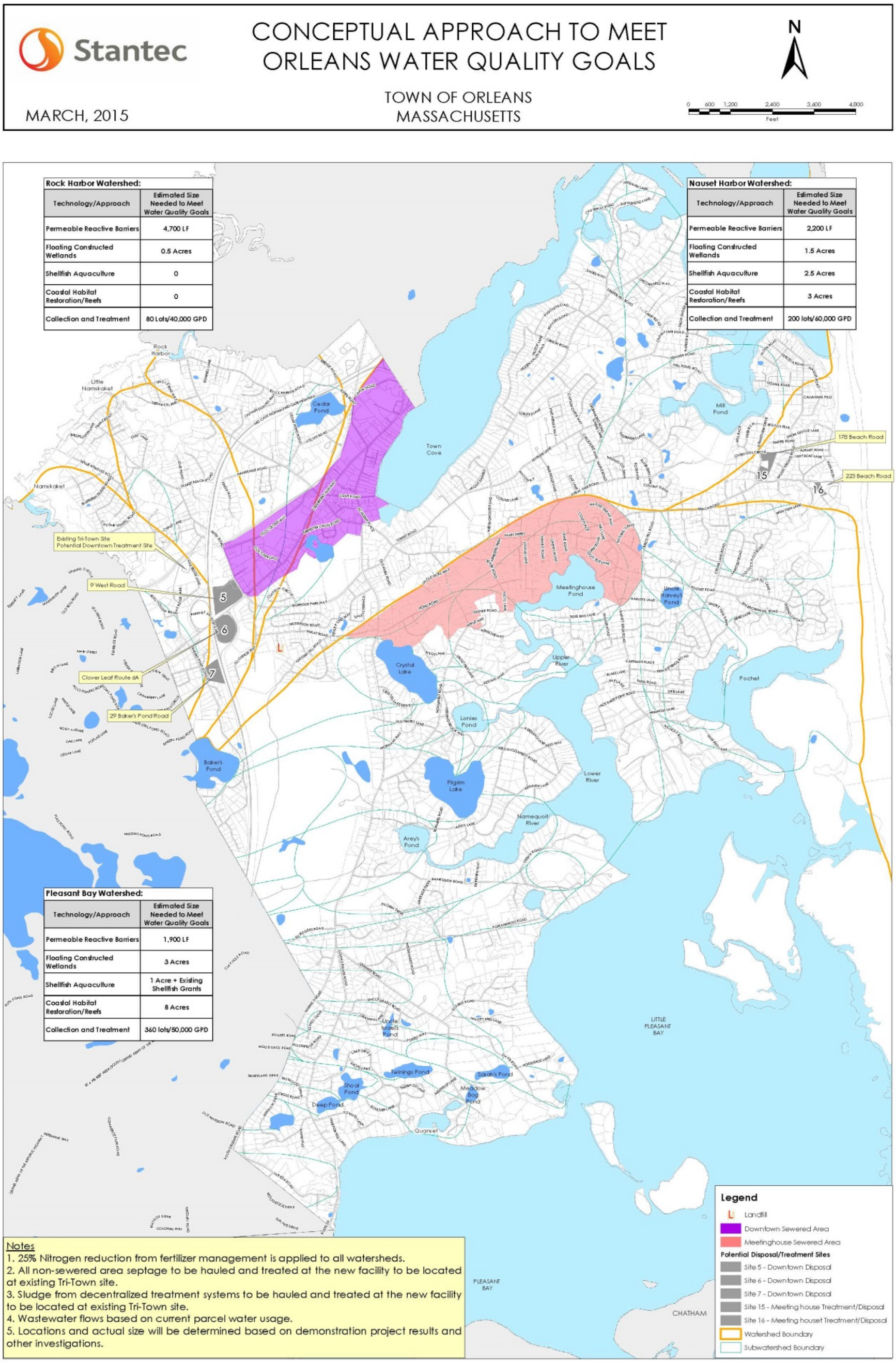
a) Design Considerations

- Most cost effective for areas with topographic relief. Size and slope of pipes are determined by minimum scouring velocity requirements;
- Installation can require deep excavations with large open cut trenches to maintain grade and require dewatering;
- Requires an allowance for infiltration/inflow;
- Operation and maintenance costs and requirements are well known; and
- Typically requires pumping stations in areas of variable topography.

b) Advantages

- Familiarity with the operation and maintenance of the systems;
- Gravity sewer systems typically have large amounts of storage volume;
- Gravity sewers generally can accommodate to future flow;
- Absence of mechanical components reduces the routine operation and maintenance required;
- Operation and maintenance limited to pumping stations; and
- Detention times and the ability to adjust/control pumping operations can shave peak flows at downstream components including wastewater treatment facilities.

Figure 1 – Conceptual Approach to Meet Orleans Water Quality Goals



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c) Disadvantages

- Construction costs are dependent on the depth of construction, and amount of dewatering;
- Deep installation can lead to wide trenches and have a greater impact to the environment and increased restoration cost;
- Reconstructing of entire roadway is typically required;
- May require several pumping stations;
- Ownership of the land and/or easements would be required to site pumping stations and/or to minimize the number of pumping stations; and
- Increased potential infiltration based on the depth, the groundwater table and the system configuration (ie. number of manholes, size of pipes, etc.).

2) Low Pressure Sewers (LPS)

A Low Pressure Sewer system has two major components: (a) private property facilities; and (b) a collection system. Private property facilities consist of a pump chamber and control panel at each property. The pumps are small and are equipped with a grinding mechanism that macerates the solids. Wastewater from the property flows by gravity to the pump chamber. The pumps automatically operate based on water level and discharge into a pressurized pipe system (1-1/2-inch increasing to 4-inches in diameter) terminating at a gravity collection sewer for gravity flow to a wastewater treatment facility for treatment and disposal. In some areas, a pumping station may be required for conveyance to a wastewater treatment facility.

a) Design Considerations

- Used with difficult site conditions including topography, poor soils, high groundwater and narrow roadways;
- Small diameter piping system typically between 1-1/2-inch to 4-inches; and
- Incorporates isolation and cleanout manholes.

b) Advantages

- The depth and width of the trenches are reduced due to small diameter piping;
- Trenchless technologies can be utilized in areas of favorable soils conditions and geography but the advantage decrease as the number of connections increase;
- Smaller pipe size with narrower and shallower trenches can reduce impacts to the environment, reduce construction restoration, and overall construction costs;
- Routine servicing at private grinder pump chamber can be done without exposure to sewage;
- Collection system operation and maintenance requires minimal access to manholes; and
- Infiltration is eliminated by the closed system design throughout the system, thereby reducing the operating and maintenance costs at downstream pumping stations and at the wastewater treatment facility.

c) Disadvantages

- Added operation and maintenance costs for the private property components (pump and controls);
- Storage is in the gravity line and/or pump chamber, and typically provides some emergency storage during a power outages since water usage is reduced.

- Risk of overflows during extended pump shutdown/failure;
- On-site components may not be acceptable to and/or increase the number of complaints from property owners;
- Operation and maintenance risks increase when dealing with seasonal and commercial users;
- Shifting operation and maintenance costs to the property owner may not be acceptable and/or increase the number of complaints particularly when installed in seasonal communities; and
- Small diameter pipe limits the flexibility to accommodate future flows.

3) Septic Tank Effluent Gravity (STEG)

A Septic Tank Effluent Gravity system has three major components: (a) private property facilities; (b) a collection system; and (c) a conveyance system. Gravity Sewers have historically been the most popular method used for the collection and conveyance of wastewater in the United States. The private property facilities consist of a chamber (existing or new septic tank) at each property where solids settle out. The collection sewers are installed on a slope from the septic tank to the collection system to enable the septic tank effluent to flow by gravity from each property. Pipes are generally 8 inches and larger and they typically are installed at a minimum depth with 5 feet of cover and a maximum depth of about 25 feet. Manholes are located a maximum of 400 feet apart and at all changes of direction or slope. In some areas, a pumping station may be required for conveyance to a wastewater treatment facility.

a) Design Considerations

- Most cost effective for areas with topographic relief. Size and slope of pipes determined by minimum scouring velocity requirements;
- Installation can require deep excavations with large open cut trenches to maintain grade and require dewatering;
- Uses the existing or a new on-site septic tank;
- Requires an allowance for infiltration/inflow;
- Operation and maintenance costs and requirements are well known; and
- Typically requires pumping stations.

b) Advantages

- The septic tank reduces the amount of solids in the effluent;
- Familiarity with the operation and maintenance of the systems;
- Gravity sewer systems typically have large amounts of storage volume;
- Gravity sewers generally can be designed to accommodate future flow;
- Absence of mechanical components reduces the routine operation and maintenance required;
- Mechanical operation and maintenance limited to pumping stations;
- Detention times and the ability to adjust/control pumping operations can shave peak flows at downstream components including wastewater treatment facilities.

c) Disadvantages

- Existing septic tank may not meet current TR-16 requirements and/or may not be structurally sound;
- Requires septic tank inspections and pump outs;
- Septage pump-outs require trucking and processing at septage receiving facility;
- Odors may result from improperly maintained septic tanks;
- Increase potential for corrosion in system components;
- Ownership of the land and/or easements would be required to site pumping stations and/or to minimize the number of pumping stations; and
- Increased potential infiltration based on the depth, the groundwater table and the system configuration (ie. number of manholes, size of pipes, etc.).

4) Septic Tank Effluent Pumping (STEP)

A Septic Tank Effluent Pumping system has two major components: (a) private property facilities; and (b) a collection system. Depending upon the distance to the termination point a conveyance system may also be required. Private property facilities consist of two pumps, pump chamber (existing or new septic tank) and control panel at each property. The pumps are small and are designed to pump septic tank effluent, but will not pump raw sewage solids. Wastewater from the property flows by gravity to the pump chamber. The pumps automatically operate based on water level and discharge into a pressurized pipe system (1-1/2-inch increasing to 4-inches in diameter) discharging to the gravity collection sewer, a pumping station for conveyance to a wastewater treatment facility, or directly at a wastewater treatment facility for treatment and disposal.

a) Design Considerations

- Difficult site conditions including varying or little topography, poor soils, rocky conditions, seismically active areas, loose sands, high groundwater, and narrow roadways;
- Septic tank utilized to retain solids from effluent;
- Small diameter piping system typically between 1-1/2-inch to 4-inches;
- Can be utilized in low pressure sewer arrangement for small communities, and
- Effluent pump design requires dual system (primary/back-up) per TR-16.

b) Advantages

- The septic tank reduces the amount of solids in the effluent;
- Pump chamber in new septic tanks can be designed to provide emergency storage volume;
- Trenchless technologies can be utilized in areas of favorable soils conditions and geography but the advantage decrease as the number of connections increase;
- Smaller pipe size with narrower and shallower trenches can reduce impacts to the environment, reduce construction restoration, and overall construction costs;
- Infiltration is reduced and/or eliminated by the closed system effluent piping, thereby reducing the operating and maintenance costs at downstream pumping stations and at the wastewater treatment facility.

c) Disadvantages

- Existing septic tank may not meet current TR-16 requirements and/or may not be structurally sound and are typically required to be replaced thereby increasing capital costs;
- Added operation and maintenance costs for the private property components (pumps, controls and septic tank pump-outs);
- Septage pump-outs require trucking and processing at septage receiving facility;
- Requires monitoring of the septic tank on a regular basis in order to avoid plugging of the pump with solids;
- Odors may result from improperly maintained septic tanks;
- Increase potential for corrosion in system components;
- Risk of overflows during extended pump shutdown/failure;
- On-site components may not be acceptable to and/or increase the number of complaints from property owners;
- Storage is in the gravity line and/or pump chamber, and typically provides up to 8-hour capacity during a power outages since water usage is reduced;
- Operation and maintenance risks increase when dealing with seasonal and commercial users;
- Shifting operation and maintenance costs to the property owner may not be acceptable and/or increase the number of complaints particularly when installed in seasonal communities; and
- Small diameter pipe limits the flexibility to accommodate future flows.

5) Vacuum Sewers (VS)

A Vacuum Sewer system has four major components: (a) gravity property connection to valve pit; (b) a vacuum collector main; (c) a vacuum collection station; and (d) a sewage pump and force main conveyance system. Wastewater from the property flows by gravity to an on-site vacuum interface valve pit/ holding tank. When a specific level has been reached, the vacuum interface valve, which operates automatically using pneumatic controls, opens for a few seconds allowing the wastewater and a volume of air to be sucked through the service pipe and into the vacuum sewer collection system. Vacuum pumps at the central collection station cycle as needed to maintain a constant level of vacuum throughout the service area. When the wastewater in the collection tanks reach a certain level, conventional sewage pumps transmit the wastewater by force main to the wastewater treatment facility for treatment.

a) Design Considerations

- Used with difficult site conditions including; flat or minimal slope topography, poor soils, high groundwater and narrow roadways;
- Vacuum collection chambers include sump and valve pit that must be vented to introduce air for vacuum;
- Vacuum collection chambers can serve multiple properties by gravity connections and be located near street for municipal access;
- Minimum slope of 0.2 percent between lifts and pipeline is installed in a saw tooth profile for lifting flow up an incline and to maintain vacuum level at end of each line;

- Two sets of pumps are required – collection (vacuum) and conveyance (sewage) – with careful selection of pumps required for proper facility operation; and
- One vacuum pumping station can typically pull vacuum in the collection system at a distance of up to 10,000 linear feet.

b) Advantages

- Collection chambers are serviced without exposure to sewage;
- A local power outage is not a factor in service at the property since no power is required at each collection chamber;
- Collection pipe diameters typically range from 8-inches to 10-inches;
- Construction costs, restoration, and environmental impacts are reduced due to smaller pipe size, narrower and shallower trenches;
- The system from private property collection chambers to the vacuum station can be monitored from a control panel located at the vacuum pumping station;
- Emergency power back-up is only needed at the combined vacuum pumps/collection tank and vacuum pumping stations; and
- Infiltration is reduced and/or eliminated by the closed system, thereby reducing the operating and maintenance costs at pumping stations and at the wastewater treatment facility.

c) Disadvantages

- Added operation and maintenance costs for the private property components;
- Requires timely response to low vacuum alarms;
- May require several vacuum stations to serve a large service area;
- Ownership of the land and/or easements would be required to site system vacuum/pumping station and/or to minimize the number of vacuum/pumping stations;
- Limited flexibility regarding future expansion, new vacuum station typical for each added service area;
- Limited storage in the collection system;
- Unsteady flows conveyed to WWTF if the majority of the service area is on vacuum stations that typically run in a batch cycle; and
- Vacuum station requires larger building to house two sets of pumps; vacuum and sewage, which will increases operation and maintenance costs.

C. Design Criteria and Data

Design criteria and data (i.e. minimum pipe sizes and slopes. materials of construction, trench depth and width, private property scope of work, restoration, typical production rates) used as part of the basis of the technologies evaluations and cost estimates are as follows:

1) Gravity Sewers (GS)

- Gravity Sewer Main Layout – Layout the system to allow gravity connections from all properties to be serviced. Pipes shall laid with a uniform slope between manholes and be installed at a minimum of 6 feet below grade in order to prevent freezing and minimize conflicts with other utilities.

- Pipe Size and Material – Pipe diameter sized to provide a cleansing velocity of 2 feet/second when flowing full based on Manning's formula using an "n" value of 0.013 but shall not be less than 8-inches in diameter. Pipe Material to be SDR 35 PVC piping or greater.
- Manholes – Installed at the end of each sewer reach; at all changes in grade, size, or alignment; and at all pipe intersections with a nominal distance of 300 to 400 linear feet. Manhole material to be precast concrete.
- Infiltration/Inflow Allowance: 200 to 500 gpd/inch diameter/mile.
- Minimum Size: Building Sewer at 4-inches; and Municipal Sewer at 8-inches.
- Location to Water Supplies: 10 feet Horizontally and 18-inches Vertically (Unless cased piping is used for necessary crossings).
- Materials: PVC, Ductile Iron, Reinforced Concrete or Other Material Approved by MassDEP.
- Typical Components: Pipe, Fittings, Manholes, Drop Manholes, Chimneys and Cleanout/Check Valve at Property Line.

2) Low Pressure Sewers (LPS)

- Pressure Sewer Main Layout – Layout the system to allow connections to all properties to be services. Pipe routing shall include long radius sweeps but not looped. Pipes shall be installed at a minimum of 5 feet below grade in order to prevent freezing and minimize conflicts with other utilities.
- Pipe Size and Material – Pipe Size diameter sized to provide a cleansing velocity based on the system's average daily flow but not less than 1-1/2-inches in diameter. Sizing shall also consider the retention times of each line segment to provide sufficient wastewater changes to reduce the potential for odor generation. Pipe Material to be Class 200, SDR 21 PVC piping or greater or HDPE SDR 11 to provide the necessary working pressure rating for the system, and to provide durability during installation.
- Isolation Valves and Check Valves – Provide Isolation Valves and Check Valves to allow isolation of individual STEP units, at points where system expansion is projected and at key locations such as property lines. Provide a valve box with a redundant check valve at property lines to protect properties from back-ups and/or flooding.
- Air Release and Vacuum Valves – Provide Automatic Air Release and Vacuum Valves to release air trapped in pressure lines and to prevent system siphoning or vacuum conditions. Provide Air Release and Vacuum Valves at all high points in a system and at least 14 pipe diameters downstream of locations where hydraulic jumps occur. Air Release/Vacuum Valves should be located in a manhole or structure to allow access for repair and maintenance.
- Cleanout Connections – Provide Cleanout Connections as a means for cleaning out pressure mains. Provide Cleanout Connections and valves to conduct required maintenance at terminal ends of branches or zones, intersections, sharp bends, and low and high points. Provide Cleanout Connections at least every 1,500 to 2,000 linear feet in all lines.
- Pump Chamber - Construct each pump chamber of concrete, high density polyethylene, or custom-molded, fiberglass-reinforced polyester resin using a filament wound process, layup and spray technique, or other approved process that will ensure a smooth and resin-rich interior surface designed for structural integrity. Lockable access opening at the ground surface with a minimum inside diameter of 24 inches. Equipped with PVC closet flange or flexible inlet flange suitable for connection to the structure's gravity sewer line. The pump chamber shall be sized to prevent accumulation of solids and designed to promote mixing during pumping actions.

- Pump System
  - Pump Removal - Pump shall be able to be removed without the need for manual disconnection of piping.
  - Grinder - The grinder should be positioned immediately below the pumping elements, securely fastened to the pump motor shaft, and driven directly by the same motor.
  - Pump Opening - The grinder should be capable of reducing all components in normal domestic sewage, including a reasonable number of foreign objects (e.g., paper, wood, plastic, glass, and rubber). Objects should be reduced to finely divided particles that will pass through the passages of the pump and a minimum 1.25 inch diameter discharging pipe.
  - Intake - The grinder should be positioned so solids are fed into it from the bottom in an upward flow, reducing the possibility of overloading or jamming. Sufficient turbulence should be created to keep the tank bottom free of permanent deposits or sludge banks.
  - Check Valve and Anti-Siphon Valve – Provide each pump system with a check valve that is installed in a horizontal position on the discharge pipe. Provide each pump system with a gravity-operated, and integral anti-siphon valve.
  - Ventilation - Provide adequate ventilation as required by State and Local regulations.
  - Controls and Alarms - Provide non-fouling level sensing devices to detect wastewater levels for initiating pump operation and to detect high water levels. Level sensing devices will not be placed near flows entering the well. Alarm indicators should include an audible alarm and a visual light.
  - Electrical Equipment – Provide wiring and electrical connections that are NEMA-rated for the environment in which they are to be placed.
- Materials: Class 200 PVC, Ductile Iron, and HDPE.
- Location to Water Supplies: 10 feet Horizontally and 18-inches Vertically (Unless cased piping is used for necessary crossings).
- Typical Components: Isolation Valves, Air Release Valves, Cleanouts, Check Valve at Property Line, and Electrical – Pumps, Control Panels, Transfer Switches.

3) Septic Tank Effluent Gravity (STEG)

- Gravity Sewer Main Layout – Layout the system to allow gravity connections to all properties to be serviced. Pipes shall be installed at a minimum of 5 feet below grade in order to prevent freezing and minimize conflicts with other utilities.
- Pipe Size and Material – Service pipe from septic tank to street collector shall be minimum 6-inches in diameter. Collector pipe in street sized to provide a cleansing velocity of 2 feet/second when flowing full based on Manning's formula using an "n" value of 0.013 but shall not be less than 8-inches in diameter. Sizing shall also consider the retention times of each line segment to provide sufficient wastewater flushing to reduce the potential for odor generation. All pipe material to be SDR 35 PVC piping or greater.
- Manholes – Installed at the end of each line; at all changes in grade, size, or alignment; and at all pipe intersections with a distance not to exceed 400 linear feet. Manhole material to be precast concrete.
- Septic Tanks – Existing Septic Tanks shall meet current Title 5 Standards. Existing Septic Tanks shall be pumped out, cleaned and pressure tested. Existing Septic Tanks which do not meet current Title 5 Standards or fail the pressure test shall be replaced.
- Infiltration/Inflow Allowance: 200 to 500 gpd/inch diameter/mile.

- Minimum Size: Building Sewer at 4-inches; and Municipal Sewer at 8-inches.
- Location to Water Supplies: 10 feet Horizontally and 18-inches Vertically (Unless cased piping is used for necessary crossings).
- Materials: PVC, Ductile Iron, Reinforced Concrete or Other Material Approved by MassDEP.
- Typical Components: Pipe, Fittings, Manholes, Drop Manholes, Cleanout/Check Valve at Property Line and Septic Tank (1,500 gallon).

4) Septic Tank Effluent Pumping (STEP)

- Pressure Sewer Main Layout – Layout the system to allow connections to all properties to be serviced. Pipe routing shall include long radius sweeps but not be looped. Pipes shall be installed at a minimum of 5 feet below grade in order to prevent freezing and minimize conflicts with other utilities.
- Pipe Size and Material – Pipe diameter sized to provide a cleansing velocity based on the system's average daily flow but not less than 1-1/2-inches in diameter. Sizing shall also consider the retention times of each line segment to provide sufficient wastewater flow-through to reduce the potential for odor generation. Pipe Material to be Class 200, SDR 21 PVC piping or greater or HDPE SDR 11 to provide the necessary working pressure rating for the system, and to provide durability during installation.
- Isolation Valves and Check Valves – Provide Isolation Valves and Check Valves to allow isolation of individual STEP units, at points where system expansion is projected, and at key locations such as property lines. Provide a valve box with a redundant check valve at property lines to protect properties from flooding.
- Air Release and Vacuum Valves – Provide Automatic Air Release and Vacuum Valves to release air trapped in pressure lines and to prevent system siphoning or vacuum conditions. Provide Air Release and Vacuum Valves at all high points in a system and at least 14 pipe diameters downstream of locations where hydraulic jumps occur. Provide Air Release/Vacuum Valves should be located in a manhole or structure to allow access for repair and maintenance.
- Cleanout Connections – Provide Cleanout Connections as a means for cleaning out pressure mains including valves, to conduct required maintenance at terminal ends of branches or zones, intersections, sharp bends, and low and high points. Provide Cleanout Connections at least every 1,500 to 2,000 linear feet in all lines.
- Septic Tanks – Existing Septic Tanks shall meet current Title 5 Standards. Existing Septic Tanks shall be pumped out, cleaned and pressure tested. Existing Septic Tanks which do not meet current Title 5 Standards or fail the pressure test shall be replaced.
- Pumps
    - Dual pump design (lead/stand-by) required per TR-16.
    - Pump design – Provide pump capable of pumping septic tank effluent through the passages of the pump and a minimum 1.25 inch diameter discharging pipe at pressure conditions required for the collection system.
    - Check Valve and Anti-Siphon Valve – Provide each pump system with a check valve that is installed in a horizontal position on the discharge pipe. Provide each pump system with a gravity-operated, and integral anti-siphon valve.
    - Ventilation - Provide adequate ventilation as required by State and Local regulations.

- Controls and Alarms - Provide non-fouling level sensing devices to detect wastewater levels for initiating pump operation and to detect high water levels. Level sensing devices will not be placed near flows entering the wet well. Alarm indicators should include an audible alarm and a visual light.
- Electrical Equipment – Provide Wiring and electrical connections that are NEMA-rated for the environment in which they are to be placed.

- Materials: Class 200 PVC, Ductile Iron and HDPE.
- Location to Water Supplies: 10 feet Horizontally and 18-inches Vertically (Unless cased piping is used for necessary crossings).
- Typical Components: Isolation Valves, Air Release Valves, Cleanouts, Check Valve at Property Line, Electrical – Pumps, Control Panels, Transfer Switches and Septic Tank (1,500 gallon).

5) Vacuum Sewers (VS)

- Vacuum Sewer Main Layout – The system layout allow gravity service connections to valve chamber vacuum connections to all properties to be serviced. Pipe routing shall include long radius sweeps in a saw tooth pattern but not looped. Pipes range from 4-inches to 10-inches and shall be installed at a minimum of 5 feet below grade in order to prevent freezing and minimize conflicts with other utilities. Pipe line lengths shall be sized based on static lift and losses with a maximum total head loss of 13 feet.
- Pipe Size and Material – Pipe diameter sized to provide a cleansing velocity using the Hazen-Williams formula for full-bore flow but not less than 1-1/2-inches in diameter. Use a C-factor of 150 for PVC pipe material and a flow that consists of 2 parts of air to 1 part of liquid. Sizing shall also consider the retention times of each line segment to provide sufficient wastewater flow-through to reduce the potential for odor generation. Pipe Material – Pipe Material to be Class 200, SDR 21 PVC piping or greater or HDPE SDR 11 to provide the necessary working pressure rating for the system, and to provide durability during installation.
- Vacuum pumps –Designed as duplex (lead/back-up) to cycle and maintain constant level of vacuum on the entire collection system.
- Collection tank – The total volume of the collection tank shall be 3 times the operating volume with a minimum size of 400 gallons. The operating volume is the sewage accumulation required to restart the discharge pump. Operating volume should be sized so that at minimum design flow, the pump will operate once every 15 minutes.
- Sewage Transfer Pumps
  - Discharge pump capacity shall be 20 percent greater than the peak design flow.
  - Motors are sized using the procedure for force mains plus 25 feet of additional head to pump against the vacuum in a collection tank.
  - Pumps shall be duplex (lead/back-up) design alternating, non-clog type.
- Standby Power - Provide 100 percent standby power at vacuum collection/transmission stations for use during normal power failure.

3. Wastewater Flows

The Downtown Area collection system is proposed to be constructed in over multiple years via one publicly bid construction contract. In order to estimate the existing wastewater flows, a 95 percent factor was applied to the 2014 and 2015 water usage data.

- Future wastewater flows for the Downtown Area were predicted based on a preferred build-out scenario previously evaluated for the Town, as summarized in the *Final Memorandum on Management of Future Downtown Wastewater Flows and Biosolids* (May 2016).
- Future wastewater flows for the Meetinghouse Pond Area were predicted based on current zoning regulations (as of March 2016). These future flows were used to develop the design annual average wastewater flow to the WWTF.
- Infiltration/Inflow flows were developed based on TR-16 - Guides for the Design of Wastewater Treatment Works, (2011 Edition as Revised in 2016) by the New England Interstate Water Pollution Control Commission. An allowance was added to the future wastewater flows to account for the normal aging of piping systems based on 300 gpd/in. diameter/mile of gravity sewer with an average gravity pipe diameter of 10-inches.

Table 1 summarizes the future build-out flows used for the design basis of the WWTF.

Table 1 – Downtown Area Annual Average Flow

Description	Existing Wastewater Flow Annual Average (gpd)	Future Wastewater Flow (with Build-out) Annual Average (gpd)
Wastewater	140,000	212,000
Infiltration / Inflow	14,500	14,500
Totals	**154,500**	**226,500**

4. Data Accumulation Survey

A. Introduction

As part of the 25% Preliminary Design Report for the Downtown Area Wastewater Collection System, Coastal Engineering Co., Inc. was engaged by AECOM to perform a Data Accumulation Survey relative to the design of the proposed new wastewater collection system in Orleans, Massachusetts.

This section of the Technical Memorandum outlines the scope of the Aerial Survey and Data Accumulation Survey performed by Coastal Engineering Co., Inc. and their Subconsultant. Refer to Appendix A for the completed survey.

B. Goals and Objectives of the Data Accumulation Survey

The goal of the Data Accumulation Survey was to acquire additional field and aerial survey data necessary for the preparation of the 25% Preliminary Design Report and to supplement the information included in the existing conditions plans prepared by Surveying and Mapping Consultants (SMC) for the Town of Orleans.

1) General

The Data Accumulation Survey included acquiring additional field and aerial survey data in order to supplement the information included in the existing conditions plans prepared by SMC for the Town of Orleans as necessary for the preparation of the 25% Preliminary Design Report. The aerial survey was flown for the Downtown Area as well as the Meetinghouse Pond Area. The imagery acquired for the Meetinghouse Pond Area was not processed and will be saved for future use. The following is the scope of the Data Accumulation Survey:

- Perform an aerial photography fly over and photogrammetric mapping for the subject area (performed by Subconsultant to Subcontractor, with ground control provided by Subcontractor);
- Perform supplemental on-ground detailed existing conditions (strip) survey within the limits of the designated right-of-ways (Approximately 6,500 l.f. including Jones Road, Liberty Lane, Locust Road and a portion of Main Street, portion of West Road and a portion of Eldredge Park Way and portion of Lots Hollow Road);
- Perform a supplemental on-ground detailed existing conditions (strip) survey within the limits of the roundabout at Route 28/Route 6A/Canal Road (to update features since completion of the SMC survey);
- Obtain visible utility/dig-safe evidence at ground level within designated right-of-ways of supplemental strip surveys;
- Obtain pipe invert elevations from available records and via observation for accessible drainage structures within supplemental strip survey roadways;
- Establish vertical benchmarks via differential levelling within designated right-of-ways of supplemental strip surveys;
- Obtain sill elevations for buildings within service area (excepting force main portion);
- Perform field checks/survey of control points as shown on November 28, 2016 SMC survey, and review with AECOM;
- Merge photogrammetric mapping data with route portion ground survey data from SMC and the approximately 6,500 l.f. supplemental detailed strip surveys performed by Subcontractor;
- Prepare an Existing Conditions Topographical Survey for use by AECOM;
- Provide digital files of the base survey in current AutoCAD format (Civil3D 2015 or older version) including one DTM surface, XML file, and a PDF. Base survey plans will be on the Mass State Plane coordinate system and NAVD 1988; and
- Perform a (1"=40' scale) Aerial Photography Fly Over for the Meetinghouse Pond Area (performed by subcontractor) and retain imagery for future use only.

2) Results of the First Phase of the Data Accumulation Survey

On January 16, 2017, Coastal Engineering provided the following deliverables and relevant technical information associated with the CAD drawings and files for the first phase of the Data Accumulation Survey:

a) PDF Files

- Cover Sheet based on sheet layout of SMC survey plus new supplemental layout locations for data collected from supplemental roadways; and
- Sheets 22-30 showing new supplemental survey layout pages for the 6,500+/- l.f. of new roadway survey.

b) ACAD Files

- Drawing File (generated in Civil3D 2016, saved in v2013 format
- The drawing file contains the following:
  - Edge of Pavement and centerline with elevation points for supplemental roadways;
  - Spot Grades for cross country portion between West Road and Salty Ridge Road;
  - Contours of supplemental areas;
  - Sill elevation labels for entire service area (or thresholds and floor elevations, where appropriate;
  - Point labels and data noting the observation point location of sills/floor/threshold measured;
  - Layout key sheet for service area; and
  - Miscellaneous building footprints and property line data from Mass GIS outside of the limits of the SMC survey area.

c) Data Files

- XML files and ASCII point files for each individual surface of supplemental roadway area;
- Coordinate files of data points used to generate surface/topographical information and building information; and
- Miscellaneous support files generated by ACAD e-transmit export of drawing file information.

3) Results of the Second Phase of the Data Accumulation Survey

Coastal Engineering Co., Inc. delivered the remaining Data Accumulation and Aerial survey on April 21, 2017. The following is a scope of the Second Phase of the Survey:

- An aerial photography fly over and photogrammetric mapping for the Downtown Area was performed by Sewell Mapping with ground control provided by Coastal Engineering Co., Inc.(CEC);
- Supplemental on-ground survey within the limits of Jones Road, Liberty Lane, Locust Road and a portion of Main Street, portion of West Road and Salty Ridge Road, portion of Eldredge Park Way and portion of Lots Hollow Road;
- Supplemental on-ground detailed existing conditions survey within the limits of the roundabout at Route 28/ Route 6A/Canal Road;
- Locating visible utility/dig-safe evidence at ground level within designated right-of-ways of supplemental strip surveys;
- Obtained pipe invert elevations from available records and via observation for accessible drainage structures within supplemental strip survey roadways;
- Established vertical benchmarks via differential levelling within designated right-of-ways of supplemental survey areas;
- Obtained sill elevations for buildings within the Downtown Area service area;
- Perform field checks/survey of surface features in 5 areas of roadways shown on November 28, 2016 SMC survey, and review with AECOM;
- Merged photogrammetric mapping data with route portion ground survey data from SMC and the 6 surveys performed by CEC;

- Prepared an Existing Conditions Topographical Survey for use by AECOM;
- Provided digital files of the base survey in current AutoCAD format (Civil3D 2015 or older version) including one DTM surface, XML file, and a PDF. Base survey plans will be on the Mass State Plane coordinate system and NAVD 1988; and
- Sewell Mapping completed an Aerial Photography Fly Over for the Meetinghouse Pond Area and retained the imagery for future use.

5. Cultural Resource Evaluation

A. Introduction

As part of the 25% Preliminary Design Report for the Downtown Area Wastewater Collection System, AECOM solicited cost proposals from independent licensed and insured professional firms with expertise in conducting Cultural Resource Evaluations. Based on the results of the solicitation, Public Archaeology Laboratory, Inc. (PAL) was engaged to perform a Cultural Resource Evaluation for the proposed new wastewater collection system.

This Technical Memorandum section outlines the Cultural Resource Evaluation prepared by PAL and their recommendations for archaeological monitoring during construction project work. Refer to Appendix B for the Cultural Resource Evaluation.

B. Goals and Objectives of the Cultural Resource Evaluation

The goal of this evaluation was to collect information about known and expected cultural resources within the project area:

- Produce a detailed archaeological sensitivity assessment of the project area; and
- Prepare a technical proposal for archaeological investigations, if necessary.

The evaluation was designed to facilitate project review by the Massachusetts Historical Commission (MHC) and compliance with all applicable federal, state, and local regulations and review including M.G.L. Chapter 9, Sections 26-27c (950 CMR 70-71).

C. Cultural Resources Review

1) General

The cultural resources review included the collection of information about known cultural resources within the project's area of potential effect (APE), including historic and archaeological resources in the Commonwealth of Massachusetts Inventory, and an assessment of existing conditions within the project area. The purpose of the work was to assemble information about previously documented historical resources within and near the project area and provide recommendations about previously documented historical resources within and near the project area and provide recommendations about significant archaeological sites that may be affected by the project.

2) Results of the Background Research

The MHC site files list dozens of historic architectural properties and archaeological sites within the vicinity of the Downtown Area Wastewater Collection System project area.

- The resources were identified through a search of the MHC's Inventory of the Historical and Archaeological Assets of the Commonwealth (MHC Inventory).
- For historic properties, the study area encompassed everything within the project area boundaries.
- For archaeological resources, the study area encompassed everything within one-quarter mile one either side of the project's outer boundaries.

- The evaluation found that there are three historic districts with 73 historic properties within the Downtown Area Wastewater Collection System area. Table 1 of the evaluation includes a list of architectural resources that were identified by the cultural resource review.
- Background research was conducted to assist with the archaeological sensitivity assessment and to develop predictive statements for the types of archaeological resources that may be present within the project area.
- Table 2 of the evaluation includes a list of archaeological resources that were identified by the culture resource review.

3) Results of the Field Assessment

A walkover/drive-over field assessment of the Downtown Area Wastewater Collection System project area was conducted by Dianna Doucette, PAL Senior Archaeologist, on February 8, 2017 to assess the integrity of the ground surface, to collect data about the current environmental setting of each area, and to look for any surface indications of archaeological sites.

- During the field assessment, all the roads that will be impacted by the proposed sewer line construction were accessed as well as the three proposed pump station locations.
- No evidence of archaeological sites was observed on the ground surface during the field assessment.

4) Results of the Sensitivity Assessment

Results of the background research and field assessment were used to develop a sensitivity ranking and predictive statements concerning the potential for the presence of Native American and EuroAmerican cultural resources.

- Overall, the archaeological sensitivity of the Downtown Area Wastewater Collection System project area is high to moderate for Native American sites dating to the Pre-Contact, Contact, and early Post-Contact periods. (ca. 8000 to 300 B.P.).
- The EuroAmerican post-contact archaeology sensitivity for land use is moderate to low.
- The post contact historic period sensitivity of the project area is moderate to low based on the historic nature of Orleans and the possibility of post-contact sites to be present und the current streets.

5) Recommendations

PAL recommends archaeological monitoring in areas assessed as high and moderate archaeological sensitivity, which includes all places where new sewer lines and pump stations will be impacting intact soils during construction (this may include areas between existing utilities).

- PAL also recommends coordinating with the Mashpee Wampanoag and Wampanoag Tribe of Gay Head/Aquinnah regarding the proposed project schedule so that a tribal cultural resource monitor can be present during construction of the project.
- The goal of the archaeological monitoring during construction will be to insure that if any significant archaeological resources, including remains and/or burials are exposed during the construction activities that they are treated appropriately in accordance with the Massachusetts Unmarked Burial Laws.
- The section of Route 28, from Academy Place to where it intersects with Route 6A, the short residential connectors that lie closest to Town Landing (Cottage Street and Cove Road), Cedar Pond (Locust Street and Jones Road), the Old Tote Road, and the three pump station sites have been assessed as having a preliminary high archaeological sensitivity due to the proximity of recorded archaeological sites and general lack of development.

- PAL also recommends a "Post-Review Discoveries" protocol, or, an Unanticipated Discoveries Plan be developed and implemented consistent with the Massachusetts Unmarked Burial Laws.

6. Geotechnical Evaluation

A. Introduction

As part of the Preliminary Design Report (25% Design) for the Downtown Area Wastewater Collection System, New England Geotech, LLC, was engaged by AECOM to perform pre-clearing and drilling for a Geotechnical Evaluation relative to the design of the proposed new wastewater collection system in the Downtown Area.

This section of the Technical Memorandum outlines the scope of the Geotechnical Evaluation performed by AECOM and New England Geotech, LLC. Refer to Appendix C for the Boring Logs.

B. Goals and Objectives of the Geotechnical Evaluation

The goal of the Geotechnical Evaluation was to collect soil data along the proposed sewer alignment necessary for the preparation of the 25% Preliminary Design Report. The data collected included depth of pavement, soil types, depth to groundwater, if encountered, and the recording of any fill or obstructions encountered during the drilling. The information from the geotechnical evaluation was used for the preliminary design of the wastewater collection system. In addition, the information from the soil investigation can be used by prospective sewer system construction bidders to determine the soil conditions in the area of the proposed collection system. The observation wells are available for long term monitoring of groundwater levels and quality.

C. Geotechnical Investigation

The Proposed Collection system in the Downtown Area includes construction of a proposed collection system (gravity sewer, low pressure sewer, STEP/STEG and/or vacuum sewer) within publicly and privately owned rights-of-way and privately owned properties in the Orleans Downtown Area. The Project will provide approximately 30,000 linear feet of pipelines within the publicly and privately owned right of way and sewer service connections within the privately owned properties.

The Geotechnical Evaluation included the drilling 95 borings in the Downtown Area in order to document the soil and groundwater conditions along the proposed Downtown Area sewer collection system route as necessary for the preparation of the 25% Preliminary Design Report. The depth of the borings ranged from 5 feet to 45 feet with an average depth of 15 feet depending upon the depth of the preliminary sewer collection system design profiles. Ten additional borings were constructed as monitor wells. Each location was pre-cleared to a minimum depth of 5-feet using "soft-dig" methods prior to drilling.

1) Prior to performing the borings in the Town roadways, approval from the Town of Orleans Highway Dept. was required. A Road Opening Permit was submitted to the Orleans Highway Dept. by N.E. Geotech, LLC. The Permit application was circulated through town departments for review and comment. On January 23, 2017 a preconstruction conference was held including Frank Nichols of the Orleans Highway Department, Lt. Kevin Higgins of the Orleans Police Department, Dan Regan of N.E. Geotech, LLC, and Reggie Donoghue of AECOM. On February 2, 2017 the Orleans Highway Department issued a Road Opening Permit allowing the geotechnical investigation within the town controlled streets to proceed.

2) An Application for a Permit to Access State Highway was filed with MassDOT in order to perform the borings in the state highway layout of Route 6A and Route 28. On February 3, 2017 representatives of AECOM met with MassDOT officials at the MassDOT Division 5 office in Taunton MA to discuss the proposed Geotechnical Evaluation. On February, 16, 2017 MassDOT issued a Permit to Access State Highway allowing the Geotechnical Investigation to proceed within the State Highway Layouts.

3) Prior to the start of the drilling operations, each boring site was staked or marked in the pavement with paint and Dig Safe was contacted by the drilling contractor to mark out the utilities in the area of the proposed borings. Several of the sites required remarking due to weather and traffic disturbing the marked locations.

4) For work in the roadways, a police detail and cruiser accompanied the drilling and pre-clearing crews for safety and traffic control. A second police detail was employed with the pre-clearing and drilling crews for traffic control along busy sections of the state highways.

5) A trailer mounted Hurricane 500 vacuum unit was used by a two man crew from Strategic Environmental Services to pre-clear the first five feet of excavation using "soft-dig" techniques. The pre-clearing is performed in order to avoid impacting underground utilities during the boring operation. Technical personnel from AECOM accompanied the pre-clearing crew and documented the pre-clearing excavations.

6) Drilling was performed by N.E. Geotech, LLC. A Geoprobe Model 6600 truck mounted direct push drill rig was employed for drilling the borings below the five foot pre-cleared depth. Direct push drilling is a method in which a drill string is advanced by pushing or vibrating. Technical personnel from AECOM accompanied the drill rig and documented the soil information from the borings.

7) In addition to the borings for the Geotechnical Investigation, ten deep observation wells were installed by N.E. Geotech, LLC to allow for sampling of groundwater and the measurement of groundwater levels at the observation well sites.

8) Record boring information from a geotechnical investigation performed for MassDOT during the design of roadway improvements that are underway at the intersections of Main Street and Route 6A, and Main Street and Route 28 was used to supplement the information from the geotechnical evaluation. Borings were not performed at the intersection of Route 6A and West Road, and in the area of the new roundabout at the intersection of Route 6A and Route 28. Borings were not performed in those locations due to a MassDOT prohibition on cutting new pavement, the location of existing utilities, and the proximity of the paving to the limit of the State Highway Layout. Both of the aforementioned projects were treated as overlay projects by MassDOT and no deep borings were performed as part of the design of the roadway improvements.

9) The proposed "Cross Country" portion of the collection system between Canal Road and Route 6A traverses through private property. Permission from the property owner will be required prior to entering onto the property for the Geotechnical Evaluation. The Town of Orleans has been in contact with the property owner and it is anticipate that permission to proceed with the remaining borings will be forthcoming. When the owner has granted permission to enter the property and proceed with the borings, we expect that it will require one day with the pre-clearing crew, and one day with the drilling crew to complete the borings on private property. At that time, four remaining borings in the State Highway Layout will also be completed.

D. Program Status

Boring logs have been prepared by AECOM for the completed borings. The boring locations, depth, and notation as to whether groundwater was encountered have been added to the preliminary sewer profile plans prepared by AECOM to accompany the Preliminary Design Report (25% Design).

When the Town of Orleans has permission from the private property owner to enter onto the property at the Cross-Country portion of the sewer collection system, the remaining eight borings will be completed. Four of the borings are on in the State Highway Layout and four are along the Cross-Country section of the sewer collection system route.

7. Collection System Work Group

A. General

The Collection System Work Group was convened to review the available collection systems technologies for the Downtown Orleans Area. Members of Town boards and committees, concerned citizens, stakeholders, a State Regulator, and representatives of AECOM participated in the Work Group sessions. This section of the Technical Memorandum outlines the Activities of the Collection System Work Group. Work Group Meetings were held on December 20, 2016, January 5, 2017, and March 9, 2017. Refer to Appendix D for the Minutes of Meetings.

B. Goals and Objectives of the Collection System Work Group

The goal of the Work Group was to review the available collection system technologies that were being considered for the Downtown Area and to provide information to the Work Group members so that they would better understand the collection system recommendations that would be included in the 25% Preliminary Design Report prepared by AECOM.

The Work Group provided an opportunity for stakeholders to ask questions and provide their input relative to the Collection System configuration for the Downtown Area. Information obtain was considered and incorporated into the 25% Preliminary Design Report, as applicable.

C. Work Group Participants

The following individuals participated in at least one of the Collection System Work Group meetings:

- Alan McClennan, Orleans Board of Selectman
- Jim Trainor, Citizen
- Gordon Smith, Orleans Taxpayers Association
- Paul Ammann, Orleans Peer Review Panel
- Len Short, Board of Water & Sewer Commissioners
- John Meyer, Board of Water & Sewer Commissioners
- Charles Harris, Eastham Alternate Representative
- Judith Bruce, Orleans Wastewater Management Steering Committee
- Fran McClennen, Pleasant Bay Alliance
- Ed Daley, Orleans Peer Review Panel
- Walter North, Citizen
- Ginia Pati, Orleans Water Alliance
- Dale Fulton, Orleans Taxpayers Association
- Lynn Bruneau, Orleans Finance Committee
- Mike Domenica, Water Resources Associates
- Brian Dudley, MassDEP
- Reggie Donoghue, AECOM
- Jeff Reade, AECOM
- Thomas Parece, AECOM

D. Work Group Meetings

1) Work Group Meeting No. 1 - December 20, 2016

At the first Collection System Work Group Meeting Alan McClennen provided an overview of the Sewer Program and Thomas Parece from AECOM provided a description of the wastewater collection system and treatment systems that were reviewed by AECOM. Participants were allowed to ask questions about a variety to topics from funding to system operation and maintenance. Thomas Parece from AECOM reviewed a collection system cost comparison and selection matrix prepared by AECOM. Work Group members were provided with a Collection System Matrix so that they could complete on their own evaluation of the available collection system technologies.

2) Work Group Meeting No. 2 - January 5, 2017

The second Collection System Work Group meeting included a review of a Downtown Area collection system phasing plan. Refer to Appendix E. Work Group members asked about the impact of construction and there was discussion with regard to the various collection system technologies. Thomas Parece from AECOM provided a description of the various technologies and responded to member's questions. Bran Dudley from MassDEP attended the meeting and participated in the discussions.

3) Work Group Meeting No. 3 - March 9, 2017

The third Collection System Work Group meeting included a question and answer session with regards to the proposed collection system and wastewater treatment facility. Thomas Parece from AECOM provided the regulatory framework and the basis of the collection system design. The cost for Operation and Maintenance of the collection system was discussed. The viability of accepting septage at the treatment facility was also discussed. Jeffrey Reade from AECOM provided a presentation on the available Wastewater Treatment Facility design technologies. The presentation focused on sequencing batch reactors and membrane bioreactor treatment technologies.

8. Enumerate Site Evaluation and Screening Criteria

A. General

As noted above, various types of collection system technologies exist that includes: (a) Gravity Sewers (GS); (b) Low Pressure Sewers (LPS); (c) Septic Tank Effluent Gravity (STEG); (d) Septic Tank Effluent Pumping (STEP); and (e) Vacuum Sewers (VS).. Each technology has been well studied and evaluated by previous consultants to the Town of Orleans. Table 2 summarizes these past studies.

Table 2 – Past Engineering Collection System Evaluations

Project	Engineering Firm	Recommendation / Conclusion
Wastewater System - Mid-1980s	LEA	• Gravity Sewers • Low Pressure Sewers
CWMP - 2010	Wright-Pierce	• Gravity Sewers • Low Pressure Sewers
Technical Review and Cost Analysis of CWMP Options - 2012	Weston & Sampson	• Gravity Sewers and STEP/STEG Similar in Costs
Consensus Planning - 2015	Stantec	• Gravity Sewers • Low Pressure Sewers

Although considerable evaluation had been previously undertaken in the studies, new information has been developed including topographic survey, subsurface investigations, a better defined service area as well as a property-by-property water usage analysis that required another analysis of the collection system technologies.

This analysis identified, defined the technology evaluation and screening criteria for the proposed Collection Systems (GS, LPS, VS, STEP, and STEG), and included: (a) Site Suitability; (b) Environmental Considerations; (c) Financial Considerations; (d) Maintenance Considerations; and (e) Other Considerations.

1) Site Suitability

- Land Ownership - Recognizes that project implementation is likely the most feasible when there is a minimal requirement to negotiate with and obtain access from private property owners, with tendency for risk to increase as the property owners increases.
  - ✓ Favorable scores (+1) are given to those technologies which can be achieved via construction predominantly in public roads and/or public rights-of-way.
  - ✓ Less favorable scores (-1) are given to those technologies which will require construction within or through a substantial number of private roads and/or private properties.
  - ✓ Neutral (0) scores are given to those technologies that contain elements of both public and private construction access, but the number of private properties affected is less than the lowest ranking technology(s).
- Constructability (Method of Installation) - Considers the likely method of installation for the technology, recognizing that conventional construction methods, at nominal depths, typically have lower risks.
  - ✓ Favorable scores (+1) are given to those technologies expected to be constructed with typical cut-and-cover trenching which is well known to the general contractors that would be available for the installation of the collection system.
  - ✓ Less favorable scores (-1) are given to those technologies which require substantial lengths of pipe to be installed by non-conventional means (e.g. horizontal directional drilling) and/or require substantial lengths of pipe to be installed in conventional open cut trenches exceeding 15 feet in depth.
  - ✓ Neutral scores (0) are given to those technologies that contain elements of both favorable (shallow, conventional trenches) and less favorable (deep trenches and/or non-conventional installation technologies), but the length of less favorable segments is less than the lowest ranking technology(s).

2) Environmental Considerations

- Permittability - Considers the potential impacts to natural resources that would occur as a result of constructing the collection system by the given technology, recognizing that the greater the potential adverse effect on natural resources regulated by federal, state, or local agencies, typically corresponds to increasing complexity, and potential uncertainty, in obtaining permits and approvals.
  - ✓ Favorable scores (+1) are given to those technologies anticipated to require the fewest number of permits and have the least adverse impact on natural resources; for example technologies whose alignments allow them to follow almost exclusively previously disturbed corridors (such as roads or rights-of-way).
  - ✓ Less favorable scores (-1) are given to those technologies whose alignments require crossing of environmentally sensitive areas (such as wetlands or woodlands) for which mitigation would likely need to be incorporated into the project in order to obtain regulatory approval.
  - ✓ Neutral scores (0) are given to those technologies that contain elements of both favorable (predominantly constructed through previously developed corridors) but include some construction within natural areas, that require some permitting, but not to the extent of the lowest ranking technology(s).

- Extent of Dewatering - Recognizes that construction in areas where the groundwater table is shallow frequently requires dewatering of the trench/pit in order to safely and efficiently install the collection system. However, as the extent of dewatering increases, there is an increase in the environmental concerns with respect to collecting, storing, treating, and discharging the construction dewatering.
  - ✓ Favorable scores (+1) are given to those technologies likely to generate the lowest volume of construction dewatering effluent, either because of the shallow nature of the trenches or because of the installation technology chosen (e.g. trenchless technologies often generate less construction dewatering because of the smaller excavation areas).
  - ✓ Less favorable scores (-1) are given to those technologies likely to generate the greatest volume of construction dewatering effluent, either because of the deep nature of the trenches or the locations through which trenches must be constructed (e.g. wetlands, areas of shallow groundwater).
  - ✓ Neutral scores (0) are given to those technologies whose construction contains elements of favorable and less favorable considerations with respect to construction dewatering, but do not approach the quantity of the lowest ranking technology(s).
- Sustainability - Considers the extent to which natural resources and/or non-renewable resources would be required to support the construction and operation of the technology. Since the use of non-renewable resources (e.g. fossil fuels) is likely to be similar for construction of any of the technologies, this parameter focuses primarily on the long term demands on non-renewable resources.
  - ✓ Favorable scores (+1) are given to those technologies that require little electricity (presumed to be generated primarily from non-renewable resources) for operation, consume little/no natural resources, and generate little/no solid waste (other than solid waste which can be repurposed for beneficial reuse).
  - ✓ Less favorable scores (-1) are given to those technologies that have high electrical demands for operation, require frequent use/disposal of 'consumables', and/or generate substantial non-recyclable waste materials.
  - ✓ Neutral scores (0) are given to those technologies having characteristics of both sustainable-favorable and sustainable-unfavorable categories, but not to the extremes of the highest or lowest ranking technology(s).

3) Financial Considerations

- Construction Costs - Considers the financial burden of constructing the technology. For this criterion, the overall cost of constructing the technology is considered; this evaluation does not attempt to make a distinction between costs borne by the Town versus costs borne by individual property owners but rather looks at the overall financial investment that must be made by the Town and the people of the Town.
  - ✓ Favorable scores (+1) are given to those technologies having the lowest construction costs.
  - ✓ Less favorable scores (-1) are given to those technologies having the highest construction costs. For the purpose of this estimate, technologies having a construction cost within 5 percent of each other are ranked the same.
  - ✓ Neutral scores (0) are assigned to those technologies that fall neither among the highest nor the lowest construction costs.

- Operation and Maintenance Costs - Considers the financial burden of operating the technology. For this criterion, the overall cost of operating the technology (e.g., over a 50 year span) is considered; this evaluation does not attempt to make a distinction between costs borne by the Town versus costs borne by individual property owners but rather looks at the overall financial investment that must be made by the Town and the people of the Town.
  - ✓ Favorable scores (+1) are given to those technologies having the lowest operating costs.
  - ✓ Less favorable scores (-1) are given to those technologies having the highest operating costs. For the purpose of this estimate, technologies having an operating cost within 10 percent of each other are ranked the same.
  - ✓ Neutral scores (0) are assigned to those technologies that fall neither among the highest nor the lowest operation and maintenance costs.
- Life Cycle Cots Analysis - Considers the financial burden of the construction cost and operation and maintenance cost of the technology over a specific life. For this criterion, the overall cost of operating the technology (e.g., over a 50 year span) is considered; this evaluation does not attempt to make a distinction between costs borne by the Town versus costs borne by individual property owners but rather looks at the overall financial investment that must be made by the Town and the people of the Town.
  - ✓ Favorable scores (+1) are given to those technologies having the lowest life cycle cost. For the purpose of this estimate, the two technologies having the lowest life cycle costs are ranked the same.
  - ✓ Less favorable scores (-1) are given to those technologies having the highest life cycle cost. For the purpose of this estimate, the two technologies having the highest life cycle costs are ranked the same.
  - ✓ Neutral scores (0) are assigned to those technologies that fall neither among the highest nor the lowest operation and maintenance costs.

4) Maintenance Considerations

- Level of Maintenance, Homeowner - Considers the anticipated (recommended) amount of maintenance that must be performed by the homeowner (or property owner) for the collection technology; measured by time, convenience, and costs.
  - ✓ Favorable scores (+1) are given to those technologies anticipated to require little to no homeowner intervention on an annual basis.
  - ✓ Less favorable scores (-1) are given to those technologies that have a reasonable probability of requiring service calls (e.g. pump out tanks, reset pumps, replace floats or valves).
  - ✓ Neutral scores (0) are assigned to those technologies that fall neither among the highest nor the lowest with respect to the level of homeowner responsibility for maintaining a fully functioning system.
- Level of Maintenance, Town - Considers the ability of the Town to perform maintenance and the type (routine vs non-routine, frequent vs infrequent) of maintenance required by the collection technology.
  - ✓ Favorable scores (+1) are given to those technologies that are considered reasonably easy for the Town to implement and do not require a substantial investment in equipment or personnel.
  - ✓ Less favorable scores (-1) are given to those technologies that may require a substantial investment in equipment or personnel, or have a greater tendency to require emergency (rather than planned) maintenance.

- ✓ Neutral scores (0) are assigned to those technologies that fall neither among the highest nor the lowest with respect to demands on the Town for ensuring a fully functioning system.

5) Other Considerations

- Reliability - Considers the track record of the technology in similar locations, including factors such as frequency of unplanned shutdowns and performance in adverse weather conditions, and/or hydraulic conditions.
  - ✓ Favorable scores (+1) are given to those technologies that are considered the most fail-safe (generally those having the least complexity and/or reliance on powered equipment).
  - ✓ Less favorable scores (-1) are given to those technologies that have a record of higher than average malfunctions and/or have a higher risk for backups in the event of a malfunction or weather event (e.g. a power outage).
  - ✓ Neutral scores (0) are assigned to those technologies that fall neither among the most or least reliable.
- Ability to Accommodate Expansion - Recognizes that homes, schools, and businesses adjacent to the study area may be added to the collection system at some point in the future in response to evolving planning and zoning, or environmental challenges.
  - ✓ Favorable scores (+1) are given to those technologies that have the greatest flexibility to accommodate additional flows without substantial additional capital investment and/or without making previously capital investments obsolete.
  - ✓ Less favorable (-1) scores are given to those technologies that have the least flexibility to accommodate additional flows without the investment of substantial capital (e.g. laying new/parallel piping; resizing wet wells or pumps, etc.).
  - ✓ Neutral scores (0) are assigned to those technologies that have no strong advantages, nor any strong disadvantages, with respect to their ability to accommodate additional sewage flows in the future.
- Area of Disturbance - Recognizes that construction within a densely developed area has the potential to adversely impact, in the short-term, abutting homes, businesses, and institutions. To the extent that the disturbance can be minimized by the technology selection, the construction anticipated to result in fewer disruptions and thus fewer complaints is desirable.
  - ✓ Favorable scores (+1) are given to those technologies that require the smallest construction footprint to install the collection system.
  - ✓ Less favorable scores (-1) are given to those technologies that require the largest construction footprint (wide, deep trenches that occupy more than 40 percent of a roadway width).
  - ✓ Neutral scores (0) are assigned to those technologies that have an average area of disturbance, and are characterized as having neither the smallest nor the largest construction footprint.
- Use of Property - Recognizes that the completed infrastructure on private property may limit the use of the property
  - ✓ Favorable scores (+1) are given to those technologies that result in less amount of impact on the future use of the property.
  - ✓ Less favorable scores (-1) are given to those technologies that result in the greatest amount of impact on the future use of the property.

- ✓ Neutral scores (0) are assigned to those technologies that have an average impact on on the future use of the property.

- Duration/Schedule - Recognizes that the public is willing to accept short-term impact for the realization of long-term benefit, but also recognizes that the longer the duration of construction disruption, the greater the potential for impact to the community.
  - ✓ Favorable scores (+1) are given to those technologies anticipated to require the shortest time to install, thereby minimizing disruptions to the community and achieving the public benefit most quickly.
  - ✓ Less favorable scores (-1) are given to those technologies anticipated to require the longest construction schedule.
  - ✓ Neutral scores (0) are assigned to those technologies whose anticipated construction duration falls in between the shortest and longest alternatives.
- Aesthetics - Considers the extent to which the collection technology, after installation, will alter the aesthetic charm of the Town.
  - ✓ Favorable scores (+1) are given to those technologies having little/no aboveground visual structures larger than a utility box.
  - ✓ Less favorable scores (-1) are given to those technologies that require either a considerable number (>3) of aboveground visual structures larger than a utility box (e.g. pump station) or that require a large visual aboveground structure in a prominent location where its presence would not easily blend with the surroundings.
  - ✓ Neutral scores (0) are assigned to those technologies that are not distinctly above the most favorable, nor the least favorable, with respect to potential aesthetic impact.

B. Analysis: Evaluate and Rate Each Technology Based on Criteria

The evaluation criteria were applied to each of the five technologies. In applying each of the criteria to each of the technologies, a consistent three level rating system was used as follows:

- Good = 1 point
- Neutral = 0 points
- Poor = -1 point

An overall rating for each technology was completed based on the criteria and weights assigned to each of the individual criteria. The technologies were ranked using both the weighted and un-weighted criteria. The three level rating system was applied to each collection system technology based on a stand-alone technology for the Downtown Area. It cannot be stressed enough that this evaluation provides a general overall comparison to each technology and that it is not the sole determination in recommending a collection system technology.

A un-weighted technology evaluation matrix for the proposed Collection Systems (GS, LPS, VS, STEP, and STEG) in the proposed Downtown Area was developed and is presented in Table 3. A Criteria Weighting Factor ranging from 1 to 5 was applied. This range avoids mathematical compression of the criteria weighting and helps to allow more discrimination between the criteria.

A weighted technology evaluation matrix for the proposed Collection Systems (GS, LPS, VS, STEP, and STEG) in the proposed Downtown Area was developed and is presented in Table 4.

Table 5 presents the summary results of each technology ranking (weighted and un-weighted) for the Downtown Area.

Table 3 – Downtown Area Collection System Un-Weighted Technology Evaluation Matrix

Criteria	Criteria Weight	Technology A Gravity Sewer		Technology B STEG		Technology C LPS		Technology D Vacuum Sewer		Technology E STEP		Hybrid GS and LPS		Hybrid GS and STEP	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Site Suitability															
Land Ownership	1	-1	-1	-1	-1	0	0	-1	-1	0	0	-1	-1	-1	-1
Constructability (Method of Installation)	1	0	0	0	0	1	1	1	1	1	1	0	0	0	0
Environmental Considerations															
Permitability	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Extent of Dewatering	1	-1	-1	-1	-1	1	1	1	1	1	1	-1	-1	-1	-1
Sustainability	1	-1	-1	-1	-1	0	0	-1	-1	0	0	-1	-1	-1	-1
Financial Considerations															
Construction Costs	1	-1	-1	-1	-1	1	1	-1	-1	1	1	0	0	0	0
Operation and Maintenance Costs	1	-1	-1	-1	-1	1	1	-1	-1	1	1	-1	-1	-1	-1
Life Cycle Cost Analysis	1	-1	-1	-1	-1	1	1	-1	-1	1	1	0	0	0	0
Maintenance Considerations															
Level of Maintenance - Homeowner	1	1	1	0	0	-1	-1	0	0	-1	-1	0	0	0	0
Level of Maintenance - Town	1	-1	-1	-1	-1	0	0	-1	-1	-1	-1	0	0	-1	-1
Impact to WWTF Operations	1	1	1	-1	-1	1	1	1	1	-1	-1	1	1	-1	-1
Other Considerations															
Reliability	1	1	1	1	1	0	0	-1	-1	0	0	1	1	1	1
Ability to Accommodate Expansion	1	1	1	1	1	-1	-1	-1	-1	-1	-1	1	1	1	1
Area of Disturbance	1	-1	-1	-1	-1	1	1	1	1	1	1	0	0	0	0
Use of Property	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	-1	-1
Duration/Schedule	1	-1	-1	-1	-1	0	0	0	0	0	0	-1	-1	-1	-1
Aesthetics	1	1	1	1	1	-1	-1	-1	-1	0	0	0	0	0	0
Total Criteria Points			(3)		(8)		3		(6)		1		(2)		(6)
Rank			4		7		1		5		2		3		5

Table 4 – Downtown Area Collection System Weighted Technology Evaluation Matrix

Criteria	Criteria Weight	Technology A Gravity Sewer		Technology B STEG		Technology C LPS		Technology D Vacuum Sewer		Technology E STEP		Hybrid GS and LPS		Hybrid GS and STEP	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Site Suitability															
Land Ownership	3	-1	-3	-1	-3	0	0	-1	-3	0	0	-1	-3	-1	-3
Constructability (Method of Installation)	3	0	0	0	0	1	3	1	3	1	3	0	0	0	0
Environmental Considerations															
Permitability	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Extent of Dewatering	3	-1	-3	-1	-3	1	3	1	3	1	3	-1	-3	-1	-3
Sustainability	4	-1	-4	-1	-4	0	0	-1	-4	0	0	-1	-4	-1	-4
Financial Considerations															
Construction Costs	5	-1	-5	-1	-5	1	5	-1	-5	1	5	0	0	0	0
Operation and Maintenance Costs	5	-1	-5	-1	-5	1	5	-1	-5	1	5	-1	-5	-1	-5
Life Cycle Cost Analysis	5	-1	-5	-1	-5	1	5	-1	-5	1	5	0	0	0	0
Maintenance Considerations															
Level of Maintenance - Homeowner	5	1	5	0	0	-1	-5	0	0	-1	-5	0	0	0	0
Level of Maintenance - Town	3	-1	-3	-1	-3	0	0	-1	-3	-1	-3	0	0	-1	-3
Impact to WWTF Operations	3	1	3	-1	-3	1	3	1	3	-1	-3	1	3	-1	-3
Other Considerations															
Reliability	4	1	4	1	4	0	0	-1	-4	0	0	1	4	1	4
Ability to Accommodate Expansion	5	1	5	1	5	-1	-5	-1	-5	-1	-5	1	5	1	5
Area of Disturbance	2	-1	-2	-1	-2	1	2	1	2	1	2	0	0	0	0
Use of Property	2	1	2	-1	-2	-1	-2	-1	-2	-1	-2	0	0	-1	-2
Duration/Schedule	2	-1	-2	-1	-2	0	0	0	0	0	0	-1	-2	-1	-2
Aesthetics	1	1	1	1	1	-1	-1	-1	-1	0	0	0	0	0	0
Total Criteria Points			**(12)**		**(27)**		**13**		**(26)**		**5**		**(5)**		**(16)**
Rank			**4**		**7**		**1**		**6**		**2**		**3**		**5**

Table 5 - Downtown Area Collection System

Component	Weighted		Un-Weighted	
	Number of Evaluation Points	Rank	Number of Evaluation Points	Rank
Individual Technologies				
Gravity Sewers	(12)	4	(3)	4
Septic Tank Effluent Gravity	(27)	7	(8)	7
Low Pressure Sewers	13	1	3	1
Vacuum Sewers	(26)	6	(6)	5
Septic Tank Effluent Pumping	5	2	1	2
Hybrid Systems				
Gravity Sewers and Low Pressure Sewers	(5)	3	(1)	3
Gravity Sewers and Septic Tank Effluent Pumping	(16)	5	(6)	5

C. Findings: Summarize Technology Selection Matrix/Screening Results

As can be seen in the ranking results, the overall ranking of the individual technologies and hybrid systems does not change between weighted and un-weighted rank for the first four components (individual technologies and hybrid systems). It only slightly changes for the remaining components.

- Low Pressure Sewer (LPS) was ranked 1 out of 7 (most favorable);
- Septic Tank Effluent Pumping (STEP) was ranked 2 out of 7;
- A Hybrid System consisting of Gravity Sewers and Low Pressure Sewers was ranked 3 out of 7;
- Gravity sewers were ranked at 4 of 7;
- A Hybrid System consisting of Gravity Sewers and Septic Tank Effluent Pumping was ranked 5 out of 7; and
- Vacuum Sewers Septic tank effluent gravity (STEG) systems were ranked least favorable.

In this analysis, key differentiators were construction impacts related to cost, environmental considerations and restoration. This focus highlights the benefits of utilizing smaller pipes from LPS and STEP systems to collect and transmit sewage flows at a lower cost of construction per service connection. However, these systems are most suitable for expansion of small service areas into an established service area and are less able to provide future expansion capacity within the same collection area due to the use of small diameter pipes.

9. System Layout and Cost Estimates

A. Figure 2 showed the updated map of the proposed Downtown Area Collection System. The map has been updated to reflect the activities which have occurred over the past three years. The map includes the following summary of the proposed plan:

- Proposed Gravity Sewers;
- Proposed LPS;
- Proposed Pumping Stations;
- Proposed Force Mains;
- Proposed WWTF; and
- Subwatershed.

B. A system layout (plan and profiles) was developed for the Downtown Area. Refer to Appendix F. The preliminary system layouts were developed in accordance with the New England Interstate Water Pollution Control Commission - TR-16, Guides for the Design of Wastewater Treatment Works, 2011 Edition as Revised in 2016. The development of the plan and profiles was based on the following information:

- Town of Orleans Assessors Records;
- USGS topographic survey;
- Town of Orleans Topography Survey by Surveying and Mapping Consultants;
- Town of Orleans Topography Survey by Coastal Engineering Co., Inc.;
- Subsurface Investigations by N.E. Geotech, LLC.;
- Cultural resource evaluations by Public Archaeology Laboratory, Inc.; and
- Supplemental information/input (Collection System Working Group and various manufacturers).

It is anticipated that the final system layouts will be further developed based on various site factors as based on the ability to obtain land and/or easements; and further investigations of existing utilities.

Figure 3 presents a flow schematic for the Downtown Area.

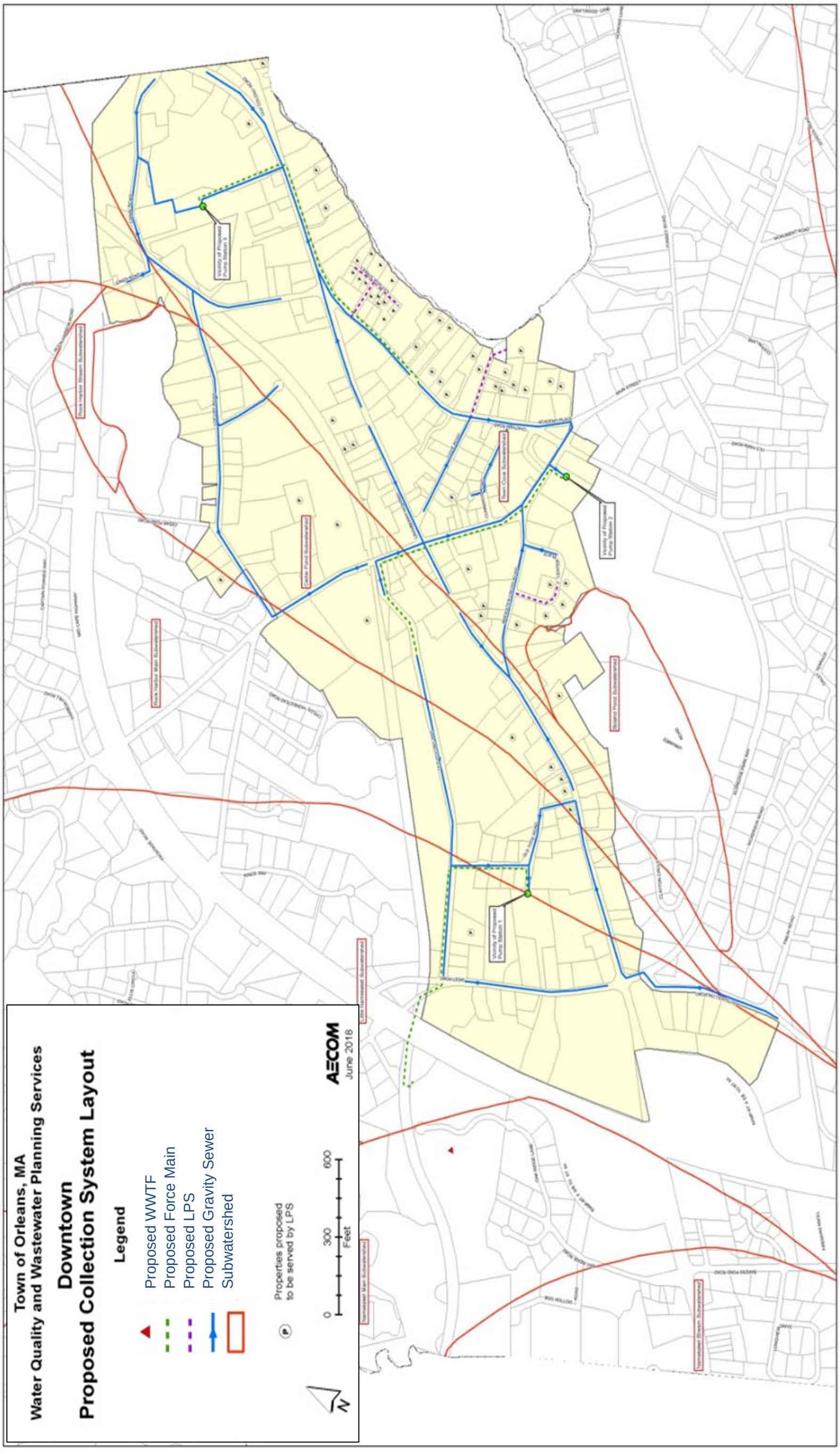
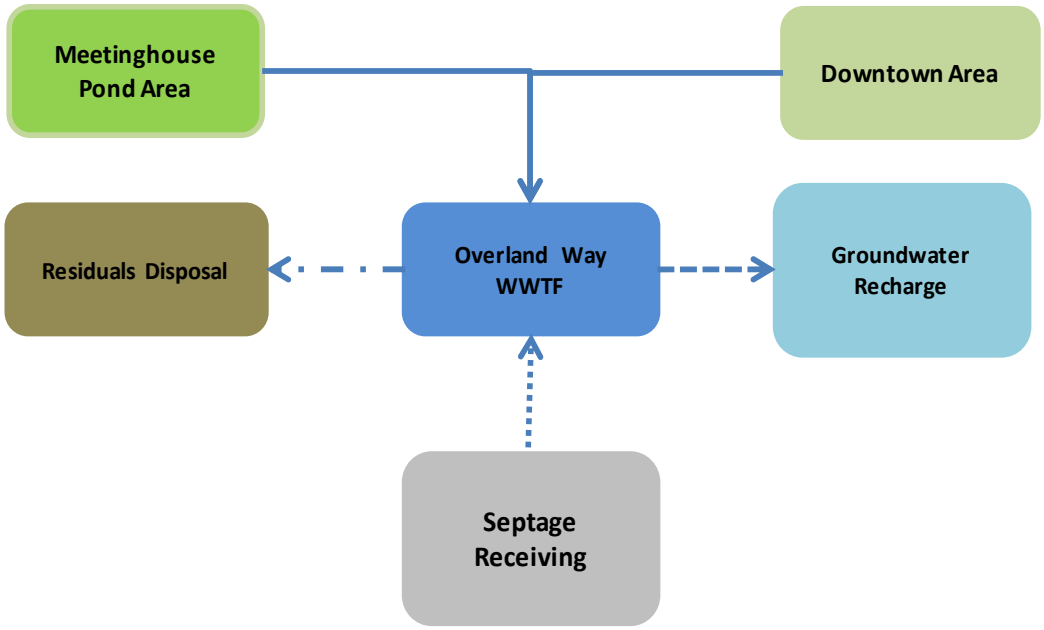


Figure 2 – Proposed Downtown Collection System layout

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Figure 3 - Downtown Area Flow Schematic



C. Preliminary cost estimates were developed based on the preliminary system layouts and included Project Costs; Annual Operation and Maintenance Costs; Replacement Costs; and Annual Monitoring Cost and is included in the following sections.

10. Development of Program Costs

Cost estimating is a critical component of a project evaluation in the early stages of planning and concept design, before selection of a definitive plan and commitment of any funds. As part of the development of this document, order-of-magnitude Program Cost estimates were developed for the Downtown Area wastewater collection system technologies:

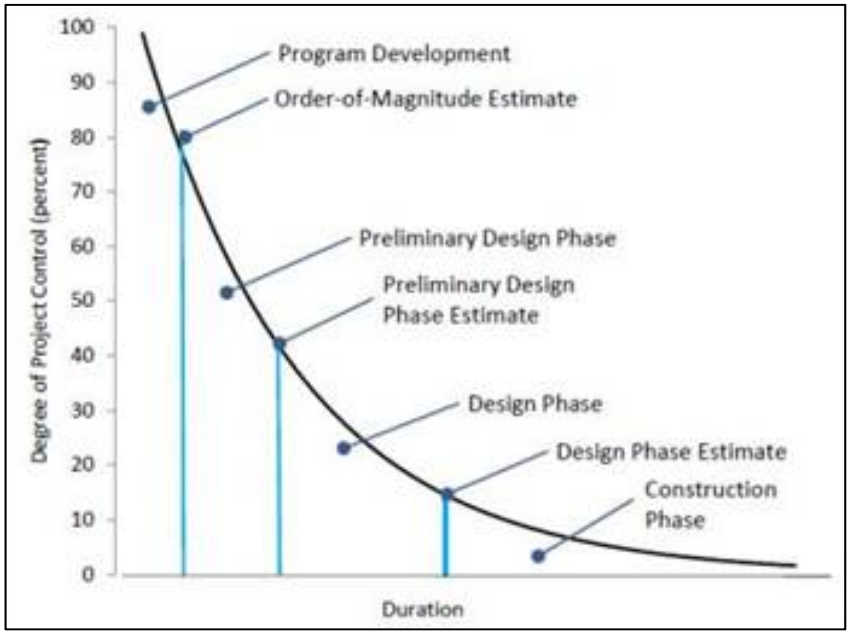
- Gravity Sewers;
- Low Pressure Sewers;
- Septic Tank Effluent Gravity;
- Septic Tank Effluent Pumping; and
- Vacuum Sewers.

As can be seen on Figure 4, as the duration of a Program move from “Program Development” to “Construction Phase”, the degree of project control or influent on the outcome of the Program diminishes. Making changes in the later phases of a Program typically results in an increase of costs.

The Program Costs for the Downtown Area wastewater collection system were developed with our in-house specialists who prepare cost estimates for construction and operation using industry standards for materials and labor as well as actual bid tabs from a library of projects. Supplemented with information obtained from the Project’s interactive workshops, manufacturer’s information, other operating facilities, and a collaborative process to fully understand the cost implications of the various alternatives, these comprehensive costs allow for informed decision making.

The Program Costs for the Downtown Area wastewater collection system include Capital Costs, Annual Operation and Maintenance Costs, Replacement Costs and Monitoring Costs. These costs obviously vary with the specific design considerations and layout configuration ultimately selected for each collection system technology. Nonetheless, it is possible to put together an estimate that can be used for Life-Cycle Cost Analysis to determine of the most cost effective technology or combination of technologies.

Figure 4 – Degree of Project Control vs. Project Duration



The Program Costs for the Downtown Area wastewater collection system presented are planning level costs and should be refined as additional informational details are identified and/or determined. For the Downtown Area, this refinement to the project scope has been updated based on completion of topographic survey, subsurface exploration, as well as the development of this 25% Preliminary Design Report for the proposed Downtown Area Collection System. It is recommended that planning level Program Costs be updated just prior to appropriation of funding for the implementation phase of the Program.

The Program Costs for the Downtown Area wastewater collection system are preliminary in nature and contain construction cost, construction contingencies, administrative, legal, construction engineering, environmental and regulatory permitting related costs. The Class 3 opinion of probable construction costs were developed in accordance with "AACE International Recommended Practice No. 18R-97 - Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries" as prepared by the Association for the Advancement of Cost Estimating (AACE) International (www.aacei.org) dated February 2, 2005. Refer to Table 6 for the AACE International Cost Estimating classification system.

Table 6- AACE International Cost Estimating Classification System

Estimate Class	Primary Classification	Secondary Classification			
	Level of Project Definition[1]	End Usage[2]	Methodology[3]	Expected Accuracy Range[4]	Preparation Effort[5]
5	0 to 2 percent	Concept Screening	Capacity Factored, Parametric Models, Judgment or Analogy	L: -20 to -50 percent H: +30 to +100 percent	1
4	1 to 15 percent	Study or Feasibility	Equipment Factored or Parametric Models	L: -15 to -30 percent H: +20 to +50 percent	2 to 4
3	10 to 40 percent	Budget Authorization or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10 to -20 percent H: +10 to +30 percent	3 to 10
2	30 to 70 percent	Control or Bid Tender	Detailed Unit Cost with Forced Detailed Take-off	L: -5 to -15 percent H: +50 to +20 percent	4 to 20
1	50 to 100 percent	Check Estimate or Bid Tender	Detailed Unit Cost with Detailed Take-off	L: -3 to -10 percent H: +3 to +5 percent	5 to 100

Notes:

1 Expressed as percent of Complete Definition

2 Typical Purpose of Estimate

3 Typical Estimating Method

4 Variation of Low and High Ranges. The state of process technology and availability of applicable reference costs data affect the range market. The +/- value represents percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50 percent level of confidence) for given scope.

5 Typical Degree of Effort Relative to Least Cost Index of 1. If the range index value of "1" represents 0.005 percent of project costs, then an index value of "100" represents 0.5 percent. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

AECOM has no control over costs of labor, materials, competitive bidding environments and procedures, unidentified field conditions, financial and/or market conditions or other factors likely to affect the opinion of probable project costs all of which are and will unavoidably remain in a state of change. It is further understood that the probable project costs for the Downtown Area wastewater collection system are a "snapshot in time" and that the reliability of this opinion of probable project costs will inherently degrade over time. The probable project costs for the Downtown Area wastewater collection system need to be indexed on a common "baseline". The construction industry uses the Engineering News Record (ENR) Construction Cost Index (www.enr.com) that is based on construction and materials costs throughout the United States. Therefore, the probable project costs for the Downtown Area wastewater collection system contained herein are based on an ENR Construction Cost Index of 11125 for August 2018.

A. Capital Costs

Capital Costs are those one-time, depreciable costs (i.e. not including any reoccurring annual costs) to construct a wastewater collection and treatment system with a design life greater than 5 years including non-traditional technologies. Capital Costs are generally financed through a loan or bond program. This provides up front funding for construction, with principal and interest payments spread out over time. Estimates have been developed to show Capital Costs by each type of system component. Defining costs by individual system component is essential given the eligibility requirements of different financing programs and revenue sources. Although not a depreciable costs, included in the Capital Costs were land purchases, at $250,000 per acre, required for locations of pumping stations that are not proposed on existing municipally owned land since it is considered an upfront cost.

B. Operation and Maintenance Costs

Operations and Maintenance (O&M) Costs relate to the day-to-day running and upkeep of the non-traditional and traditional technologies. O&M Costs include items such as labor, utilities, chemicals, etc. In order to achieve maximum asset life and reduce O&M costs, the establishment of standardized O&M procedures is critical. Standardized procedures helps personnel operate all assets within acceptable operational levels and ensures that each person is following the same routines. Lack of regular maintenance may result in the deterioration of the system components and result in rapid failure and reduced nitrogen removal from the environment as well as the ability to meet operating permits. O&M Costs are an annual cost generally paid through fee or tax revenues as costs accrue. O&M Costs will vary greatly by technology solution and have been estimated on a technology-by-technology basis.

C. Replacement Costs

In addition to O&M Costs, system components will malfunction and/or fail and therefore Replacement Costs, including Repair Costs, become a necessary part of the overall costs of the wastewater collection system. Replacement Costs are capital costs that will be required in the future when the original equipment has reached its useful life such as a pump at 10 years. Replacement Costs are used to replace components and/or equipment that have failed or malfunctioned such as; failed ejector pumps from LPS or STEP sewer systems, or pump bearings, mixers or control valves installed at conveyance pumping stations. As part of an Asset Management Program, a schedule of assets with their useful life should be developed since understanding the costs for partial replacement and full replacement of an asset will become necessary for sound financial planning. If more funding is spent on a repair to an asset, there will be a decreased need for the replacement of the asset. However, if greater funding is spent to replace the asset, there will be a decreased need for repairs to an asset. Overall there is a balance between how much to fund in each category in order to achieve the most efficient system. Like Capital Costs and unlike Annual O&M Costs, Replacement Costs are generally financed through a loan or bond program. This provides up front funding for construction, with principal and interest payments spread out over time. Estimates have been developed to show Replacement Costs by each type of system component for the Downtown Area wastewater collection system. Defining costs by individual system component is essential given the eligibility requirements of different financing programs and revenue sources.

D. Monitoring Costs

Monitoring is an essential component of adaptive management. Monitoring will assess the effectiveness of implementing the different collection system technologies. The results of monitoring will indicate which technologies are preferred based on long-term performance and which are less successful. This allows adjustments in the phased approach to improve overall performance of the solution. Like O&M Costs, Monitoring Costs are an annual cost generally paid through fee or tax revenues as costs accrue. Monitoring Costs will vary greatly by technology solution and have been estimated on a technology-by-technology basis.

11. Development and Assumptions of Program Costs

The development and assumptions of the Program Costs for the wastewater collection system for both public property and private property installation were estimated from various source of information including past AECOM projects and manufacturers information. The presented above, the Capital Costs for the Downtown Area wastewater collection system includes both public property and private property installation in order to present the entire cost of the Program. It should be noted that the Town has not determined what entity will be responsible for the Capital Costs of the wastewater system components located on private property. In addition, the Capital Costs for Downtown Area wastewater collection system do not include an allowance for any reconfiguration and/or upgrade to existing interior plumbing and/or electrical systems.

A. Capital Costs

Capital Costs for the Downtown Area wastewater collection system for both public property and private property installation were estimated by compiling typical unit costs for gravity sewers, vacuum sewers, low pressure sewers, septic tank effluent pumping/gravity and septic tank effluent pumping and, as applicable, pumping stations and force mains. Table 7 presents a Menu of Collection System Construction Unit Costs not including the contractor's mobilization, contractor's overhead and profit and project contingency.

Table 7 - Menu of Collection System Construction Unit Costs

Description	Unit	Unit Cost
Custom Pump Station	Each	$904,900
Force Main	L.F.	$180
Gravity Sewer	L.F.	$200
Gravity Sewer - Private Property	Each	$12,100
Low Pressure Sewer	L.F.	$150
Low Pressure Sewer - Private Property	Each	$18,100
STEG - Private Property	Each	$12,100
STEG Sewer	L.F.	$200
STEP - Private Property	Each	$25,300
STEP Force Main	L.F.	$150
Submersible Pump Station	Each	$422,300
Vacuum Collection/Transmission Station	Each	$1,327,200
Vacuum Sewer	L.F.	$170
Vacuum Sewer - Private Property	Each	$15,800
Wet Pit /Dry Pit Pump Station	Each	$723,900

Table 8 presents a Menu of Other Collection System Unit Costs required as part of the Project Costs. The Unit Costs are based on a traditional municipal design-bid-construct process and include the

costs for paying minimum wage rates per Massachusetts Prevailing Wage Law for public works projects G.L. c. 149, §§ 26 - 27 ("The Prevailing Wage Law") which establishes minimum wage rates for workers on public construction projects. In addition, review of actual construction costs for other similar projects was reviewed, adjusted for local bidding costs, and utilized to develop these unit costs.

Table 8 - Menu of Other Collection System Costs

Description	Unit	Unit Value
Overhead and Profit	Percent	22.0
Contingency	Percent	15.0
Project Services	Percent	35.0
Planning/Consultation	Percent	5.0
Design Engineering	Percent	10.0
Construction Engineering	Percent	15.0
Town Administrative	Percent	5.0

B. Operation and Maintenance Costs

Operation and Maintenance Costs for Downtown Area wastewater collection system for both public property and private property installation were estimated by compiling typical scope items and associated costs for gravity sewers, vacuum sewers, low pressure sewers, septic tank effluent pumping/gravity and septic tank effluent pumping and, as applicable, pumping stations and force mains. The following is a summary of the scope of work items. It should be noted that this summary consists of components that should be included in the normal operation and “preventive” and “predictive” maintenance of the wastewater collection system. It should also be noted that the Town has not determined what entity will be responsible for the Operation and Maintenance Costs of the wastewater system component located on private property.

- 1 full time employee for administration, operation and maintenance of each type of technology (Gravity Sewers; Low Pressure Sewers; Septic Tank Effluent Gravity; Septic Tank Effluent Pumping; and Vacuum Sewers) including Private Property Components such as pumps, valves, and vaults/tanks;
- A minimum of 260 hours per year for each type of Pump Station (Custom Pump Station; Submersible Pump Station; Vacuum Pump Station; and Wet Pit /Dry Pit Pump Station);
- Utilities, chemicals, etc. per each type of Pump Station (Custom Pump Station; Submersible Pump Station; Vacuum Pump Station; and Wet Pit /Dry Pit Pump Station) based on 25 horsepower pumps each running an average of 15 minutes per day at $0.15 per kWh; miscellaneous supplies (i.e. fuses, lamps, filters, grease, etc.); and chemicals for odor control.
- Clean and TV 15 percent of sewers per year for Gravity Sewer and STEG technologies;
- Clean 25 percent of pressure/vacuum pipes per year for Low Pressure Sewer, STEP and Vacuum Sewer technologies as well as force mains; and
- Pump-out Septic Tanks Every 3 Years for STEP and STEG technologies in order to avoid septic conditions and plugging of pumps as well as cleaning of the screen/filters in the STEP systems.
- Power costs for private pumps for LPS, or STEP systems based on 0.5-1 HP and 250 hours per year (350 gal/home/45 gal) x (8 pump outs x 5 min = 0.67 hours/day) x 356 d = 250 hours/yr.).

C. Replacement Costs

- Equipment (i.e. pumps or pump parts - impellers and bearings) for each type of Pump Station (Custom Pump Station; Submersible Pump Station; Vacuum Pump Station; and Wet Pit /Dry Pit Pump Station) at 1 percent of original Capital Cost of the Pump Station per year;
- Equipment (ie. pumps and valves) located on Private Property for Low Pressure Sewer, STEP and Vacuum Sewer technologies at 5 percent of total number connections per year; and
- Pumps at each type of Pump Station (Custom Pump Station; Submersible Pump Station; Vacuum Pump Station; and Wet Pit /Dry Pit Pump Station) replace every 25 years.

D. Monitoring Costs

- Calibration of monitoring equipment at each type of Pump Station (Custom Pump Station; Submersible Pump Station; Vacuum Pump Station; and Wet Pit /Dry Pit Pump Station) at $2,500 per year;
- Monitoring of Private Property Components (i.e. pumps, valves, and vaults/tanks) to verify system integrity estimated at 8 hours per connection per year.

12. Life-Cycle Cost Analysis

A Life-Cycle Costs evaluation of the various collection system alternatives was performed to compare the Program Costs (Project Costs, Annual Operation and Maintenance Costs, Replacement Costs and Monitoring Costs). The assumptions used in the Life-Cycle Cost Analysis are as follows:

- Evaluation Period of 50 Years with a Rate of Return of 3.0 percent (matches the inflation rate noted below).
- Inflation Rate of 3.0 percent annually based on the average ENR Construction Cost Index from January 2005 through August 2018.
- The proposed Downtown Area wastewater collection system consists of only one type of collection system technology even though it may not be technical feasible in all cases.
- The proposed Downtown Area wastewater collection system consists of a hybrid system which is typically the most cost effective alternative. For comparison, two hybrid systems were evaluated for the Downtown Area wastewater collection system: (1) Gravity Sewer and Low Pressure Sewer and Gravity Sewer and Septic Tank Effluent Pumping.
- The Program Costs include work that occur on public property and private property (Capital Costs, Annual Operation and Maintenance Costs, Replacement Costs and Monitoring Costs) which will vary with the specific design considerations and will change the Life-Cycle Cost Analysis.

Based on the estimated quantities developed from the updated system layout, estimated Program Costs and Life-Cycle Cost Analysis Assumptions a Life-Cycle Cost was developed for each of the technologies. The result of the Life-Cycle Cost Analysis is presented in Table 9 for the Downtown Area wastewater collection system. Refer to Appendix G for the Life-Cycle Cost Analysis.

Table 9 - Downtown Area Life-Cycle Cost Analysis (50 Years)

Type of Cost	Gravity Sewers	Septic Tank Effluent Gravity	Low Pressure Sewers	Vacuum Sewers	Septic Tank Effluent Pumping	Hybrid (GS and LPS)	Hybrid (GS and STEP)
Capital	$36.927	$38,537	$26.350	$44.271	$33.133	$29.929	$30.995
O&M, Replacement and Monitoring	$0.731	$0.775	$0.432	$0.890	$0.476	$0.529	$0.536
Present Value	$55.726	$58.472	$37,471	$67.173	$45.390	$43.538	$44.782

Note: Costs in Millions of Dollars

13. Recommendation

A. Type of Collection System

The standalone comparison of the individual technologies would result in the recommendation of a low pressure sewer system for the Downtown area. However, based on the technical evaluation considering system flexibility, greater familiarity of system components, and economic evaluation (Life-Cycle Cost Analyses) it is recommended that a "hybrid" wastewater collection system consisting of gravity sewers and low pressure sewers be constructed in the Downtown Area. The "hybrid" configuration is recommended because of the following:

- The ability to accommodate changes in wastewater flow caused by zoning changes and business dynamics;
- The ability to phase the design and construction particularly when considering the unknown performance of the non-traditional technologies;
- The overall low construction and operations 50-year life cycle cost;
- Proven long term reliability of gravity sewers and low pressure sewer in the New England Area;
- Greater familiarity of system components by General Contractors, Contract Operators and Design-Built-Operate Teams;
- Generally a higher public acceptance;
- Reduced potential for odor generation and corrosion; and
- Reduced risk of operation and maintenance in seasonal communities.

A hybrid system that takes advantage of the newer collection system design strategies to provide services to the individual properties, with a gravity sewer system, designed to eliminate deep excavations and the need for pumping stations as much as possible, that can collect the flows and provide the capacity for long-term expansion and a low pressure sewer system that provided cost-effective service to low laying properties and areas.

A LPS system is recommended for use in the hybrid plan due to the additional cost and maintenance burden of the STEP System from the additional private property components (resulting in about a $850,000 higher life cycle cost over 50 years). Additional factors include added costs for septage management requirements, the higher potential for corrosion and odors from the septic conditions of the STEP system at the property, as well as increase in difficulty in the biological process of the septic effluent and septage at a wastewater treatment facility.

B. Other

a) Utilize similar collection system alternatives in each of the proposed services areas and standardize design details/configurations since this reduces overall project costs.

b) Utilize the updated information to prepare a Notice of Project Change to the approved CWMP and funding applications in order to obtain grants and loans.

c) Inflate project costs to the year anticipated for implementation. The ENR's Cost Index History Tables can be used for estimating inflation on future cost projections that are then used for development of future Capital Improvement Plans and Financing Plans.

d) Perform a Capacity Analysis of the Gravity Sewers regarding wastewater flows generated from the Meetinghouse Pond Area.

14. Design Data

A. Collection System

The Preliminary Design Data for the collection system located within the Downtown Area is presented in Table 10.

Table 10 - Downtown Area Collection System Preliminary Design Data

	Pump Station		
Description	**1**	**2**	**3**
Gravity Sewer Length (linear feet)	8,300	9,500	13,000
Gravity Sewer Size (inches)	8 to 12	8 to 10	8
Gravity Sewer Material	PVC or DI	PVC or DI	PVC or DI
Number of Properties	70	122	116
LPS Length (linear feet)	---	1,000	1,000
LPS Size (inches)	---	1.5 to 2.5	1.5 to 2.5
LPS Material	---	PVC or HDPE	PVC or HDPE
Number of Properties	---	10	10

B. Pump Stations

The Preliminary Design Data for the pump stations located within the Downtown Area is presented in Table 11.

Table 11 – Downtown Area Pump Station Preliminary Design Data

Description	Pump Station 1	Pump Station 2	Pump Station 3
Average Daily Flow (gpd)	211,600	132,000	72,000
Average Daily Flow (gpm)	147	92	50
Infiltration/Inflow (gpd)	14,700	10,400	5,900
Infiltration/Inflow (gpm)	10.2	7.2	4.1
Peaking Factor	4.91	5.34	6.01
Peak Daily Flow (gpd)	1,053,600	711,200	437,500
Peak Daily Flow (gpm)	740	500	325
Force Main Length (linear feet)	2,700	3.600	2,900
Force Main Size (inches)	8	6	6
Force Main Material	PVC or HDPE	PVC or HDPE	PVC or HDPE
Velocity (fps)	4.72	5.67	3.69
Number of Pumps	3	2	2
Total Dynamic Head (feet)	68	137	56
Static Head (feet)	39	63	29
Horsepower (estimated)	40	50	15
Type of Drive	VFD	VFD	VFD

15. Preliminary Plans, Specifications, and Required Permits

A. Plans and Specifications

The Downtown Area Collection System design will require Contract Documents (plans and specifications) for public bidding. The plans will be plotted on 24-inch by 36-inch vellums and the specifications will be printed on 8-1/2 inch by 11-inch paper. The Contract Documents will include the MassDEP requirements for projects funded by the Massachusetts SRF Loan Program.

Table 11 shows a preliminary list of drawings and Table 12 shows a preliminary list of specifications for the Collection System. These lists will be updated as the final design proceeds toward completion.

Table 11 - Preliminary List of Drawings

Drawing No.	Drawing Title	Collection System	Pump Stations
General			
--	Cover and Index of Drawings	X	X
--	Sheet Key Plans	X	X
---	General Notes, Abbreviations and Legends	X	X
Site			
LA-1	Existing Conditions Plan	---	X
LA-2	Layout Plan	---	X
LA-3	Grading and Drainage Plan	---	X
LA-6	Site Construction Details	---	X
LA-7	Environmental Details I	---	X
LA-8	Environmental Details II	---	X
Architectural			
A-1	Abbreviations and Symbols	---	X
A-2	Building Ground Level Plan	---	X
A-3	Building Elevations and Sections	---	X
A-4	Room Finish Schedule, Door Schedule and Details	---	X
A-5	Miscellaneous Schedules and Details	---	X
Structural			
S-1	Building Foundation Plan	---	X
S-2	Roof Framing Plan and Details	---	X
S-3	Building Sections and Details	---	X
S-4	Wetwell Plan, Sections and Details	---	X
GS-1	Notes and Details I	---	X
GS-2	Notes and Details II	---	X
Mechanical			
M-1	Abbreviations and Symbols,	X	X
M-2	Yard Piping	---	X
M-3	Building Plan and Sections	---	X
M-4	Wetwell Plan and Sections	---	X
M-5	General Mechanical Schematics and Details I	X	X
M-6	General Mechanical Schematics and Details II	X	X
M-7	General Mechanical Schematics and Details III	X	X
M-8	General Mechanical Schematics and Details IV	X	X
M-9	General Mechanical Schematics and Details V	X	X
M-10	Gravity Sewer Plan and Profile – No. of Drawings TBD	X	---
M-11	Low Pressure Sewer Plan and Profile – No. of Drawings TBD	X	---
M-12	Force Main Plan and Profile – No. of Drawings TBD	X	---

Drawing No.	Drawing Title	Collection System	Pump Stations
HVAC			
HV-1	Notes, Legends and Abbreviations	---	X
HV-2	Building Floor Plan	---	X
HV-3	Legends, Schedules, and Details	---	X
Plumbing			
P-1	Notes, Legends and Abbreviations	---	X
P-2	Building Floor Plan	---	X
P-3	Legend, Schedule, and Details	---	X
Electrical			
E-1	Legend and General Notes	---	X
E-2	Site Plan (1” = 20’)	---	X
E-3	Single Line Diagrams and Schematics	---	X
E-4	Control Wiring Diagrams and Block Wiring Diagrams	---	X
E-5	Conduit and Panel Board Schedules and Details	---	X
E-6	Fire and Security Riser Diagram	---	X
E-7	Duct Bank Sections and Details	---	X
E-8	Lighting and Power – Building Floor Plan	---	X
E-9	Lighting and Power – Wetwell Plan	---	X
Instrumentation			
I-1	Legend, Symbols and Notes	---	X
I-2	PLC Network Diagrams	---	X
I-3	Instrument Installation Details	---	X

Table 12 - Preliminary List of Specifications

Section	Title
Section 00001	Title Sheet
Section 00003	Table of Contents
BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT	
Section 00005	Invitation to Bid
Section 00100	Instructions and Information for Bidders
Section 00300	Form for General Bid
Section 00305	Commonwealth of Massachusetts DCAM Update Statement
Section 00310	Bid Bond
Section 00350	Form for Subbid
Section 00375	Affidavit
Section 00420	Subcontract
Section 00430	Notice of Award
Section 00500	Form for Agreement
Section 00600	Payment Bond
Section 00610	Performance Bond
Section 00650	Notice to Proceed
Section 00700	General Conditions
Section 00852	Special Conditions - General
Section 00855	Special Conditions - Commonwealth of Massachusetts
Section 00858	Special Conditions - Permits and Licenses
Section 00859	Special Conditions – Massachusetts Equal Employment Opportunity
Section 00862	Special Conditions - MassDEP Policy Memoranda
Section 00905	Change Order Form
Section 00945	Certificate of Substantial Completion
Section 00950	Waiver of Liens
Section 00960	Certificate of Final Payment and Completion of Work
Section 00965	Transfer of Title

Section	Title

TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

Section 01020	Allowances
Section 01025	Measurement and Payment
Section 01030	Special Requirements
Section 01090	Reference Standards
Section 01140	Environmental Protection
Section 01310	Miscellaneous Testing and Soil Data
Section 01500	Temporary Facilities
Section 01570	Traffic Management and Maintenance
Section 01640	Special Mechanical and Electrical Equipment Requirements
Section 01700	Contract Closeout

DIVISION 2 - SITE WORK

Section 02100	Site Preparation
Section 02220	Earthwork
Section 02440	Site Improvements
Section 02444	Chain Link Fence and Gates
Section 02483	Planting Operations
Section 02485	Loaming and Seeding
Section 02503	Paving, Curbing and Sidewalks
Section 02620	Insulation and Jacketing
Section 02625	Polyvinyl Chloride Sewer Pipe
Section 02629	Pressure Pipe
Section 02630	Ductile Iron Sewer Pipe
Section 02635	HDPE Force Main
Section 02725	Manholes, Catch Basins, Handholes, and Pull Boxes

DIVISION 3 – CONCRETE

Section 03100	Concrete Formwork
Section 03200	Concrete Reinforcement
Section 03250	Concrete Specialties
Section 03300	Cast-In-Place Concrete
Section 03305	Concrete Repair and Surfacing Products
Section 03345	Concrete Placing, Curing and Finishing
Section 03604	Non-Shrink Grout

Section	Title
DIVISION 4 – MASONRY – Not Used	
DIVISION 5 – METAL WORK – Not Used	
DIVISION 6 – WOOD AND PLASTIC	
Section 06100	Carpentry
Section 06192	Prefabricated Wood Trusses
Section 06160	Sheathing
Section 06200	Finish Carpentry
Section 06700	Fiberglass Fabrications
DIVISION 7 – THERMAL AND MOISTURE PROTECTION	
Section 07156	Waterproofing and Dampproofing
Section 07210	Building Insulation
Section 07240	Exterior Insulation and Finish System
Section 07311	Asphalt Shingles
Section 07317	Wood Shingles
Section 07400	Metal Roofing, Siding and Flashing
Section 07900	Sealants and Firestopping
DIVISION 8 – DOORS AND WINDOWS	
Section 08100	Metal Doors and Frames
Section 08220	Fiberglass Reinforced Plastic Doors and Frames
Section 08510	Steel Windows
Section 08700	Finish Hardware
Section 08800	Glass and Glazing
DIVISION 9 - FINISHES	
Section 09900	Painting
DIVISION 10 - SPECIALTIES	
Section 10200	Louvers
Section 10440	Signs
Section 10475	Emergency and Miscellaneous Equipment
Section 10520	Fire Extinguishers

Section	Title

DIVISION 11 - EQUIPMENT

Section 11286	Sluice Gates, Slide Gates and Operators
Section 11300	Submersible Pump Station
Section 11306	Prefabricated LPS Systems
Section 11317	Sump Pumps
Section 11340	Variable Frequency Drives
Section 11348	Odor Control System

DIVISION 12 – FURNISHINGS – Not Used

DIVISION 13 - SPECIAL CONSTRUCTION

Section 13300	Instrumentation and Control System
Section 13350	Field Instruments
Section 13400	Supervisory Control and Data Acquisition (SCADA) System
Section 13500	Security Surveillance System
Section 13768	Fiber Optic Media

DIVISION 14 - CONVEYING SYSTEMS – Not Used

DIVISION 15 - MECHANICAL

Section 15050	Mechanical General Conditions
Section 15080	Mechanical Insulation
Section 15100	Process Piping
Section 15195	Natural Gas Piping System
Section 15300	Fire Protection
Section 15400	Plumbing Systems
Section 15500	Heating, Ventilating and Air Conditioning
Section 15950	HVAC Testing, Adjusting and Balancing

DIVISION 16 - ELECTRICAL

Section 16050	Electrical General Conditions
Section 16071	Seismic Controls for Electrical Work
Section 16085	Miscellaneous Equipment
Section 16120	Wires and Cables
Section 16130	Raceways and Fittings
Section 16160	Panelboards
Section 16402	Underground Systems

Section	Title
Section 16426	Metal-Enclosed Draw-out Switchgear-Low Voltage
Section 16450	Grounding System
Section 16500	Lighting System
Section 16601	Lighting Protection
Section 16612	Engine Generator
Section 16721	Fire Alarm System
Section 16760	Telecommunication Systems
Section 16920	Motor Control Centers
Section 16921	Switchboards
Section 16922	Electrical Power System Studies
Section 16924	Electrical Power Commissioning
Section 16998	Filed Inspection and Acceptance

B. Permits

Table 13 identifies the permits and approvals that are likely to be required for construction of each Phase of the Downtown Area Collection System. This list will be updated as the final design proceeds toward completion.

Table 13 - Preliminary List of Permits

Agency Name	Permit
Orleans Building Department	Building Permit (by Construction Contractor)
Orleans Site Plan Review Committee	Certificate of Appropriateness
Orleans Conservation Commission	Wetlands Notice of Intent/Order of Conditions *
Massachusetts Historical Commission	Certificate of Appropriateness
Old's Kings Highway Historic District	Certificate of Appropriateness
MassDEP	Water Quality Permit *
MassDEP	Plan and Specification Approval
Massachusetts Natural Heritage	Conservation Permit*
U.S. Army Corps of Engineers	Programmatic General Permit *
U.S. EPA	NPDES Permit for construction dewatering permit *

* By Construction Contractor

C. Preliminary Schedule

Table 14 shows the anticipated schedule to implement the construction of each contract of the Downtown Area System.

Table 14 - Preliminary Schedule

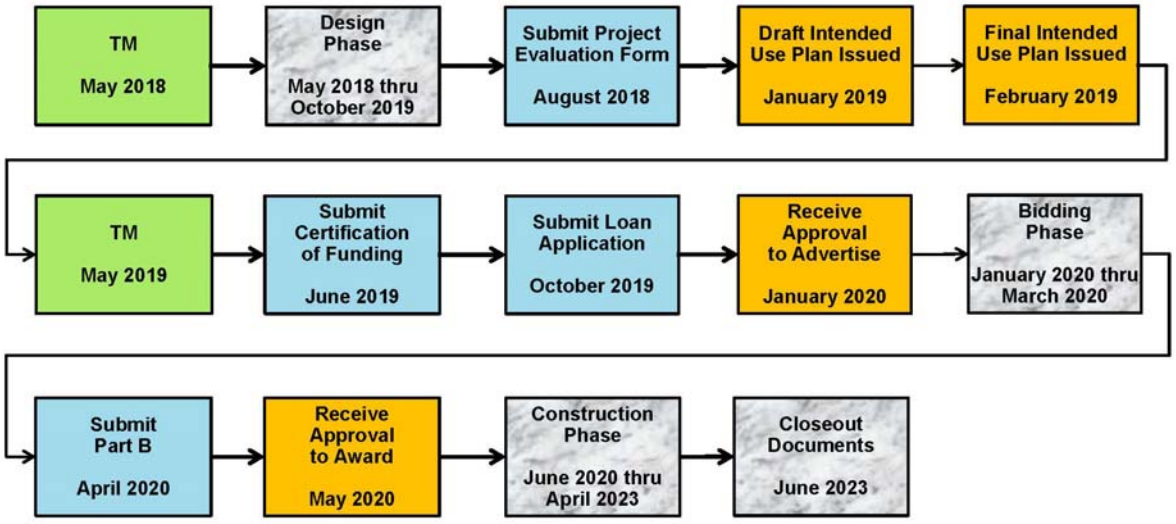
Task	Duration (Months)	
	WWTF	Collection System
Prepare Draft Plans and Specifications	9 to15	9 to 15
Town and MassDEP Review	3 to 4	3 to 4
Finalize Plans and Specifications	1	1
Obtain Permits	3 to 7	3 to 7
Construction	12 to 18	24 to 36
Startup and Testing	2 to 3	1 to 2
Total	30 to 48	41 to 65

16. SRF Funding

Figure 5 shows a flow chart of the State Revolving Funds program with:

- Green Boxes – Town meeting Action;
- Gray Boxes – Engineering Services related to Design, Bidding Construction and Closeout;
- Orange Boxes – MassDEP Action Items; and
- Blue Boxes - Engineering Services related to SRF (Project Evaluation Form, Certification of Funding, Loan Application, and Part B).

Figure 5 - State Revolving Fund (SRF) Loan Program Schedule



17. References

- AACE International - AACE International Recommended Practice No. 18R-97, Cost Estimate Classification System As Applied in Engineering, Procurement and Construction for the Process Industries, 2005
- AIRVAC, Inc. – Vacuum System Design Manual, 2001
- Biological Wastewater Treatment by Grady, Daigger, & Lim
- Cape Cod Commission – Barnstable County Cost Report, Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod, Revised 2014
- Commonwealth of Massachusetts - 310 CMR 15.000: The State Environmental Code, Title 5: Standard Requirements for the Siting, Construction, Upgrade and Expansion of On-Site Sewage Treatment and Disposal Systems and for the Transport and Disposal of Septage
- Commonwealth of Massachusetts, Department of Labor Standards – Topical Outline of Massachusetts Prevailing Wage Law, March 2012
- Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal by MassDEP
- Iowa Department of Natural Resources - Alternative Collection Systems Technology Assessment and Design Guidance, August 2007
- Lacey, Washington – 20-Year Life Cycle Analysis of Effluent Sewer (STEP) System, 2013
- New England Interstate Water Pollution Control Commission - The Northeast Guide for Estimating Staffing at Publicly and Privately Owned Wastewater Treatment Plants, 2008
- New England Interstate Water Pollution Control Commission - TR-16, Guides for the Design of Wastewater Treatment Works, 2011 Edition
- Orenco Systems, Inc. – Operational Costs of Two Pressure Sewer Technologies: Effluent (STEP) Sewers and Grinder Sewers, 2014; Small Community Collection Systems: Construction Costs, 2014; and Decentralized Design Considerations and Life Cycle Costs, 2015
- Process Design Manual: Land Treatment of Municipal Wastewater – Supplement on Rapid Infiltration and Overland Flow" by United States EPA (EPA 625/1-81-013a)
- Process Design Manual: Land Treatment of Municipal Wastewater by United States EPA (EPA 625/1-81-013)
- United States Environmental Protection Agency - Decentralized Systems Technology Fact Sheet Low Pressure Pipe Systems, September 1999
- US EPA – Alternative Wastewater Collection System Manual, 1991
- Wastewater Engineering: Treatment, Disposal, and Reuse by AECOM (Metcalf & Eddy)
- Wastewater Treatment Plant Design: Manual of Practice (MOP 8) by Water Environment Federation
- Water Environment Research Foundation (2010)
- Water Reuse: Issues, Technologies, and Applications by AECOM (Metcalf & Eddy)

Appendix A

Downtown Area Topographic Survey

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AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559
www.aecom.com

508.833.6950 tel
508.833.6951 fax

Memorandum

To	George Meservey, Director of Planning & Community Development Michael Domenica, PE, Program Manager
CC	Betsy Shreve, AICP, AECOM Project Director Paula Winchell, AECOM Reggie Donoghue, P.E., AECOM
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Task Number 10.1.C – 25% Preliminary Design Report** **Deliverable 10.1.C.1 – Data Accumulation Survey**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	April 3, 2017

Approvals	Date	Signature / Initials
George Meservey, Orleans, MA Director of Planning & Community Development		
Michael Domenica, PE, Water Resources Associates, Program Manager		

1. Introduction

As part of the 25% Preliminary Design Report for the Downtown Orleans Wastewater Collection System, Coastal Engineering Co., Inc. was engaged by AECOM to perform a Data Accumulation Survey relative to the design of the proposed new wastewater collection system in Orleans, Massachusetts.

This Technical Memorandum outlines the scope of the Aerial Survey and Data Accumulation Survey performed by Coastal Engineering and their Subconsultant. Refer to the attachments for plans delivered to date by Coastal Engineering Co., Inc.

2. Goals and Objectives of the Data Accumulation Survey

The goal of the Data Accumulation Survey was to acquire additional field and aerial survey data necessary for the preparation of the 25% Preliminary Design Report and to supplement the information included in the existing conditions plans prepared by Surveying and Mapping Consultants (SMC) for the Town of Orleans.

3. Data Accumulation Survey

A. General

The Data Accumulation Survey included acquiring additional field and aerial survey data in order to supplement the information included in the existing conditions plans prepared by SMC for the Town of Orleans as necessary for the preparation of the 25% Preliminary Design Report. The aerial survey was flown for the Downtown Orleans area as well as the Meetinghouse area. The imagery acquired for the Meetinghouse area was not processed and will be saved for future use. The following is the scope of the Data Accumulation Survey:

- Perform an aerial photography fly over and photogrammetric mapping for the subject area (performed by Subconsultant to Subcontractor, with ground control provided by Subcontractor);
- Perform supplemental on-ground detailed existing conditions (strip) survey within the limits of the designated right-of-ways (Approximately 6,500 l.f. including Jones Road, Liberty Lane, Locust Road and a portion of Main Street, portion of West Road and a portion of Eldredge Park Way and portion of Lots Hollow Road);
- Perform a supplemental on-ground detailed existing conditions (strip) survey within the limits of the roundabout at Route 28/Route 6A/Canal Road (to update features since completion of the SMC survey);
- Obtain visible utility/dig-safe evidence at ground level within designated right-of-ways of supplemental strip surveys;
- Obtain pipe invert elevations from available records and via observation for accessible drainage structures within supplemental strip survey roadways;
- Establish vertical benchmarks via differential levelling within designated right-of-ways of supplemental strip surveys;
- Obtain sill elevations for buildings within service area (excepting force main portion);
- Perform field checks/survey of control points as shown on November 28, 2016 SMC survey, and review with AECOM;
- Merge photogrammetric mapping data with route portion ground survey data from SMC and the approximately 6,500 l.f. supplemental detailed strip surveys performed by Subcontractor;
- Prepare an Existing Conditions Topographical Survey for use by AECOM;
- Provide digital files of the base survey in current AutoCAD format (Civil3D 2015 or older version) including one DTM surface, XML file, and a PDF. Base survey plans will be on the Mass State Plane coordinate system and NAVD 1988; and
- Perform a (1”=40’ scale) Aerial Photography Fly Over for the Meetinghouse Pond Area (performed by subcontractor) and retain imagery for future use only.

B. Results of the First Phase of the Data Accumulation Survey

On January 16, 2017, Coastal Engineering provided the following deliverables and relevant technical information associated with the CAD drawings and files for the first phase of the Data Accumulation Survey:

1. PDF Files
   - Cover Sheet based on sheet layout of SMC survey plus new supplemental layout locations for data collected from supplemental roadways; and
   - Sheets 22-30 showing new supplemental survey layout pages for the 6,500+/- l.f. of new roadway survey.

2. ACAD Files

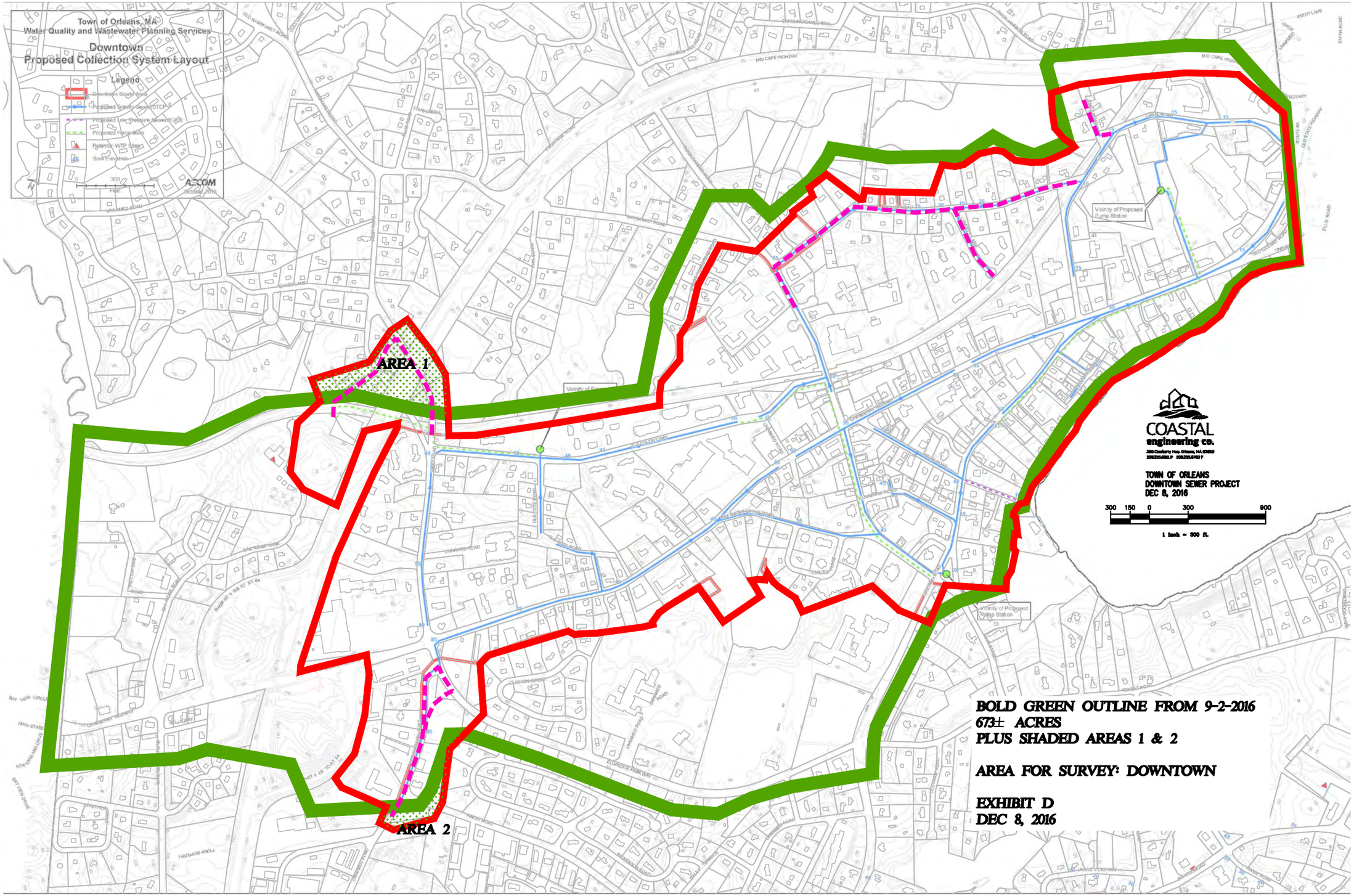
- Drawing File (generated in Civil3D 2016, saved in v2013 format
- The drawing file contains the following:
    - Edge of Pavement and centerline with elevation points for supplemental roadways;
    - Spot Grades for cross country portion between West Road and Salty Ridge Road;
    - Contours of supplemental areas;
    - Sill elevation labels for entire service area (or thresholds and floor elevations, where appropriate;
    - Point labels and data noting the observation point location of sills/floor/threshold measured;
    - Layout key sheet for service area; and
    - Miscellaneous building footprints and property line data from Mass GIS outside of the limits of the SMC survey area.

3. Data Files

- XML files and ASCII point files for each individual surface of supplemental roadway area;
- Coordinate files of data points used to generate surface/topographical information and building information; and
- Miscellaneous support files generated by ACAD e-transmit export of drawing file information.

C. Results of the Second Phase of the Data Accumulation Survey

The deliverable date for Coastal Engineering Co., Inc. to provide the remaining Data Accumulation and Aerial survey is April 21, 2017. Coastal Engineering Co., Inc. has recently confirmed that they are on track for completion by the deliverable date.


Town of Orleans, MA
Water Quality and Wastewater Planning Services
Downtown
Proposed Collection System Layout
Legend
Downtown Sewer Area
Proposed Gravity Sewer/STEP
Proposed Low Pressure Sewers (LPS)
Proposed Force Main
Potential WTP Sites
Soil Evaluation
AECOM
October, 2016
AREA 1
AREA 2
Vicinity of Proposed Pump Station
COASTAL engineering co.
TOWN OF ORLEANS
DOWNTOWN SEWER PROJECT
DEC 8, 2016
300 150 0 300 900
1 inch = 300 ft.
BOLD GREEN OUTLINE FROM 9-2-2016
673± ACRES
PLUS SHADED AREAS 1 & 2
AREA FOR SURVEY: DOWNTOWN
EXHIBIT D
DEC 8, 2016

January 16, 2017 Project No.: C18686.00

AECOM Technical Services, Inc.
Attn: Martin R. Donoghue, P.E.
9 Jonathan Bourne Drive
Pocasset, MA 02559
VIA EMAIL: Martin.Donoghue@aecom.com
T: 508-833-6967, C: 508-237-7161

Re: Summary of Deliverables Provided
Supplemental Topographical Survey (Limited In-Fill and Sills)
Downtown Wastewater Collection System
Downtown Area of Orleans, MA

The following is a listing of the accompanying deliverable items and relevant technical information associated with the drawings and/or files provided for this phase:

All points, data, surfaces, and information provided are based on NAVD 88 vertical datum and NAD 83 horizontal datum, and are supplemental for use in conjunction with the Existing Base Plan prepared by SMC dated November 28, 2016. The supplemental roadways are: a portion of Lots Hollow Road, Locust Road, a portion of Main Street, Liberty Lane, Jones Road, a portion of West Road, a section across a town owned parcel, and a portion of Salty Ridge Road.

PDF Files:

- Cover Sheet: Sheet layout of SMC survey, plus new/supplemental layout locations for supplemental roadways.
- Sheets 22-30: New/supplemental layout pages for the 6,500+ l.f. of supplemental roadways.

ACAD Files:

- Drawing file (generated in Civil3D 2016, saved in v2013 format) containing:
  - *EOP and centerline with elevation points for supplemental roadways.*
  - *Spot grades for "cross-country" portion between West Rd and Salty Ridge Rd.*
  - *Contours of supplemental areas.*
  - *Sill elevation labels for entire services area. (or thresholds and floor elevations, where appropriate).*
  - *Point labels and data noting the observation point location of sills/floor/threshold measured.*
  - *Layout key sheet for service area.*
  - *Misc. buildings and property lines from Mass GIS data outside of SMC survey area.*

Data Files:

- XML files and ASCII point files for each individual surface of supplemental roadway surveys.
- Coordinate files of data points used to generate surface/topographical information and building information.
- Misc. support files generated by e-transmit export of drawing information.

NOTES:

1. HORIZONTAL DATUM IN U.S. SURVEY FEET IS REFERENCED TO THE MASSACHUSETTS STATE PLANE MAINLAND COORDINATE SYSTEM (NAD83) BASED UPON SMARTNET RTK NETWORK.
2. VERTICAL DATUM IN U.S. SURVEY FEET REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) BASED UPON SMARTNET RTK NETWORK.
3. SIDELINES OF RIGHTS OF WAY AND PROPERTY LINES ARE AS SHOWN ON PLANS PREPARED BY SMC SURVEYING AND MAPPING CONSULTANTS, ENTITLED: "EXISTING CONDITIONS SURVEY ORLEANS, MA, FOR TOWN OF ORLEANS, REVISED: NOVEMBER 28, 2016. WHERE SUPPLEMENTAL RIGHT OF WAY AND PROPERTY LINE INFORMATION WAS REQUIRED, TOWN OF ORLEANS AND/OR MASS GIS DATA WAS USED.
4. BUILDING LOCATIONS SHOWN HEREON ARE AS SHOWN ON PLANS PREPARED BY SMC SURVEYING AND MAPPING CONSULTANTS, ENTITLED: "EXISTING CONDITIONS SURVEY ORLEANS, MA, FOR TOWN OF ORLEANS, REVISED: NOVEMBER 28, 2016. UPDATED AND SUPPLEMENTAL BUILDING LOCATIONS ARE BASED ON PLANIMETRICS FROM JW SEWALL AERIAL SURVEY OF FEBRUARY 27, 2017.
5. SUPPLEMENTAL TOPOGRAPHIC SURVEY BY COASTAL ENGINEERING COMPANY, INC (CEC) SHOWN ON SHEETS 22 THROUGH 30 IS BASED ON AERIAL SURVEY PERFORMED BY JW SEWALL AND SUPPLEMENTAL FIELD SURVEY BY CEC. CONTOUR DATA IS BASED UPON THE AERIAL SURVEY BY JW SEWALL, EXCEPT FOR ROADWAY AREAS WITHIN THE LIMITS OF THE SMC PLAN, AND THE ROUNDABOUT SHOWN ON SHEET 23. ELEVATIONS AND SITE FEATURES FOR ALL MAIN INTERIOR ROADWAYS WITHIN COVERAGE AREA ARE BASED ON PLANS BY SMC SURVEYING AND MAPPING CONSULTANTS, ENTITLED: "EXISTING CONDITIONS SURVEY ORLEANS, MA, FOR TOWN OF ORLEANS, REVISED: NOVEMBER 28, 2016.
6. LOCATION OF WATER, SEWER, TELEPHONE, ELECTRIC, AND GAS LINES ARE APPROXIMATE, BASED UPON RECORD LOCATION INFORMATION PROVIDED TO CEC, AND FOR REFERENCE ONLY. CONTRACTOR SHALL FOLLOW ALL DIG SAFE MARKINGS. CONTRACTOR SHALL NOTIFY DIGSAFE (1-888-344-7233) AND ALL UTILITY COMPANIES PRIOR TO EXCAVATION. SEE UTILITY NOTES BELOW.

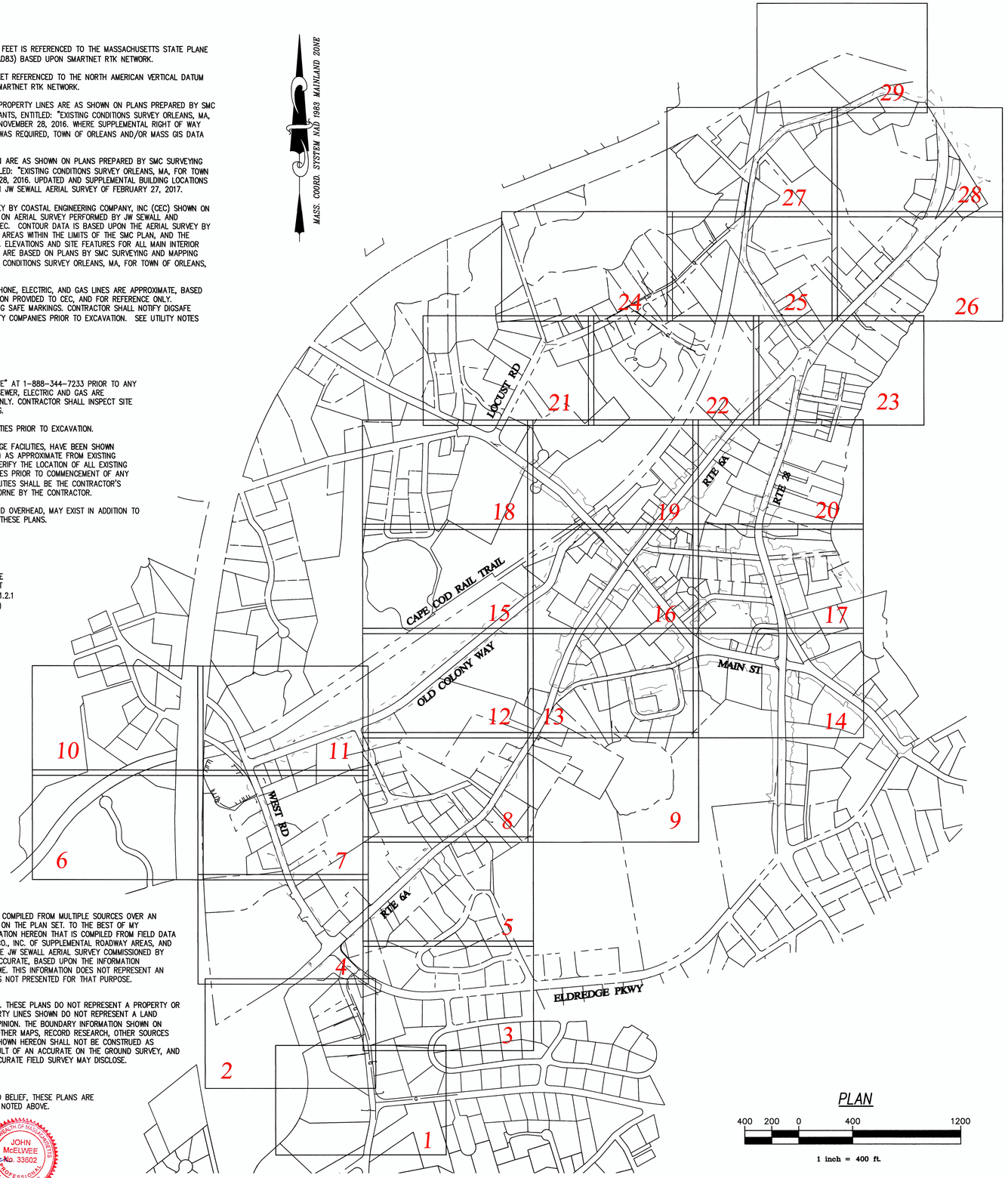
UTILITY NOTES

1. CONTRACTOR SHALL NOTIFY "DIG-SAFE" AT 1-888-344-7233 PRIOR TO ANY EXCAVATION. LOCATIONS OF WATER, SEWER, ELECTRIC AND GAS ARE APPROXIMATE AND FOR REFERENCE ONLY. CONTRACTOR SHALL INSPECT SITE AND FOLLOW ALL DIG-SAFE MARKINGS.
2. CONTRACTOR SHALL NOTIFY ALL UTILITIES PRIOR TO EXCAVATION.
3. EXISTING UTILITIES, INCLUDING DRAINAGE FACILITIES, HAVE BEEN SHOWN WHENEVER POSSIBLE AND ARE SHOWN AS APPROXIMATE FROM EXISTING RECORDS. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UNDERGROUND AND OVERHEAD UTILITIES PRIOR TO COMMENCEMENT OF ANY WORK. ANY DAMAGE TO EXISTING UTILITIES SHALL BE THE CONTRACTOR'S RESPONSIBILITY AND ANY EXPENSE BORNE BY THE CONTRACTOR.
4. EXISTING UTILITIES, UNDERGROUND AND OVERHEAD, MAY EXIST IN ADDITION TO THE UTILITY INFORMATION SHOWN ON THESE PLANS.

PLAN SET:

THE PLAN SET SHOWING EXISTING SITE CONDITIONS INCLUDES DRAWING SHEET NUMBERS C0.0.1 (KEY SHEET) AND C1.2.1 THROUGH C1.2.29 (30 SHEETS TOTAL)

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE



SURVEYOR'S NOTES:

THE INFORMATION HEREON HAS BEEN COMPILED FROM MULTIPLE SOURCES OVER AN EXTENDED NUMBER OF YEARS NOTED ON THE PLAN SET. TO THE BEST OF MY KNOWLEDGE AND BELIEF, THE INFORMATION HEREON THAT IS COMPILED FROM FIELD DATA SURVEYS BY COASTAL ENGINEERING CO., INC. OF SUPPLEMENTAL ROADWAY AREAS, AND THE CONTOUR DATA SHOWN FROM THE JW SEWALL AERIAL SURVEY COMMISSIONED BY COASTAL ENGINEERING CO., INC. IS ACCURATE, BASED UPON THE INFORMATION AVAILABLE AND PROVIDED AT THE TIME. THIS INFORMATION DOES NOT REPRESENT AN ACCURATE BOUNDARY SURVEY AND IS NOT PRESENTED FOR THAT PURPOSE.

THIS IS A DATA ACCUMULATION PLAN. THESE PLANS DO NOT REPRESENT A PROPERTY OR BOUNDARY SURVEY, AND THE PROPERTY LINES SHOWN DO NOT REPRESENT A LAND SURVEYOR'S PROPERTY BOUNDARY OPINION. THE BOUNDARY INFORMATION SHOWN ON THESE PLANS WAS COMPILED FROM OTHER MAPS, RECORD RESEARCH, OTHER SOURCES OF INFORMATION. THE BOUNDARIES SHOWN HEREON SHALL NOT BE CONSTRUED AS HAVING BEEN OBTAINED AS THE RESULT OF AN ACCURATE ON THE GROUND SURVEY, AND ARE SUBJECT TO CHANGE AS AN ACCURATE FIELD SURVEY MAY DISCLOSE.

TO THE BEST OF MY KNOWLEDGE AND BELIEF, THESE PLANS ARE SUBSTANTIALLY CORRECT EXCEPT AS NOTED ABOVE.

APRIL 21, 2017
DATE

JOHN McELWEE, P.L.S.
COASTAL ENGINEERING CO., INC.

COMMONWEALTH OF MASSACHUSETTS — JOHN McELWEE — No. 33602 — PROFESSIONAL LAND SURVEYOR

PLAN

400 200 0 400 1200

1 inch = 400 ft.

LEGEND

SB	STONE BOUND
CB	CONCRETE BOUND
MHB	MASS HIGHWAY BOUND
DH	DRILL HOLE
IP	IRON PIPE
•	PK. REBAR, NAIL, SPIKE
H/T	HUB & TACK
SSM	STEEL SURVEY MARKER
EP/LP	ESCUTCHEON PIN/LEAD PLUG
BRK	BRICK
LTIMB	LANDSCAPE TIMBER
FND	FOUND
N/F	NOW OR FORMERLY
NF	NOT FOUND
W/	WITH
(S)	SURVEY
(R)	RECORD
	DENOTES COMMON OWNERSHIP
	(FEE HOOK)
MISC	MISCELLANEOUS
N.T.S.	NOT TO SCALE
	PROPERTY LINE
	SIDELINE
	TOWN LINE
	STATE LINE
	STONE WALL
	RAILING
	TREE LINE
	TREE (DIA & TYPE)
	DECIDUOUS TREE
	EVERGREEN TREE
	SHRUB
	BOULDER
x	FENCE
CLF	CHAIN LINK FENCE
SF	STOCKADE FENCE
WIF	WROUGHT IRON FENCE
P&R	POST & RAIL FENCE
PF	PICKET FENCE
STK	STOCKADE FENCE
	GUARD RAIL
RET WALL	RETAINING WALL
	CURBING(TYPE)
BIT CONC	BITUMINOUS CONCRETE
GRAN	GRANITE
100.51 / T / 100.06	TOP OF CURB / BOTTOM OF CURB
	EDGE OF STREAM
	EDGE OF MARSH
	APPROXIMATE WETLAND BOUNDARY
WF#4-1	WETLAND FLAG
	MARSH
	SIGNAL CASE
	RR SIGNAL
WP	WHISTLE POST
SW	SWITCH
GP	GUARD POST (BOLLARD)
FL	FLOOD LIGHT
TRANS	TRANSFORMER
HVAC	HEATING VENTILATION AIR CONDITIONING
TC	TRASH CAN
PM	PARKING METER
	SIGN
PVI	POST VALVE INDICATOR
	TRAVERSE POINT
ST / NF	SEPTIC TANK NOT FOUND OR NOT VISIBLE. SHOWN PER AVAILABLE RECORDS
ST / S SMH/MH R=73.00	SEPTIC TANK COVER OR SEPTIC COMPONENT LOCATED IN FIELD WITH ELEVATION
BVW	BORDERING VEGETATED WETLAND
CCB	CAPE COD BERM
CP	CONRETE POST
MP	METAL POST
WP	WOODEN POST
LOLS	LIMIT OF LIDAR SURVEY (SMC)
VP	VENT PIPE
BLIMB	BOTTOM LANDSCAPE TIMBER
P&R	POST AND RAIL FENCE
	SILL REFERENCE SPOT
F.FL.	FINISHED FLOOR
28	SHEET REFERENCE

TS	TRAFFIC SIGNAL
MAST / ARM	TRAFFIC SIGNAL/MAST ARM
TSCC	TRAFFIC SIGNAL CONTROL CABINET
FA	FIRE ALARM BOX
RD	ROOF DRAIN
FF	FINISHED FLOOR
TH	THRESHOLD
H'CAP	HANDICAP RAMP
MB	MAILBOX
HH	HANDHOLE
	GUY POLE
	GUY WIRE
UP#	UTILITY POLE
UP/LP	UTILITY POLE/LIGHT POLE
LP	LIGHT POLE
LPB	LIGHT POLE BASE
OHW	OVERHEAD WIRE
WH	WIRE HEIGHT
(M)	MARKED
DMH	DRAIN MANHOLE
CB	CATCH BASIN
CI	CURB INLET
FES	FLARED END SECTION
R	RIM
I	INVERT
NPV	NO PIPE VISIBLE
T'STONE	THROATSTONE
CMP	CORRUGATED METAL PIPE
RCP	REINFORCED CONCRETE PIPE
CIP	CAST IRON PIPE
PVC	POLYVINYL CHLORIDE
VCP	VITREOUS CLAY PIPE
CPP	CORRUGATED PLASTIC PIPE
CU	CONNECTION UNKNOWN
AC	ASBESTOS CONCRETE
UG	UNKNOWN GATE
GG	GAS GATE
GMH	GAS MANHOLE
GM	GAS METER
OM	OTHER MANHOLE
TMH	TELEPHONE MANHOLE
EMH	ELECTRIC MANHOLE
EM	ELECTRIC METER
SMH	SEWER MANHOLE
WG R=73.00	WATER GATE FOUND
WS	WATER SERVICE PER TIE CARDS SUPPLIED BY TOWN
	HYDRANT
WM	WATER METER
WMH	WATER MANHOLE
W	WATER LINE
S	SEWER LINE
T	TELEPHONE LINE
E	ELECTRIC LINE
D	DRAIN LINE
G	GAS LINE
CATV	CABLE TELEVISION LINE
BH#	BORE HOLE
TH#	TEST HOLE
MW	MONITORING WELL
	WELL
+ 30.2	SPOT ELEVATION
	INTERMEDIATE CONTOUR
30	INDEX CONTOUR
	RIPRAP
	BOULDER
	TRAFFIC SIGNAL
	ZONE AE
	ZONE VE
	ZONE X
	BVW BOUNDARY
	GIS - WETLANDS
	COASTAL BANK
	SALTMARSH BOUNDARY

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508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA

ORLEANS, MA

SHEET TITLE
KEY SHEET

SCALE	AS NOTED
DRAWING FILE	C18686-MASTER-X.dwg
DATE	4-21-17
DRAWN BY	JLH
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C0.0.1

1 OF 28 SHEETS

PROJECT NO. C18686.00

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MID-CAPE HIGHWAY – EXIT 12

MAP 40 PARCEL 122
N/F
DIANA A FARRANDINO TR
BLACKSTONE REALTY TRUST
55 BLUE HERON RD
WELLFLEET, MA 02667

20 LOTS HOLLOW RD
MAP 40 PARCEL 121
N/F
PETER & SUSAN WILE FAM TR
PO BOX 1129
S DENNIS, MA 02660

19 LOTS HOLLOW RD
MAP 40 PARCEL 85
N/F
DONCROFT LLC
C/O 19 LOTS HOLLOW LLC
245 PINE STREET
YARMOUTH PORT, MA 02675

28 LOTS HOLLOW RD
MAP 47 PARCEL 1
N/F
ELEAZER HARDING ATWOOD LLC
40 BAKERS POND RD
ORLEANS, MA 02653

21 LOTS HOLLOW RD
MAP 47 PARCEL 2
N/F
NANCY E & SYDNEY E
AHLSTROM
21 LOTS HOLLOW RD
ORLEANS, MA 02653

1 FINLAY RD
MAP 47 PARCEL 81
N/F
ROBERT L GILL
PO BOX 1181
ORLEANS, MA 02653

LOTS HOLLOW ROAD

NICKERSON ROAD

FINLAY ROAD

BENCHMARK:
RR SPK IN UP#110/5
EL.=92.59

MATCH LINE SHEET 2

MATCH LINE SHEET 3

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
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C1.2.1

1 OF 29 SHEETS

PROJECT NO. C18686.00

MATCH LINE SHEET 4

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

ROUTE 6A CRANBERRY HIGHWAY

MID-CAPE HIGHWAY – RTE. 6

MID-CAPE HIGHWAY – EXIT 12

MATCH LINE SHEET 1

MATCH LINE SHEET 3

LOTS HOLLOW ROAD

STATION 43
RODCAP SET
N 2748295
E 1065549
ELEV=76.72

APPROX. 18" CPP OUTFALL INV=73.26

0 LOTS HOLLOW RD
MAP 40, PARCEL 83
NSTAR ELECTRIC COMPANY
PROPERTY TAX DEPT
PO BOX 270
HARTFORD, CT 06141

2 LOT HOLLOW RD
MAP 40 PARCEL 125
N/F
ROBERT SNOW BERGER
PO BOX 301
ORLEANS, MA 02653

6 LOT HOLLOW RD
MAP 40 PARCEL 124
N/F
HEMANT PATEL
203 RT 6A
ORLEANS, MA 02653

10 LOT HOLLOW RD
MAP 40 PARCEL 123
N/F
PETER & SUSAN WILE FAM TR
PO BOX 1129
S DENNIS, MA 02660

14 LOT HOLLOW RD
MAP 40 PARCEL 122
N/F
DIANA A FARRANDINO TR
BLACKSTONE REALTY TRUST
55 BLUE HERON RD
WELLFLEET, MA 02667

20 LOTS HOLLOW RD
MAP 40 PARCEL 121
N/F
PETER & SUSAN WILE FAM TR
PO BOX 1129
S DENNIS, MA 02660

DMH RIM=76.12 INV=73.76
CB RIM=75.14 T.O. CONC. BAFFLE =71.99
DMH RIM=82.48 NO ACCESS
CB RIM=82.09
DMH RIM=82.27 NO ACCESS
CB RIM=82.36
SILL EL=88.8
SILL EL=88.7
SILL EL=92.0
SILL EL=92
RET. WALL
GRAVEL
BIT.CONC.
TOWN LINE
STATE LINE

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
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C1.2.2

2 OF 29 SHEETS

PROJECT NO. C18686.00

MATCH LINE SHEET 5

MATCH LINE SHEET 4

MATCH LINE SHEET 2

MATCH LINE SHEET 1

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

CLAYTON CIRCLE

ELDREDGE PARK WAY

NICKERSON ROAD

LOTS HOLLOW ROAD

STATION #343
RODCAP SET
N 2748299.79
E 1065540.44
ELEV=76.70

9 LOTS HOLLOW RD
MAP 40 PARCEL 84
N/F
NSTAR ELECTRIC COMPANY
PROPERTY TAX DEPT
PO BOX 270
HARTFORD, CT 06141

CB RIM=75.36 INV=71.57

CB RIM=76.61 NPV (FULL)

CB RIM=75.78 INV.(e)=70.36 INV.(b)=70.47

DMH RIM=76.21 NPV

DMH RIM=75.09 INV.=71.26

DMH RIM=76.12 INV.=73.76

CB RIM=75.14 T.O. CONC. BAFFLE =71.89

DMH RIM=76.13 NPV

DMH RIM=76.74 NPV

DMH RIM=76.22 NPV

DMH RIM=76.39 NPV

CB RIM=82.09

DMH RIM=82.27 NO ACCESS

CB RIM=82.36

GRAVEL

BIT.CONC.

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
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C1.2.3

3 OF 29 SHEETS

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MATCH LINE SHEET 7

MATCH LINE SHEET 2

MATCH LINE SHEET 5

MATCH LINE SHEET 3

WEST ROAD

SKAKET CORNERS

ROUTE 6A CRANBERRY HIGHWAY

ELDREDGE PARK WAY

#12 1 1/2 STORY WOOD

#6 1 STORY MASONRY MAP 40 LOT H N/F TOWN INC PLAN BK 35691-A

#98 1 STORY WOOD

#192 MAP 40 LOT L N/F COMMONWEALTH OF MASSACHUSETTS BK 6503 PG 139

#199 MAP 40 LOT 40 N/F NSTAR ELECTRIC COMPANY PLAN BK 18010-82

STATION#191 MAG NAIL FND N 2748546.20 E 1065360.06 ELEV=78.17

E 1064962.39 ELEV=73.81

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

COASTAL engineering co.

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PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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C1.2.4

4 OF 29 SHEETS

PROJECT NO. C18686.00

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MATCH LINE SHEET 8

MATCH LINE SHEET 7

MATCH LINE SHEET 4

MATCH LINE SHEET 3

ROUTE 6A CRANBERRY HIGHWAY

CLAYTON CIRCLE

STATION#189
MAG NAIL FND
N 2748993.15
E 1065732.03
ELEV=71.68

#189 1 STORY BRICK
MAP 40 LOT 18
N/F HIGGINS REALTY, INC
BK 2370 PG 141
FFL EL=79.1

#74 1 1/2 STORY WOOD
SIL EL=71.8

#73 1 1/2 STORY WOOD
SIL EL=69.9

#75 2 STORY WOOD
SIL EL=73.9

#77 2 STORY WOOD
SIL EL=78.7

#79 2 STORY WOOD
SIL EL=79.3

#76 2 STORY WOOD
SIL EL=72.1

#69 1 STORY WOOD
SIL EL=68.4

#67 2 STORY WOOD
SIL EL=57.1

#68 1 STORY WOOD
SIL EL=62.4

#66 1 STORY WOOD
SIL EL=61.9

#65 1 1/2 STORY WOOD
SIL EL=70.9

#64 2 STORY WOOD
SIL EL=72.1

#63 2 STORY WOOD
SIL EL=71.4

#62 2 STORY WOOD
SIL EL=74.9

#61 2 STORY WOOD
SIL EL=82.3

#60 2 STORY WOOD
SIL EL=82.5

#59 2 STORY WOOD
SIL EL=73.5

#58 1 STORY MASONRY BANKING CENTER
FFL EL=73.1

#57 FILER BUILDING
SIL EL=72.4

LAUNDROMAT
SIL EL=76.9

MAP 40 LOT 17
OWEN APARTMENT
PLAN BK 0349/033

MAP 40 LOT 38
N/F JAMES & SUSAN G
BK 4079 PG 163

MAP 40 LOT 39
CONDOMINIUM
PLAN 18010-X
339/26

MAP 40 LOT 36
N/F THOMAS J VASCH TR
BK 3485 PG 9

MAP 40 LOT 35
N/F ORLEANS SQUARE LLC
BK 28656 PG 47

MAP 40 LOT 34
N/F MAID TO PLEASE
QH18023 PG 42

MAP 40 LOT 33
N/F ROBERT E CALLER &
JOANN A CALLER
BK 3465 PG 313

MAP 40 LOT 32
N/F KEVIN CONEY
BK 11878 PG 139

MAP 40 LOT 31
N/F CAPE COD PROPERTIES
BK 2839 PG 44

MAP 40 LOT 30
N/F C & F LAND HOLDERS LLC BK
24514 PG 291

MAP 40 LOT 29
N/F C & F LAND HOLDERS LLC
BK 24514 PG 291

MAP 40 LOT 28
CONDOMINIUM
PLAN BK 365/42

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS, MA
ORLEANS DOWNTOWN AREA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
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C1.2.5

5 OF 29 SHEETS

PROJECT NO. C18686.00

MATCH LINE SHEET 10

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

OVERLAND WAY

MID-CAPE HIGHWAY – RTE. 6

MATCH LINE SHEET 7

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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C1.2.6

6 OF 29 SHEETS

PROJECT NO. C18686.00

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MATCH LINE SHEET 6

MATCH LINE SHEET II

MATCH LINE SHEET 8

MATCH LINE SHEET 5

MATCH LINE SHEET 4

WEST ROAD

LANDINGS EDGE

STATION#192
MAG NAIL FND
N 2749117.21
E 1065[illegible].39
ELEV=73.81

STATION#193
MAG NAIL FND
N 2749385.51
E 1065372.98
ELEV=65.84

PLAN

1 inch = 40 ft.

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

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AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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C1.2.7

7 OF 29 SHEETS

PROJECT NO. C18686.00

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MATCH LINE SHEET 12

MATCH LINE SHEET 11

MATCH LINE SHEET 7

MATCH LINE SHEET 9

MATCH LINE SHEET 5

ANTHONY DRIVE

CRANBERRY HIGHWAY

ROUTE 6A

OLD TOTE ROAD

TOWN GIS WETLAND 3

ZONE X

APPROXIMATE BVW BOUNDARY

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

STATION#186
MAG NAIL FND
N 2750027.80
E 1065719.83
ELEV=35.25

STATION#187
MAG NAIL FND
N 2749796.79
E 1066811.81
ELEV=39.51

STATION#194
MAG NAIL FND
N 2749696.56
E 1065696.42
ELEV=44.79

STATION#195
MAG NAIL FND
N 2749159.84
E 1066159.04
ELEV=45.74

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
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C1.2.8

8 OF 29 SHEETS

PROJECT NO. C18686.00

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MATCH LINE SHEET 13

MATCH LINE SHEET 8

ZONE X

APPROXIMATE BVW BOUNDARY

MAP 33 LOT 88
N/F ORLEANS CONSERVATION TRUST
BK 16175 PG 201

MAP 33 LOT 100
N/F ANTHONY V. CARDILLI &
BK 9133 PG 14

MAP 33 LOT 90
N/F JAMES & JAMIE E. VIEW TRS
PLAN BK 13584-B

#47
1 STORY WOOD

#51
1 STORY WOOD
OLD TAVERN INN

POOL

LEACH FIELD

BOLAND POND

17.23

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
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C1.2.9

9 OF 29 SHEETS

PROJECT NO. C18686.00

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE



SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
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C1.2.10

10 OF 29 SHEETS

PROJECT NO. C18686.00

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

WEST ROAD

CAPE COD RAIL TRAIL

OLD COLONY WAY

OLD TOTE ROAD

APPROXIMATE BVW BOUNDARY

MATCH LINE SHEET 12

MATCH LINE SHEET 8

MATCH LINE SHEET 10

STATION #201
MAG NAIL SET
N 2749902.88
E 1064699.87
ELEV=39.35

STATION #49
MAG NAIL SET
N 2750202.51
E 1065522.14
ELEV=37.64

#79 2 STORY WOOD N/F OLD COLONY VILLAGE

#84 N/F TOWN OF ORLEANS

#83 1 STORY WOOD

#89 1 STORY WOOD

#73 2 STORY WOOD

#6 1 STORY WOOD

MAP 33 LOT 39 TOWNHOUSE 39 PLAN 368 PG 41

MAP 33 LOT 33 N/F KENDELL FARRAR & ROBERT CABANA BK 19948 PG 187

MAP 33 LOT 30 N/F CHRISTINA & THOMAS BRATBERG BK 19146 PG 276

MAP 33 LOT 29 N/F BRATBERG

MAP 33 LOT 36 N/F MARY JANE CORRY BK19146 PG 59

DETENTION POND
+ 25.46

+ 15.90

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
DRAWN BY	JLH
CHECKED BY	

C1.2.11

11 OF 29 SHEETS

PROJECT NO. C18686.00

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MATCH LINE SHEET 15

MATCH LINE SHEET 11

MATCH LINE SHEET 13

MATCH LINE SHEET 8

CAPE COD RAIL TRAIL

OLD COLONY WAY

TOWN GIS WETLAND

TOWN GIS WETLAND

1 STORY MASONRY MARKETPLACE

MAP 33 LOT 54 TOWNHOUSES PLAN 38153 PG B1-B6

MAP 33 LOT 54 N/F ORLEANS MARKETPLACE LLC BK 13444 PG 265

MAP 33 LOT 55 N/F ROBIN REALTY CORP BK 13532 PG 37

MAP 33 LOT 44 N/F 65 OLD COLONY WAY LLC BK 29602 PG 88

STATIONING SEE MAC 5 TRAVERSE N: 2950429.90 E: 1068042.90 ELEV=45.48

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

COASTAL engineering co.
260 Cranberry Hwy. Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
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C1.2.12

12 OF 29 SHEETS

PROJECT NO. C18686.00

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MATCH LINE SHEET 16

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

LIMIT OF MASSDOT SURVEY

ROUTE 6A CRANBERRY HIGHWAY

BREWSTER CROSS ROAD

CENTER PLACE

STATION#183
MAG NAIL FND
N 2750476.28
E 1067057.78
ELEV=36.94

STATION#184
MAG NAIL FND
N 2750328.58
E 1066889.58
ELEV=43.08

STATION#324
MAG SET
N 2750570.02
E 1067479.98
ELEV=33.45

APPROXIMATE B/W BOUNDARY

TOWN GIS WETLAND

MATCH LINE SHEET 12

MATCH LINE SHEET 14

MATCH LINE SHEET 9

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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C1.2.13

13 OF 29 SHEETS

PROJECT NO. C18686.00

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MATCH LINE SHEET 17

MATCH LINE SHEET 13

LIMIT OF MASSDOT SURVEY

MAIN STREET

ACADEMY PLACE

STATION #190
MAG NAIL FND
N 2750798.32
E 1068037.59
ELEV=45.20

STATION #329
MAG SET
N 2750705.85
E 1068256.424
ELEV=42.70

MAP 34 PARCEL 88
N/F
SANDRI REALTY INC.
CERT 26767
L.C. PLAN 13584-B
L.C. PLAN 13584-C

MAP 34 PARCEL 97
N/F
MAURICE & MARC FEIGENBAUM, TRS.
FINELLE REALTY TRUST
CERT 147071
LC PLAN 11919-B,D,F,H

MAP 34 LOT 94
N/F KENNETH E. & PATRICIA TERRERA
PLAN BK 11919-H

MAP 34 LOT 92
N/F ARC ROCK INN, LLC
PLAN BK 11919-G

MAP 34 LOT 91
N/F MEMORIAL TRAC PACE

MAP 34 LOT 22
N/F JOSHUA LARSON & KATHLEEN SMITH
BK 29346 PG 321

MAP 34 LOT 77
N/F ACADEMY PLACE
BK 22648 PG 243

MAP 34 LOT 78
N/F JOHN EDWARD STOMAS
BK 6722 PG 265

MAP 34 LOT 79
N/F ORLEANS UNITED METHODIST CHURCH
BK 8587 PG 171

MAP 34 LOT 80
N/F ORLEANS UNITED METHODIST
BK 12903 PG 89

MAP 34 PARCEL 90
N/F TOWN OF ORLEANS
VILLAGE GREEN
BK 582 PG 338

MAP 34 PARCEL 85
N/F
EASTHAM-ORLEANS-WELLFLEET
REGIONAL SCHOOL DISTRICT
CERT 23663
L.C. PLAN 18010-V

MAP 34 PARCEL 77
N/F
MARY WRIGHT BENNER
BK 23160 PG 294

MAP 34 PARCEL 24
N/F
CARTER F. AND LINDA LLOYD
BK 10645 PG 174

MAP 37 PARCEL 23
N/F
TOWN OF ORLEANS
BK 4687 PG 45

#57
1 STORY BRICK
MAP 34 LOT 88
N/F SANDRI REALTY INC

#64
1 STORY WOOD

#70
1 1/2 STORY BRICK

#5
1 1/2 STORY WOOD

#67
2 STORY BRICK
MAP 34 LOT 89
N/F TOWN OF ORLEANS LIBRARY

#1
2 1/2 STORY WOOD

#3
2 STORY WOOD

#7
DWELLING

#81
2 STORY WOOD

#82
DWELLING

#83
DWELLING

ZONE X

ZONE AE

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

LEACHING RECHARGE BASIN

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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ORLEANS DOWNTOWN AREA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

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C1.2.14

14 OF 29 SHEETS

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MATCH LINE SHEET 18

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

40.36

TOWN GIS WETLAND

ZONE X

MATCH LINE SHEET 12

CAPE COD RAIL TRAIL

OLD COLONY WAY

MATCH LINE SHEET 16

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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ORLEANS DOWNTOWN AREA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

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C1.2.15

15 OF 29 SHEETS

PROJECT NO. C18686.00

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MATCH LINE SHEET 19

MATCH LINE SHEET 15

MATCH LINE SHEET 17

MATCH LINE SHEET 13

CAPE COD RAIL TRAIL

OLD COLONY WAY

COVE ROAD

MAIN STREET

CRANBERRY HIGHWAY

ROUTE 6A

CUMMINGS ROAD

DOANE TERRACE

LIMIT OF MASSDOT SURVEY

STATION#156
MAG NAIL SET
N 2751679.86
E 1067198.01
ELEV=50.15

STATION#294
MAG SET
N 2751522.21
E 1067547.51
ELEV=57.55

STATION#151
MAG NAIL SET
N 2751414.46
E 1065846.46
ELEV=56.49

STATION#173
MAG NAIL FND
N 2750886.46
E 1067866.46
ELEV=49.74

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

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C1.2.16

16 OF 29 SHEETS

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SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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SEAL

PROJECT
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ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

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C1.2.17

17 OF 29 SHEETS

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MATCH LINE SHEET 21

NAMSKAKET ROAD

2 ROCK HARBOR ROAD
MAP 25 PARCEL 24-3
N/F
DELIA A QUINN
PO BOX 524
ORLEANS MA 02653

LOCUST ROAD

4 MAIN STREET
MAP 25 PARCEL 52
N/F
NAUSET ASSOCIATES, LLC
PO BOX 2466
ORLEANS MA 02653

STATION#261
MAG SET
N 2752322.38
E 1066497.92
ELEV=34.44

MAIN STREET

MAP 25 PARCEL 76
N/F
KILBY LAND COMPANY
CERT 132539
L.C. PLAN 37855A

CHILDS HOMESTEAD ROAD

MATCH LINE SHEET 19

MATCH LINE SHEET 15

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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C1.2.18

18 OF 29 SHEETS

PROJECT NO. C18686.00

MATCH LINE SHEET 21

MATCH LINE SHEET 22

MATCH LINE SHEET 18

MATCH LINE SHEET 20

MATCH LINE SHEET 16

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

8 CARDINAL LN
MAP 25 PARCEL 54
N/F
MAIN STREET CORNERS LLC
PO BOX 2300
ORLEANS, MA 02653

MAP 25 PARCEL 53
N/F
ARLY LYNN PIKE, TR.
SNOWLY REALTY TRUST
LC 6299 PG 184
PL BK 401 PG 47

MAP 25 PARCEL 57
12 MAIN STREET CONDOMINIUM
MASTER DEED
BK 3519 PG 8
PL BK 365 PG 50

CARDINAL LANE

MAIN STREET

TOWN GIS WETLAND

MAP 25 PARCEL 59
N/F
SNOW REALTY TRUST
CERT 85571
L.C. PLAN 40135A
PL BK 553 PG 69

MAP 25 PARCEL 74
N/F
NICKERSON LUMBER CO.
BK 894 PG 220
PL BK 403 PG 96

LIMIT OF MASSDOT SURVEY

STATION #262
MAG SET
N 2352002.67
E 1066873.55
ELEV=49.03

MAP 25 PARCEL 71
N/F
ERICA E. TABER, TR.
30 MAIN STREET NOMINEE TRUST
BK 10860 PG 120
PL BK 300 PG 17

CAPE COD RAIL TRAIL

CRANBERRY HIGHWAY

ROUTE 6A

TOWN GIS WETLAND

LIMIT OF MASSDOT SURVEY

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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AECOM - TOWN OF ORLEANS
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ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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C1.2.19

19 OF 29 SHEETS

PROJECT NO. C18686.00

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MATCH LINE SHEET 22

MATCH LINE SHEET 23

MATCH LINE SHEET 19

ROUTE 6A CRANBERRY HIGHWAY

STATION#290
MAG NAIL SET
N 2752425.73
E 1068311.67
ELEV=64.73

STATION#163
MAG NAIL FND
N 2752361.45
E 1068863.63
ELEV=35.62

STATION#75
MAG NAIL FND
N 2752503.15
E 1068505.19
ELEV=61.02

APPROXIMATE COASTAL BANK BOUNDARY

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

LIMIT OF MASSDOT SURVEY

SOUTHWARD DRIVE

MATCH LINE SHEET 17

ZONE AE

ZONE VE

LOLS

GRAVEL PARKING AREA

LEACHING AREA

#50 EMACK & BOLIO'S ICE CREAM

#55 ORLEANS PIZZA

#20

#25

#35

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

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C1.2.20

20 OF 29 SHEETS

PROJECT NO. C18686.00

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MATCH LINE SHEET 24

MATCH LINE SHEET 22

MATCH LINE SHEET 18

MATCH LINE SHEET 19

CEDAR POND ROAD

LOCUST ROAD

ROCK HARBOR ROAD

10 LOCUST ROAD
MAP 25 PARCEL 24-1
THOMSON HASKELL L &-M KAY TRS
HASKELL L&M KAY THOMSON REV
PO BOX 7
ORLEANS, MA 02653

20 LOCUST ROAD
MAP 25 PARCEL 27
N/F
PATRICK & THERESA CARMODY
158 TANGLEWOOD DR
SOUTHINGTON CT 06489

16 LOCUST ROAD
MAP 25 PARCEL 26
N/F
ROBERT L & SAVASTA A JORDAN
16 LOCUST RD
ORLEANS MA 02653

14 LOCUST ROAD
MAP 25 PARCEL 25
N/F
BRIAN D & MARGARET ALLARD
PO BOX 1283
ORLEANS MA 02653

12 LOCUST ROAD
MAP 25 PARCEL 24-2
N/F
JEAN-PAUL & GAIL MANGEOLLE
4 SUTTON PLACE
ACTON, MA 01720

26 LOCUST ROAD
MAP 25 PARCEL 34
N/F
STEVEN & DONNA SHERVANIAN
26 LOCUST RD
ORLEANS MA 02653

30 LOCUST ROAD
MAP 25 PARCEL 35
N/F
BRUCE C & ELIZABETH PETERS
30 LOCUST RD
ORLEANS MA 02653

27 LOCUST RD
MAP 25 PARCEL 48
N/F
KAREN A & MICHAEL P FRAHER
926 CROWELLS BOG RD
BREWSTER MA 02631

15 LOCUST RD
MAP 25 PARCEL 49
N/F
CONTINENTAL CABLE SYSTEM
1 COMCAST CENTER
PHILADELPHIA PA 19103

9 LOCUST RD
MAP 25 PARCEL 50
N/F
BARRY L & MYSTLE CUMMINGS
PO BOX 868
PROVINCETOWN MA 02657

5 LOCUST RD
MAP 25 PARCEL 51
N/F
GOLD CROWN LLC
5 LOCUST RD
ORLEANS MA 02653

33 LOCUST
MAP 25 PAR
N/F
MARIANNE & KATHE
33 LOCUST
ORLEANS MA

STATION#259
MAG SET
N 2753015.35
E 1066880.29
ELEV=20.14

STATION#260
MAG SET
N 2752565.80
E 1066641.90
ELEV=35.43

SWAMP

TOWN GIS WETLAN

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS, MA
ORLEANS DOWNTOWN AREA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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MATCH LINE SHEET 24

MATCH LINE SHEET 25

MATCH LINE SHEET 21

MATCH LINE SHEET 23

MATCH LINE SHEET 19

MATCH LINE SHEET 20

LIBERTY LANE

FREEDOM TRAIL

PATRIOTS WAY

CAPE COD RAIL TRAIL

ROUTE 6A CRANBERRY HIGHWAY

37 LOCUST RD
MAP 25 PARCEL 45

39 LOCUST RD
MAP 25 PARCEL 44
N/F
THOMAS J GARDNER
39 LOCUST RD
ORLEANS MA 02653

LIBERTY LANE/FREEDOM TRAIL/PARTIOTS WAY
MAP 25 PARCEL 43

N/F
JOHN & SUSAN HENRY
21 PRATT ST
ESSEX CT 06426

35 LOCUST RD
MAP 25 PARCEL 46
N/F
KATHERINE MINER LYNCH
9 DICKINSON RD
BRIGHTON MA 02135

33 LOCUST RD
MAP 25 PARCEL 47
N/F
MARIANNE & KATHERINE MINER
33 LOCUST RD
ORLEANS MA 02653

STATION#257
MAG SET
N 2753149.07
E 1067736.65
ELEV=22.31

STATION#290
MAG SET

TOWN GIS WETLAND

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

SEPTIC LOCATIONS PER RECORD PLAN
UNABLE TO ACCESS PROPERTY

1 STORY MASONRY
GOVERNORS PROVINCE INN

POOL

MAP 26 LOT 23
N/F RESORT ENTERPRISES INC
PLAN BK 19048-A

MAP 26 LOT 22
N/F RESORT ENTERPRISES INC
PLAN BK 19048-B

MAP 26 LOT 21
N/F
MEREDITH B KELLY TR
BK 19053
PG 259

LEACH FIELD

PLAN

40 20 0 40 120

1 inch = 40 ft.

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

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AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
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C1.2.22

22 OF 29 SHEETS

PROJECT NO. C18686.00

MATCH LINE SHEET 25

MATCH LINE SHEET 26

MATCH LINE SHEET 22

MATCH LINE SHEET 20

ROUTE 6A CRANBERRY HIGHWAY

CANAL ROAD

COTTAGE STREET

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

STATION#285
MAG SET
N 2752958.09
E 1068911.39
ELEV=34.04

STATION#302
MAG SET
N 2752603.58
E 1069057.36
ELEV=33.48

ZONE AE

APPROXIMATE COASTAL BANK

RIPRAP

APPROXIMATE LOCATION OF BIKE PATH

DOUBLE DRAGON RESTAURANT

MAP 26 LOT 34
N/F ROMAN CATHOLIC BISHOP OF FALL RIVER
BK 661 PG 308

MAP 26 LOT 30
N/F ROMAN CATHOLIC BISHOP OF FALL RIVER
BK 5166 PG 171

MAP 26 LOT 28
CONDOMINIUM
PLAN BK 422/100

MAP 26 LOT 29
N/F SEARS PARKS PLACE LLC
BK 29500 PG 256

MAP 26 LOT 47
CONDOMINIUM
PLAN BK 1062/213

MAP 26 LOT 44
N/F RAILROAD MARINE INC
BK 1421 PG 455

MAP 26 LOT 43
N/F DONALD R JOSCHAMER
BK 44446 PG 330

MAP 26 LOT 45
N/F RAILROAD MARINE INC
BK 1421 PG 455

MAP 26 LOT 61
N/F GREGORY M & THERESA J NORGEOT
BK 12385 PG 162

MAP 26 LOT 60
N/F ALAN B & KATHLEEN M SMITH
BK 11245 PG 253

MAP 26 LOT 59
N/F DANIEL U HOLBROOK
BK 23382 PG 105

MAP 26 LOT 58
N/F DANIEL U HOLBROOK
BK 24030 PG 319

MAP 26 LOT 62
N/F DANIEL R JOHNSON
BK 12080 PG 312

MAP 26 LOT 10
N/F ANDREA M MURPHY TR
BK 33749 PG 46

MAP 26 LOT 48
N/F ORLEANS ROAD INC
BK 31460 PG 62

MAP 26 LOT 49
N/F JEFF W & RHODA S RICKER
BK 3025 PG 172

MAP 26 LOT 51
N/F MARIE ET AL ALLYN YOSSEF
BK 23657 PG 311

MAP 26 LOT 52
N/F JEFFREY W & RHODA S RICKER
BK 3025 PG 172

MAP 26 LOT 53
N/F STANLEY R & LINDA E HOLDEN TR
BK 11027 PG 310

MAP 26 LOT 54
N/F STANLEY R & LINDA E HOLDEN TR
BK 11027 PG 310

MAP 26 LOT 55
N/F MICHEL D & BARBARA S ROY
BK 10233 PG 46

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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PROJECT
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ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

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C1.2.23

23 OF 29 SHEETS

PROJECT NO. C18686.00

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

CEDAR POND

3.75

CEDAR POND ROAD

LOCUST ROAD

LIBERTY LANE

7 CEDAR POND ROAD
MAP 25 PARCEL 33
N/F
JUDITH DANIELS & JILL L PALMER
CONNIE PERRY & OTHERS
180 BLACKSTONE ST
UXBRIDGE, MA 01569

32 LOCUST ROAD
MAP 25 PARCEL 32
N/F
STEPHEN PETERS
192 ROCK HARBOR RD
ORLEANS MA 02653

34 LOCUST ROAD
MAP 25 PARCEL 36
N/F
THOMAS & BENVE MCDONNELL
22 OXFORD CT
RAMSEY NJ 07446

38 LOCUST ROAD
MAP 25 PARCEL 37
N/F
ERIN STRAITON
38 LOCUST RD
ORLEANS

42 LOCUST ROAD
MAP 25 PARCEL 38

N/F
JACQUELYN FULCHER
LIFE EST
42 LOCUST RD
ORLEANS MA 02653

N/F
WILLIAM & JUDITH RISKO TRS
46 LOCUST RD
ORLEANS MA 02653

46 LOCUST ROAD
MAP 25 PARCEL 39

48 LOCUST RD
MAP 25 PARCEL 40
N/F
MATTHEW D HILLMAN
48 LOCUST RD
ORLEANS MA 02653

52 LOCUST RD
MAP 25 PARCEL 41
N/F
ROBERT D BENGLE TR
52 LOCUST RD
ORLEANS MA 02653

49 LOCUST RD
MAP 25 PARCEL 42
N/F
JOHN J & SANDRA K OCONNOR
49 LOCUST RD
ORLEANS MA 02653

MATCH LINE SHEET 21

MATCH LINE SHEET 22

MATCH LINE SHEET 25

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

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1 inch = 40 ft.

C:\Users\jhastings\Desktop\C18686-00\C18686-MASTER-X.dwg Apr 21, 2017 - 1:25pm

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COASTAL
engineering co.
260 Cranberry Hwy. Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
DRAWN BY	JLH
CHECKED BY	

C1.2.24

24 OF 29 SHEETS

PROJECT NO. C18686.00

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MATCH LINE SHEET 27

MATCH LINE SHEET 24

MATCH LINE SHEET 26

MATCH LINE SHEET 22

MATCH LINE SHEET 23

LOCUST ROAD

CAPE COD RAIL TRAIL

CANAL ROAD

APPROXIMATE BVW BOUNDARY

ZONE AE

N/F
JUDITH GAMSEY
515 TRAINING FIELD RD

64 LOCUST RD
MAP 18 PARCEL 6

62 LOCUST RD
MAP 18 PARCEL 3
N/F
SUSAN M BAUMGART TRUST
1203 NORTH WESTGATE RD
MT PROSPECT, IL 60056

58 LOCUST RD
MAP 18 PARCEL 2
N/F
MARCIA ALEXANDER
PO BOX 1566
ORLEANS, MA 02653

56 LOCUST RD
MAP 18 PARCEL 1
N/F
MARCIA ALEXANDER
PO BOX 1566
ORLEANS, MA 02653

63 LOCUST RD
MAP 18 PARCEL 4
N/F
JEAN M SMITH
C/O KATHERINE A BUNZICK
155 HARWICH RD
ORLEANS, MA 0265

57 LOCUST RD
MAP 26 PARCEL 26
N/F
BRIAN W COULSON SR
PO BOX 1200
ORLEANS, MA 02653

53 LOCUST RD
MAP 26 PARCEL 25
N/F
CE M & CARMELITA DINWIDDIE
53 LOCUST RD
ORLEANS, MA 02653

60 LOCUST RD
MAP 18 PARCEL 7
TOWN OF ORLEANS
CAPE COD RAIL TRAIL
19 SCHOOL RD
ORLEANS, MA 02653

59 CANAL RD
MAP 18 PARCEL 27
REHOLD ORLEANS LLC
C/O STOP & SHOP SUPERMARKET CO
1385 HANCOCK ST/RE TAX DEPT
QUINCY, MA 02169

MAP 18 LOT 27
ORLEANS BOARDS LLC
PLAN BK 33774-A

MAP 26 LOT 33
N/F ROMAN CATHOLIC
BISHOP OF FALL RIVER
BK 674 PG 166

MAP 26 LOT 35
N/F ROMAN CATHOLIC
BISHOP OF FALL RIVER
BK 2949 PG 218

MAP 26 LOT 35
N/F THREE CAPES COD
COMMUNITY DEVELOPMENT CORP
BK 19040 PG 299

MAP 26 LOT 36
CDS REALTY
PLAN BK 33581-A

MAP 26 LOT 28
2 STORY WOOD
N/F ROMAN
CATHOLIC BISHOP
OF FALL RIVER
BK 674 PG 166

#57
1 STORY WOOD

#53
1 STORY WOOD

#61
1 STORY WOOD

#59-65
2 STORY WOOD

#63
2 STORY BRICK

#67
PARKING

POOL

LEACH PIT

BIT CONC PARKING

GRAVEL

GRASS

SHRUBS

STATION#253
MAG SET
N 2775628.46
E 1067991.50
ELEV=19.44

DMH
RIM=19.25
INV.(e)=15.13
INV.(b)=14.41

DMH
RIM=19.50
NPV

CB
RIM=19.37
INV.(e)=15.47
INV.(b)=16.19

CB
RIM=18.97
INV.=14.89

DMH
RIM=20.03
INV.(e)=14.79
INV.(b)=14.28

DMH
RIM=28.56
INV.(e)=approx
INV.(b)=23.33

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R=-0.46

SMH
R=-0.49

SMH
R=-0.53

SMH
R=-0.56

SMH
R=-0.59

SMH

MATCH LINE SHEET 28

MATCH LINE SHEET 25

MATCH LINE SHEET 23

ROUTE 6A CRANBERRY HIGHWAY

OLD COUNTY ROAD

JUDAHS WAY

ZONE AE

ZONE VE

APPROXIMATE SALTMARSH BOUNDARY

SALTMARSH BOUNDARY

APPROXIMATE LOCATION RIDGEAD

STATION#195
MAG NAIL FND
N 2753326.16
E 1069161.32
ELEV=25.43

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

COASTAL engineering co.
260 Cranberry Hwy. Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
DRAWN BY	JLH
CHECKED BY	

C1.2.26

26 OF 29 SHEETS

PROJECT NO. C18686.00

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MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

MID-CAPE HIGHWAY – RTE. 6

TOWN GIS WETLAND

TOWN GIS WETLAND

TOWN GIS WETLAND

12 JONES RD
MAP 18 PARCEL 14
NSTAR ELECTRIC COMPANY
PROPERTY TAX DEPT
PO BOX 270
HARTFORD, CT 06141

10 JONES RD
MAP 18 PARCEL 13
NADEAU BRIELLE &
DIGIACOMO MAT
10 JONES RD
ORLEANS, MA 02653

6 JONES RD
MAP 18 PARCEL 12
CHMIDT PHILIP & ELLEN ET ALI
6 JONES RD
ORLEANS, MA 02653

11 JONES RD
MAP 18 PARCEL 10
ARATH VIRGINIA L
11 JONES RD
ORLEANS, MA 02653

7 JONES RD
MAP 18 PARCEL 9
N/F
CHRISTINA L MARTIN
C/O KUMAR SENTHIL TRUSTEE
930 MAIN ST SUITE 603
ACTON, MA 0172

46 CANAL RD
MAP 18 PARCEL 8
TOWN OF ORLEANS
19 SCHOOL RD
ORLEANS, MA 0265

N/F
JUDITH GAMSEY
515 TRAINING FIELD RD
CHATHAM, MA 02633

CEDAR POND

CAPE COD RAIL TRAIL

42 CANAL RD
MAP 18 PARCEL 24
TOWN OF ORLEANS
CAPE COD RAIL TRAIL
19 SCHOOL RD
ORLEANS, MA 02653

JONES ROAD

CANAL ROAD

MATCH LINE SHEET 29

ZONE AE

MASS MAIL FAC
N 2754651.60
E 1068698.60
ELEV=10.53

38 CANAL RD
MAP 18 PARCEL 23
AKTOV LLC
66 PONDSIDE CR
CENTERVILLE, MA 02632

#21
1 STORY WOOD

#31
1 1/2 STORY WOOD

#31
1 STORY MASONRY

MAP 18
LOT 23
N/F JONATHAN
POINVILLE ET AL
BK 16481
PG 88

31 CANAL RD
MAP 18 PARCEL 25
FRANK I & SYLVIA WHITE
175 MAIN ST
ORLEANS, MA 02653

GARAGE

APPROXIMATE BVW BOUNDARY

STATION#250
MAG SET
N 2754236.67
E 1068369.85
ELEV=15.50

APPROXIMATE BVW BOUNDARY

APPROXIMATE BVW BOUNDARY

43 CANAL RD
MAP 18 PARCEL 26
N/F
STANLEY W & DIANE L OVE
43 CANAL RD
ORLEANS, MA 02653

#43
1 1/2 STORY WOOD

ROAD BARN

APPROXIMATE BVW BOUNDARY

44 RT 6A
MAP 18 PARCEL 30
REHOLD ORLEANS LLC
C/O STOP & SHOP SUPERMARKET CO
1385 HANCOCK ST/RE TAX DEPT
QUINCY, MA 02169

#21
1 STORY WOOD

ZONE AE

MATCH LINE SHEET 28

MATCH LINE SHEET 25

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

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COASTAL engineering co.
260 Cranberry Hwy. Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
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CHECKED BY	

C1.2.27

22 OF 29 SHEETS

PROJECT NO. C18686.00

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MATCH LINE SHEET 29

MATCH LINE SHEET 27

MATCH LINE SHEET 26

MAP 18 PARCEL 37
CAPE GIFTS & GOLF INC
8 CANAL RD
ORLEANS, MA 02653

MAP 18 LOT 36
N/F STEVE ANDERSON
BK 2921 PG 206

STATION#288
MAG NAIL FND
N 2754723.43
E 1069032.00
ELEV=19.36

STATION#281
MAG SET
N 2754618.41
E 1069804.66
ELEV=12.55

STATION#282
MAG SET
N 2753984.50
E 1069809.79
ELEV=15.65

STATION#168
MAG NAIL FND
N 2754135.23
E 1070065.52
ELEV=6.86

ROUTE 6A CRANBERRY HIGHWAY

OLD STATE HIGHWAY

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

ZONE X

ZONE AE

ZONE VE

LIMIT OF MODERATE WAVE ACTION

TOWN GIS WETLAND

DETENTION BASIN 3.77

DETENTION BASIN 0.53

MAP 18 LOT 40
N/F HOWARD G HAYES TR
PLAN BK 41709-A

MAP 18 LOT 41
N/F ORLEANS SEWALL LLC
PLAN BK 31714-E

MAP 18 LOT 42
N/F ORLEANS SEWALL LLC
PLAN BK 31714-E

MAP 18 LOT 43
N/F ORLEANS SEWALL LLC
PLAN BK 31714-E

MAP 18 LOT 30
N/F ORLEANS SEWALL LLC
PLAN BK 31714-A

MAP 18 LOT 31
N/F ORLEANS SEWALL LLC
PLAN BK 31714-E

MAP 18 LOT 51
N/F SHAW G TRANOR
BK 27651
PG 326

MAP 18 LOT 50
N/F TOWN OF ORLEANS
BK 27651 PG 175

MAP 18 LOT 52
N/F HOWARTH HOLDING
BK 27651 PG 175

MAP 18 LOT 48
N/F TOWN OF ORLEANS

MAP 18 LOT 29
CONDOMINIUM
PLAN BK 31714-H

APPROXIMATE COASTAL BANK

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

COASTAL engineering co.
260 Cranberry Hwy, Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
DRAWN BY	JLH
CHECKED BY	

C1.2.28

28 OF 29 SHEETS

PROJECT NO. C18686.00

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CAPE COD RAIL TRAIL

MID-CAPE HIGHWAY – RTE. 6

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

TOWN GIS WETLAND

ZONE AE

8 CANAL RD
MAP 18 PARCEL 21
BYRNE RICHARD A & JANET M TRS
CAPE TRADEWINDS II REALTY TR
8 CANAL RD
ORLEANS, MA 02653

24 CANAL RD
MAP 18 PARCEL 22
FURMAN REALTY TRUST
PO BOX 175
ORLEANS, MA 02653

15 CANAL RD
MAP 18 PARCEL 37
CAPE GIFTS & GOLF
8 CANAL RD
ORLEANS, MA 0265

5 CANAL RD
MAP 18 PARCEL 38
BOTSINI–PRIME LLC
450 STATION AVENUE
S YARMOUTH, MA 02664

STATION#279
MAG SET
N 2754885.22
E 1089299.35
ELEV=14.17

STATION#173
MAG NAIL FND

CANAL ROAD

MATCH LINE SHEET 27

MATCH LINE SHEET 28

SEE SHEET C0.0.1 FOR KEY MAP AND LEGEND

PLAN

40 20 0 40 120

1 inch = 40 ft.

COASTAL
engineering co.
260 Cranberry Hwy, Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT
AECOM - TOWN OF ORLEANS
ORLEANS DOWNTOWN AREA
ORLEANS, MA

SHEET TITLE
PLAN SHOWING EXISTING SITE CONDITIONS

SCALE	AS NOTED
DRAWING FILE	C18686-X.dwg
DATE	4-21-17
DRAWN BY	JLH
CHECKED BY	

C1.2.29

29 OF 29 SHEETS

PROJECT NO. C18686.00

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Appendix B

Downtown Area Cultural Resource Evaluation

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AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559
www.aecom.com

508.833.6950 tel
508.833.6951 fax

Memorandum

To	George Meservey, Director of Planning & Community Development Michael Domenica, PE, Program Manager
CC	Betsy Shreve, AICP, AECOM Project Director Paula Winchell, AECOM Reggie Donoghue, P.E., AECOM
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Task Number 10.1.C – 25% Preliminary Design Report** **Deliverable 10.1.C.3 – Cultural Resource Evaluation**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	March 29, 2017

Approvals	Date	Signature / Initials
George Meservey, Orleans, MA Director of Planning & Community Development		
Michael Domenica, PE, Water Resources Associates, Program Manager		

1. Introduction

As part of the 25% Preliminary Design Report for the Downtown Orleans Wastewater Collection System, AECOM solicited cost proposals from independent licensed and insured professional firms with expertise in conducting Cultural Resource Evaluations. Based on the results of the solicitation, Public Archaeology Laboratory, Inc. (PAL) was engaged to perform a Cultural Resource Evaluation for the proposed new wastewater collection system in Orleans, Massachusetts

This Technical Memorandum outlines the Cultural Resource Evaluation prepared by PAL and their recommendations for archaeological monitoring during construction project work. Refer to the attachedment.

2. Goals and Objectives of the Cultural Resource Evaluation

The goal of this evaluation was to collect information about known and expected cultural resources within the project area:

- Produce a detailed archaeological sensitivity assessment of the project area;
- Prepare a technical proposal for archaeological investigations, if necessary;

The evaluation was designed to facilitate project review by the Massachusetts Historical Commission (MHC) and compliance with all applicable federal, state, and local regulations and review including M.G.L. Chapter 9, Sections 26-27c (950 CMR 70-71).

3. Cultural Resources Review

A. General

The cultural resources review included the collection of information about known cultural resources within the project's area of potential effect (APE), including historic and archaeological resources in the Commonwealth of Massachusetts Inventory, and an assessment of existing conditions within the project area. The purpose of the work was to assemble information about previously documented historical resources within and near the project area and provide recommendations about previously documented historical resources within and near the project area and provide recommendations about significant archaeological sites that may be affected by the project.

B. Results of the Background Research

The MHC site files list dozens of historic architectural properties and archaeological sites within the vicinity of the Orleans Downtown Area Wastewater Collection System (ODWCS) project area.

- The resources were identified through a search of the MHC's Inventory of the Historical and Archaeological Assets of the Commonwealth (MHC Inventory).
- For historic properties, the study area encompassed everything within the project area boundaries.
- For archaeological resources, the study area encompassed everything within one-quarter mile one either side of the project's outer boundaries.
- The evaluation found that there are three historic districts with 73 historic properties within the ODWCS area. Table 1 of the evaluation includes a list of architectural resources that were identified by the cultural resource review.
- Background research was conducted to assist with the archaeological sensitivity assessment and to develop predictive statements for the types of archaeological resources that may be present within the project area.
- Table 2 of the evaluation includes a list of archaeological resources that were identified by the culture resource review.

C. Results of the Field Assessment

A walkover/drive-over field assessment of the ODWCS project area was conducted by Dianna Doucette, PAL Senior Archaeologist, on February 8, 2017 to assess the integrity of the ground surface, to collect data about the current environmental setting of each area, and to look for any surface indications of archaeological sites.

- During the field assessment, all the roads that will be impacted by the proposed sewer line construction were accessed as well as the three proposed pump station locations.
- No evidence of archaeological sites was observed on the ground surface during the field assessment.

D. Results of the Sensitivity Assessment

Results of the background research and field assessment were used to develop a sensitivity ranking and predictive statements concerning the potential for the presence of Native American and EuroAmerican cultural resources.

- Overall, the archaeological sensitivity of the ODWCS project area is high to moderate for Native American sites dating to the Pre-Contact, Contact, and early Post-Contact periods. (ca. 8000 to 300 B.P.).
- The EuroAmerican post-contact archaeology sensitivity for land use is moderate to low.

- The post contact historic period sensitivity of the project area is moderate to low based on the historic nature of Orleans and the possibility of post-contact sites to be present und the current streets.

E. Recommendations

PAL recommends archaeological monitoring in areas assessed as high and moderate archaeological sensitivity, which includes all places where new sewer lines and pump stations will be impacting intact soils during construction (this may include areas between existing utilities).

- PAL also recommends coordinating with the Mashpee Wampanoag and Wampanoag Tribe of Gay Head/Aquinnah regarding the proposed project schedule so that a tribal cultural resource monitor can be present during construction of the project.
- The goal of the archaeological monitoring during construction will be to insure that if any significant archaeological resources, including remains and/or burials are exposed during the construction activities that they are treated appropriately in accordance with the Massachusetts Unmarked Burial Laws.
- The section of Route 28, from Academy Place to where it intersects with Route 6A, the short residential connectors that lie closest to Town Landing (Cottage Street and Cove Road), Cedar Pond (Locust Street and Jones Road), the Old Tote Road, and the three pump station sites have been assessed as having a preliminary high archaeological sensitivity due to the proximity of recorded archaeological sites and general lack of development.
- PAL also recommends a “Post-Review Discoveries” protocol, or, an Unanticipated Discoveries Plan be developed and implemented consistent with the Massachusetts Unmarked Burial Laws.

Public Archaeology Laboratory

Memorandum
Orleans Downtown Area Wastewater Collection System Project
Orleans, Massachusetts

Cultural Resource Evaluation

February 24, 2017

Submitted to:

AECOM
9 Jonathan Bourne Drive
Pocasset, MA 02559

In response to a request from AECOM, PAL conducted a cultural resources evaluation as part of a proposed new wastewater collection system in Orleans, Massachusetts (Figure 1). The project will include construction of sewer lines and three pump stations in the downtown area of Orleans (Figure 2).

The goal of the evaluation was to collect information about known and expected cultural resources within the project area, produce a detailed archaeological sensitivity assessment of the project area, and prepare a technical proposal for archaeological field investigations, if necessary. The evaluation was designed to facilitate project review by the Massachusetts Historical Commission (MHC) and compliance with all applicable federal, state and local regulations and review including M.G. L. Chapter 9, Sections 26-27c (950 CMR 70-71).

The cultural resources review included the collection of information about known cultural resources within the project's area of potential effect (APE), including historic and archaeological resources in the Commonwealth of Massachusetts Inventory, and an assessment of existing conditions with the project area. The purpose of the work was to assemble information about previously documented historical resources within and near the project area and provide recommendations about significant archaeological sites that may be affected by the project.

PAL compiled information about previously documented cultural resources and assessed the sensitivity of the project area for the potential to contain previously unrecorded archaeological sites. **For purposes of this proposal, PAL assumes that the project does not have the potential to affect historic structures or landscapes, and that the project tasks are limited to known and potential archaeological resources only.**

This memorandum summarizes the results of the cultural resources evaluation and recommendations for archaeological monitoring during project construction work. The sensitivity assessment included background research and a walkover/drive-over field assessment of the project area.

Results of the Background Research

The MHC site files list dozens of historic architectural properties and archaeological sites within the vicinity of the Orleans Downtown Area Wastewater Collection System (ODWCS) project area. The resources were identified through a search of the MHC's Inventory of the Historic and Archaeological Assets of the Commonwealth (MHC Inventory). The study areas established for the purposes of the identification effort were broadly defined to provide information about the types of resources located around the project area. For historic properties, the study area encompassed everything within the project area boundaries; and for archaeological resources, the study area encompassed everything within one-quarter mile on either side of the project's outer boundaries for a total width of one-half mile (Figure 3).

Architectural and Historic Resources

There are three historic districts with 73 historic properties listed within the ODWCS, one of which is listed in the National Register of Historic Places (see Figure 1; Table 1). Most the inventoried properties fall within the Orleans Town Center historic district (ORL.C). Two other historic districts abut downtown area: Rock Harbor historic district (ORL.A) and Main Street East (ORL.D). Three war memorials (ORL.908, ORL.910, and ORL.911) fall within Academy Place Park, one of the proposed pump station locations, which may also have been the location of the Rock Harbor Academy, built in 1827 and shown on an 1857 map of Orleans (Walling 1857). In 1877, the Academy building was replaced with the Snow Library (1877 - 1952) on Main Street and Chatham Road (MHC 1984).

The following is a list of architectural resources that were identified by this cultural resource review:

Table 1. Evaluated and Unevaluated Architectural Properties Recorded within the ODWCS Project Area.

MHC #	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.33	Hurd, Bangs House	11 Jones Rd	1830	Federal;
ORL.34	Unknown	6 Jones Rd	1789	Federal;
ORL.35	Swain, Eunice - Winchester, S. Coleman House	43 Canal Rd	1790	Federal;
ORL.36	Snow, Lt. Prence - Snow, Jonathan House	31 Canal Rd	1723	No style;
ORL.38	Swain, Sue House	64 Locust Rd	1750	Colonial;
ORL.39	Baker, Cal House	63 Locust Rd	1890	Victorian Eclectic;
ORL.40		58 Locust Rd	1850	No style;
ORL.41	Mayo, Josuah - Myrick, Capt. Josiah House/ Snow, Sarah - Greenhalge, Richard House	52 Locust Rd	1788	Federal;

MHC #	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.42	Peter House	39 Locust Rd	1827	No style;
ORL.43	Smith, E. House/ Cape Cable Television Associates	15 Locust Rd	1875	No style;
ORL.68	Knowles House/ Smith, Fannie - Young, Mehitable House	9 Locust Rd	1800	Greek Revival;
ORL.69	Knowles House/ Mayo, Arthur - Brooks House	5 Locust Rd	1875	Victorian Eclectic;
ORL.76	Gould, Nathaniel House	36 West Rd	1830	Federal; Greek Revival;
ORL.77	Orleans Jail/ Long, N. - Marquite, George House	24 West Rd	1770	No style;
ORL.78	Long, M. House	12 West Rd	1795	Federal;
ORL.85	Sparrow, Joel House	4 Main St	1850	No style;
ORL.86	Vanasse, Clarence Guest House/ Orleans Council on Aging Office	12 Main St	1875	Queen Anne;
ORL.87	Rogers, Prince Dry Goods Store/ Besse, Dr. Albion Drugstore	28 Main St	1875	Greek Revival;
ORL.88	U. S. Post Office - Orleans Branch/ The Clothes Works Store	31 Main St	1858	Altered beyond recognition; Greek Revival;
ORL.89	Davis and Chase Drugstore/ Cole Universalist Church Parish House	46 Main St	1890	Italianate;
ORL.90	Horton, E. R. - Belcher House	45 South Orleans Rd	1880	Colonial Revival;
ORL.91	French Cable Station	41 South Orleans Rd	1891	Victorian Eclectic;
ORL.92	Newcomb, Capt. Thomas Snow/ Peacock Alley Shops	35 South Orleans Rd	1850	Greek Revival;
ORL.93	Nickerson, Winsor House/ Pulitzer, Lily Dress Shop	21 South Orleans Rd	1840	Italianate;
ORL.94	Murray's Fabric Shop	11 South Orleans Rd	1880	No style;
ORL.95	Music Pad, The	7 South Orleans Rd	1890	No style;

MHC #	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.96	Higgins - Norgeot, Gaston House	5 South Orleans Rd	1874	Greek Revival;
ORL.97	Higgins, Benjamin House/ Deschamps, Ralph House	16 South Orleans Rd	1861	Greek Revival;
ORL.98	Swain, Capt. William House/ Arbor Restaurant - Wells Boarding House	20 South Orleans Rd	1900	No style;
ORL.99	Upham, Edgar H. House	42 South Orleans Rd	1911	Queen Anne;
ORL.100	Myrick, Richard House/ Smith, Alton House	19 Cove Rd	1894	Queen Anne;
ORL.101	Knowles, Clarence Two-Family House	14 Cove Rd	1890	Federal;
ORL.102	Unknown	17 Cove Rd	1900	Queen Anne;
ORL.103	Smith, Warren House/ Eagle Wing Restaurant	3 Doane Terr	1800	No style;
ORL.104	Orleans Methodist Chapel	12 Cove Rd	1840	Greek Revival;
ORL.105	Smith, T. A. - Ellis, Lloyd Market/ Orleans Fishermans Market	8 Cove Rd	1875	No style;
ORL.106	Knowles, Clarence Bakery/ Timbucktoo Travel Agency	6 Cove Rd	1890	Greek Revival;
ORL.107	Snow, Aaron House/ Aaron's Folly - Orleans Inn	3 Old County Rd	1881	Second Empire;
ORL.108	Fulcher, Alfred Double House	41 Cranberry Hwy	1820	Federal;
ORL.109	Young, David General Store/Marvel, Dr. Reuben - Eldredge, Judah Hous	8 Judah's Way	1858	Greek Revival;
ORL.111	Snow Double House/ Double Dragon Inn	57 Cranberry Hwy	1800	No style;
ORL.112	Snow, Joseph C. House/ Harbor View - Davis, Leander House	5 North Cottage St	1900	No style;
ORL.113	Young, David House/ Orleans Catholic Church Thrift Shop	54 Cranberry Hwy	1858	Second Empire;

MHC #	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.114	French Atlantic Cable Station Superintendent House/ Hall, George House	71 Canal Rd	1880	No style;
ORL.115	Young, Jonathan Jr. House/ Tree's Place Gift Shop	60 Cranberry Hwy	1875	Italianate;
ORL.116	Howard Johnson Restaurant/ Adam's Rib Restaurant	63 Cranberry Hwy	1935	No style;
ORL.117	Davis, Dr. S. T. House and Office/ Marvel, Dr. Reuben House and Office	80 Cranberry Hwy	1880	Victorian Eclectic;
ORL.118	Lake, Leander Houses/ Jolly Jack Antique Store	81 Cranberry Hwy	1900	Victorian Eclectic;
ORL.120	Nickerson, Eugene House	94 Cranberry Hwy	1900	Victorian Eclectic;
ORL.121	Howes, William House	85 Cranberry Hwy	1900	Queen Anne;
ORL.122	Shattuck, Abigail House	111 Cranberry Hwy	1874	Italianate;
ORL.123	Young, Jonathan Store/ Coles, George House - Barber, Ruth Barn	117 Cranberry Hwy	1858	Altered beyond recognition; Greek Revival;
ORL.124	Snow, Joe Jesse House	121 Cranberry Hwy	1900	Queen Anne;
ORL.125	Bassett, Albert House	116 Cranberry Hwy	1885	Victorian Eclectic;
ORL.126	Mayo, J. C. - Percival, Joseph W. House	120 Cranberry Hwy	1852	Greek Revival;
ORL.127		14 Brewster Cross Rd	1790	No style;
ORL.128	Hohn, F. Tailor Sho/ Higgins, Joshua House p	139 Cranberry Hwy	1800	Greek Revival;
ORL.129	Boland, James House/ Higgins, Simeon House - Shattuck, Abel Tavern	143 Cranberry Hwy	1750	Colonial;
ORL.130	Higgins, Simeon Tavern Wing/ Olde Tavern Motel	151 Cranberry Hwy	1829	Federal;
ORL.131	Village Lobster House	157 Cranberry Hwy	1880	Queen Anne;
ORL.132	Kingman, Seth House/ Eldredge, Charles J. House	164 Cranberry Hwy	1798	Federal;

MHC #	Historic/Common Name	Orleans Address	Date of Construction	Architectural Style
ORL.144	French Atlantic Cable Station Worker Housing/ Geers, George House	2 Academy Pl	1880	No style;
ORL.145	Knowles, Richard House/ Snow, Azariah House	8 Academy Pl	1752	No style;
ORL.396	Higgins, Benjamin Barn/ Red Balloon Toy and Gift Shop	16 South Orleans Rd		No style;
ORL.902	Jeremiah's Gutter Site Marker	Canal Rd	1976	
ORL.903	Orleans Oldest House Marker	Canal Rd	1976	
ORL.904	Doane, John House Site Marker	Main St	1976	
ORL.905	French Atlantic Cable Station Marker	41 South Orleans Rd	1976	
ORL.906	Young, Jonathan Windmill	33 Cranberry Hwy	1793	
ORL.907	Higgins Tavern Site Marker	154 Cranberry Hwy	1976	
ORL.908	Orleans World War I Monument	5 Academy Pl		
ORL.910	Orleans World War II Memorial	5 Academy Pl	1954	
ORL.911	Orleans Korean and Vietnam War Monument	5 Academy Pl	1981	

*Listed in the National Register of Historic Places

Archaeological Resources

Background research was conducted to assist with the archaeological sensitivity assessment and to develop predictive statements for the types of archaeological resources that may be present within the project area. Background research for the project was accessed through the Orleans Historical Society's online archives, a review of MHC's cultural resource database, literature review, and a review of PAL's collection of resources from conducting extensive work on Cape Cod. Several sources of information in PAL's database relative to environmental and pre- and post-contact historic contexts for Orleans and Cape Cod were reviewed for information on known and expected archaeological resources (PAL 2016; Banister and Herbster 2015; Gillis and Herbster 2013; Herbster and Heitert 2011; Waller and Leveillee 2011). Cultural resource inventory files maintained at the MHC were also reviewed for updated information on known historic and archaeological resources in proximity to the project area (MHC 1984, 1987; Decima 1995; Decima et al. 1992; Edens 1995;

Edens et al. 1995). Primary and secondary histories and historical maps and atlases were examined to assess changes in land use, to locate any documented structures, and to trace the development of transportation networks (an important variable in the location of post-contact archaeological sites). Town and regional histories, and historical maps and atlases were consulted to locate possible sites dating to the post-contact period within and close to the project area (Waller 1880, 1905, 1910; Walling 1857, 1858). Taken together, information from these various sources was used to arrive at a preliminary assessment of the archaeological sensitivity of the project area.

The archaeological sensitivity of the project area is defined by the presence of favorable environmental conditions and the presence of known archaeological sites in similar environmental settings. Well-drained soils near freshwater resources were preferred locations for Native American groups. Soil associations within the Orleans project area mostly consist of well-drained Carver-Hinesburg loamy coarse sands and Carver coarse sands of varying slopes that formed on glacial outwash plains (USDA 1993).

Archaeological resources include 14 Native American pre-contact archaeological sites within one half mile of the proposed project area (see Figure 1; Table 2). There are no post-contact (i.e., post European contact) archaeological sites recorded within one half mile of the proposed project area. Seven of the 14 previously recorded pre-contact sites (19-BR-208, -529, -532, -616, -625, -810, and -938) are recorded within the boundaries of the proposed ODWCS project area. These sites have yielded evidence of Native American activity spanning back to at least the Late Archaic Period (ca. 5000 to 3000 years before present [B.P.]), and consist of artifacts such as stone tools and pottery, and features such as fire hearths, indicative of campsites and lithic (stone tool) workshops. One site also contained human burials. The Franz Site (19-BN-810), was a burial site identified near Town Landing that consisted of shell middens with pottery sherds, diagnostic Late Woodland (ca. 1000 to 450 B.P.) Levanna projectile points, bifacial tool blades and bone or antler fragments (MHC site files).

The following is a list of archaeological resources that were identified by this cultural resource review:

Table 2. Unevaluated Pre-Contact Archaeological Sites Recorded within One-Half Mile of the ODWCS Project Area.

Site Name	MHC Site #	Towns	Temporal Period	Site Type
Peter Hunts Site	19-BN-208*	Orleans	Woodland	Campsite
Fisk Farm Site	19-BN-373	Orleans	Woodland	Unknown
Oak Ridge Site	19-BN-490	Orleans	Transitional Archaic	Campsite/workshop
Namskaket Site	19-BN-491	Orleans	Late Archaic	Campsite
Gove Site	19-BN-529*	Orleans	Unknown	Unknown
Ellis Site	19-BN-532*	Orleans	Archaic and Woodland	Campsite

Site Name	MHC Site #	Towns	Temporal Period	Site Type
Cemetery Site	19-BN-615	Orleans	Late Archaic	Campsite
Estlin Site	19-BN-616*	Orleans	Late Archaic	Lithic workshop
Orleans Elementary School	19-BN-625*	Orleans	Unknown	Habitation site
Unknown	19-BN-701	Brewster	Unknown	Lithic workshop
Ps1-3-1	19-BN-741	Brewster	Unknown	Flake scatter
Forren Site	19-BN-809	Brewster	Late Archaic/Early Woodland	Habitation site, lithic workshop
Franz Site	19-BN-810*	Orleans	Late Woodland/Contact	Burial, shell midden, habitation site.
Ellis Road	19-BN-938*	Eastham	Unknown	Flake scatter

*Sites recorded within the project area boundaries.

Results of the Field Assessment

A walkover/drive-over field assessment of the ODWCS project area was conducted by Dianna Doucette, PAL Senior Archaeologist, on February 8, 2017 to assess the integrity of the ground surface, to collect data about the current environmental setting of each area, and to look for any surface indications of archaeological sites. A combination of variables affecting archaeological sensitivity, such as evidence of prior ground disturbance or the presence of favorable environmental attributes, was noted throughout the project area. During the field assessment, all of the roads that will be impacted by the proposed sewer line construction were assessed as well as the three proposed pump station locations. Most of the project's impact areas are located within and below paved roads, except for a section of Old Tote Road and the three proposed pump stations parcels, which are grassy, open areas (Photographs 1 - 8).

Although the construction will occur primarily within and below the paved roads that have likely been previously disturbed by subsurface utilities, intact soils containing archaeological sites may exist below the pavement. The three pump station areas are in open, grassy areas that appear to have been previously disturbed. Pump Station #1, on the north side of Old Colony Way, and directly across the street from Old Tote Road, is a flat, open field with three visible ventilation pipes along the edges of the parcel that may be indicative of underground septic utilities or a leaching field (see Photograph 6). Soils in this area consist of well-drained Carver-Hinesburg loamy coarse sands that formed on glacial outwash plains. Pump Station #2, at the intersection of Chatham Road, Academy Place, and Main Street is an open, grassy park, also with well-drained Carver-Hinesburg loamy coarse sands (see Photograph 7). The small triangular park contains three war memorials, as mentioned above, and background research also indicated that the Rock Harbor Academy, and then the Snow Library, were previously in this area. Pump Station #3 is located at the edge of the T.J. Max shopping plaza parking lot, on a grassy strip that consists of excessively drained Carver coarse sands (see Photograph 8). This area contains an existing pump station and appears disturbed.

The field assessment focused on looking for any surface indications of archaeological sites, including but not limited to artifact scatters, stone foundations, dams, stone walls, and trash deposits. No evidence of archaeological sites was observed on the ground surface during the field assessment. Areas of disturbance, such as sand pits or quarries, or areas of recognizable grading, were not visible during the field assessment to suggest that the soils beneath the roads have been displaced, however, it is likely that utilities in the Orleans downtown area, and landscaping and utilities in the new residential areas, created some disturbance. Although the ODWCS project includes the installation of new sewer lines under roads that have likely been previously disturbed by subsurface utilities, there are several roads that have likely only been graded and paved, but not otherwise disturbed by utility installations.

Results of the Sensitivity Assessment

Results of the background research and field assessment were used to develop a sensitivity ranking and predictive statements concerning the potential for the presence of Native American and EuroAmerican cultural resources. Native American archaeological sensitivity was determined by assessing key environmental attributes, the presence of documented cultural resources in and adjacent to the project area, and the degree of disturbance. Key environmental attributes are proximity to fresh or salt water, well-drained soils, and level topography. EuroAmerican archaeological sensitivity is determined by assessing information collected during the background research and walkover. Numerous large-scale surveys have determined that historic EuroAmerican sites are not directly correlated with specific environmental variables and that documentary information is not always accurate. As a result, documentary research used in conjunction with an evaluation of the physical condition of a project area and the presence of visible sites is the most useful approach to determining the sensitivity of a project area

High archaeological sensitivity is assigned to locations that exhibit favorable environmental conditions, have sustained little or no ground disturbance, or are located in proximity to known archaeological sites. Areas of moderate archaeological sensitivity are those areas that have been impacted by construction or exhibited some adverse environmental characteristics such as moderate slope (10–15 percent grade) or rocky or poorly drained soils. Areas with low archaeological sensitivity include areas that are perennially wet, exhibit severe slope (greater than 15%), or have been severely impacted by development, construction, excavation, or erosion.

Overall, the archaeological sensitivity of the ODWCS project area is high to moderate for Native American sites dating to the Pre-Contact, Contact, and early Post-Contact periods (ca. 8000 to 300 B.P.) (Figures 4 and 5). The archaeological sensitivity is defined primarily by the project area's physical location within sandy, well-drained soils adjacent to the shoreline and freshwater wetlands and by the presence of previously recorded archaeological sites and documented post-contact period land use. Archaeological evidence of pre-contact period Native American activity could include subsistence-related features such as hearths, food storage/disposal pits, living areas including post molds, lithic workshops, and diagnostic chipped and ground stone tool assemblages. Expected pre-contact site types would include base camps, or logistic field camps and foraging locations in proximity to these brooks where seasonally available (waterfowl, fish) resources could be assured, and burial sites.

The ODWCS project traverses previously designated areas containing recorded Native American camp sites and burial site/s along Town Cove, and has the potential to contain other unmarked burial features and/or pre-contact Native American archaeological sites. Any unmarked Late Woodland Period (ca. 1000 to 450 B.P.) burial features in the project area are likely to resemble those already identified. The likelihood of Contact or early Post-Contact Period Native American sites along Town Cove is also high to moderate.

The EuroAmerican post-contact archaeological sensitivity for land use is moderate to low. The sewer lines run through some of the earliest established business areas and remnants of older buildings and businesses could be present under the present roadways. In addition, several historical markers suggest that eighteenth and possibly seventeenth century meeting places were located along Main Street, Route 6A, Chatham Road. However, much of Orleans consisted of pasture and agricultural land up until residential development began in the mid-twentieth century. Remnants of the Rock Harbor Academy meeting house may be present within the proposed pump station location in the village green at Academy Place Park.

The post-contact historic period sensitivity of the project area is moderate to low based on the historic nature of Orleans and the possibility of post-contact sites to be present under the current streets. Post-contact sites could include cellar holes and foundations related to early settlement patterns and subsistence related activities, and/or evidence of small-scale industrial activities.

Recommendations

The ODWCS project area is located adjacent to several archaeological sites that have yielded evidence of Native American activity spanning back to the Late Archaic Period. Because archaeological sites are located below the ground surface and could be below a paved surface, and, given the proximity of the ODWCS project area to known Native American archaeological sites, **PAL recommends archaeological monitoring in areas assessed as having high and moderate archaeological sensitivity, which includes all places where new sewer lines and pump stations will be impacting intact soils during construction (this may include areas between existing utilities).** The archaeological monitoring will be conducted under an archaeological permit issued by the State Archaeologist's office at the MHC and in compliance with M.G.L. c. 9, ss. 26-27 C (950 CMR 70). In addition, PAL recommends coordinating with the Mashpee Wampanoag and Wampanoag Tribe of Gay Head/Aquinnah (WTGH/A) Tribal Historic Preservation Officers (THPOs) regarding the proposed project schedule, so that a tribal cultural resource monitor can be present during the fieldwork portion of the project. The THPOs will also be consulted for information that may assist with the archaeological investigations. Informant interviews may also be conducted in order to gather more information about reported sites and/or cultural resources in the project vicinity.

The goal of the archaeological monitoring will be to ensure that if any significant archaeological resources, including human remains and/or burials, are exposed during the construction activities that they are treated appropriately in accordance with the Massachusetts Unmarked Burial Law (M.G.L. c. 7 s. 38A; c. 9, ss. 26A & 27C; c. 38, s. 6; and c. 114, s. 17, as amended by Chapter 659 of the Acts of 1983, Chapter 386 of the Acts of 1989, and Chapter 140 of the Acts 2003). The monitoring will involve the close visual examination of exposed subsoils to identify any potential archaeological deposits and/or human remains that may be located within construction impact areas. Having a representative from the Mashpee Wampanoag Tribe on-site, as well as an experienced archaeologist,

during the construction process to determine the significance of a soil anomaly or artifact/s immediately will enable the project proponent to move forward and avoid work stoppage situations.

Information on the previous belowground disturbance within the project area, including any available geotechnical data and soil boring logs, will be reviewed prior to the construction process to identify specific areas to be monitored. In most areas the proposed project impacts will occur under or at the edge of paved roadways, where previous road construction and improvements have occurred; the installation of mid-to-late twentieth century utilities make it unlikely that intact, undisturbed soils are present, which affects the likelihood that archaeological deposits may be present. In addition, the location of the sewer lines within clustered residential developments means it is less likely that large Native American or post-contact period sites or activity areas survived in the immediate areas surrounding the paved roadways.

The section of Route 28, from Academy Place to where it intersects with Route 6A, the short residential connectors that lie closest to Town Landing (Cottage Street and Cove Road), Cedar Pond (Locust Street and Jones Road), the Old Tote Road, and the three pump station parcels have been assessed as having a preliminary high archeological sensitivity due to the proximity of recorded archaeological sites and general lack of development. Moderate archaeological sensitivity has been assigned to remaining areas to be impacted due to their proximity to wetlands and/or previously recorded sites. However, based on the review of soil boring data and the acquisition of additional information on previous belowground disturbance, some of the areas assessed as having moderate archaeological sensitivity may be reassessed to low.

PAL also recommends a “Post-Review Discoveries” protocol, or, an Unanticipated Discoveries Plan (UDP), be developed and implemented consistent with the Massachusetts Unmarked Burial Law (MGL Chpt. 38, Sec. 6; Chpt 9, Sec. 26A and 27C; and Chpt 7, Sec. 38A; all as amended) to formalize procedures guiding the discovery of any significant cultural resources and/or evidence of human remains during construction in areas not recommended for archaeological monitoring.

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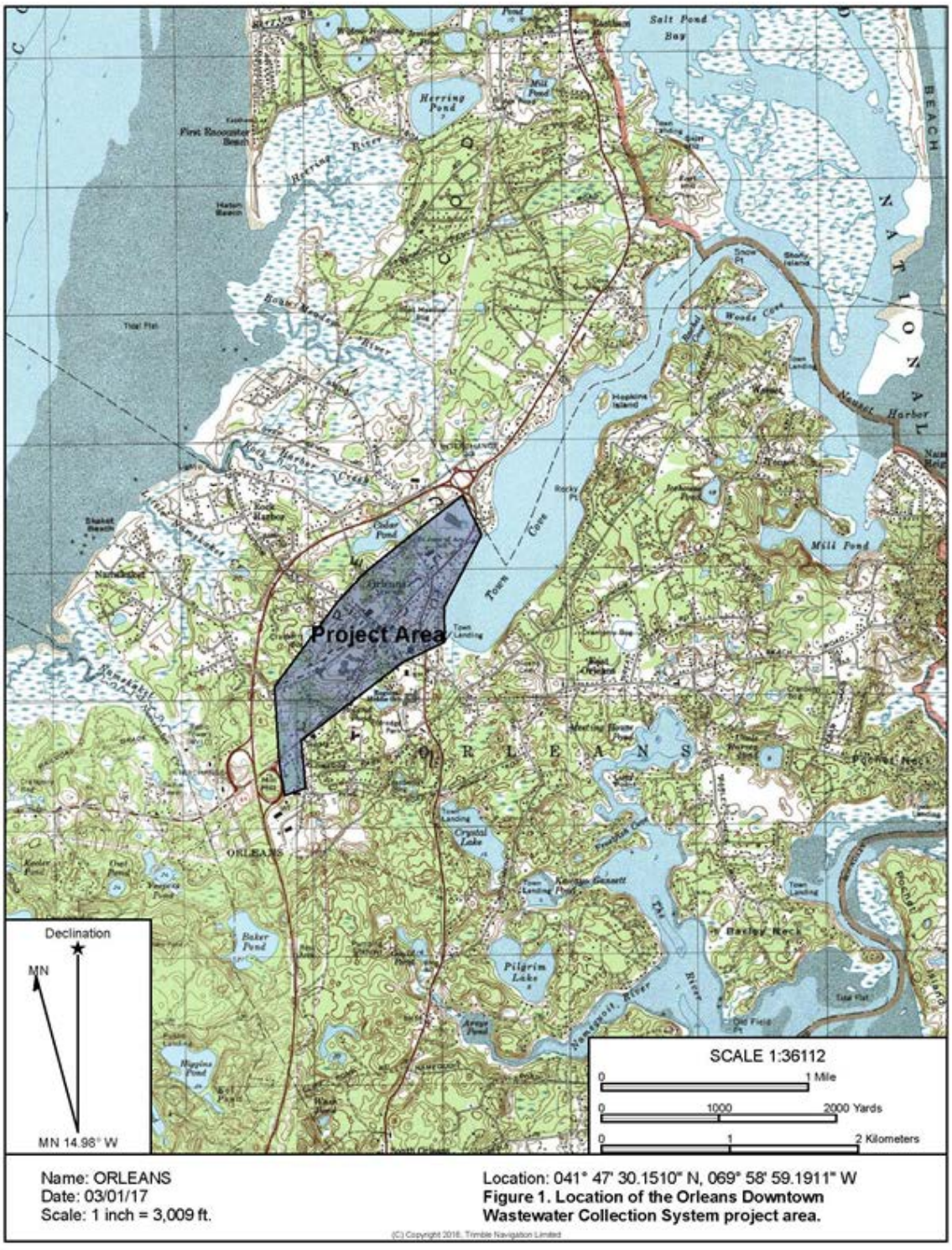
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Project Area
Declination
MN
MN 14.98° W
SCALE 1:36112
0 1 Mile
0 1000 2000 Yards
0 1 2 Kilometers
Name: ORLEANS
Date: 03/01/17
Scale: 1 inch = 3,009 ft.
Location: 041° 47' 30.1510" N, 069° 58' 59.1911" W
Figure 1. Location of the Orleans Downtown Wastewater Collection System project area.
(C) Copyright 2016. Trimble Navigation Limited

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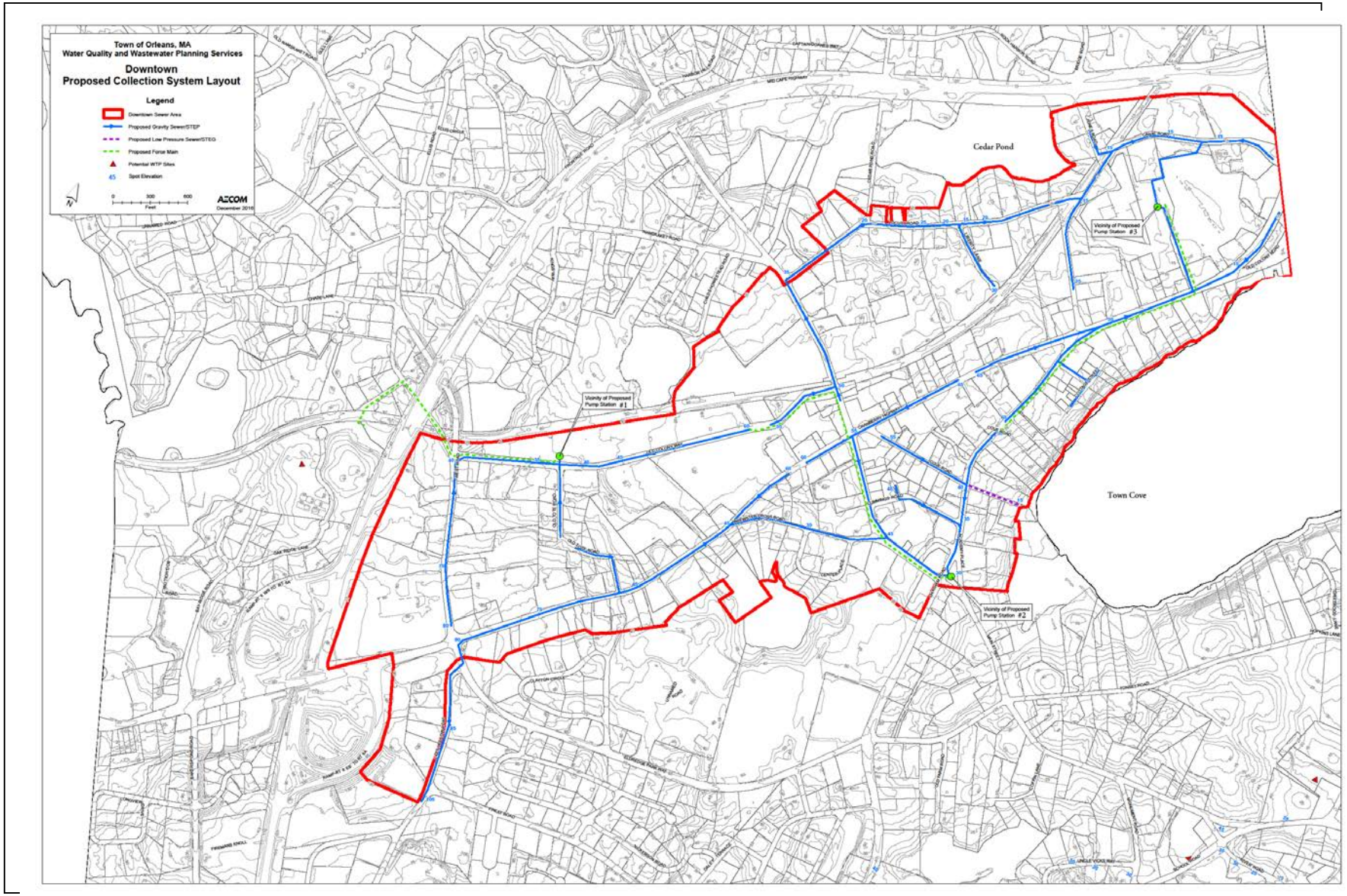


Figure 2. Proposed plan of the Orleans Downtown Wastewater Collection System, Orleans, MA.

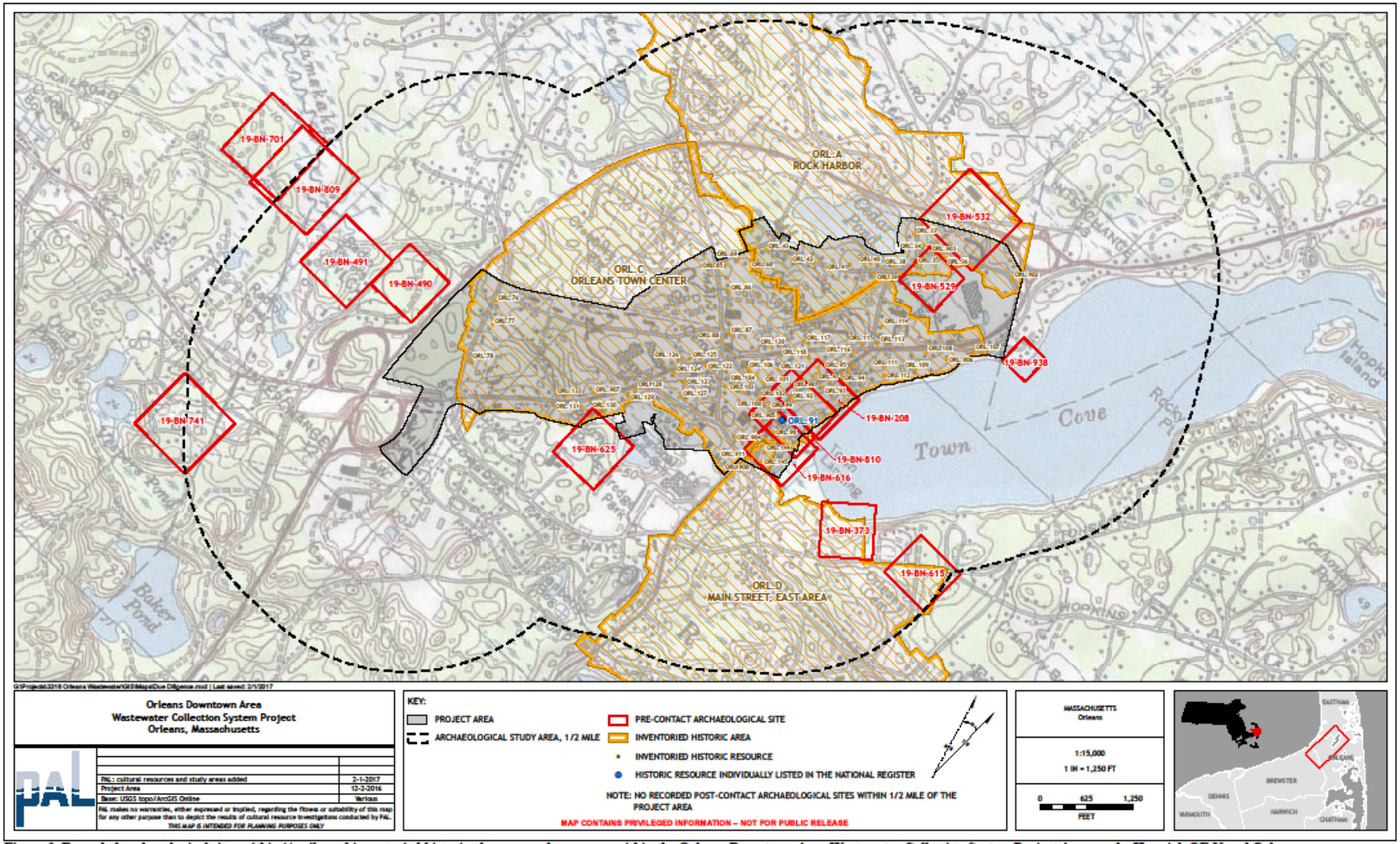


Figure 3. Recorded archaeological sites within ½ mile and inventoried historic aboveground resources within the Orleans Downtown Area Wastewater Collection System Project Area on the Harwich OE N and Orleans, Massachusetts USGS topographic quadrangles, 7.5 minute series.

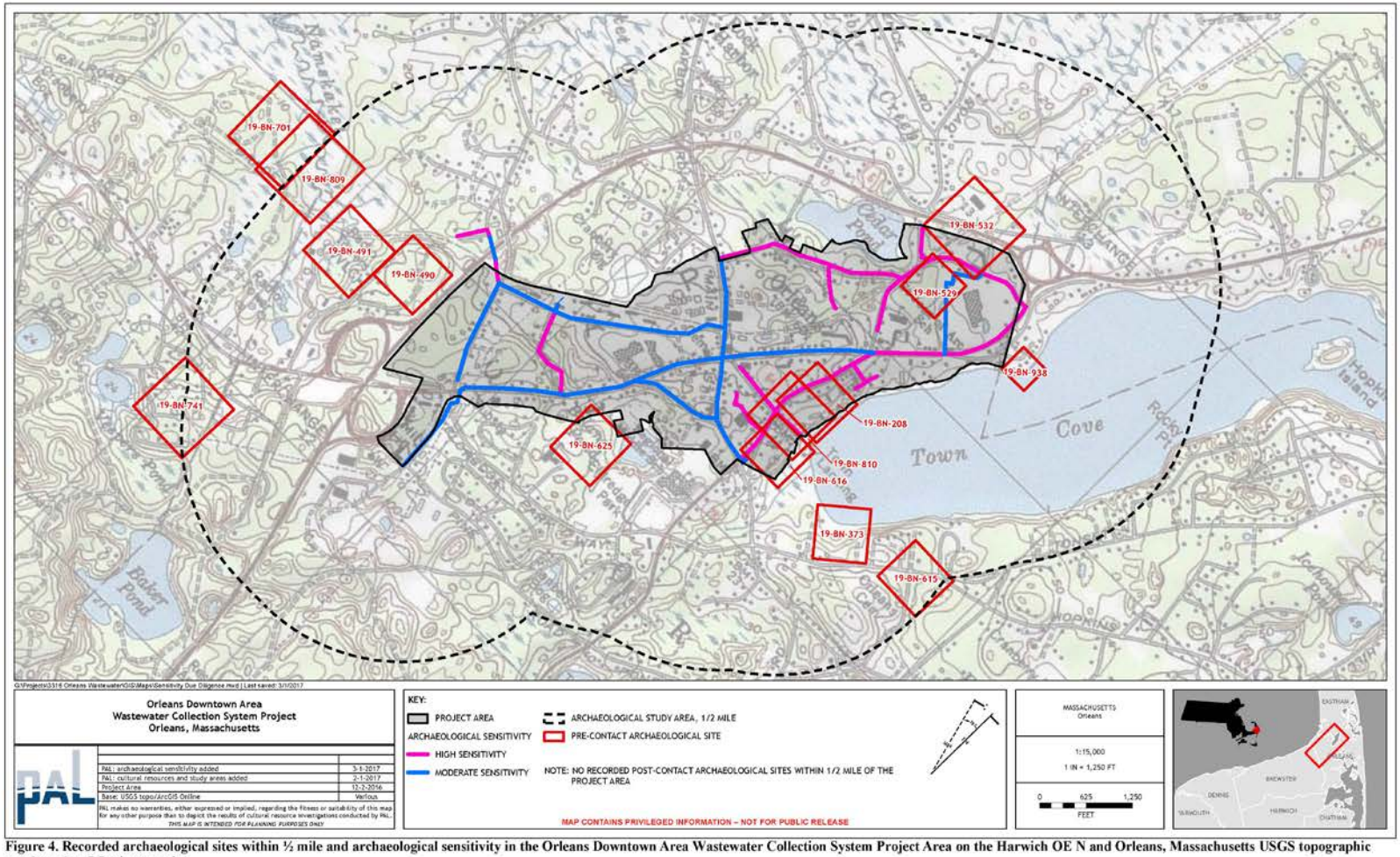


Figure 4. Recorded archaeological sites within ½ mile and archaeological sensitivity in the Orleans Downtown Area Wastewater Collection System Project Area on the Harwich OE N and Orleans, Massachusetts USGS topographic quadrangles, 7.5 minute series.

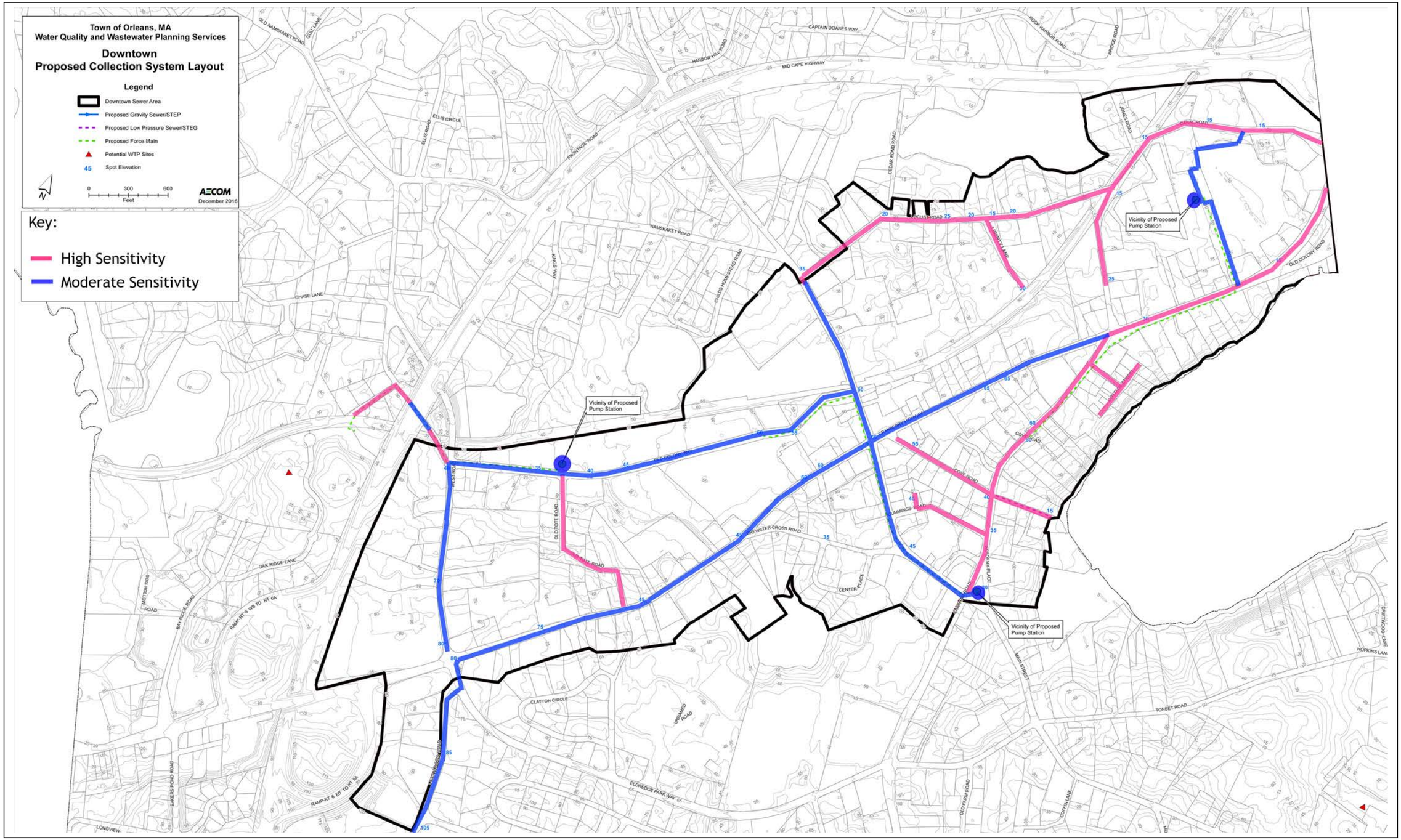


Figure 5. Plan of the Orleans Downtown Wastewater Collection System project area showing archaeological sensitivity.



Photograph 1. West Street, view north from the Jail House Tavern.



Photograph 2. Old Tote Road, view north towards Pump Station #1 Site.



Photograph 3. Old Tote Road, view south.



Photograph 4. Old Colony Way at the intersection with Main Street, view east.



Photograph 5. Cottage Street, view southeast toward Town Cove.



Photograph 6. Pump Station #1, Old Colony Way, view northwest.



Photograph 7. Pump Station #2, Academy Place, view north.



Photograph 8. Pump Station #3, view north.

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Appendix C

Downtown Area Geotechnical Evaluation Boring Logs

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AECOM
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Pocasset, MA 02559
www.aecom.com

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508.833.6951 fax

Memorandum

To	George Meservey, Director of Planning & Community Development Michael Domenica, PE, Program Manager
CC	Betsy Shreve, AICP, AECOM Project Director Paula Winchell, AECOM Reggie Donoghue, P.E., AECOM
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Task Number 10.1.C – 25% Preliminary Design Report** **Draft Deliverable 10.1.C.2 – Geotechnical Evaluation**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	April 14, 2017

Approvals	Date	Signature / Initials
George Meservey, Orleans, MA Director of Planning & Community Development		
Michael Domenica, PE, Water Resources Associates, Program Manager		

1. Introduction

This Technical Memorandum outlines the scope of the Geotechnical Evaluation performed by AECOM and New England Geotech, LLC. Refer to the attachments for the boring logs and a plan showing the location of the borings performed for the Geotechnical Evaluation.

As part of the Preliminary Design Report (25% Design) for the Downtown Orleans Wastewater Collection System, New England Geotech, LLC, was engaged by AECOM to perform preclearing and drilling for a Geotechnical Evaluation relative to the design of the proposed new wastewater collection system in the Downtown Area of Orleans, Massachusetts.

The Proposed Collection system in the Orleans Downtown Area includes construction of a proposed hybrid collection system (gravity sewer, low pressure sewer, STEP/STEG and/or vacuum sewer) within publicly and privately owned rights-of-way and privately owned properties in the Orleans Downtown Area. The Project will provide approximately 30,000 linear feet of pipelines within the publicly and privately owned right of way and sewer service connections within the privately owned properties. The project includes evaluating subsurface soils for the design of the collection system in the Orleans Downtown Area. Drilling to date included performing 95 borings within the Downtown Area of the Town of Orleans. The soil borings were drilled to a depth of 10 to 40 feet with an average depth of 15 feet. Continuous soil samples were collected from the borings. Ten additional borings were constructed as monitor wells. Each location was pre-cleared to a minimum depth of 5-feet using “soft-dig” methods prior to drilling.

Proposed Downtown Area Groundwater Discharge Locations – The Geotechnical Evaluation included evaluating subsurface soils for a groundwater discharge from the Downtown Area wastewater treatment facility. Drilling included ten soil borings and installing monitor wells. The soil borings were drilled to a depth of approximately 80 feet. Continuous soil samples were collected between 5 to 80 feet. Each location was pre-cleared using "soft-dig" methods to a depth of 5-feet prior to drilling. A total of ten monitoring wells were installed. The 2-inch diameter monitoring wells were installed with 10-feet to 15-feet of 10-slot well screen to approximately 10-feet below the water table. The total depth of the wells varied, but did not exceed 80 feet.

2. Goals and Objectives of the Geotechnical Evaluation

The goal of the Geotechnical Evaluation was to collect soil data along the proposed sewer alignment necessary for the preparation of the Preliminary Design Report (25% Design). The data collected included depth of pavement, soil types, depth to groundwater, if encountered, and the recording of any fill or obstructions encountered during the drilling. The information from the geotechnical evaluation will be used for the preliminary design of the wastewater collection system. In addition, the information from the soil investigation can be used by prospective sewer system construction bidders to determine the soil conditions in the area of the proposed collection system. The observation wells will be tested and information collected from the wells will be used for hydrogeological studies for the potential treated wastewater effluent discharge sites. The wells will also be available for long term monitoring of groundwater levels and quality.

3. Geotechnical Investigation

The Geotechnical Evaluation included the drilling 95 borings in the Downtown Area in order to document the soil and groundwater conditions along the proposed Downtown Area sewer collection system route as necessary for the preparation of the Preliminary Design Report (25% Design). The depth of the borings ranged from 5 feet to 45 feet with an average depth of 15 feet depending upon the depth of the preliminary sewer collection system design profiles.

A. Prior to performing the borings in the Town roadways, approval from the Town of Orleans Highway Dept. was required. A Road Opening Permit was submitted to the Orleans Highway Dept. by N.E. Geotech, LLC. The Permit application was circulated through town departments for review and comment. On January 23, 2017 a preconstruction conference was held including Frank Nichols of the Olreans Highway Department, Lt. Kevin Higgins of the Orleans Police Department, Dan Regan of N.E. Geotech, LLC, and Reggie Donoghue of AECOM. On February 2, 2017 the Orleans Highway Dept. issued a Road Opening Permit allowing the geotechnical investigation within the town controlled streets to proceed.

B. An Application for a Permit to Access State Highway was filed with MassDOT in order to perform the borings in the state highway layout of Route 6A and Route 28. On February 3, 2017 representatives of AECOM met with MassDOT officials at the MassDOT Division 5 office in Taunton MA to discuss the proposed Geotechnical Evaluation. On February, 16, 2017 MassDOT issued a Permit to Access State Highway allowing the Geotechnical Investigation to proceed within the State Highway Layouts.

C. Prior to the start of the drilling operations, each boring site was staked or marked in the pavement with paint and Dig Safe was contacted by the drilling contractor to mark out the utilities in the area of the proposed borings. Several of the sites required remarking due to weather and traffic disturbing the marked locations.

D. For work in the roadways, a police detail and cruiser accompanied the drilling and preclearing crews for safety and traffic control. A second police detail was employed with the preclearing and drilling crews for traffic control along busy sections of the state highways.

F. A trailer mounted Hurricane 500 vacuum unit was used by a two man crew from Strategic Environmental Services to preclear the first five feet of excavation using "soft-dig" techniques. The pre-clearing is performed in order to avoid impacting underground utilities during the boring operation. Technical personnel from AECOM accompanied the preclearing crew and documented the pre-clearing excavations.

G. Drilling was performed by N.E. Geotech, LLC. A Geoprobe Model 6600 truck mounted direct push drill rig was employed for drilling the borings below the five foot pre-cleared depth. Direct push drilling is a method in which a drill string is advanced by pushing or vibrating. Technical personnel from AECOM accompanied the drill rig and documented the soil information from the borings.

H. In addition to the borings for the Geotechnical Investigation, ten deep observation wells were installed by N.E. Geotech, LLC to allow for sampling of groundwater and the measurement of groundwater levels at the observation well sites.

I. Record boring information from a geotechnical investigation performed for MassDOT during the design of roadway improvements that are underway at the intersections of Main Street and Route 6A, and Main Street and Route 28 was used to supplement the information from the geotechnical evaluation. Borings were not performed at the intersection of Route 6A and West Road, and in the area of the new roundabout at the intersection of Route 6A and Route 28. Borings were not performed in those locations due to a MassDOT prohibition on cutting new pavement, the location of existing utilities, and the proximity of the paving to the limit of the State Highway Layout. Both of the aforementioned projects were treated as overlay projects by MassDOT and no deep borings were performed as part of the design of the roadway improvements.

J. The proposed "Cross Country" portion of the collection system between Canal Road and Route 6A traverses through private property. Permission from the property owner will be required prior to entering onto the property for the Geotechnical Evaluation. The Town of Orleans has been in contact with the property owner and it is anticipate that permission to proceed with the remaining borings will be forthcoming. When the owner has granted permission to enter the property and proceed with the borings, we expect that it will require one day with the preclearing crew, and one day with the drilling crew to complete the borings on private property. At that time, four remaining borings in the State Highway Layout will also be completed.

4. Program Status

Boring logs have been prepared by AECOM for the completed borings and will be included in the Preliminary Design Report (25% Design). The boring locations, depth, and notation as to whether groundwater was encountered have been added to the preliminary sewer profile plans prepared by AECOM to accompany the Preliminary Design Report (25% Design).

When the Town of Orleans has permission from the private property owner to enter onto the property at the Cross-Country portion of the sewer collection system, the remaining eight borings will be completed. Four of the borings are on in the State Highway Layout and four are along the Cross-Country section of the sewer collection system route.

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Lots Hollow Road
Orleans, MA

Boring: B-1

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue
Field Techs: C.Hayden, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Mat	Depth
1	0 ft to 5 ft				0 - 8" : Asphalt					1
2					8" - 10" : Gravel					2
3					10" - 5' : Orange/Brown fine sand					3
4										4
5										5
6	5 ft to 10 ft	3.8 ft	dry		Tan to Light Brown medium sand					6
7										7
8										8
9										9
10					---------- End of Boring at 10' ----------					10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Lots Hollow Road
Orleans, MA

Boring: B-2

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft	Moistu		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 8" : Asphalt 8" - 10" : Gravel 10" - 5' : Brown\Orange fine sand					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	3.8 ft	dry		5 to 8 ft: Tan fine sand, intermittent Iron-staining 8 to 8.8 ft: Tan fine silty sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	3.3 ft	dry		10 to 10.7 ft: Brown silt, trace clay 10.7 to 12.9 ft: Tan fine/very fine sand 12.9 to 13.3 ft: Brown silt					11
12										12
13										13
14										14
15					---------- End of Boring at 13' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Lots Hollow Road
Orleans, MA

Boring: B-3

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0-10" : Asphalt 10" - 16" : Gravel road base 16" - 5' : Orange/Brown fine sands					1
6	5 ft to 10 ft	3.7 ft	dry		5 to 5.8 ft: Tan fine sand, little medium sand 5.8 to 13.9 ft: Tan-Light Brown fine to medium sand, trace coarse sand					6
11	10 ft to 15 ft	3.9 ft	dry		---------- End of Boring at 14' ----------					11
16										16
21										21
26										26

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Lots Hollow Road
Orleans, MA

Boring: B-4

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh Field Techs: C.Hayden, B.Morrill
Pre-Clear Contractor: Strategic Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech Driller: Hayes Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 8" : Asphalt 8" - 16" : Gravel 16" - 5' : Orange/Brown, fine to med sand. Large cobbles encountered					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	3.5 ft	dry		Tan fine sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4 ft	dry		Tan fine sand, mottled					11
12										12
13										13
14										14
15					---------- End of Boring at 13' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Lots Hollow Road
Orleans, MA

Boring: B-5

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 5" : Asphalt 5" - 11" : Gravel 11"-13" : Dark brown soil 13" - 14" : Organic looking material 14" - 5' : Orange\Brown fine sand					
6	5 ft to 10 ft	3.3 ft	dry		5 to 7.6 ft: Tan medium sand, trace small gravel 7.6 to 8.3 ft: Brown fine sand, little silt					
11	10 ft to 15 ft	3.5 ft	dry		10 to 12.6 ft: Tan medium sand, trace small gravel 12.6 to 13.5 ft: Tan medium to coarse sand ---------- End of Boring at 13' ----------					

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Boring: B-8

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: S.Chmiel, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/16/2017

Depth	Sample Identification	Rec (ft	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 to 6” Dark Brown Loamy Sand With Fine Roots (Topsoil)					1
2					6 to 60” Tan Medium to Coarse Sand With Pebbles					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.75			5.00' - 6.25' : Orange\Brown medium - coarse sand					6
7					6.25' - 6.75' : Some cobbles					7
8					6.75' - 7.00' : Medium - coarse sand					8
9					7.00' - 8.25' : Fine sand (bagged)					9
10					8.25' - 8.75' : Very fine w/ some silt					10
11	10 ft to 15 ft	4.0			10.00' - 10.25' : Organic silt and fine sand					11
12					10.25' - Bottom ; Orange\Brown fine to medium sand.					12
13										13
14										14
15					---------- End of Boring @ 15' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Boring: B-9

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh Field Techs: S.Chmiel, B.Morrill
Pre-Clear Contractor: Strategic Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech Driller: Hayes Drill Date: 3/16/2017

Depth	Sample Identification	Rec (ft	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 to 2" Dark Brown Loamy Sand With Fine Roots (Topsoil)					1
2					2 to 24" Light Tan Medium to Fine Sand with Small to Medium Roots					2
3					24 to 60" Tan Fine Sand With Pebbles					3
4										4
5										5
6	5 ft to 10 ft	4			5.00' - 6.00' : Orange\Tan fine to medium sand					6
7					6.00' - 6.75' : Tan medium-coarse sand w/ silt fines					7
8					6.75' - 7.75' : Medium-coarse sand					8
9					7.75' - 8.5': Silt fine layer over medium - coarse sand					9
10					8.50' - 9.00' : Light tan coarse sand					10
11	10 ft to 15 ft	4	Damp		10.00' - 15.00' : Tan coarse sand with medium sand mixed.					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft	5			15.00' - 16.75' : Light Tan coarse sand					16
17					16.75' - 19.50' : Light Tan fine and medium sand					17
18					19.50' - 20.00' : Orange fine and medium sand					18
19										19
20										20
21	20 ft to 25 ft	5			20.00' - 21.50' : Fine to medium sand. (bagged @ 21.50 and 22.50)					21
22					21.50' - 26.00' : Fine, dense, sand w/ some clay-like materials					22
23										23
24										24
25										25
26	25 ft to 30 ft				---------- End of Boring @ 26' ----------					26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

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250 Apollo Drive
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Site Location: Route 6A
Orleans, MA

Boring: B-10

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Field Techs: S.Chmiel, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date:

Well Data

Boring Depth:
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 6” Dark Brown Loamy Sand With Fine Roots (Topsoil)					1
2					6 to 60” Medium to Fine Silty Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft				Location needs to be re pre-cleared due to running into some hard material ~ 3-4 ft down					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Project Manager: Reggie Donoghu
Pre-Clear Contractor: Strategic
Drill Contractor: NE Geotech

Field Techs: S.Chmiel, B.Morrill
Driller: Hayes

Pre-Clear Date: 3/13/2017
Drill Date: 3/16/2017

Boring: B-11

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft	Moistu	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 to 7" Dark Brown Loamy Sand With Fine Roots (Topsoil)					1
2					7 to 60" Brown Medium Damp Silty Sand With Stones and Cobbles					2
3										3
4										4
5										5
6	5 ft to 10 ft	4			5.00' - 6.00' : Brown fine sand					6
7					6.00' - 9.00' : Brown\Tan, densely packed, fine silty sand					7
8										8
9										9
10										10
11	10 ft to 15 ft	4.5			10.00' - 13.00' : Tan\Orange, densely packed, fine silty sand					11
12					13.00' - 13.50' : Light tan fine sand					12
13					13.50' - 14.00' : Dense silt layer					13
14					14.00' - 14.50' : Light tan fine sand					14
15										15
16	15 ft to 20 ft	4.5			15.00' - 17.25' : Light tan fine sand					16
17					17.25' - 20.00' : Light tan medium - coarse sand					17
18										18
19										19
20										20
21	20 ft to 25 ft	4			20.00' - 25.00' : Light tan fine sand					21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft	5			25.00' - 25.50' : Light tan fine sand					26
27					25.50' - 26.00' : Brown fine to medium sand					27
28					26.00' - 28.00' : light tan fine sand					28
29					28.00' - 28.50' : Silt layer					29
30					28.50' - 29.00' : Tan fine to medium sand 29.00' - 30.00' : Rusty and grey fine sand and silt. Lg rock at 30'					30
31	30 ft to 32 ft	2			30.00' - 30.25' : Rest of rock for previous core					31
32					30.25' - 32.00' : Medium - coarse sand					32
33					---------- End of Boring @ 32' ----------					33
34										34
35										35

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
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Site Location: Route 6A
Orleans, MA

Boring: B-12

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: S.Chmiel, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				Fine Roots					1
2					36" to 60" Tan Medium to Course Sand with Stones and Cobbles					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.5			5.00' - 7.25' : Orange fine to medium sand					6
7					7.5' - 7.50' : Brown fine sand					7
8					7.75 : Tree root					8
9					8.00' - 8.50' : Tan fine sand					9
10										10
11	10 ft to 15 ft	4			10.00' - 11.50' : Tan fine sand					11
12					11.50' - 15.00' : Fine to medium sand					12
13										13
14										14
15					---------- End of Boring @ 15' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Boring: B-13

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: S.Chmiel, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 3" Dark Brown Loamy Sand With Fine Roots (Topsoil)					1
2					3 to 60" Tan Fine to Medium Silty Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	5			5.00' - 6.00' : Tan fine to medium sand					6
7					6.00' - 7.00' : Fine sand					7
8					7.00' - 8.00' : Fine to medium sand					8
9					8.00' - 11.00' : Fine silty sand					9
10										10
11	10 ft to 15 ft				---------- End of Boring @ 11' ----------					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Boring: B-14

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: S.Chmiel, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 6" Dark Brown Loamy Sand With Fine Roots (Topsoil)					1
2					6 to 60" Tan Fine to Medium Silty Sand With Pebbles					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.75			5.00' - 6.00' : Brown, dense, silty sand					6
7					6.00' - 7.50' : Brown fine sand					7
8					7.50' - 8.00' : Rust colored, silt material					8
9					8.00' - 10.00' : Grey clay-like material					9
10										10
11	10 ft to 15 ft				10.00' - 13.00' : True clay, grey					11
12										12
13					---------- End of Boring @ 13' ----------					13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Boring: B-15

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/22/2017

Depth	Sample Identification	Rec (ft)	Moistu	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 to 10" Dark Brown Loamy Sand With Landscape Material					1
2					10 to 60" Tan Fine Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft				5 to 7 Ft: Tan Fine to Medium Sand with Stones and Pebbles					6
7					7 to 10 Ft: Light Tan Dense Silty Fine Sand with Stones and Pebbles					7
8										8
9										9
10					10 to 12.2 Ft: Tan Medium Sand with Pebbles					10
11	10 ft to 15 ft									11
12					12.2 to 13.4 Ft: Light Gray Dense Silty Clay Sand					12
13					13.4 to 18 Ft: Light Tan Fine Sand					13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18			Wet		18 to 19.6 Ft: Tan to Brown Dense Damp Silty Sand with Pebbles					18
19					19.6 to 21.3 Ft: Light Tan Fine Sand					19
20										20
21	20 ft to 25 ft				21.3 to 23 Ft: Light Tan to Gray Damp Silty Clay Sand					21
22										22
23					23 to 25 Ft: Tan to Brown Fine to Medium Sand					23
24										24
25					25 to 27 Ft: Dense Damp Tan to Gray Silty Sand					25
26	25 ft to 30 ft									26
27										27
28					---------- End of Boring @ 27' ----------					28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/22/2017

Boring: B-16

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 8" Dark Brown Loamy Sand With Landscape Material					1
2					8 to 60" Tan Fine to Medium Sand With Pebbles					2
3										3
4										4
5										5
6	5 ft to 10 ft				5 to 6.5 Ft: Tan Fine Sand					6
7					6.5 to 11 Ft: Gray to Light Brown Dense Silty Fine Sand with Trace Clay and Multiple Fine Sand					7
8										8
9										9
10										10
11	10 ft to 15 ft				---------- End of Boring @ 11' ----------					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Route 6A
Orleans, MA

Boring: B-17

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: S. Chmiel, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/17/2017

Depth	Sample Identification	Rec (ft)	Moistu	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 to 6" Dark Brown Loamy Sand With Landscape Material					1
2					6 to 60" Tan Medium to Course Sand With Pebbles					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.5			5.00' - 5.75' : Tan fine sand					6
7					5.75' -7.00' : Cobble and gravel layer					7
8					7.00' - 7.50' : Fine sand with small amounts of silty sand					8
9					7.50' - 8.00' : Fine to medium sand					9
10										10
11	10 ft to 15 ft				10.00' - 11.00' : Brown fine to medium sand					11
12					11.00' - 13.00' : Orange coarse sand					12
13					---------- End of Boring @ 12' ----------					13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-18

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue | Field Techs: S. Chmiel, B.Morrill
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/17/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 10" Dark Brown Loamy Sand (Topsoil)					1
2					10 to 60" Light Brown Silty Sand with Pebbles and Stones					2
3										3
4										4
5										5
6	5 ft to 10 ft	4			5.00' - 6.25' : Brown\Orange, silty (50%) fine sand					6
7					6.25' - 7.00' : Orange fine sand					7
8					7.00' - 7.25' : Silt with fine sand					8
9					7.25' - 8.00' : Orange fine to medium sand					9
10					8.00' - 9.00' : Fine silty sand ---------- End of Boring @ 10' ----------					10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644 Client: Town of Orleans	AECOM 250 Apollo Drive Chelmsford, Massachusetts (978) 905-2100	**Boring: B-22**	
Site Location: RT 6A Orleans, MA		Boring Number: Sheet: 1 of 1 Surface Elevation (ft-asl):	**Well Data** Boring Depth: Screen Depth: Screen length:
Project Manager: Reggie Donogh	Field Techs: S. Chmiel, B.Morrill	Equipment: Geoprobe 6620, Vac-truck Inside Diameter: 2"	
Pre-Clear Contractor: Strategic	Pre-Clear Date: 3/16/2017		
Drill Contractor: NE Geotech	Driller: Hayes	Drill Date: 3/17/2017	

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 10" Dark Brown Loamy Sand (Topsoil)					1
2					10 to 60" Light Tan Saturated Silty Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.5			5.00' - 6.50' : Fine medium sand					6
7					6.50' - 6.75' : Silty fine sand					7
8					6.75' - 8.50' : Tan\Orange coarse - medium sand					8
9										9
10										10
11	10 ft to 15 ft	2			10.00' - 12.00' : Orange\Tan coarse sand with some medium material					11
12					---------- End of Boring @ 12' ----------					12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644 Client: Town of Orleans Site Location: RT 6A Orleans, MA	AECOM 250 Apollo Drive Chelmsford, Massachusetts (978) 905-2100				**Boring: B-23**						
					Boring Number: Sheet: 1 of 1 Surface Elevation (ft-asl): Equipment: Geoprobe 6620, Vac-truck Inside Diameter: 2"				**Well Data** Boring Depth: Screen Depth: Screen length:		
Project Manager: Reggie Donogh	Field Techs: S. Chmiel, B.Morrill										
Pre-Clear Contractor: Strategic		Pre-Clear Date: 3/16/2017									
Drill Contractor: NE Geotech	Driller: Hayes	Drill Date: 3/17/2017									

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 20" Dark Brown Loamy Sand (Topsoil)					1
2					20 to 60" Tan Fine to Medium Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.5			5.00' - 6.25' : Tan fine to medium sand					6
7					6.25' - 6.50' : Silty fine sand					7
8					6.50' - 7.00' : Orange fine to medium sand					8
9					7.00' - 8.00' : Brown silty fine sand					9
10					8.00' - 8.50' : Orange fine to medium sand ---------- End of Boring @ 10' ----------					10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-24

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel, B.Morrill
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/17/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 14" Dark Brown Loamy Sand with Fine Roots (Topsoil)					1
2					14 to 18" Tan Sand Mixed with Gravel					2
3					18 to 60" Light Tan to Gray Damp Silty Sand with Clay					3
4										4
5										5
6	5 ft to 10 ft				5.50' : Came into contact with water main, Stop work					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-25

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date:

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 12" Dark Brown Loamy Sand (Topsoil)					1
2					12 to 18" Gravel					2
3					18 to 60" Tan Fine to Medium Sand with Stones and Pebbles					3
4										4
5										5
6	5 ft to 10 ft				Potential Unmarked Waterline, did not complete					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-26

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel, B.Morrill
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/17/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 8" Dark Brown Loamy Sand (Topsoil)					1
2					8 to 60" Tan Fine Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	4			5.00' - 9.00' : Tan fine sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4			10.00' - 14.00' : Tan fine sand. Silty horizons at 11.5 & 12.0					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft	3			15.00' - 16.50' : Brown fine sand					16
17					16.50' - 17.50' : Silty clay material					17
18					17.50' - 18.00' : Tan medium sand					18
19					---------- End of Boring @ 18' ----------					19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-27

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date:

Depth	Sample Identification	Rec (ft	Moistu	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fil Ma	Depth
1	0 ft to 5 ft				0 to 20" Dark Brown Loamy Sand (Topsoil)					1
2					20 to 60" Tan Fine Sand with Pebbles					2
3										3
4										4
5										5
6	5 ft to 10 ft				Potential Unmarked Waterline, did not complete					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-31

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 6" Dark brown Loamy Sand (Topsoil)					1
2					6 to 60" Tan Course Sand with Pebbles and Stones					2
3										3
4										4
5										5
6	5 ft to 10 ft				5 to 9 Ft: Dark Brown Damp Course Sand with Small Stones or Pebbles					6
7										7
8										8
9					9 to 9.4 Ft: Dark Brown and Gray Damp Clay Sand					9
10					9.4 to 11 Ft: Light Tan Damp Fine Sand					10
11	10 ft to 15 ft				11 to 14 Ft: Light Tan Damp Fine to Medium Sand with Stones and Pebbles					11
12										12
13										13
14										14
15					---------- End of Boring @ 14' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-32

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 8" Dark Brown Loamy Sand (Topsoil)					1
2					8 to 60" Tan Fine to Medium Sand with Pebbles					2
3										3
4										4
5										5
6	5 ft to 10 ft				Unclear Gas Line Markings, did not complete					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-33

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 20" Dark Brown Loamy Sand (Topsoil)					1
2					20 to 30" Pavement					2
3					30 to 60" Tan Medium to Course Sand with Pebbles					3
4										4
5										5
6	5 ft to 10 ft				5 to 6 Ft. Light Tan Fine Sand					6
7					6 to 7.7 Ft: Tan Medium to Course Sand with Stones 7.7 to 8.5 Ft: Light Tan Fine Sand with Pebbles					7
8										8
9					8.5 to 9.3 Ft: Light Tan Medium to Course Sand 9.3 to 11.9 Ft: Light Tan Fine to Medium Sand					9
10										10
11	10 ft to 15 ft				11.9 to 12.7 Ft: Light Tan Fine Sand					11
12					12.7 to 13.5 Ft: Tan Fine to Medium Sand					12
13										13
14					14.7 to 15.3 Ft: Gray to Blue Dense Damp Clay					14
15					15.3 to 17 Ft: Gray Saturated Medium to Course Sand					15
16	15 ft to 20 ft									16
17					17 to 18.3 Ft: Tan Damp Fine to Medium Sand					17
18					18.3 to 19.5 Ft: Brown to Gray Damp Fine to Medium Sand					18
19					19.5 to 20 Ft: Gray Damp Medium to Course Sand					19
20					20 to 21.4 Ft: Dark Brown Damp Course Sand with Stones and Pebbles					20
21	20 ft to 25 ft				21.4 to 22 Ft: Gray Damp Fine to Medium Silty Sand					21
22					---------- End of Boring @ 22' ----------					22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-34

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 12" Dark Brown Loamy Sand (Landscape Medium)					1
2					12 to 14" Pavement					2
3					14 to 36" Tan to Gray Damp Silty Sand					3
4					36 to 60" Gray Silty Clay Sand					4
5										5
6	5 ft to 10 ft				5 to 6 Ft: Tan Fine Sand					6
7					6 to 12 Ft: Tan Fine to Medium Sand with Stones and Pebbles					7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12					12 to 12.3 Ft: Dense Damp Gray Silty Sand with Trace of Clay					12
13					12.3-14 Ft: Gray Damp Fine to Medium Sand with Stones and Pebbles					13
14					14 to 15 Ft: Dark Brown Damp Medium to Course Sand					14
15					---------- End of Boring @ 15' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-35

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date:

Depth	Sample Identification	Rec (ft	Moistu	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fil Ma	Depth
1	0 ft to 5 ft				0 to 10" Dark Brown Loamy Sand (Landscape Material)					1
2					10 to 20" Light Tan Silty Fine to Medium Sand					2
3					20 to 48" Gray Silty Clay Sand					3
4					Refusal at 48" Due to Silt and Clay					4
5										5
6	5 ft to 10 ft									6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 6A
Orleans, MA

Boring: B-36

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 10" Dark Brown Loamy Sand (Topsoil)					1
2					10 to 18" Pavement					2
3					18 to 30" Tan Course Sand					3
4					30 to 60" Silty Clay Sand					4
5										5
6	5 ft to 10 ft				5 to 9.3 Ft: Tan Medium to Course Sand with Small Stones and Pebbles					6
7										7
8										8
9					9.3 to 10 Ft: Gray Silty Fine Sand					9
10					---------- End of Boring at 10' ----------					10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cottage Street
Orleans, MA

Boring: B-38

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1-5	0 ft to 5 ft				0 - 6" : Grass, loam 6" - 5' : Orange\Brown medium sand. Large cobble encountered					1-5
6-10	5 ft to 10 ft	4 ft	dry		Tan-Brown fine to medium sand, trace silt					6-10
11-15	10 ft to 15 ft	4.1 ft	dry		10 to 10.6 ft: Tan-Brown fine to medium sand, trace silt 10.6 to 12.4 ft: Brown fine sand, little medium silty sand 12.4 to 14.1 ft: Brown silt, some fine sand fining to clay					11-15
16-20	15 ft to 20 ft	3.7 ft	dry		Tan fine to medium sand, Iron-staining from 15 to 16.4 ft					16-20
21-25	20 ft to 25 ft	3.4 ft	dry		20 to 28.4 ft: Tan medium sand, little coarse sand					21-25
26-30	25 ft to 30 ft	3.4 ft	dry		---------- End of Boring at 30' ----------					26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 28
Orleans, MA

Boring: B-39

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 8" Landscape Medium of Mulch and Loamy Sand					1
2					8 to 12" Loamy Sand					2
3					12 to 36" Tan Medium to Course Sand					3
4					36 to 60" Light Tan Fine Silty Damp Sand					4
5										5
6	5 ft to 10 ft				5 to 7 Ft: Tan Fine Silty Sand					6
7					7 to 7.8 Ft: Gray to Brown Damp Fine Silty Sand with Trace of Gray Clay					7
8					7.8 to 11.5 Ft: Light Tan Fine Sand					8
9										9
10										10
11	10 ft to 15 ft				11.5 to 13 Ft: Tan to Light Tan Damp Silty Sand					11
12										12
13					13 to 14 Ft: Tan Medium to Course Sand with Stones					13
14										14
15					---------- End of Boring at 14' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 28
Orleans, MA

Boring: B-40

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S.Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 10" Dark Brown Loamy Sand with Small Roots (Topsoil)					1
2					10 to 60" Tan Fine to Medium Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft				5 to 7.5 Ft: Tan Fine Sand					6
7					7.5 to 8.6 Ft: Tan Fine to Medium Sand					7
8					8.6 to 11.2 Ft: Tan Fine Sand					8
9										9
10										10
11	10 ft to 15 ft				11.2 to 13.4 Ft: Light Tan Saturated Fine Silty Sand					11
12										12
13					13.4 to 15 Ft: Light Tan to Gray Damp Sand					13
14					---------- End of Boring at 13' ----------					14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: North Cottage Stree
Orleans, MA

Boring: B-41

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 4" : Asphalt					1
2					4" - 5" : Gravel					2
3					5" - 5' : Brown medium sand					3
4										4
5										5
6	5 ft to 10 ft	3.7 ft	dry		Tan medium to coarse sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	3.6 ft	dry		10 to 10.6 ft: Tan medium to coarse sand					11
12					10.6 to 11.2 ft: Tan-Orange coarse sand, some medium sand					12
13					11.2 18.9 ft: Tan medium to coarse sand, trace fine gravel					13
14										14
15										15
16	15 ft to 20 ft	3.9 ft	dry							16
17										17
18										18
19										19
20					---------- End of Boring 20' ----------					20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Brewster Cross Ro, Orleans, MA

Boring: B-43

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 6" : Asphalt					1
2					6" - 12" : Tar gravel					2
3					12" - 5' : Brown fine to medium sand					3
4										4
5										5
6	5 ft to 10 ft	3.6 ft	dry		5 to 6 ft: Tan fine sand, trace medium gravel					6
7					6 to 13.7 ft: Brown-Grey fine sand, trace silt					7
8										8
9										9
10										10
11	10 ft to 15 ft	3.7 ft	dry							11
12										12
13										13
14										14
15					---------- End of Boring 15' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Brewster Cross Ro
Orleans, MA

Boring: B-44

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donog
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fil Mat.	Tube	Fil Mat.	Depth
1	0 ft to 5 ft				0 - 6" : Asphalt					1
2					6" - 12" : Tar gravel					2
3					12" - 5' : Brown fine to medium sand					3
4										4
5										5
6	5 ft to 10 ft	4.1 ft	dry		5 to 8.3 ft: Brown fine sand, little silt					6
7					8.3 to 8.8 ft: Tan medium sand, some fine sand					7
8					8.8 to 9.1 ft: Tan fine sand, little silt					8
9										9
10					---------- End of Boring 10' ----------					10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

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Site Location: Brewster Cross Ro
Orleans, MA

Boring: B-45

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 25 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donog
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 6" : Asphalt					1
2					6" - 12" : Tar gravel					2
3					12" - 5' : Brown fine to medium sand					3
4										4
5										5
6	5 ft to 10 ft	2 ft	dry		Brown/Light Brown fine to medium sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4.1 ft	dry		10 to 11.5 ft: Tan medium sand, little coarse sand					11
12					11.5 to 14.1 ft: Brown-Grey, mottled fine sand, some silt					12
13										13
14										14
15										15
16	15 ft to 20 ft	4.4 ft	dry		Brown, Iron-stain-mottled fine to medium sand					16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft	3.5 ft	dry		20 to 22 ft: Tan/Grey fine sand, little silt					21
22					22 to 22.8 ft: Tan fine sand, little medium sand					22
23					22.8 to 23.5 ft: Grey, Iron-stain-mottled fine sand, little silt					23
24										24
25					---------- End of Boring 25' ----------					25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Brewster Cross Ro
Orleans, MA

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Boring: B-46

Boring Number:
Sheet: 1 of 2
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 40 ft
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 8" : Asphalt					1
2					8" - 12" : Gravel					2
3					12" - 5' : Brown fine to medium sand					3
4										4
5										5
6	5 ft to 10 ft	4.2 ft	dry		5 to 7.2 ft: Tan fine to medium sand					6
7					7.2 to 7.4 ft: Broken cobble					7
8					7.4 to 9.2 ft: Brown fine sand, little silt					8
9										9
10										10
11	10 ft to 15 ft	4 ft	dry		Brown silt, some fine sand					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft	3.1 ft	dry		15 to 16.7 ft: Brown silt, trace fine sand					16
17					16.7 to 17 ft: Grey silt, little clay					17
18					17 to 26.7 ft: Plastic Grey clay					18
19										19
20										20
21	20 ft to 25 ft	4 ft	moist							21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft	4 ft	moist /	wet						26
27					26.7 to 27.5 ft:Grey sandy silt					27
28					27.5 to 28.8 ft: Brown, Iron-stain-mottled fine sand, little silt					28
29					28.8 to 29 ft: Tan medium sand, some fine sand					29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
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Site Location: Main Street
Orleans, MA

Boring: B-46, continued

Boring Number:
Sheet: 2 of 2

Surface Elevation (ft-asl): ____

Equipment: Geoprobe 6620
Inside Diameter: 2"

Well Data

Boring Depth: 40 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue
Pre-Clear Contractor: Strategic
Drill Contractor: NE Geotech

Pre-Clear Date: 2/17/2017
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
31	30 ft to 35 ft	3.5 ft	wet		30 to 30.4 ft: Tan medium to coarse sand					31
32					30.4 to 33 ft: Brown, Iron-stain-mottled fine sand, little silt					32
33					33 to 33.5 ft: Tan medium sand					33
34										34
35										35
36	35 ft to 40 ft	3 ft	wet		Tan medium sand, little coarse sand					36
37										37
38										38
39										39
40					---------- End of Boring 40' ----------					40

Project Number: 60476644
Client: Town of Orleans

Site Location: Main Street
Orleans, MA

AECOM
250 Apollo Drive
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Project Manager: Reggie Donogh | Field Techs: C.Hayden

Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/21/2017

Boring: B-47

Boring Number:
Sheet: 1 of 2
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Sorting	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1–5	0 ft to 5 ft					Pre-Cleared to 5 ft Brown fine to medium sand					1–5
6–10	5 ft to 10 ft	3.8 ft		dry		5 to 6 ft: Dense, Brown fine sand 6 to 8.6 ft: Loose, Tan fine sand, little medium sand 8.6 to 8.8 ft: Tan/Grey fine sand, little silt					6–10
11–15	10 ft to 15 ft	3.2 ft		dry		10 to 10.7 ft: Tan /Grey silt, trace fine sand 10.7 to 12 ft: Tan fine to medium sand 12 to 13.2 ft: Tan fine to medium sand, little coarse sand, trace fine gravel					11–15
16–20	15 ft to 20 ft	3.8 ft		dry		Tan fine to medium sand, little coarse sand, trace fine gravel					16–20
21–25	20 ft to 25 ft	3.9 ft		dry		Tan fine to medium sand, little coarse sand, trace fine gravel					21–25
26–30	25 ft to 30 ft	3.7 ft		dry		Tan medium sand, little fine sand					26–30

Project Number: 60476644
Client: Town of Orleans

Site Location: Main Street
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Boring: B-47, continued

Boring Number:
Sheet: 2 of 2

Surface Elevation (ft-asl): ____

Equipment: Geoprobe 6620
Inside Diameter: 2"

Well Data

Boring Depth: 40 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue | Field Techs: C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft)	Sorting	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
31	30 ft to 35 ft	3.7 ft		wet		Tan medium sand, little fine sand					31
32											32
33											33
34											34
35											35
36	35 ft to 40 ft	3.5 ft		wet		35 to 37.8 ft: Tan medium sand, **wet**					36
37						37.8 to 38.5 ft: Coarse sand, little medium sand					37
38						---Red/Orange Iron staining from 38.2 to 38.5 ft					38
39											39
40						---------- End of Boring at 40' ----------					40

Project Number: 60476644
Client: Town of Orleans

Site Location: Main Street
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Boring: B-48

Boring Number:
Sheet: 1 of 1

Surface Elevation (ft-asl): ____

Equipment: Geoprobe 6620
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donoghu | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft)	Sorting	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.
1	0 ft to 5 ft					0 - 10" : Asphalt 10" - 12" : Gravel 12" - 5' : Orange\Brown fine to medium sand				
6	5 ft to 10 ft	4 ft		dry		5 to 7 ft: Tan fine to medium sand ---Brown silt lenses: 5.7 to 5.9 ft and 6.6 to 6.7 ft 7 to 7.5 ft: Mottled, Brown silt 7.5 to 7.7 ft: Loose, Tan fine to medium sand 7.7 to 9 ft: Mottled, Brown silt and fine sand				
11	10 ft to 15 ft	2.5 ft		dry		Tan/Brown fine to medium sand, broken cobble/large gravel fragments ---------- End of Boring 15' ----------				

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Brewster Cross Ro
Orleans, MA

Boring: B-49

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 5" : Asphalt					1
2					5" - 6" : Gravel					2
3					6" - 5' : Orange\Brown fine to medium sand. Larger cobbles encountered					3
4										4
5										5
6	5 ft to 10 ft	4 ft	dry		10 to 11.8 ft: Tan fine to medium sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4.2 ft	moist		11.8 to 13.5 ft: Brown mottled fine sand					11
12					13.5 to 14.2 ft: Brown medium sand, trace coarse sand					12
13										13
14										14
15										15
16	15 ft to 20 ft	3.3 ft	moist		15 to 16.9 ft: Tan, Iron-stained medium sand					16
17					16.9 to 17.1 ft: Brown, mottled fine sand					17
18					17.1 to 18.3 ft: Tan, Iron-stained medium to coarse sand					18
19										19
20					---------- End of Boring 20' ----------					20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

Site Location: Main Street
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Boring: B-50

Boring Number:
Sheet: 1 of 2

Surface Elevation (ft-asl):

Equipment: Geoprobe 6620
Inside Diameter: 2"

Well Data

Boring Depth: 35 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date:
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft)	Sorting	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat.	Depth
1-5	0 ft to 5 ft					Brown fine to medium sand					1-5
6-10	5 ft to 10 ft	3.5 ft		dry		5 to 5.8 ft: Tight Brown-Orange fine to medium sand, trace coarse sand 5.8 to 7.7 ft: Dense brown silt and fine sand ---medium sand lenses: 6.3 to 6.5 ft and 6.6 to 6.7 ft 7.7 to 8.1 ft: Tan medium sand 8.1 to 8.5 ft: Brown medium sand					6-10
11-15	10 ft to 15 ft	4.2 ft		dry		10 to 11.5 ft: Tan medium sand, little coarse sand, **wet at 11.2 ft** 11.5 to 13.5 ft: Dense, mottled Brown/Tan fine sand, some silt 13.5 to 14.2 ft: Tan/Light brown medium sand, little coarse sand, **dry**					11-15
16-20	15 ft to 20 ft	3.2 ft				15 to 16.5 ft: Tan fine to medium sand, Iron-staining from 15.5 to 15.6 ft 16.5 to 18 ft: Tan fine/very fine sand ---intermittent brown silt lenses, ranging between 1/8" to 1" thick 18 to 18.2 ft: Tan very fine sand, multiple brown silty clay varves					16-20
21-25	20 ft to 25 ft	3.7 ft				20 to 23.3 ft: Tan fine sand ---Brown silt lenses: 22.2 to 22.4 ft and 22.8 to 22.9 ft 23.3 to 23.7 ft: Brown mottled silt					21-25
26-30	25 ft to 30 ft	3.9 ft				Mottled, Tan fine to medium sand					26-30

Project Number: 60476644
Client: Town of Orleans

Site Location: Main Street
Orleans, MA

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Boring: B-50, continued

Boring Number:
Sheet: 2 of 2

Surface Elevation (ft-asl): ____

Equipment: Geoprobe 6620
Inside Diameter: 2"

Well Data

Boring Depth: 35 ft
Screen Depth:
Screen length:

Project Manager: Mark Owen
Field Techs: C.Hayden

Pre-Clear Contractor: Strategic
Pre-Clear Date:

Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft)	Sorting	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
31	30 ft to 35 ft	2.3 ft		wet		30 to 30.5 ft: Tan medium sand, moist (large chunk of gravel at 30.5 ft)					31
32						30.6 to 31.1 ft: Brown fine sand, little medium sand, **wet** 31.1 to 32.3 ft: Brown medium sand, little coarse sand, **wet**					32
33											33
34						**Note:** 32.3 to 33.3 ft fell out of the liner back into borehole					34
35						---------- End of Boring 35' ----------					35
36											36
37											37
38											38
39											39
40											40

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Academy Place
Orleans, MA

Boring: B-52

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 13" Pavement					1
2					13 to 18" Gravel					2
3					18 to 60" Light Tan Fine to Medium Sand					3
4										4
5										5
6	5 ft to 10 ft				5 to 6 Ft: Tan Fine to Medium Sand with Stones and Pebbles					6
7					6 to 10 Ft: Light Tan Fine Sand					7
8										8
9										9
10					---------- End of Boring at 10' ----------					10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Academy Place
Orleans, MA

Boring: B-53

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghe
Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 7" Dark Brown Loamy Sand with Fine roots (Topsoil)					1
2					7 to 60" Tan Fine Sand with Pebbles and Stones					2
3										3
4										4
5										5
6	5 ft to 10 ft				5 to 5.6 Ft: Gray Dense Silty Sand					6
7					5.6 to 6.4 Ft: Tan Fine to Medium Silty Sand with Orange Redox Concentrations 6.4 to 8.5 Ft: Gray Damp Fine Silty Sand					7
8					8.5-9.5 Ft: Brown Fine Silty Sand					8
9					9.5 to 10.5 Ft: Tan Fine Sand					9
10					10.5 to 11.5 Ft: Gray Silty Clay Sand					10
11	10 ft to 15 ft				11.5 to 13 Ft: Tan to Light Tan Medium to Course Sand					11
12										12
13					---------- End of Boring at 13' ----------					13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cove Road
Orleans, MA

Boring: B-54

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue
Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 8" Pavement					1
2					8 to 12" Gravel					2
3					12 to 60" Tan Fine to Medium Sand with Pebbles and Stones					3
4										4
5										5
6	5 ft to 10 ft				5 to 5.5 Ft: Light Tan Fine Sand					6
7					5.5 to 8.3 Ft: Tan Fine to Medium Sand with Pebbles and Stones					7
8					8.3 to 12.7 Ft. gray Dense Damp Fine Silty Sand					8
9										9
10										10
11	10 ft to 15 ft									11
12					12.7 to 13 Ft. Tan Medium to Course Sand with Pebbles					12
13										13
14					---------- End of Boring at 12' ----------					14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 28
Orleans, MA

Boring: B-56

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: S. Chmiel
Field Techs: C.Hayden, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/21/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 9" Dark Brown Loamy Sand with Fine Roots (Topsoil)					1
2					9 to 60" Tan Fine Silty Sand with Pebbles					2
3										3
4										4
5										5
6	5 ft to 10 ft				5 to 8.3 Ft: Tan Fine to Medium Sand with Pebbles					6
7										7
8					8.3 to 12.7 Ft: Gray to Light Brown Dense Damp Silty Sand					8
9										9
10										10
11	10 ft to 15 ft									11
12					12.7 to 13 Ft: Tan Medium to Course Sand					12
13										13
14					---------- End of Boring at 13' ----------					14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: RT 28
Orleans, MA

Boring: B-57

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/15/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date:

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 10" Dark Brown Loamy Sand with Fine Roots (Topsoil)					1
2					10 to 60" Tan Fine Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft				Potential Unmarked Waterline, did not complete					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Locatio Cummings Roa
Orleans, MA

Boring: B-58

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Mark Ov
Field Techs: C.Hayden, B.Mon
Pre-Clear Contractor: Strategic
Pre-Clear Date:
Drill Contractor: NE Geote
Driller: Hayes
Drill Date:

Depth	Sample Identification	Rec (%	Moist	PID (ppm	Field Identification	Description	Fill Mat.	Tube	Fill W	Depth
1	0 ft to 5 ft				0 - 3" : Asphalt					1
2					~2'' of dirt fill					2
3					5''-60'' - fine to medium orange brown sand					3
4										4
5										5
6	5 ft to 10 ft				Location not yet drilled					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cummings Road
Orleans, MA

Boring: B-59

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Mark Owen
Field Techs: C.Hayden, B.Morrill
Pre-Clear Contractor: Strategic
Pre-Clear Date:
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date:

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 3" : Asphalt					1
2					Some vegetative material (roots) around 3''					2
3					5''-60" - fine to medium orange brown sand					3
4										4
5										5
6	5 ft to 10 ft				Location not yet drilled					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cove Road
Orleans, MA

Boring: B-60

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 5" : Asphalt					1
2					5" - 5' : Fine to medium sand.					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.6 ft	dry		5 to 5.6 ft: Brown fine to medium sand, trace coarse sand					6
7					5.6 to 7.9 ft: Tan fine sand					7
8			dry		7.9 to 8.4 ft: Tan-Light Brown fine sand, some medium sand					8
9			moist		8.4 to 11 ft: Brown fine to medium sand					9
10										10
11	10 ft to 15 ft	3.7 ft	moist		11 to 13.7 ft: Brown mottled fine sand, little silt					11
12										12
13										13
14										14
15					---------- End of Boring 12' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cove Road
Orleans, MA

Boring: B-61

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 4" : Asphalt					1
2					4" - 5" : Gravel					2
3					5" - 5' : Brown\Orange fine to medium sand.					3
4										4
5										5
6	5 ft to 10 ft	3.5 ft	dry		5 to 7.7 ft: Tan, Iron-stained medium sand, some fine sand					6
7					7.7 to 8.1 ft: Brown silt					7
8					8.1 to 8.5 ft: Tan, Iron-stained medium sand, some fine sand					8
9										9
10										10
11	10 ft to 15 ft	3.5 ft	dry		10 to 11.8 ft: Brown fine sand, little medium sand					11
12					11.8 to 12.6 ft: Light Orange/Tan medium sand					12
13					12.6 to 13.5 ft: Brown silt					13
14										14
15					---------- End of Boring 12' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Tote Road
Orleans, MA

Boring: B-62

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue | Field Techs: C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 60'' - Brown/ Orange medium sand with some finer material					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	3.8 ft	dry		Tan/Brown fine to medium sand, trace coarse sand, coarsening downward					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	3.8 ft	dry		10 to 11.6 ft: Tan-Brown medium to coarse sand, trace fine gravel					11
12					11.6 to 12.7 ft: Tan/Brown fine silty sand, little medium sand, trace gravel					12
13					12.7 to 13.1 ft: Mottled grey/brown silt, little clay					13
14					13.1 to 13.8 ft: Plastic Brown silt and clay					14
15										15
16	15 ft to 20 ft	3.8 ft	dry		15 to 15.9 ft: Plastic Brown silt and clay, trace fine sand					16
17					15.9 to 18.8 ft: Interchanging 4" layers of Brown silty clay and fine sand					17
18										18
19										19
20										20
21	20 ft to 25 ft	UNK	dry		Liner stuck in macro; soil was hammered out by driller: -Dense, mottled Grey/Tan fine sand					21
22										22
23										23
24										24
25					---------- End of Boring at 22' ----------					25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: West Road
Orleans, MA

Boring: B-63

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1-5	0 ft to 5 ft				0 - 60'' - Brown fine to medium sand, moist near bottom					1-5
6-10	5 ft to 10 ft	3.7 ft	dry		Brown to Tan fine sand, little medium sand					6-10
11-15	10 ft to 15 ft	3.4 ft	dry		Tan fine sand, trace medium sand					11-15
16-20	15 ft to 20 ft	3.5 ft	dry		15 to 17.7 ft: Tan fine sand, trace medium sand 17.7 to 18.5 ft: Brown-Orange fine sand, trace medium silty sand ---------- End of Boring at 17' ----------					16-20
21-30										21-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: West Road
Orleans, MA

Boring: B-64

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: S. Chmiel, C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 3/15/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 10” Pavement (Top 5” New)					1
2					10 to 12” Gravel With Pebbles					2
3					12 to 60” Tan Medium to Fine Sand With Pebbles					3
4										4
5										5
6	5 ft to 10 ft	4.2 ft	dry		5 to 12 ft: Light Brown/Tan fine sand, trace medium sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4.4 ft	dry		12 to 12.6 ft: Brown fine sand, some silt					11
12					12.6 to 13.1 ft: Tan fine to medium sand, silty clay varve at 12.8 ft					12
13					13.1 to 13.4 ft: Brown clayey silt					13
14					13.4 to 14 ft: Light Brown/Tan fine sand, trace medium sand					14
15					---------- End of Boring at 15' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: West Road
Orleans, MA

Boring: B-65

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft)	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 60" - Brown fine to medium sand, moist near bottom					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	4 ft	dry		Tan-Orange fine to medium sand, trace pulverized cobble -with some coarse sand between 7.5 to 8.1 ft					6
7										7
8										8
9										9
10					---------- End of Boring at 10' ----------					10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: West Road
Orleans, MA

Boring: B-66

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1-5	0 ft to 5 ft				0 - 60'' - Brown fine to medium sand, moist near bottom					1-5
6-10	5 ft to 10 ft	3.5 ft	dry		Tan-Light Brown fine to medium sand, little silt ---------- End of Boring at 10' ----------					6-10
11-30										11-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: West Road
Orleans, MA

Boring: B-67

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 60'' - Brown fine to medium sand, moist near bottom					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	1 ft	dry		5 to 6 ft: Brown fine sand, root fibers					6
7					6 ft: Broken cobble in tip; cobble likely located at 7 ft due to hard drilling					7
8										8
9										9
10										10
11	10 ft to 15 ft	4 ft	dry		Dense Brown mottled fine sand, some Iron-staining					11
12										12
13										13
14										14
15					---------- End of Boring at 10' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: West Road
Orleans, MA

Boring: B-68

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech
Driller: Hayes
Date Completed: 2/22/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat.	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 60'' - Brown fine to medium sand, moist near bottom					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	2 ft	dry		Brown/Orange fine to medium sand, trace broken cobble at 5.5 ft and in tip of macro (Broken cobble in tip caused reduction in recovery)					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	3 ft	dry		10 to 11 ft: Brown medium sand, some fine sand, trace broken cobble					11
12					11 to 13 ft: Brown/Orange fine sand, trace coarse sand					12
13										13
14										14
15					---------- End of Boring at 11' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-69

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 8" : Asphalt 8" - 9" : Gravel 9" - 5' : Brown fine to medium sand					1-5
6-10	5 ft to 10 ft	3.8 ft	dry		5 to 8.7 ft: Tight, Brown-Grey mottled fine sand 8.7 to 8.8 ft: Tan brown-mottled fine sand					6-10
11-15	10 ft to 15 ft	3.4	dry		Tight, Brown-Grey mottled fine sand **-->intermittent fine to medium sand lenses** ---------- End of Boring at 15' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-70

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 8" : Asphalt 8" - 9" : Gravel 9" - 5' : Brown fine to medium sand					1-5
6-10	5 ft to 10 ft	3.4 ft	dry		5 to 6.7 ft: Brown fine sand, some medium sand 6.7 to 7 ft: Tan/Brown medium sand 7 to 8.4 ft: Fine sand, trace large gravel -->Transition from Tan to Brown to Orange/Brown in color ---------- End of Boring at 10' ----------					6-10
11-15	10 ft to 15 ft									11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-71

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1	0 ft to 5 ft				0 - 8" : Asphalt 8" - 9" : Gravel 9" - 5' : Brown fine to medium sand					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	4 ft	dry		5 to 5.1 ft: Brown fine sand 5.1 to 5.5 ft: Tan medium to coarse sand, little fine sand, pulverized cobble/large gravel 5.5 to 9 ft: Tight, Brown mottled fine sand **-->Orange in color from 7.5 to 7.6 ft**					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4.1	dry		10 to 13.8 ft: Tight, Brown-Grey mottle fine sand **-->pulverized cobble/large gravel from 11.6 to 12 ft** 13.8 to 14.1 ft: Orange coarse sand, some medium sand ---------- End of Boring at 15' ----------					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-72

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1	0 ft to 5 ft				0 - 8" : Asphalt					1
2					8" - 9" : Gravel					2
3					9" - 5' : Brown fine to medium sand					3
4										4
5										5
6	5 ft to 10 ft	4 ft	dry		5 to 5.3 ft: Red/Brown coarse sand					6
7					5.3 to 7.1 ft: Brown/Tan medium sand, little fine sand					7
8					7.1 to 7.4 ft: Brown fine sand					8
9					7.4 to 8 ft: Tan coarse sand, broken cobble fragments					9
10					8 to 9 ft: Tan brown-mottled fine sand ---------- End of Boring at 10' ----------					10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-73

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hay | Started: 2/17/2017
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/17/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	i	Description	Fill Mat.	Tube	Fill Mat.	Depth
1-5	0 ft to 5 ft				0 - 6" : Asphalt 6" - 7" : Gravel 7" - 5' : Orange\Brown fine sand					1-5
6-10	5 ft to 10 ft	3.6 ft	dry		Tight, Brown/Tan fine to medium sand ---------- End of Boring at 10' ----------					6-10
11-15	10 ft to 15 ft									11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-74

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategoic | Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 8" : Asphalt 8" - 5' : Orange\Brown\Lt Brown fine to medium sand					1-5
6-10	5 ft to 10 ft	3.8 ft	dry		Tan fine to medium sand **-->Trace medium gravel from 7.5 to 8.8 ft** ---------- End of Boring at 10' ----------					6-10
11-15	10 ft to 15 ft									11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-75

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Date Completed: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1	0 ft to 5 ft				0 - 6" : Asphalt 6" - 7" : Gravel 7" - 5' : Orange\Brown fine to medium sand					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	4 ft	dry		5 to 6.8 ft: Tan fine to medium sand 6.8 to 9 ft: Brown fine sand, little medium sand **-->Grey silt lens at 6.7 ft**					6
7										7
8										8
9										9
10					---------- End of Boring at 10' ----------					10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-76

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 8" : Asphalt 8" - 4.5' : Orange\Brown fine to medium sand. 4.5' - 5' : Light brown sand					1-5
6-10	5 ft to 10 ft	3.4 ft	dry		5 to 6 ft: Brown fine sand, little medium sand 6 to 8 ft: Tan medium sand; intermittent, brown silty fine sand layers 8 to 8.4 ft: Brown silty fine sand ---------- End of Boring at 10' ----------					6-10
11-15	10 ft to 15 ft									11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-77

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 6" : Asphalt 6" - 4.5' : Orange\Brown fine sand 4.5' -5' : Light brown sand					1-5
6-10	5 ft to 10 ft	4 ft	dry		5 to 6.1 ft: Tan fine to medium sand 6.1 to 7 ft: Tan/Brown fine to medium sand, trace fine gravel, broken cobble 7 to 8.9 ft: Tan Brown-mottled fine sand 9.0 ft: Broken cobble in drive-shoe ---------- End of Boring at 10' ----------					6-10
11-15	10 ft to 15 ft									11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Tote Road
Orleans, MA

Boring: B-78

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/20/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1-5	0 ft to 5 ft				0 - 60'' - Brown/ Orange medium sand with some finer material					1-5
6-10	5 ft to 10 ft	4 ft	dry		5 to 7.3 ft: Tan, Iron-stained fine to medium sand 7.3 to 9 ft: Tan fine sand					6-10
11-15	10 ft to 15 ft	3.9 ft	dry		Tan fine sand with intermittent Iron-staining ---------- End of Boring at 13' ----------					11-15
16-30										16-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Tote Road
Orleans, MA

Project Manager: Reggie Donogh | Field Techs: C.Hayden

Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/20/2017

Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/22/2017

Boring: B-79

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 60'' - Brown/ Orange medium sand with some finer material					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	4.4 ft	dry		5 to 7.6 ft: Tan/Orange-mottled fine to medium sand, little coarse sand					6
7					7.6 to 9.4 ft: Mottled Tan/Brown fine sand, some silt					7
8										8
9										9
10										10
11	10 ft to 15 ft	4.1 ft	dry		Brown silt and fine sand, Iron-staining					11
12										12
13										13
14										14
15					---------- End of Boring at 14' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-80

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 11 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1	0 ft to 5 ft				0 - 6" : Asphalt 6" - 7" : Gravel 7" - 4' : Orange\Brown fine sand 4' - 5' : Asphalt Layer - Refusal for pre-clean					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	3.6 ft	dry		5 to 7.2 ft: Dense, Brown fine sand, little medium sand 7.2 to 8.6 ft: Brown fine to medium sand, trace medium gravel					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4 ft	dry		Dense, Brown-Grey mottled fine sand, trace silt					11
12										12
13										13
14										14
15					---------- End of Boring at 15' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Old Colony Way
Orleans, MA

Boring: B-81

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 12 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Date Completed: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1-5	0 ft to 5 ft				0 - 6" : Asphalt 6" - 5' : Orange\Brown fine to medium sand with <5% angular gravel. Few cobbles encountered					1-5
6-10	5 ft to 10 ft	4.3 ft	dry		5 to 8 ft: Tan brown fine to medium sand, trace fine gravel 8 to 9.3 ft: Dense Brown fine sand, trace silt					6-10
11-15	10 ft to 15 ft	3.6 ft	dry		10 to 10.2 ft: Dense Brown fine sand, trace silt 10.2 to 13.6 ft: Tan brown-mottled fine to medium sand ---------- End of Boring at 12' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Intersection of Main St. and Old Colony Way Orleans, MA

Boring: B-82

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft	Moistu		Field Identification	Description	Fill Mat	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 6" : Asphalt					1
2					6" - 8" : Gravel					2
3					8" - 5' : Brown fine to medium sand.					3
4										4
5										5
6	5 ft to 10 ft	3.5 ft	dry		5 to 7.9 ft: Orange/Tan fine to medium sand					6
7					7.9 to 8.5 ft: Tan coarse sand and fine gravel, some medium sand					7
8										8
9										9
10										10
11	10 ft to 15 ft	3.7 ft	dry		10 to 10.3 ft: Tan coarse sand and fine gravel, some medium sand					11
12					10.3 to 11 ft: Tan/Orange mottled fine to medium sand					12
13					11 to 13.7 ft: Loose, Tan fine sand					13
14										14
15					---------- End of Boring at 13' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Main Street West
Orleans, MA

Boring: B-83

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft)	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 10" : Asphalt					1
2					10" - 5' : Orange and brown, fine to medium sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.8 ft	dry		5 to 5.3 ft: Brown fine to medium sand					6
7					5.3 to 8.1 ft: Tan fine sand					7
8					8.1 to 8.5 ft: Brown fine sand, trace root fibers					8
9					8.5 to 8.8 ft: Tan fine sand					9
10										10
11	10 ft to 15 ft	4.1 ft	dry		Mottled, Tan fine to medium sand, interlayered brown fine sand and silt					11
12										12
13										13
14										14
15					---------- End of Boring at 12' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Main Street West
Orleans, MA

Boring: B-84

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft)	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 10" : Asphalt					1
2					10" - 5' : Orange and brown, fine to medium sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.6 ft	dry		5 to 5.5 ft: Tan fine sand, trace medium gravel					6
7					5.5 to 5.7 ft: Brown fine sand, little brown silt lenses					7
8					5.7 to 8.6 ft: Tan fine sand, intermittent brown silt lenses					8
9										9
10										10
11	10 ft to 15 ft	3.7 ft	dry		10 to 13 ft: Tan medium sand, little coarse sand					11
12					---Brown silt lenses at 12 ft and 12.5 ft					12
13					13 to 13.4 ft: Mottled, Brown silt and fine sand					13
14					13.4 to 13.7 ft: Tan very fine sand					14
15					---------- End of Boring at 13' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Main Street West
Orleans, MA

Boring: B-85

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Date Completed: 2/21/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 10" : Asphalt over gravel					1
2					10" - 5' : Orange/Brown fine sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.7 ft	dry		5 to 6 ft: Tan/Orange medium sand					6
7					6 to 6.7 ft: Brown fine sand and silt					7
8					6.7 to 8.7 ft: Brown/Tan fine to medium sand					8
9										9
10										10
11	10 ft to 15 ft	3.5 ft	dry		10 to 11.1 ft: Tan medium sand, little coarse sand					11
					---Thin layer of brown silt and root fibers at 10.9 ft					
12					11.1 to 12.3 ft: Mottled, Tan medium sand 12.3 to 12.5 ft: Orange medium to coarse sand					12
13										13
14					12.5 to 13.3 ft: Tan fine to medium sand 13.3 to 13.5 ft: Brown fine sand, little silt					14
15					---------- End of Boring at 11' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Main St (West)
Orleans, MA

Boring: B-86

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 12 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 12" : Asphalt 12" - 5' : Orange-brown, fine to medium sand					1-5
6-10	5 ft to 10 ft	3.6 ft			Tan medium sand **-->wet at 6.5 ft**					6-10
11-15	10 ft to 15 ft	3.9 ft			10 to 10.8 ft: Tan medium sand 10.8 to 12 ft: Brown fine sand, little medium sand 12 to 12.6 ft: Brown fine to medium sand 12.6 to 13.4 ft: Brown fine sand 13.4 to 13.9 ft: Dense,Brown silt, trace fine sand ---------- End of Boring at 12' ----------	5				11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Road
Orleans, MA

Boring: B-87

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/22/2017

Depth	Sample Identification	Rec (ft	Moistur		Field Identification	Description	Fil Mat'l	Tube	Fil Ma	Depth
1	0 ft to 5 ft				0" to 8" - Pavement 8" to 10" - Gravel 10" to 60" - Fine Sand					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	3.9 ft	dry		5 to 6.1 ft: Tan fine to medium sand 6.1 to 6.5 ft: Brown mottled fine sand and silt 6.5 to 6.7 ft: Tan fine sand lens 6.1 to 6.5 ft: Brown mottled fine sand and silt					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	4.2	dry		10 to 12.5 ft: Dense Brown mottled fine sand and silt 12.5 to 13.2 ft: Mottled Tan fine sand, trace coarse sand 13.2 to 14.2 ft: Dense Brown mottled fine sand and silt					11
12										12
13										13
14										14
15					---------- End of Boring at 15' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Road
Orleans, MA

Boring: B-88

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat.	Depth
1-5	0 ft to 5 ft				0" to 8" - Pavement 8" to 12" - Gravel 12" to 60" - Silty Fine Sand					1-5
6-10	5 ft to 10 ft	3.3 ft			5 to 5.3 ft: Brown fine sand, root fibers observed 5.3 to 6.9 ft: Tan brown-mottled fine to medium sand 6.9 to 7.4 ft: Mottled, Brown fine sand, little silt, historic root system 7.4 to 8.3 ft: Mottled, Tan medium sand					6-10
11-15	10 ft to 15 ft	3.5 ft			10 to 12 ft: Tan medium sand, trace fine sand 12 to 12.3 ft: Brown fine to medium sand, little coarse sand 12.3 to 12.7 ft: Brown/Tan fine to medium sand 12.7 to 13.5 ft: Mottled, Brown silt, little fine sand, trace clay 13.5 (tip) ft: Brown/Red medium sand ---------- End of Boring at 12' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Road
Orleans, MA

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/17/2017

Boring: B-89

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1	0 ft to 5 ft				0 to 8" Pavement					1
2					8 to 10" Gravel					2
3					10 to 60" Tan Medium to Course Sand with Stones					3
4										4
5										5
6	5 ft to 10 ft	3.6 ft			5 to 6.5 ft: Brown, silty fine sand					6
7					6.5 to 8.6 ft: Tan medium sand, little coarse sand					7
8										8
9										9
10										10
11	10 ft to 15 ft	3.4 ft		moist	10 to 10.6 ft: Tan medium sand, little coarse sand					11
12				wet	10.6 to 13.4 ft: Tan coarse sand, some medium sand					12
13										13
14										14
15					---------- End of Boring at 14' ----------					15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Road
Orleans, MA

Project Manager: Reggie Donoghu | Field Techs: R. Donoghue, C.F

Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017

Drill Contractor: NE Geotech | Driller: Ha | Drill Date: 2/22/2017

Boring: B-90

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft			0" to 12" - Pavement					1
2				12" to 18" - Gravel					2
3				18" to 48" - Fine Sand					3
4				48" to 60" - Coarse Sand and Cobbles					4
5									5
6	5 ft to 10 ft	4 ft		5 to 6.6 ft: Tan fine to medium sand					6
7				6.6 to 9 ft: Brown fine sand, some silt, trace coarse sand					7
8									8
9									9
10									10
11	10 ft to 15 ft	4 ft		Brown mottled fine sand and silt, **wet at 12 ft**					11
12									12
13									13
14									14
15									15
16	15 ft to 20 ft	4.7		15 to 15.7 ft: Brown fine to medium sand					16
17				15.7 to 19.7 ft: Brown fine sand and silt					17
18									18
19									19
20				---------- End of Boring at 18' ----------					20
21									21
22									22
23									23
24									24
25									25
26									26
27									27
28									28
29									29
30									30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Street
Orleans, MA

Boring: B-91

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 30 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0" to 8" - Pavement 8" to 16" - Gravel 16" to 30" - Coarse Sand 30" to 60" - Fine Sand					1-5
6-10	5 ft to 10 ft	3.6 ft	wet		Tan brown-mottled medium sand, little coarse sand					6-10
11-15	10 ft to 15 ft	3.8 ft	wet		Orange-Light Brown medium sand, little coarse sand					11-15
16-20	15 ft to 20 ft	3.7			Tan brown-mottled medium sand, little coarse sand **-->wet at 16.3 ft**					16-20
21-25	20 ft to 25 ft	3.3			Medium to coarse sand, intermittently switches between Tan and Orange					21-25
26-30	25 ft to 30 ft				Tan coarse sand ---------- End of Boring at 27' ----------					26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Street
Orleans, MA

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Boring: B-92

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0" to 8" - Pavement 8" to 14" - Gravel 14" to 60" - Fine Sand					1-5
6-10	5 ft to 10 ft	3.8 ft	wet		Tan medium sand, little fine sand					6-10
11-15	10 ft to 15 ft	3.8 ft	wet		Tan medium sand, little fine sand ---------- End of Boring at 11' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Street
Orleans, MA

Boring: B-93

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 25 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0" to 6" - Pavement 6" to 12" - Gravel 12" to 60" - Fine Sand					1-5
6-10	5 ft to 10 ft	3.7 ft	wet		5 to 5.7 ft: Tan medium sand 5.7 to 6.2 ft: Tan fine sand 6.2 to 7.2 ft: Tan fine to medium sand 7.2 to 8.7 ft: Light Brown medium sand, trace fine and coarse sand **-->tight Grey fine to medium sand at 8.4 ft**					6-10
11-15	10 ft to 15 ft	4.4 ft	wet		Brown silt and fine sand **-->coarse sand and gravel lens at 12.3 to 12.6 ft**					11-15
16-20	15 ft to 20 ft	3.3 ft	wet		15 to 15.9 ft: Brown silt and fine sand 15.9 to 17.3 ft: Dense Dark Grey fine sand and silt 17.3 to 18.3 ft: Brown medium sand, little coarse sand					16-20
21-25	20 ft to 25 ft	3 ft	wet		20 to 21 ft: Tan medium sand, trace coarse sand 21 to 23 ft: Tan coarse sand, trace medium gravel ---------- End of Boring at 21' ----------					21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Street
Orleans, MA

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Boring: B-94

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 25 ft
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1-5	0 ft to 5 ft				0" to 12" - Pavement (2 layers) 12" to 24" - Gravel 24" to 60" - Fine Sand					1-5
6-10	5 ft to 10 ft	3.1 ft			5 to 5.7 ft: Light Brown/Orange medium sand 5.7 to 8.1 ft: Tan medium sand, some coarse sand **-->broken cobble fragment at 7.5 ft**					6-10
11-15	10 ft to 15 ft	3.5 ft	wet		10 to 11 ft: Tan coarse sand 11 to 11.4 ft: Tan fine to medium sand 11.4 to 11.7 ft: Orange/Red medium sand, trace medium gravel 11.7 to 12 ft: Tan fine sand, some fine gravel 12 to 12.8 ft: Tan medium to coarse sand 12.8 to 13.5 ft: Mottled Tan/Orange fine sand					11-15
16-20	15 ft to 20 ft	3.3 ft	wet		15 to 16 ft: Light Brown fine sand 16 to 16.4 ft: Light Brown medium sand 16.4 to 17.3 ft: Light Brown/Orange coarse sand 17.3 to 18.3 ft: Light Brown/Orange medium to coarse sand 10 to 11 ft: Tan coarse sand					16-20
21-25	20 ft to 25 ft	3.4 ft	wet		20 to 22.6 ft: Light Orange medium to coarse sand **-->Transition from Light Orange to Tan at 22 ft** 22.6 to 22.8 ft: Tan fine sand 22.8 to 23.4 ft: Tan fine sand, some medium sand ---------- End of Boring at 22' ----------					21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Locust Street
Orleans, MA

Boring: B-95

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 25 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donos | Field Tech: S. Chmiel, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/15/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fil Mat	Tube	Fil Mat	Depth
1	0 ft to 5 ft				0 to 8" Pavement					1
2					8 to 10" Gravel					2
3					10 to 60" Tan Medium to Course Sand with Stones					3
4										4
5										5
6	5 ft to 10 ft	3.1 ft	moist		5 to 5.5 ft: Brown fine sand					6
7					5.5 to 8.1 ft: Brown/Tan medium sand, little coarse sand					7
8										8
9										9
10										10
11	10 ft to 15 ft	3.6 ft	moist /	wet	10 to 16 ft: Tan medium sand, some coarse sand, **wet at 12.4 ft**					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft	3 ft	wet		16 to 18 ft: Tan coarse sand, some medium sand, trace rotted rock					16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft	3 ft	wet		20 to 22.5 ft: Tan medium to coarse sand					21
22					22.5 to 23 ft: Tan fine sand, little medium sand					22
23										23
24										24
25					---------- End of Boring at 25' ----------					25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Liberty Lane
Orleans, MA

Boring: B-96

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 2" : Asphalt 2" - 5' : Dark orange to brown, fine to medium sand					1-5
6-10	5 ft to 10 ft	3.3 ft	wet		5 to 5.5 ft: Dark Brown fine sand, some medium sand 5.5 to 7.5 ft: Orange to Brown to Tan fine to medium sand, trace large gravel and broken cobble 7.5 to 8.3 ft: Brown fine sand and silt					6-10
11-15	10 ft to 15 ft	4.6 ft	wet		Brown/Grey silt and fine sand, little medium sand ---------- End of Boring at 13' ----------					11-15
16-30										16-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Liberty Lane
Orleans, MA

Boring: B-97

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 4" : Asphalt 4" - 5' : Brown/Orange fine to medium sand. Larger cobbles encountered.					1-5
6-10	5 ft to 10 ft	4.3 ft	wet		5 to 8.6 ft: Tight brown fine sand, trace medium sand 8.6 to 9 ft: Loose, Tan fine sand					6-10
11-15	10 ft to 15 ft	3.9 ft	wet		10 to 12 ft: Brown fine sand, little medium sand 12 to 12.5 ft: Dense, Light Brown fine sand and silt 12.5 to 12.9 ft: Tan fine to medium sand 12.9 to 13.9 ft: Light Brown fine sand ---------- End of Boring at 11' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-98

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0"-12" : Asphalt over gravel 12" - 5' : Orange-brown and brown, medium to fine sand					1-5
6-10	5 ft to 10 ft	3.6 ft			5 to 6.8 ft: Tan fine sand 6.8 to 8.6 ft: Tan fine to medium sand, trace coarse sand					6-10
11-15	10 ft to 15 ft	3.6 ft	wet		10 to 12.2 ft: Tan/Orange fine to coarse sand 12.2 to 13.6 ft: Orange medium sand, some coarse sand ---------- End of Boring at 12' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-99

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data
Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/16/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0"-10" : Asphalt 10" - ? : Medium to coarse sand with some fine material. Orange-brown and brown, small angular gravel 5%					1-5
6-10	5 ft to 10 ft	3.5 ft			5 to 6.8 ft: Tan medium sand, trace coarse sand 6.8 to 7 ft: Dark Red/Brown coarse sand 7 to 7.4 ft: Tan/Orange coarse to medium sand 7.4 to 7.5 ft: Dense Brown fine sand and silt, broken cobble fragments 7.5 to 8.6 ft: Tan medium sand					6-10
11-15	10 ft to 15 ft	3.5 ft	wet		10 to 11.7 ft: Tan medium to fine sand 11.7 to 12.7 ft: Tan medium to coarse sand, little fine sand **-->wet at 12.3 ft** 12.7 to 13.5 ft: Brown/Red medium to coarse sand, trace fine gravel ---------- End of Boring at 11' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-100

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0 - 8" : Asphalt 8"-12" : Orange sand, fine to medium 1' - 5' : Light brown and brown, fine to medium sand with <5% medium sized cobble					1-5
6-10	5 ft to 10 ft	3.3 ft	moist		Tan medium to coarse sand, trace fine gravel					6-10
11-15	10 ft to 15 ft	3.5 ft	moist		Tan medium to coarse sand, trace fine gravel ---------- End of Boring at 12' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-101

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 20 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Tech: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 44				0 to 14" : Pavement 14" to 20" : Gravel 20" to 5 ft : Orange to brown fine to medium sand					1-5
6-10	5 ft to 10 ft	3.2 ft	moist		Tan to Light Brown medium to coarse sand, trace fine gravel					6-10
11-15	10 ft to 15 ft	3.3 ft	moist		10 to 11.3 ft: Tan medium to coarse sand, trace fine gravel 11.3 to 12.5 ft: Tan/Light Grey coarse sand 12.5 to 13.3 ft: Tan/Light Grey tight, coarse sand and medium gravel, broken cobble					11-15
16-20	15 ft to 20 ft	3.3 ft	moist		15 to 15.7 ft: Grey tight, fine sand 15.7 to 18.3 ft: Tan medium sand ---------- End of Boring at 19' ----------					16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-102

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 20 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0" to 4" - Pavement 4" to 9" - Gravel 9" to 60" - Medium Sand					1-5
6-10	5 ft to 10 ft	2.8 ft	moist		5 to 7.3 ft: Tan medium to coarse sand, trace fine gravel 7.3 to 7.8 ft: Tan coarse sand, broken cobble fragments					6-10
11-15	10 ft to 15 ft	3.7 ft	wet		10 to 12.5 ft: silt, little fine sand, trace clay (Blue-Grey to Brown color transition) 12.5 to 12.6 ft: Red/Brown silt 12.6 to 13.7 ft: Brown fine sand, trace medium sand					11-15
16-20	15 ft to 20 ft	3.6 ft	wet		15 to 18.4 ft: Brown/Green-Grey mottled fine sand, little silt 18.4 to 18.6 ft: Red/Brown fine sand, little medium sand ---------- End of Boring at 18' ----------					16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Jones Way
Orleans, MA

Boring: B-103

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 20 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0" to 6" - Pavement 6" to 12" - Hardener 12" to 60" - Medium to Coarse Sand					1-5
6-10	5 ft to 10 ft	3.4 ft	moist to wet		Tan to Light Orange medium to coarse sand					6-10
11-15	10 ft to 15 ft	3.4 ft	wet		10 to 11.5 ft: Tan to Light Orange medium sand, little fine sand, trace coarse sand 11.5 to 13.4 ft: Tan/Grey medium sand					11-15
16-20	15 ft to 20 ft	3.6 ft	wet		15 to 16 ft: Grey/Tan medium sand 16 to 18.6 ft: Mottled fine sand (Tan with brown streaks) ---------- End of Boring at 18' ----------					16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-104

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Mark Owen
Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1-5	0 ft to 5 ft				0" to 8" - Pavement 8" to 24" - Gravel 24" to 60" - Silty Sand & perched water Groundwater @ 60" +/-					1-5
6-10	5 ft to 10 ft	3 ft	moist to wet		5 to 5.5 ft: Tan to Light Orange medium to coarse sand 5.5 to 6 ft: Tan mottled silt, little clay 6 to 6.3 ft: Tan fine sand 6.3 to 8 ft: Tan medium sand, little coaarse sand, rock in drive-shoe					6-10
11-15	10 ft to 15 ft	3.6 ft	wet		Tan fine to medium sand ---------- End of Boring at 14' ----------					11-15
16-20	15 ft to 20 ft									16-20
21-25	20 ft to 25 ft									21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-105

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 25 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat	Depth
1-5	0 ft to 5 ft				0" to 8" - Pavement 8" to 12" - Gravel 12" to 60" - Medium Sand					1-5
6-10	5 ft to 10 ft	3.6 ft	moist to wet		5 to 8.6 ft: Tan toYellow medium to coarse sand **-->wet at 6.5 ft**					6-10
11-15	10 ft to 15 ft	3.6 ft	wet		Tan medium to coarse sand, little fine gravel					11-15
16-20	15 ft to 20 ft	3.7 ft	wet		15 to 16.5 ft: Tan fine to coarse sand, trace fine gravel 16.5 to 18.1 ft: Tan medium to coarse sand, trace fine gravel 18.1 to 18.7 ft: Grey silt, little clay					16-20
21-25	20 ft to 25 ft	4.1 ft	wet		20 to 20.9 ft: Grey silt, some clay 20.9 to 21 ft: Brown silt 21.0 to 22.9 ft: Grey fine sand 22.9 to 23.1 ft: Grey silt 23.1 to 24.1 ft: Grey fine sand ---------- End of Boring at 22' ----------					21-25
26-30	25 ft to 30 ft									26-30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/15/2017

Boring: B-106

Boring Number:
Sheet: 1 of 2
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 35 ft
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1–5	0 ft to 5 ft				0" to 8" - Pavement 8" to 12" - Gravel 12" to 60" - Medium Sand					1–5
6–10	5 ft to 10 ft	3.2 ft	moist to wet		5 to 5.7 ft: Tan medium sand, some coarse sand 5.7 to 6.2 ft: Tan fine to medium sand 6.2 to 8 ft: Tan/Orange medium to coarse sand, trace fine gravel -->Orange from Iron-staining 8 to 8.2 ft: Brown silt					6–10
11–15	10 ft to 15 ft	3.7 ft	moist moist moist wet		10 to 10.2 ft: Brown coarse sand 10.2 to 11.2 ft: Brown to Grey to Red-Orange silt, some clay, root fibers observed 11.2 to 12.2 ft: Mottled Tan-Brown fine sand 12.2 to 13.2 ft: **SAA 10.2 to 11.2 ft** 13.2 to 13.7 ft: Red/Brown fine sand					11–15
16–20	15 ft to 20 ft	3.1 ft	wet		15 to 16.2 ft: Light Brown to Brown/Tan fine to medium sand 16.2 to 16.4 ft: Tan to Light Grey fine sand 16.4 to 16.5 ft: Grey silt 16.5 to 17.7 ft: Grey medium to coarse sand, trace fine to medium gravel 17.7 ft: Grey medium to coarse sand and fine gravel					16–20
21–25	20 ft to 25 ft	2.9 ft	wet		20 to 20.9 ft: Grey fine sand 20.9 to 21.5 ft: Grey medium sand 21.5 to 22.9 ft: Grey coarse sand, little medium sand					21–25
26–30	25 ft to 30 ft	2.9 ft			Grey medium to coarse sand					26–30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-106, continued

Boring Number:
Sheet: 2 of 2
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 35 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
31	30 ft to 35 ft	3.2 ft	wet		30 to 30.6 ft: Grey medium sand 30.6 to 33.2 ft: Grey medium to coarse sand					31
32										32
33										33
34										34
35					---------- End of Boring at 34' ----------					35
36	35 ft to 40 ft									36
37										37
38										38
39										39
40										40

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-107

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Tech: R. Donoghue, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/8/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture	PID (ppm)	Field Identification	Description	Fil Mat.	Tube	Fil Mat	Depth
1	0 ft to 5 ft				0" to 7" - Pavement					1
2					7" to 10" - Gravel					2
3					10" to 24" - Fine to Medium Sand					3
4					24" to 48" - Coarse Sand					4
5					48" to 60" - Fine to Medium Sand					5
6	5 ft to 10 ft	3 ft			5 to 7.8 ft: Tan medium to coarse sand					6
7					7.8 to 8 ft: Red/Brown fine sand					7
8										8
9										9
10										10
11	10 ft to 15 ft	3.3 ft	wet		10 to 11.1 ft: Brown medium sand, trace coarse sand					11
12					11.1 to 12.7 ft: Light Brown/Green silt, trace clay					12
13					12.7 to 12.8 ft: Brown silt, trace clay					13
14					12.8 to 13 ft: Brown fine sand					14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20					---------- End of Boring at 14' ----------					20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cove Road
Orleans, MA

Boring: B-113

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donoghue | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/21/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 5" : Asphalt					1
2					5" - 6" : Gravel					2
3					6" - 5' : Brown fine sand.					3
4										4
5										5
6	5 ft to 10 ft	3.9 ft			Tan fine to medium sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	3.3 ft	dry		10 to 10.2 ft: Brown very fine sand					11
12					10.2 to 10.9 ft: Brown fine sand, intermittent brown silt lenses					12
13					10.9 to 11.4 ft: Brown/Orange fine to coarse sand and fine gravel					13
14					11.4 to 12.5 ft: Brown fine sand					14
15					12.5 to 13.2 ft: Tight, Brown fine sand ---------- End of Boring at 12' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Academy Place
Orleans, MA

Boring: B-114

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs:
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/16/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date:

Depth	Sample Identification	Rec (ft)	Moist	PID (ppm)	Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 10" Pavement					1
2					10 to 20" Gravel					2
3					20 to 60" Tan Fine Sand					3
4										4
5										5
6	5 ft to 10 ft				Did not complete, no drill depth detrimined					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft									11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft									16
17										17
18										18
19										19
20										20
21	20 ft to 25 ft									21
22										22
23										23
24										24
25										25
26	25 ft to 30 ft									26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cove Road
Orleans, MA

Boring: B-115

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moistu		Field Identification	Description	Fill Mat	Tube	Fill Ma	Depth
1	0 ft to 5 ft				0 - 4" : Asphalt					1
2					4" - 5' : Brown medium sand. Medium to large cobbles encountered.					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.3 ft	moist /	wet	5 to 7.2 ft: Tan-Grey fine sand, trace fine gravel					6
7					7.2 to 7.9 ft: Orange/Light Brown medium to coarse sand, little fine gravel					7
8					7.9 to 8.3 ft: Broken cobble					8
9										9
10										10
11	10 ft to 15 ft	3.4 ft	wet		10 to 11 ft: Orange medium to coarse sand, little fine gravel					11
12					11 to 13.4 ft: Tan/Orange fine to medium sand					12
13										13
14										14
15					---------- End of Boring at 15' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cove Road
Orleans, MA

Project Manager: Reggie Donogh | Field Techs: B.Morrill, C. Hayden

Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/21/2017

Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/23/2017

Boring: B-116

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Depth	Sample Identification	Rec (ft)	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0" - 5" : Asphalt					1
2					5" - 5' : Orange\Brown medium sand. Medium - Large (angular and round) cobbles encountered					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.4 ft	moist /	wet	Brown very fine sand and silt, **wet at 6.5 ft**					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	3.5 ft	wet		Loose, Brown fine sand, saturated					11
12										12
13										13
14										14
15					---------- End of Boring at 15' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Cove Road
Orleans, MA

Boring: B-117

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 2/21/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 2/23/2017

Depth	Sample Identification	Rec (ft)	Moist		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 - 6" : Asphalt					1
2					6" - 7" : Gravel					2
3					7" - 5' : Brown\Orange medium to fine sand.					3
4										4
5										5
6	5 ft to 10 ft	4 ft	dry		5 to 6.8 ft: Tan, Iron-stained medium to coarse sand, little fine gravel					6
7					6.8 to 9 ft: Tan-Light Brown fien to medium sand, some silt from 8.2 to 9 ft					7
8										8
9										9
10										10
11	10 ft to 15 ft	4 ft	dry		Tan-Brown fine sand, Trace fine gravel, broken cobble at 12.5 ft					11
12										12
13										13
14										14
15					---------- End of Boring at 12' ----------					15
16										16
17										17
18										18
19										19
20										20
21										21
22										22
23										23
24										24
25										25
26										26
27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM

250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: West Road
Orleans, MA

Boring: B-119

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-truck
Inside Diameter: 2"

Well Data

Boring Depth: 10 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh | Field Techs: S. Chmiel, C.Hayden
Pre-Clear Contractor: Strategic | Pre-Clear Date: 3/13/2017
Drill Contractor: NE Geotech | Driller: Hayes | Drill Date: 3/15/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 8” Dark Brown Loamy Sand with Fine Roots (Topsoil)					1
2					8 to 60” Tan Medium to Fine Sand					2
3										3
4										4
5										5
6	5 ft to 10 ft	3.7 ft	dry		Light Brown/Tan fine to medium sand, trace coarse sand					6
7										7
8										8
9										9
10					---------- End of Boring at 10' ----------					10
11										11
12										12
13										13
14										14
15										15
16										16
17										17
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29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-121

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth:
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: B.Morrill, C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date: 2/14/2017
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0 to 1 ft: Pavement 1 to 1.3 ft: Fine to medium orange sandl 1.3 to 1.5 ft: Brown-grey fine to medium sand 1.5 ft to 5 ft : Orange-brown, fine to medium sand					1
2										2
3										3
4										4
5										5
6	5 ft to 10 ft	3 ft	moist		5 to 7.8 ft: Tan medium to coarse sand 7.8 to 8 ft: Red/Brown fine sand					6
7										7
8										8
9										9
10										10
11	10 ft to 15 ft	3.3 ft	wet		10 to 11.5 ft: Brown medium to coarse sand, trace fine gravel 11.5 to 12.1 ft: Grey fine sand, little medium sand 12.1 to 13.3 ft: Grey medium sand					11
12										12
13										13
14										14
15										15
16	15 ft to 20 ft	2.7	wet		15 to 16 ft: Grey medium to coarse sand 16 to 17.7 ft: Grey fine to medium sand					16
17										17
18										18
19										19
20					---------- End of Boring at 16' ----------					20
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27										27
28										28
29										29
30										30

Project Number: 60476644
Client: Town of Orleans

AECOM
250 Apollo Drive
Chelmsford, Massachusetts
(978) 905-2100

Site Location: Canal Street
Orleans, MA

Boring: B-123

Boring Number:
Sheet: 1 of 1
Surface Elevation (ft-asl):
Equipment: Geoprobe 6620, Vac-Truck
Inside Diameter: 2"

Well Data

Boring Depth: 15 ft
Screen Depth:
Screen length:

Project Manager: Reggie Donogh
Field Techs: C. Hayden
Pre-Clear Contractor: Strategic
Pre-Clear Date:
Drill Contractor: NE Geotech
Driller: Hayes
Drill Date: 2/15/2017

Depth	Sample Identification	Rec (ft)	Moisture		Field Identification	Description	Fill Mat.	Tube	Fill Mat.	Depth
1	0 ft to 5 ft				0-4" Gravel (driveway material) 4-60" - Fine to medium orange, brown sand					1
6	5 ft to 10 ft	3.5 ft	moist /	wet	Dark Brown-Brown fine to medium sand, trace coarse sand and root fibers -wet at 6 ft -some coarse sand and fine gravel from 8 to 8.4 ft					6
11	10 ft to 15 ft	4.4 ft	wet		10 to 13.5 ft: Light brown fine to medium sand, trace gravel 13.5 to 14.4 ft: Light Brown fine sand, little medium sand, trace tree twigs ---------- End of Boring at 15' ----------					11
16										16
21										21
26										26

Town of Orleans, MA
25% Preliminary Design Report

Geotechnical Investigation
Downtown Borings

Legend

- Downtown Sewer Area
- Boring - Completed
- Boring - Pending

N

0 500 1,000
Feet

AECOM
April 13, 2017

HARBOR HILL ROAD
ROCK HARBOR ROAD
MID CAPE HIGHWAY
EASTHAM ROTARY
ROUTE 6A
OLD STATE HIGHWAY
ELLIS ROAD
CEDAR POND ROAD
NAMSKAKET ROAD
HOMESTEAD ROAD
CHILDS
LOCUST ROAD
JONES ROAD
CANAL ROAD
CRANBERRY HIGHWAY
COTTAGE STREET
WEST ROAD
OLD COLONY WAY
OAK RIDGE LANE
UNNAMED ROAD
OLD TOTE ROAD
BREWSTER CROSS ROAD
CENTER PLACE
CHATHAM ROAD
MAIN STREET
CLAYTON CIRCLE
UNNAMED ROAD
LOTS HOLLOW ROAD
RAMP-RT.6 EB TO RT.6A
NICKERSON ROAD
ELDREDGE PARK WAY
FINLAY ROAD
UNNAMED ROAD
OLD FARM ROAD
COFFIN LANE
TONSET ROAD
MEETING HOUSE ROAD
DRIFTWOOD LANE
UNNAMED ROAD
HOPKINS LANE
KAREN WAY

B-1 B-2 B-3 B-4 B-5 B-7 B-8 B-9 B-10 B-11 B-12 B-13 B-14 B-15 B-16 B-17 B-18 B-22 B-23 B-24 B-25 B-26 B-27 B-30 B-31 B-33 B-34 B-36 B-38 B-39 B-40 B-41 B-43 B-44 B-45 B-46 B-47 B-48 B-49 B-50 B-51 B-52 B-53 B-54 B-55 B-56 B-57 B-58 B-59 B-60 B-61 B-62 B-63 B-64 B-65 B-66 B-67 B-68 B-69 B-70 B-71 B-72 B-73 B-74 B-75 B-76 B-77 B-78 B-79 B-80 B-81 B-82 B-83 B-84 B-85 B-86 B-87 B-88 B-89 B-90 B-91 B-92 B-93 B-94 B-95 B-96 B-97 B-98 B-99 B-100 B-101 B-102 B-103 B-104 B-105 B-106 B-107 B-109 B-110 B-111 B-112 B-113 B-114 B-115 B-116 B-117 B-118 B-120 B-121 B-123 MA-4 MA-7

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Appendix D
Collection System Workgroup Meeting Minutes

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AECOM
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Meeting Minutes

To	George Meservey, Director of Planning & Community Development Michael Domenica, PE, Program Manager
CC	Betsy Shreve-Gibb, AICP, AECOM Project Director Martin R. Donoghue, P.E., AECOM
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Collection System Work Group No. 1 – FInal Meeting Minutes**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date and Time	December 20, 2016, 1:00 pm

1. Attendees and Affiliation

Alan McClennen, Orleans Board of Selectmen	Jim Trainor, Resident
Gordon Smith, OTA	Paul Ammann, Orleans Peer Review Panel
Len Short, Board of Water & Sewer Commissioners	John Meyer, Board of Water & Sewer Commissioners
Charles Harris, Eastham Alternate Representative	Fran McClennen, Citizen
Judith Bruce, Orleans Wastewater Management Steering Committee	Ed Daley, Orleans Peer Review Panel
Walter North	Ginia Pati, OWA
Martin R. Donoghue, P.E., AECOM	Thomas Parece, P.E., AECOM

2. Minutes

- The meeting began with an overview presented by Alan McClennen.
- Tom Parece reviewed the paper slide presentation with the attendees
- Paul Ammann questioned the changing number of properties in the Downtown sewer service area. Tom Parece explained the evolution of the downtown district and the changes to the boundary of the district included the district boundary following property lines, the removal of the area west of Route 6 and the Eldredge Park Way area.
- Tom Parece reviewed the plans showing the boundaries of the Downtown and Meeting House areas.
    - 250K gpd average design flow for the Downtown area including 391 parcels.
    - 110K gpd average design flow for the Meetinghouse area.
    - Flows will vary based on the season.
    - A 100% reserve area will be required by the state for recharge of the treated effluent.
- Paul Ammann asked if the septage treatment component was optional. Tom Parece responded that it was to be determined.
- Tom Parece responded to a question about whether the Meetinghouse area included all properties that were in the Meetinghouse Pond Watershed. Treatment of 100% of the Nitrogen from that area is required.
- Tom Parece mentioned that the cost of the project is $95 Million with non-traditional technologies versus $150 million for a conventional system under the CWMP.
- Paul Ammann asked if the piping size would be adequate if the demonstration projects are not successful. John Meyer responded that an 8-inch pipe at minimum slope would accommodate more than the projected flows.
- Tom Parece reviewed the Program Costs and Major Cost Components.
- John Meyer stressed the importance of budgeting for equipment replacement based on his experience with water systems.
- Tom Parece reviewed the required monitoring. Daily, weekly, monthly, and quarterly flows and monitor well sampling and testing.
- Tom Parece responded to a question about the PRB technology. The technology has already been proven in other applications specifically mining operations.
- A question was asked if it was more costly to sewer an area versus using NRBs. The answer was yes assuming NRBs are proven to work.
- Tom Parece reviewed the types of wastewater collection systems and the costs of the options that were evaluated. The Life Cycle Cost Analysis was also discussed.
- Paul Ammann questioned the costs. Tom Parece responded about looking at each technology individually based on regulatory requirements and local cost considerations.
- Paul Ammann mentioned that some communities allowed the use of the old leaching system in the event of a power outage. Tom Parece responded that MassDEP would not allow that. John Meyer mentioned that some states allow a separate tank for emergency overflow.

- Paul Ammann questioned the $16K cost for tanks, pumps, panels etc. and the cost of using public versus private contractors for installation of the components on private property. A discussion occurred among the attendees regarding work on private property – will the Town perform the installation on the private property; who will perform oversight of installations by private contractors; is mandatory hookups required; what in the impact on the ability to meet the TMDL: etc. Tom Parece stated that the cost estimates from Orenco were based on using only one pump. TR-16 requires two pumps for STEP systems. Tom Parece gave Paul Ammann a copy of a cost estimate from Orenco.
- Tom Parece recommended Asset Management for equipment upgrades for all traditional and non-traditional technologies.
- Tom Parece reviewed WWTF technologies, CAS, SBR, MBR, etc.
- John Meyer asked if Odor Control was included in the budget. Tom Parece responded that it was.
- Paul Ammann questioned the O&M costs for STEP systems. John Meyer stressed the importance of taking care of the infrastructure. John Meyer mentioned that like other pipe materials, plastic pipe could break and leak and therefore still requires maintenance.
- Ed Daley questioned the use of contingencies versus actual costs. Tom Parece responded that the contingencies could be reduced as more information becomes available such as the updated survey and geotechnical investigation.
- A question was asked about the financing and if the favorable rate for construction could be applied to system operation and maintenance. Tom Parece stated no that the SRF 0% financing was only for capital costs. One of the attendees mentioned that the operation and maintenance would be included in the town's operating budget and would not require financing. Tom Parece stated that the users would pay the operating costs.
- Tom Parece discussed the full-depth road reconstruction and off season construction. The construction duration and phasing of construction was also discussed.
- Paul Ammann stated that the piping for a STEP system could be installed in the shoulder of the road. Tom Parece responded that the location of existing utilities would determine where the sewer piping will be installed. In addition, a preliminary review of the SMC survey indicates that other utilities are already installed in both roadway shoulders. Paul Ammann further inquired if AECOM intended to design the installation of the collection piping in the shoulders of the roads where possible to minimize construction costs. Tom Parece said yes.
- The use of the fields at the Middle School as well as the 223 Beach Road site for disposal of the treated effluent was discussed.
- John Meyers asked about the number of pump stations proposed for the Downtown Area. Tom Parece stated that the preliminary layout has four pump stations but as more information is obtained that the number could change.
- Paul Ammann asked for clarification on the estimated maintenance time for pump station O&M. Tom Parece stated that it is based on one full time person for the collection system plus 260 hours for each pump station.
- John Meyer asked where the number of operational staff came from. Tom Parece responded NEIWPCC.
- The option to Design, Build, and Operate the system was discussed. Ed Daly stressed the importance of having a "tight" spec.
- The option to evaluate the contractor prior to bidding for the WWTF was discussed.
- Paul Ammann questioned the necessity to pump out the septic tanks every three years. Alan McClennen responded that it was required by the 208 plan.

- Tom Parece explained the collection system evaluation process.
- Paul Ammann questioned why the rankings did not include looking at the singular use of a technology instead of a ranking for hybrid systems. Tom Parece stated that the collection system comparison did evaluate the singular use of a technology as well as hybrid systems (GS/LPS and GS/STEP).
- Tom Parece stated that whether it is a single or hybrid technology, the Meetinghouse Area would require sewering 100% of the properties as to TMDL required 100% nitrogen reduction.
- Construction timing and phasing was discussed. Additional phases will add to the cost of the project. The system service area will need to be expanded if the demonstration projects are found to not be effective in removing nitrogen.
- Ed Daley requested that the Town Cove watershed be shown on future plans.
- Tom Parece informed the attendees that AECOM would send an updated worksheet for ranking the technologies. Ed Daly requested that columns be added for the hybrid options.

3. Action Items

Item Number	Description	Responsibility	Due Date
1	Update and distribute the Collection System Matrix to attendees.	AECOM	12/23/16
2	Distribute the Collection System Evaluation Guide to attendees.	AECOM	12/23/16
3	Return the independently Collection System Evaluation Matrix to AECOM.	All	12/30/16
4	Compile the independently Collection System Evaluation Matrix results and distribute to attendees for review and comments.	AECOM	01/06/16
5	Submit comments to AECOM on the independently Collection System Evaluation Matrix results.	All	01/13/16

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Meeting Minutes

To	George Meservey, Director of Planning & Community Development Michael Domenica, PE, Program Manager
CC	Betsy Shreve-Gibb, AICP, AECOM Project Director Martin (Reggie) Donoghue, P.E., AECOM
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Collection System Work Group No. 2 – Final Meeting Minutes**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date and Time	January 5, 2017, 10:00 am

1. Attendees and Affiliation

Alan McClennen, Orleans Board of Selectmen	Jim Trainor, Resident
Gordon Smith, OTA	Paul Ammann, Peer Review
Judith Bruce, Orleans Wastewater Management Steering Committee	Fran McClennen, Citizen
Walter North	Ed Daly, Orleans Peer Review Panel
Brian Dudley, MassDEP	Ginia Pati, OWA
Martin “Reggie” Donoghue, P.E., AECOM	Thomas Parece, P.E., AECOM

2. Minutes

- The meeting began with overview of why the meeting was being held presented by Reggie Donoghue.
- Tom Parece passed out a Downtown Phasing Plan and reviewed the plan with the attendees.
- Paul Ammann inquired as to whether the Downtown Service area had changed. Tom Parece responded that it had not changed. The new plan only identified potential areas for phasing the downtown sewer construction and included watershed delineations.
- Judith Bruce questioned if a generic or Orleans specific approach was being taken relative to AECOM'S evaluation. Tom Parece responded that some generic as well as local conditions were taken into account.
- Ginia Pati supported the more affordable approach and was against dewatering and "Chatham like" disturbance of roads and businesses.
- Ed Daly suggested looking at the financial impacts of the options and using a 1 to 5 grading system. Walter North questioned the weighting and amount of deviation. Tom Parece responded that the same results were found looking at the non-weighted rankings as the weighted rankings.
- Tom Parece stated that the impact varies in different areas. The groundwater separation at site 1A is greater than 40-feet. It was noted that more site specific information when the survey and geotechnical evaluation had been completed.
- Paul Ammann asked about the minutes from the last meeting and the number of respondents. Four persons had responded and the meeting minutes had not been issued yet.
- Judith Bruce asked if the ratings were specific to Orleans. Tom Parece responded that some generic as well as local conditions were taken into account.
- Alan McClennen added that the results of the 25-percent design report will be helpful. Alan mentioned that he had been to Washington and in Yelm and Calmas the property owners construct the STEP systems and then it is managed by the municipality. The private to public legal procedure will need to be looked at. There are questions about on lot infrastructure. For 350 parcels, the on-site conditions would need to be known and there is a concern about the Town taking responsibility for privately constructed STEP systems.
- Brian Dudley responded that the Town can determine how it will construct the on lot infrastructure. Brian cited the Provincetown system as an example.
- Judith Bruce stated that a Private-Public partnership was important. There could be problems with a private developer constructing the least costly system and then walking away. Need to look at if the system can be expanded and what are the costs down the road.
- Paul Ammann added that it is well established that a STEP system can be expanded.
- Tom Parece discussed site suitability and then began a description of the technologies under consideration.
- Tom Parece described Gravity Sewers. Minimum size 8-inch and minimum and maximum velocities were important. For Orleans, an 8-inch to 12-icnh sewer would be typical. The sewer would be 6-feet to 10-feet +/- deep and the excavation would be 5-feet to 8-feet wide.
- Ginia Pati asked about groundwater levels, as it relates to the necessary dewatering/storage/removal of the incoming groundwater when excavating for deep trenches, for the use of big pipes. Based on the recent Chatham excavations, it can be an elaborate and very expensive process. Tom Parece responded that the groundwater depths vary throughout the Town but in most areas is not anticipated to be a major factor during construction.

- Walter North asked if the Meetinghouse Pond Area was included in the evaluation and planning. Tom Parece responded yes.
- Judith Bruce asked about problems that occurred with the sewer system in Provincetown. Tom Parece responded that it was the result of a cell phone in the sewer that caused a break in the line as it was being transported towards the Vacuum Pump Station. Brian Dudley added that there was also a cracked valve vault. Tom Parece added that Fourth of July traffic had impeded identifying and solving the problem. After the event, additional shut off valves and procedures were put in place to prevent a reoccurrence.
- Paul Ammann stated that maintenance needed to be considered for gravity sewers. Tom Parece that all technologies need to consider maintenance and that gravity sewers are a tried and true technology. The Quality control has improved. The manholes are vacuum tested and the pipes are pressure tested.
- Judith Bruce asked what the life of a gravity system was. Tom responded 100 years for the collection system, 50 to 75 years for the buildings, and 10 years for the equipment.
- Judith Bruce stated that maintenance costs would be a major consideration in choosing a technology. Tom Parece agreed and noted that when the financial model is finalized, the O&M costs are a major factor on affordability.
- Ed Daley stated that procurement specification would be important. Tom Parece added that upfront costs and O&M costs would be considered.
- Tom Parece described the piping system for force mains include air release valves and clean outs and maintenance costs.
- Ginia Pati inquired about using HDD for lengths of 500 to 700 feet and working around utilities. Tom Parece mentioned the longer the length the deeper the installation is and requires additional fluid for the installation. In addition services will need to be installed and due to the locations of buildings would most likely be installed via open-cut excavation. This is what is occurring in Eastham.
- Fran McClennen asked if HDD can be used for large pipe. Tom Parece responded that it can be done with the technology available today.
- Judith Bruce asked if a large sleeve could be installed ahead of the State paving project. Tom Parece responded that coordination would be needed and is on-going.
- Specifications were discussed for DBO. Tom Parece responded that the more specific the requirements are the less flexibility exists and the cost savings is reduced. In addition, it was noted that you should not specify means and methods.
- The MassDOT moratorium on digging after new paving was discussed.
- Tom Parece described the Low Pressure Sewer technology. There would be a chamber (pump/wet well) at each house and a control panel. A generator plug could be provided to operate the system in the event of a long power outage. If the power is out, the water use would decrease due to the dishwasher and laundry not be running. Also showering would be reduced.
- Ginia Pati mentioned using a tech services firm like Coastal Engineering for maintaining the onsite system. Tom Parece responded that it depends on who operates the system. It could be the Town or a private contractor. In addition, the specifications could be written to specify warranties and service agreements. It could be paid for as part of the construction bid.
- Paul Ammann questioned if a Low Pressure Sewer System could run all the way to the treatment plant? Tom Parece responded that they may able to but the hydraulics would need to be calculated the final design.

- Paul Amman stated that trenchless technology could be used for STEP systems and not for gravity systems.
- Paul Amman mentioned the problems with the grinder pumps in Falmouth and Chelmsford. The pumps only have a life of 8 to 10 years. Tom parece responded that there were design and construction issues in those communities and described the pumps.
- Walter North questioned about on site and seasonal issues with Low Pressure Sewer systems. Tom Parece responded that with Gravity systems, the pipes are empty. Low Pressure Sewers and STEP systems would require winterizing for seasonal properties.
- Gordon Smith stated that the manufacturer requires removal of pump. Tom Parece added that winterization would be required and is not required for Low Pressure Sewer Systems. Gordon Smith added that winterization is not required for STEP systems. Tom Parece responded that this would need to be reviewed with the manufacturers during the final design phase.
- Ed Daley asked what is the failure mode of grinder pumps. Tom Parece responded that less than 2-percent are a problem and typically it is the result of misuse by the homeowner.
- Ginia Pati stated that with grinder pumps, the issue is local and not downstream. A STEP system will not break.
- Tom Parece described STEG technology. Tom mentioned that existing septic tanks would be pumped, holed, and filled.
- Paul Amman stated that would apply to all technologies. Tom Parece responded affirmatively but that in addition the septic tank would have to be replaced for STEG or STEP systems.
- Ginia Pati questioned that the sewer would only serve a portion of the town. Tom Parece responded that the area was identified by the Consensus Agreement. Alan McClennen stated that under the CWMP, 52-perenct of the Town was to be sewered.
- Paul Amman and Ed Daley wanted to be shown the septic tank pumping requirements. Tom Parece responded that pumping every 3 years was required under the 208 plan. Brian Dudley added that under Title 5 the recommendation is to pump every 3 years to protect the integrity of the system, 3 years is an appropriate measure for the collection system.
- Ed Daley requested documentation of the 208 pumping requirement.
- Tom Parece continued the description of the STEG technology.
- Walter North asked if large flows or expansion can be accommodated. Tom Parece responded that gravity systems are more flexible and hydraulics drive the design of LPS or STEP systems and therefore reduces the flexibility to accommodate expansion.
- Paul Ammann stated the need to design for the future. Tom Parece responded that the Non-Traditional technologies may or may not work and again noted that hydraulics drive the design of LPS or STEP systems. Tom Parece stated that it was important to optimize the pipe design and it had cost Plymouth about $60 million because of low flows in a very long force main.
- Tom Parece stated that the pipeline sizing is proportional with variable flows and will be impacted with seasonal conditions. A consideration is to use two force mains to accommodate variable flows.
- Walter North stated the importance of choosing a technology that will not be undersized if the flow doubles.

- Ed Daley inquired about the philosophy of the engineering community. Do all engineers want gravity systems? Tom Parece based on studies, if there is greater than 100 feet between properties, gravity sewers may not be cost effective. Brian Dudley stated that based on his experience with CWMPs for other communities, a hybrid system is common. The majority of the collection systems are gravity. This is more affordable over the long run.
- Ginia Pati stated that a Chatham approach would not be affordable. Brian Dudley added that the Chatham collection system was primarily gravity.
- Tom Parece described the STEP collection system technology.
    - Pumping liquids and not solids.
    - Concern if power is out.
    - A larger storage volume is needed if there is a power outage.
    - TR-16 recommends a duplex pump system for STEP
- Ed Daley added that the mean time between failures for STEP pumps is 20 years. Tom Parece responded that TR-16 still recommends two pumps for STEP and is used as the basis of design/approval by MassDEP. Paul Ammann requested a link to TR-16 showing the requirement for 2 pumps in a STEP system. Tom Parece responded that it would be provided.
- Walter North asked about HDD and numerous utilities. Tom Parece responded that it would not be cost effective in most cases.
- Alan McClennen added that STEP systems have disadvantages. The owner may be responsible for on-site equipment or the Town would bear the cost if the Town is responsible.
- Tom Parece responded that we are waiting to for the Town to decide who will be responsible for on-site components O&M. In addition, who would pay for the on-site component has not been determined yet. Also, the Project Costs do no included private property interior costs such as electrical panel upgrade and pumping reconfiguration.
- Jim Trainor mentioned that it could be an issue for replacement.
- Ed Daley asked if the STEP system could be behind the building. Tom Parece stated yes but if the Town was going to install and/or maintain on-site sites that the Town would need to obtain right-of-entry approval/easements from the property owners.
- Tom Parece described the Vacuum system technology.
- Brian Dudley stated that with vacuum systems you are limited to 13-feet of vacuum. In Provincetown they had to add insulation to the valve pits in the first year.
- Tom Parece described the variable seasonal flows in Siasconset in Nantucket.
- Ed Daley inquired about when and how to make decisions. Tom Parece stated that the Amended CWMP will have to present a recommended plan but that the design would include as much flexibility as reasonable. A zoning article is coming up for Town Meeting action and the impact to the system would be need to be reviewed.
- Tom Parece described Risk Analysis and Evaluation. The purpose of the exercise is to understand the pros and cons of each system.
- Tom Parece stated that getting the sills in the Downtown Area will help with determining if properties con be services by gravity or if pumping is required. With the data, AECOM will be able to evaluate the technology mix. If was also noted that collection system will not be designed to serve plumbing in the basement.

- Allan McClennen added that we do not have the elements today. After the 25-percent PDR is completed, we will have more specifics.
- Tom Parece stated that the plans will be updated to show system configuration changes and the locations where pumping would be required for the Downtown Area.
- Ed Daly asked what are the phases shown on the plan? Tom Parece responded that they are the construction phases for implementing the Downtown Area collection system addressing the tributary areas to Town Cove first.
- Tom Parece stated that it would be more costly to phase the construction. The phasing was discussed as well as the pump station layout and the force main system.
- Alan McClennan and Ed Daly discussed Rock Harbor.
- Tom Parece, In conclusion, the hybrid system was the best option.
- Ed Daly recommended a 1-5 rating system.

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Meeting Minutes

To	George Meservey, Director of Planning & Community Development Michael Domenica, PE, Program Manager
CC	Betsy Shreve-Gibb, AICP, AECOM Project Director Martin (Reggie) Donoghue, P.E., AECOM
Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Collection System Work Group Meeting No. 3 – Final Meeting Minutes**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date and Time	March 9, 2017, 9:00 am

1. Attendees and Affiliation

Alan McClennen, Orleans Board of Selectmen	Lynn Bruneau, Orleans Finance Committee
Gordon Smith, Orleans Taxpayers Association	Paul Ammann, Orleans Peer Review Panel
Judith Bruce, Orleans Wastewater Management Steering Committee	Fran McClennen, Citizen
Dale Fulton, Orleans Taxpayers Association	Charles Harris, Eastham Volunteer
John Meyer, Orleans Board of Water and Sewer Commissioners	Mike Domenica, P.E., Program Manager
Walter North	Martin “Reggie” Donoghue, P.E., AECOM
Jeffrey Reid, AECOM	Thomas Parece, P.E., AECOM

Plus two others who did not sign the attendance sheet

2. Minutes

- Tom Parece began the meeting with an introduction and a discussion of Regulatory Documents applicable to the design of the wastewater collection system. He commenced a slide presentation that began with a meeting agenda.
- Paul Amman stated that the Regulations don't make sense and that he had surveyed 20 municipalities. From his research, homes used a single STEP pump.
- John Meyer questioned Paul Amman as to whether his information was from salesmen and does he have back up information? Paul Amman responded that he would provide a synopsis.
- Tom Parece stated that MassDEP interprets "recommend" in the design documents as "shall".
- Tom Parece described the FY-18 Funding Request Rationale slide.
- Lynne Bruneau asked about the schedule for special legislation. Tom Parece responded that it should move fast. The decision on Design Build would be made this fall. Tom described project funding and discussed the STM in the fall.
- Paul Amman and Lynne Bruneau discussed the slides and early fall work.
- Walter North asked about project costs? Alan McClennen said that they were waiting for the selectmen's package with the costs.
- Lynne Bruneau asked about the 25% preliminary design for the Downtown Area. Tom Parece responded that it was already funded.
- Reggie Donoghue provided a status update on the Survey, Geotechnical Evaluation, and the Cultural Resource Evaluation.
- The preliminary collection system design profile slide was discussed and there was a discussion on serving basements. A decision would need to be made if all basements are to be served. This would require lowering the collection system or installing additional Low Pressure Sewer systems. Lynne Bruneau asked if it had to be a Town wide decision and Walter North asked if it is a marginal adjustment. Lynne Bruneau asked if the sill elevations were acquired for only the Downtown Area. Tom Parece responded that it was just obtained for the Downtown Area. Tom Parece asked which group makes the decision? Alan McClennen responded that there would be no answer until the selectmen have reviewed the issue.
- An attendee asked about the aerial survey coverage and if it included the Meetinghouse Area. Tom Parece stated that it did.
- John Meyer asked about the survey and Tom Parece responded that the sills were picked up by Coastal Engineering to supplement the survey performed by SMC survey.
- Walter North asked if the likely outcome would be a hybrid collection system and are hybrid systems common? Tom Parece responded yes and that a high percentage of systems are hybrid.
- Paul Ammann asked if manholes would be required in the street. Reggie Donoghue responded that manholes would be required for pressure system (LPS, STEP and force main) cleanouts and air release valves.
- Jeffrey Reade presented the Sewage Treatment system designs under consideration. He described the Sequencing Batch Reactor (SBR) and Membrane Bioreactor (MBR) Systems. The required components for each system were described.
- The anticipated permit effluent requirements are 30 mg/l TSS, 30 mg/l BOD, and 10 mg/l Nitrogen. It is possible that the state could require stricter standards. The disposal area and method have not yet been determined.

- John Meyer mentioned the target nitrogen limit should be 5-7 mg/l and 10- 15 mg/l for TSS & BOD.
- Paul Ammann mentioned that the Bioclere system at the condominium complex where he lives can treat down to 5 mg/l Nitrogen. He also mentioned that the Chatham WWTP was over capacity.
- Jeff Reade mentioned that the Provincetown WWTP discharged Nitrogen at 4 mg/l.
- Tom Parece stated that MassDEP may require lower limits at the disposal sites.
- Paul Amman asked what Yarmouth-Dennis was doing. Jeff Reade responded that he did not know.
- Alan McClennen mentioned that there is a cost associated with a reduction in the Nitrogen limit and other measures such as PRBs could be installed at the discharge sites to address Nitrogen.
- Tom Parece mentioned that the groundwater at the Nauset Regional Middle School site measured 35 mg/l Nitrogen and that number had been reduced downstream of the PRB wells. Adaptive Management would need to be employed.
- Walter North asked to please explain the MBR vs SBR technology for treatment? Jeff Reade responded that an SBR cycles in time and MBR uses a fixed barrier (membrane). The MBR has higher solids quantity and is more expensive to run. The MBR treatment system has a smaller footprint. The SBR cycles with slug flows and post equalization is required.
- John Meyer asked how to address seasonal flows? Jeff Reade responded that the SBR system works in Provincetown and an MBR system works well for seasonal flows. Provincetown uses two SBR systems to address high summer flows.
- Paul Ammann referenced an article on MBR and STEP systems. The membrane lasts longer with STEP effluent and costs need to be reviewed.
- Jeff Reade reviewed the MBR conceptual design slide.
- Paul Ammann questioned the need for a filter for prescreening prior to the MBR for STEP effluent? Jeff Reade responded that MBR manufacturers typically require screens.
- Jeff Reade continued with his WWTP system descriptions. For SBR systems the screening is not as rigorous and post equalization would be required.
- One of the members asked if one process had more of an odor issue than the other. Jeff Reade responded “not really, the processes are similar”.
- John Meyer asked about the odor control system? Jeff Reade responded that it was under design. He noted that chemical odor control was expensive. Other odor control measures include carbon absorption and biofilters with organic media. He suggested a carbon filter after the biofilter. The details are still being worked out.
- One member was concerned about odor control. It is a critical issue and there needs to be assurances.
- Jeff Reade mentioned that septage could be received in an enclosed area of the WWTP.
- Mike Domenica mentioned that there would be a transfer station if septage is not treated at the plant.
- One member asked about solids processing. Tom Parece responded that the facility was not proposed to include dewatering and noted that larger plants can thicken to 25% solids.
- Mike Domenica asked about heat recovery options? Jeff Reade responded that the facility would be too small to be cost effective and we did not want to lose site of the primary goal of Nitrogen removal.
- Jeff Reade continued with the review of the treatment processes.

- Paul Ammann asked if there were screens in the system. Jeff Reade stated that the MBR manufacturer requires 2mm screening. Paul Ammann asked if system operators had been called to find out their experience. Jeff Reade responded that the screen requirement would be driven by the design and manufacturer's warranty requirements.
- Jeff Reade mentioned that STEP effluent requires supplemental carbon. He believes that Orenco grossly underestimated the carbon requirement.
- Jeff Reade discussed wastewater characteristics and the septage market. There may be a revenue opportunity.
- Dale Fulton asked about the operation costs for treating septage. Jeff Reade responded that the infrastructure will already be there in the facility.
- Lynne Bruneau asked about the collection system phasing and declining population? Tom Parece mentioned that Tri-Town Septage Treatment Facility was designed for 45K gpd and was collecting about 20K gpd during the last four years. He suggested designing the treatment plant for 16K gpd of septage.
- Fran McClennen asked about the relative cost of treating liquid effluent versus liquids plus solids. Jeff Reade responded that it needs evaluation. It is probably similar but the energy requirement may be similar or higher for STEP effluent.
- Mike Domenica mentioned that transportation cost is dominant to the septage haulers. Labor and fuel costs are key components. The Orleans WWTF would have a captive septage market.
- Alan McClennen mentioned that there was record information on septage for Orleans. The WWTF could collect septage from Eastham, Wellfleet, Truro and Provincetown.
- Paul Ammann mentioned that there was an economic risk with treating septage. There is also a concern with collecting Nitrogen from the Lower Cape and discharging it to Orleans groundwater.
- Judith Bruce mentioned that the nitrogen would end up in Cape Cod Bay, a water body shared by other towns.
- Walter North asked if there were cost tradeoffs? Jeff Reade responded that we don't know yet and the preliminary design is being worked out.
- John Meyer asked if the nitrogen discharge limit is lowered, which technology is better? Jeff Reade responded that it was approximately equal. If the limit is less than 3 mg/l N in the future, tertiary treatment will be required as an added process.
- Judith Bruce mentioned that if low interest loans and grants are available now, they should be taken advantage of. Tom Parece stated for Nantucket, an MBR was cheaper to install but more expensive to operate.
- Mike Domenica asked about the advantage of using a contract operator? Jeff Reade responded that you need to keep it simple. SBR is a well-known technology including on Cape Cod. It is hard to get an operator with familiarity and experience with MBR technologies.
- Walter North asked if one technology was better for phasing or as a fallback if the alternative approaches do not work? Tom Parece responded that the systems could be phased and built, if required, to serve additional areas.
- Jeff Reade stated that if there were site constraints, the MBR process is better since it required less land area. If there were no site constraints, the SBR technology was preferable.
- Tom Parece discussed the effluent disposal investigation.
- Paul Ammann asked about the capacity of the Beach Road site, and did it include backup capacity? Tom Parece responded 200,000 gpd and it did include backup capacity.

- Paul Ammann asked if there were any community issues with the Beach Road site? Tom Parece responded that there may be a public perception concern.
- Judith Bruce mentioned that there have been comments about Nauset and now an uproar about Tri-Town Septage Treatment Facility effluent disposal. There may well be concerns.
- Tom Parece stated that the effluent disposal site investigation was continuing, the hydrogeological study was continuing at the Site 1/1A and at Route 6 Exit 12 Cloverleaf. They are testing today and it is ongoing. Once we have well and test pit data, we can run the groundwater model. Preliminary information indicates that the Route 6 Exit 12 Cloverleaf site can accommodate 360K gpd.
- Fran McClennen asked if the financial model included disposal site variables? Tom Parece responded that it did.
- Paul Ammann asked about the Regional School and the types of discharge? Tom Parece responded that it would likely be wick wells at the Cloverleaf site, open basins at the Site 1/1A, and subsurface disposal at the Regional School. There may be more than 360K gpd capacity at the school site.
- Lynne Bruneau asked about peak flows? Tom Parece responded that peaking factors would be used in the design of the system.
- Paul Ammann asked if AECOM would be looking at a single sewer technology or a hybrid system. Tom Parece mentioned that the evaluation included using a single technology for the service areas but that a hybrid system provide the most flexibility for the Downtown Area.
- Walter North mentioned that the burden on the homeowner needed to be a consideration.
- One member stated that a STEP system was expensive to maintain. Paul Ammann responded that it would be a lower cost to the Town and that there would be a wide range of costs to the property owners.
- Alan McClennen mentioned that AECOM is looking at the impact of zoning changes on the Downtown Area.
- Paul Amman mentioned that Yelm, WA had oversized their sewer force main resulting in a velocity of less than one fps. Lynne Bruneau asked about the requirements. Tom Parece referenced the regulations which dictate system sizing and mentioned unreasonable detention times in the force mains if the flow is too low resulting in operational problems including generation of odors.
- Tom Parece mentioned that for gravity sewers, PVC pipe was commonly used and DI pipe was used for deep sewers. LPS and STEP system are constructed with HDPE or PVC pipe. The friction factor can vary depending on the pipe material.
- Tom Parece described the collection system Operation and Maintenance slide.
- Fran McClennen asked about garbage disposals and that Orleans does not allow garbage disposals.
- Paul Ammann mentioned that sludge heights in the septic tanks could be measured in order to vary pump out times. John Meyer responded that it is hard to determine sludge height in a septic tank.
- Tom Parece stated that the average cost for a septic tank pump out (combination of residential house and commercial properties) is approximately $450.
- Tom Parece recommended creating a list of decisions to be made. Fran McClennen suggested that a timeline be added to the list.
- Tom Parece compared unit costs. The costs do not include work inside the house (plumbing upgrades and/or rerouting).

- Lynne Bruneau asked about replacement of existing septic tanks. Tom Parece responded that more time and money could be spent trying to find out about existing tanks but that most municipalities discovered that the septic tanks were required to be replaced.
- Tom Parece stated that the capital costs Downtown Area are based on a typical implementation (Design-Bid-Build) but that Financial Model has the ability to adjust for Design-Build-Operate implementation.
- Paul Ammann stated that the costs are double for maintenance of a grinder pump system versus a STEP system. Tom Parece responded that the costs utilized are based upon Orenco and E-One information.
- Tom Parece reviewed the Cost Analysis slide.
- Judith Bruce asked if AECOM was just looking at STEP vs LPS and if AECOM was leaning towards a hybrid system? Tom Parece responded yes to both questions.
- Judith Bruce asked when AECOM will have a cost estimate? Tom Parece responded “in about a month”.
- Alan McClennen provided a recap on the meeting and the status of the program. Presently we are on target and the key decisions will be made in October.

Appendix E

Downtown Area Collection System Phasing Plan

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Town of Orleans, MA
Water Quality and Wastewater Planning Services

Downtown
Proposed Collection System Layout

Legend

- Potential WTP Sites
- Proposed Force Main
- Proposed Low Pressure Sewer/STEG
- Proposed Gravity Sewer/STEP
- Parcel
- Subwatershed
- Properties proposed to be served by LPS

Downtown Phasing Plan

- Phase 1
- Phase 2
- Phase 3
- Phase 4

0 300 600
Feet

AECOM
September 2017

Rock Harbor Stream Subwatershed
Rock Harbor Main Subwatershed
Little Namskaket Stream Subwatershed
Little Namskaket Subwatershed
Namskaket Main Subwatershed
Cedar Pond Subwatershed
Town Cove Subwatershed
Boland Pond Subwatershed
Namskaket Stream Subwatershed

Vicinity of Proposed Pump Station
Vicinity of Proposed Pump Station
Vicinity of Proposed Pump Station

OLD NAMSKAKET ROAD
GULL LANE
NAMSKAKET ROAD
ELLIS ROAD
ELLIS CIRCLE
FRONTAGE ROAD
HARBOR HILL ROAD
CAPTAIN DOANES WAY
MID CAPE HIGHWAY
BRIDGE ROAD
ROCK HARBOR ROAD
JOYCE ROAD
CANAL ROAD
CEDAR POND ROAD
LOCUST ROAD
OLD COLONY ROAD
KINGS WAY
CHILDS HOMESTEAD ROAD
UNNAMED ROAD
CHASE LANE
OLD COLONY WAY
WEST ROAD
CRANBERRY HIGHWAY
COVE ROAD
CUMMINGS ROAD
BREWSTER CROSS ROAD
CENTER PLACE
CHATHAM ROAD
ACADEMY PLACE
OLD TOTE ROAD
OUTER ST
OAK RIDGE LANE
BOG HOLLOW ROAD
OAK RIDGE ROAD
RAMP RT 6 WB TO RT 6A
RAMP RT 6 EB TO RT 6A
ROTCH WOOD ROAD
CLAYTON CIRCLE
UNNAMED ROAD
ELDREDGE PARK WAY
NICKERSON ROAD
FINLAY ROAD
DALEY TERRACE
FIREMANS KNOLL
LONGVIEW DRIVE
BAKERS POND ROAD
MAIN STREET
TONSET ROAD
HOPKINS LANE
DRIFTWOOD LANE
OLD FARM ROAD
COFFIN LANE
NORMANS ROAD
RIVER ROAD
SCHOOL ROAD ROAD

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Appendix F

Downtown Area Collection System 25% Preliminary Design Plan and Profiles

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Approved:____ Checked:____ Designer:____ Project Management Initials:

MID-CAPE HIGHWAY – ROUTE 6
NAMSKAKET ROAD
ROCK HARBOR ROAD
POND
LOCUST ROAD
MAIN STREET
CAPE COD RAIL TRAIL
OLD COLONY WAY
WEST ROAD
OLD TOTE ROAD
CRANBERRY HIGHWAY
ROUTE 6A
BREWSTER CROSSROAD
COVE ROAD
CUMMINGS ROAD
ROUTE 28
ACADEMY PLACE
SOUTH ORLEANS ROAD
BOLAND POND
TOWN COVE

02 C-101 02 C-102 02 C-103 02 C-104 02 C-105 02 C-106 02 C-107
01 C-101 01 C-102 01 C-103 01 C-104 01 C-105 01 C-106 01 C-107 01 C-108 01 C-109 01 C-110 01 C-111 01 C-112 01 C-113 01 C-114 01 C-115 01 C-116 01 C-117
03 C-101 03 C-103 03 C-104 03 C-105 03 C-106 03 C-107 03 C-108 03 C-109 03 C-110 03 C-111 03 C-112 03 C-113 03 C-114 03 C-115 03 C-116

SHEET KEY

01 C-108 — 25% PDR SHEET

MAIN STREET PROJECT WORK (COMPLETED SPRING 2018)

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Downtown Area
Plans and Profiles

25% Preliminary
Design Report

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Proj Check:	M. DONOGHUE
Date:	SEPT. 2018
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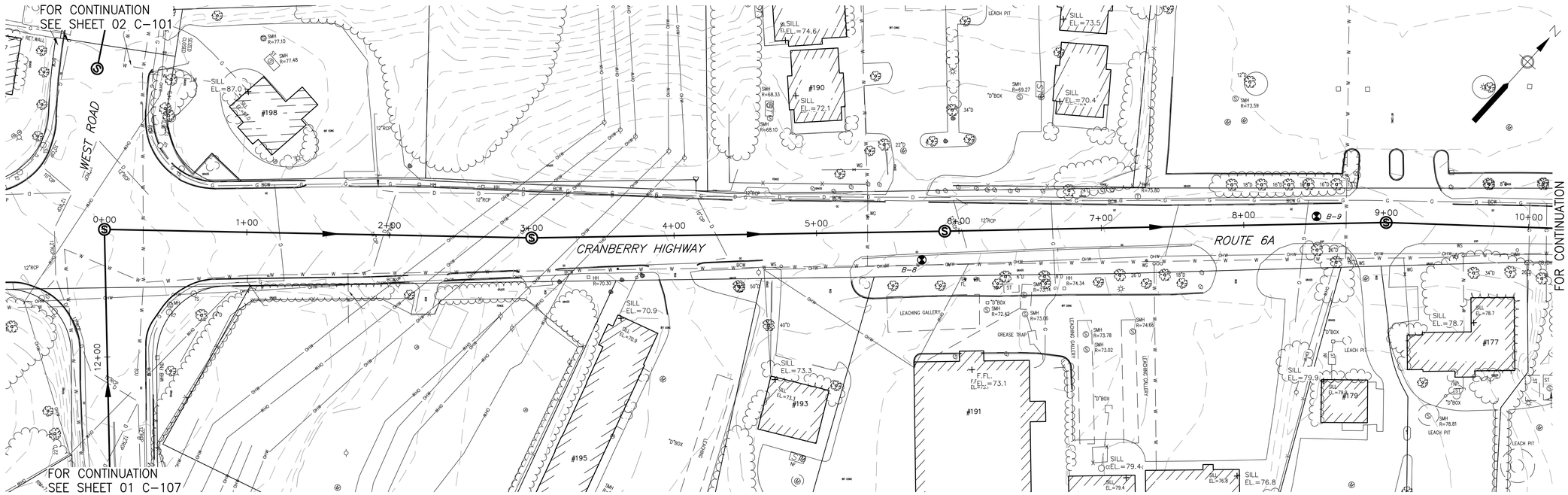
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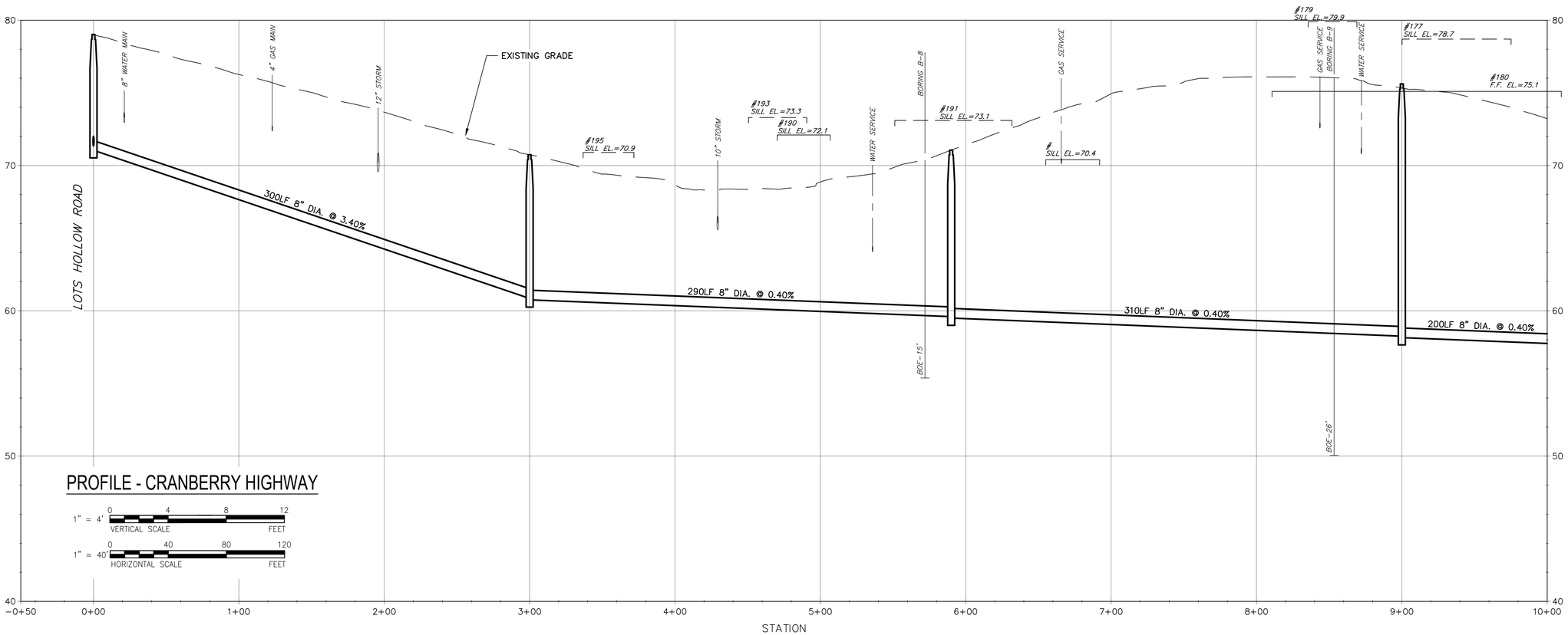
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PLAN - CRANBERRY HIGHWAY

SCALE: 1"=40'



PROFILE - CRANBERRY HIGHWAY

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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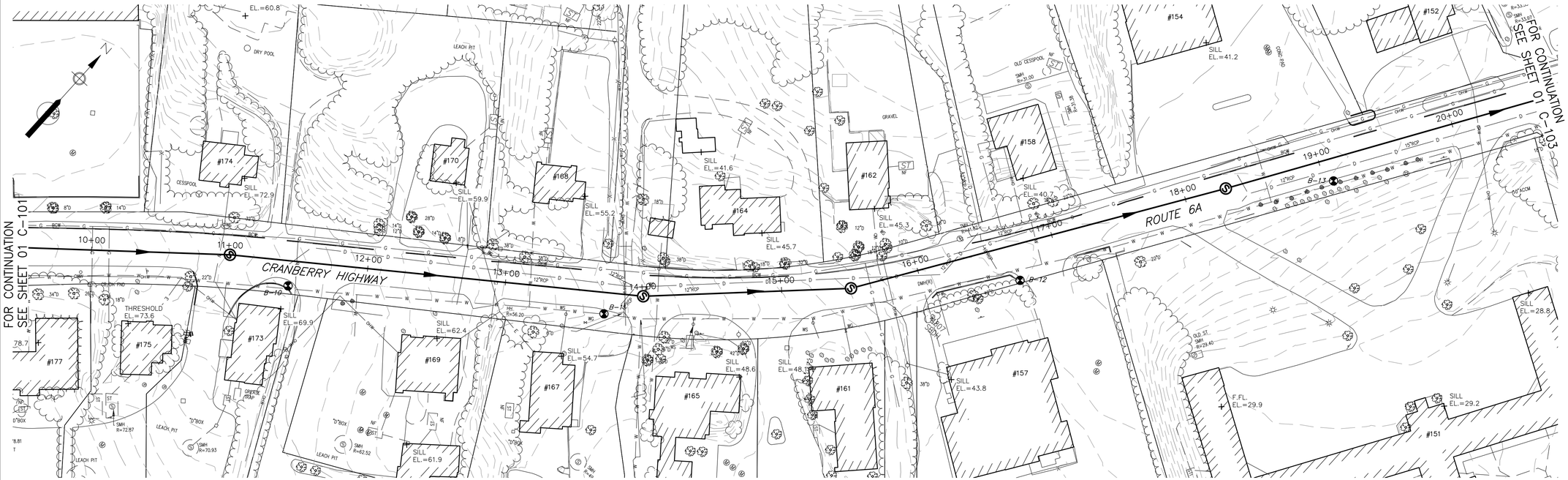
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PLAN AND PROFILE SEWER
CRANBERRY HIGHWAY I

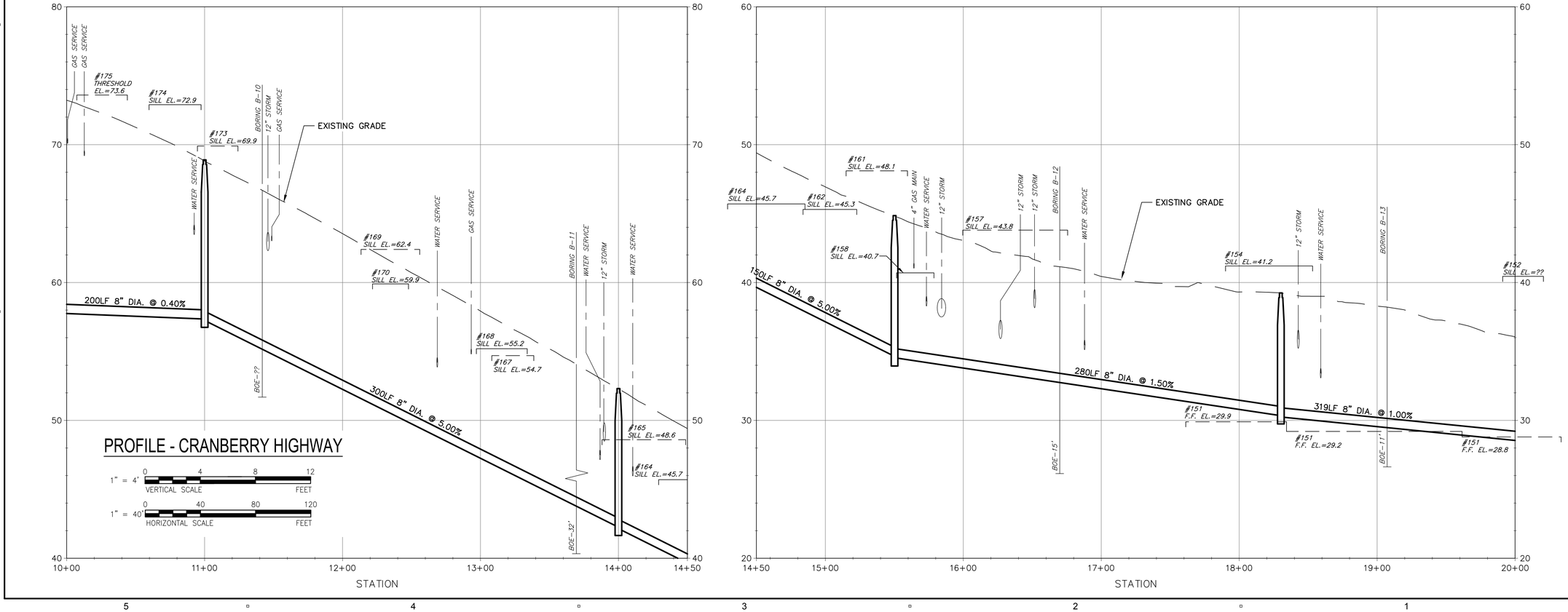
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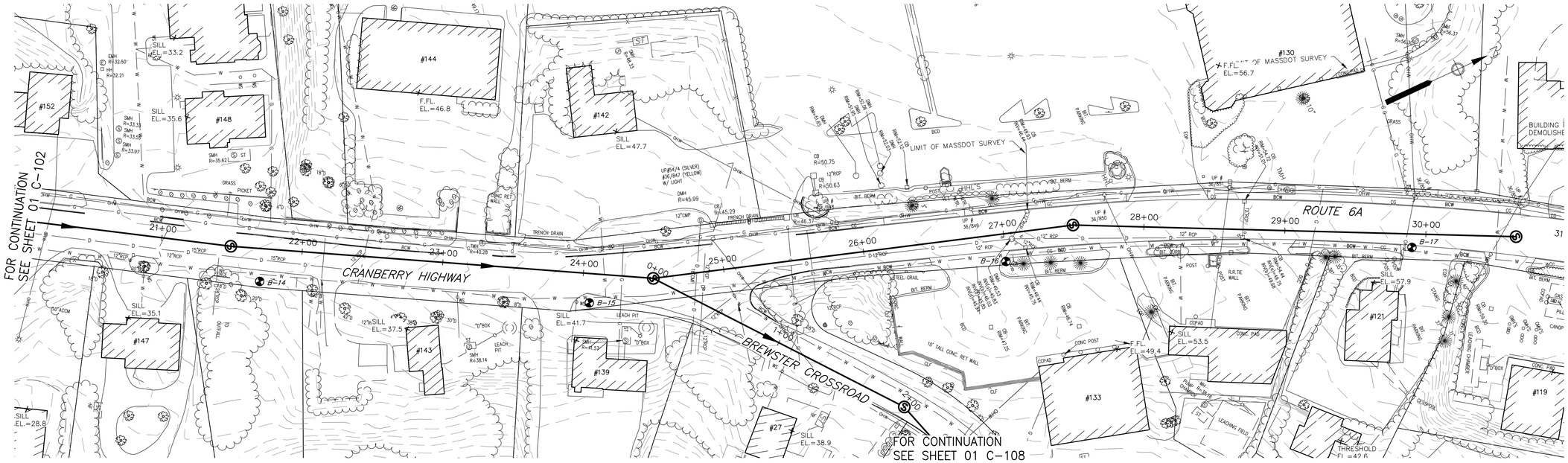
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PLAN AND PROFILE SEWER
CRABERRY HIGHWAY II

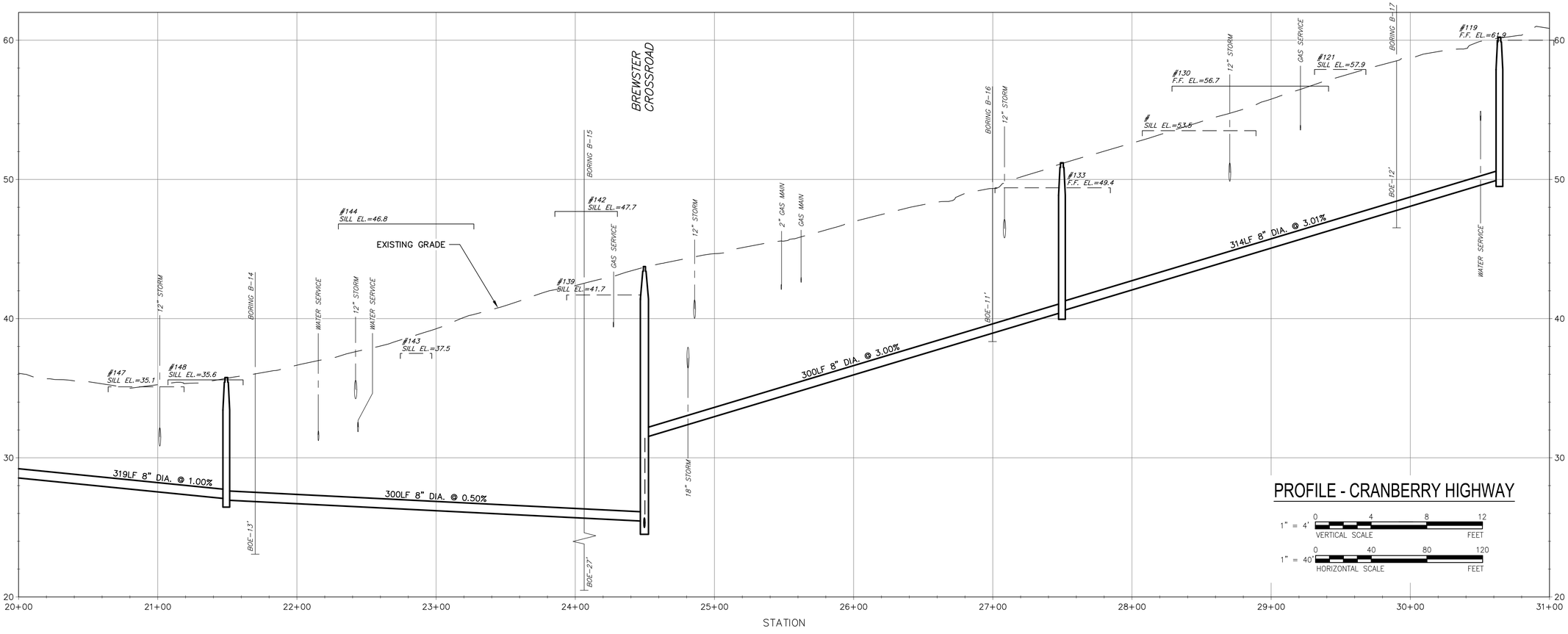
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PLAN - CRANBERRY HIGHWAY

SCALE: 1"=40'



PROFILE - CRANBERRY HIGHWAY

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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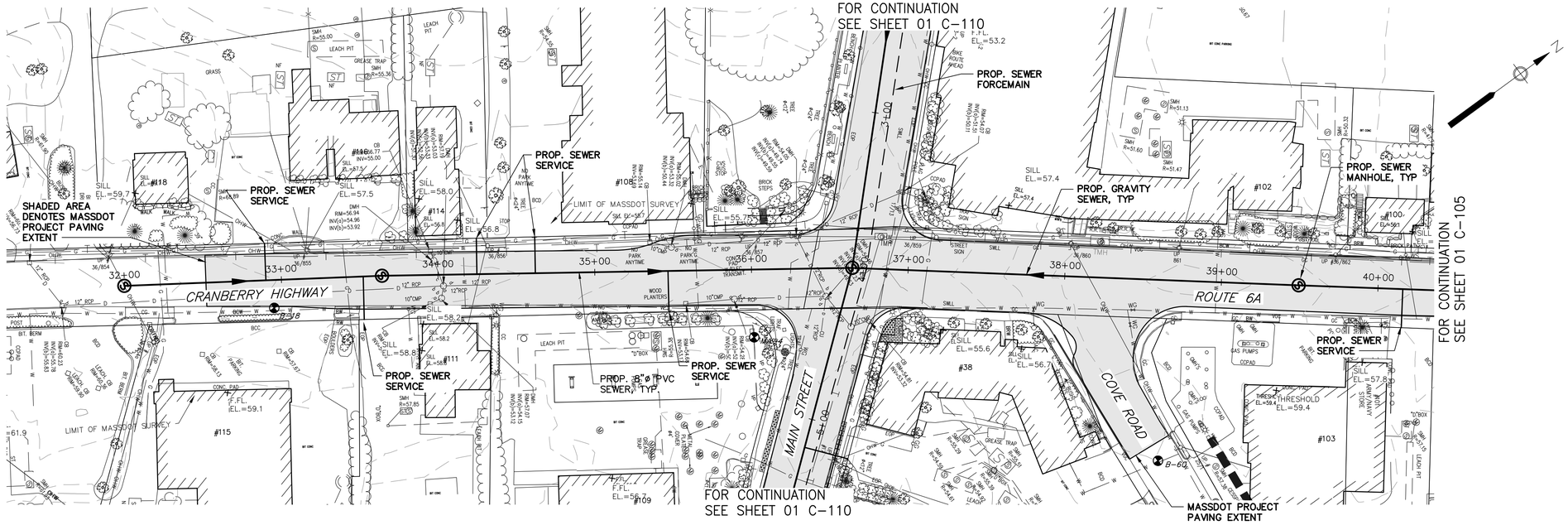
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PLAN AND PROFILE SEWER CRANBERRY HIGHWAY III

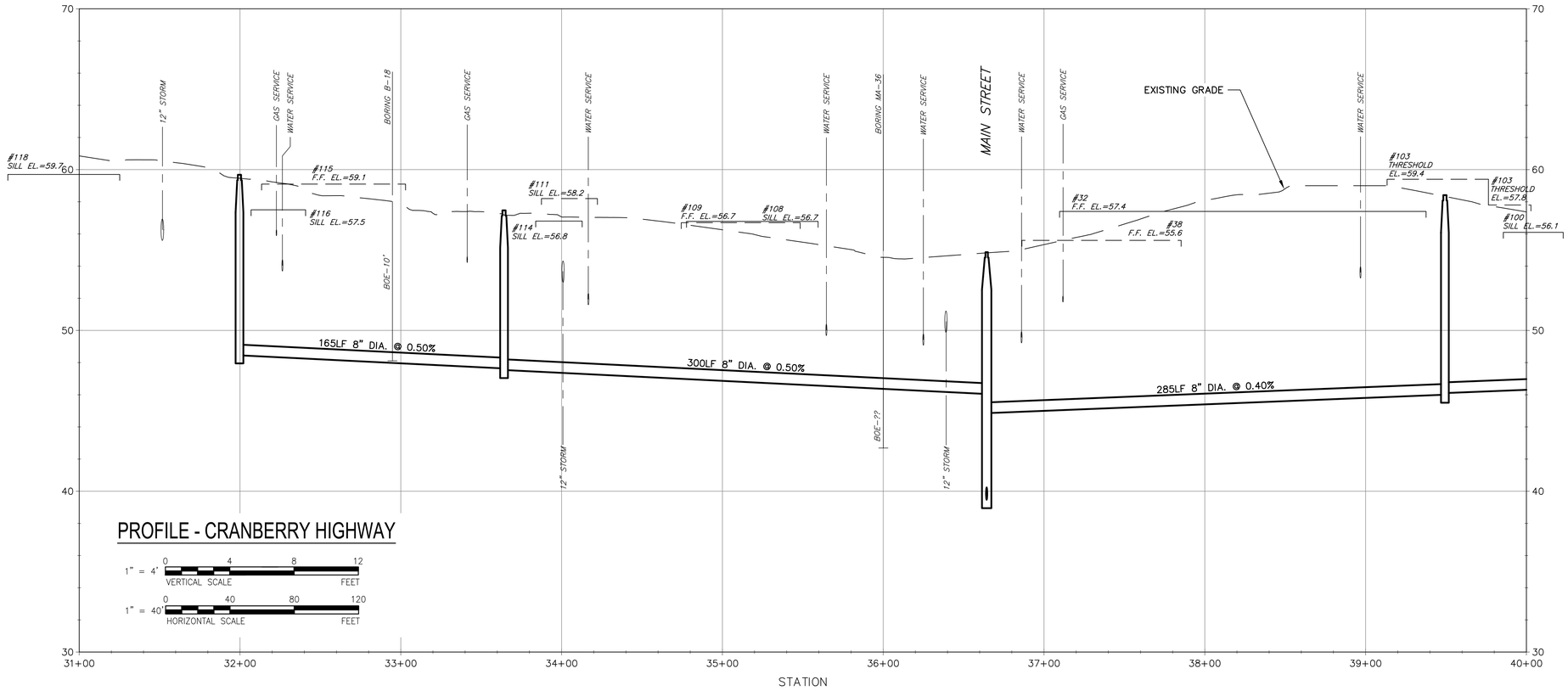
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PLAN - CRANBERRY HIGHWAY

SCALE: 1"=40'



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SKETCH PLAN SHOWING
LIMITS OF MDOT PAVING
5-19-2017

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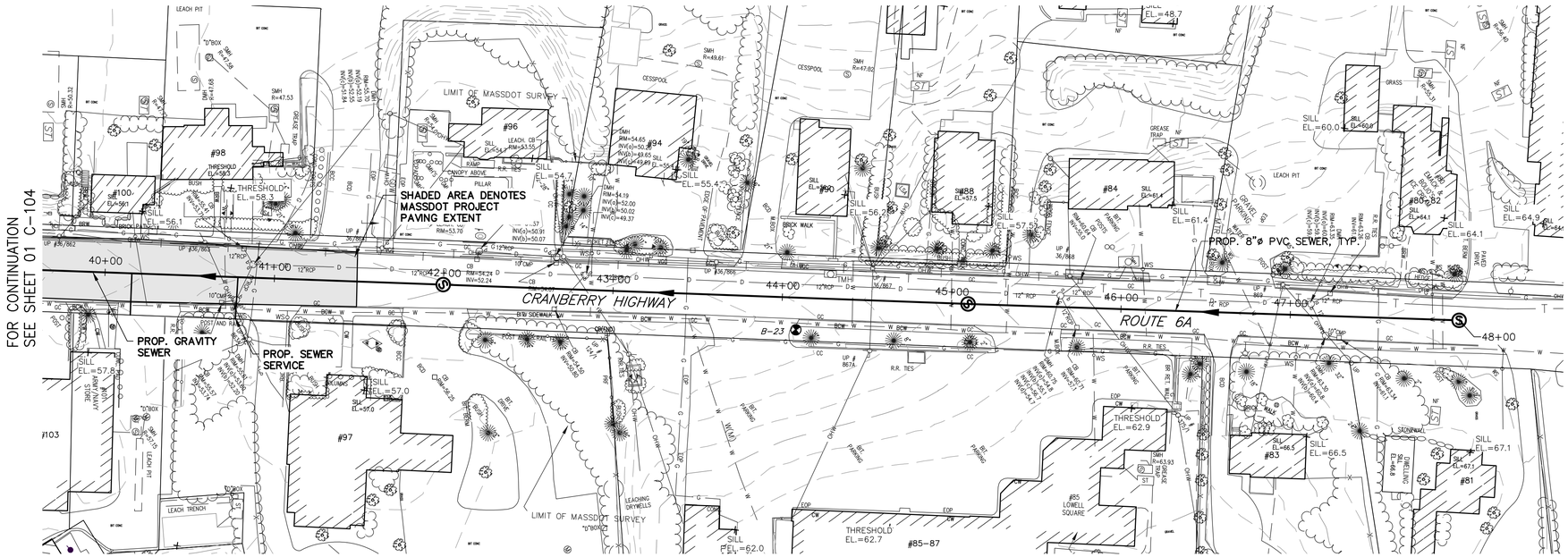
PLAN AND PROFILE SEWER CRANBERRY HIGHWAY IV

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PLAN - CRANBERRY HIGHWAY

SCALE: 1"=40'



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LIMITS OF MDOT PAVING
5-19-2017

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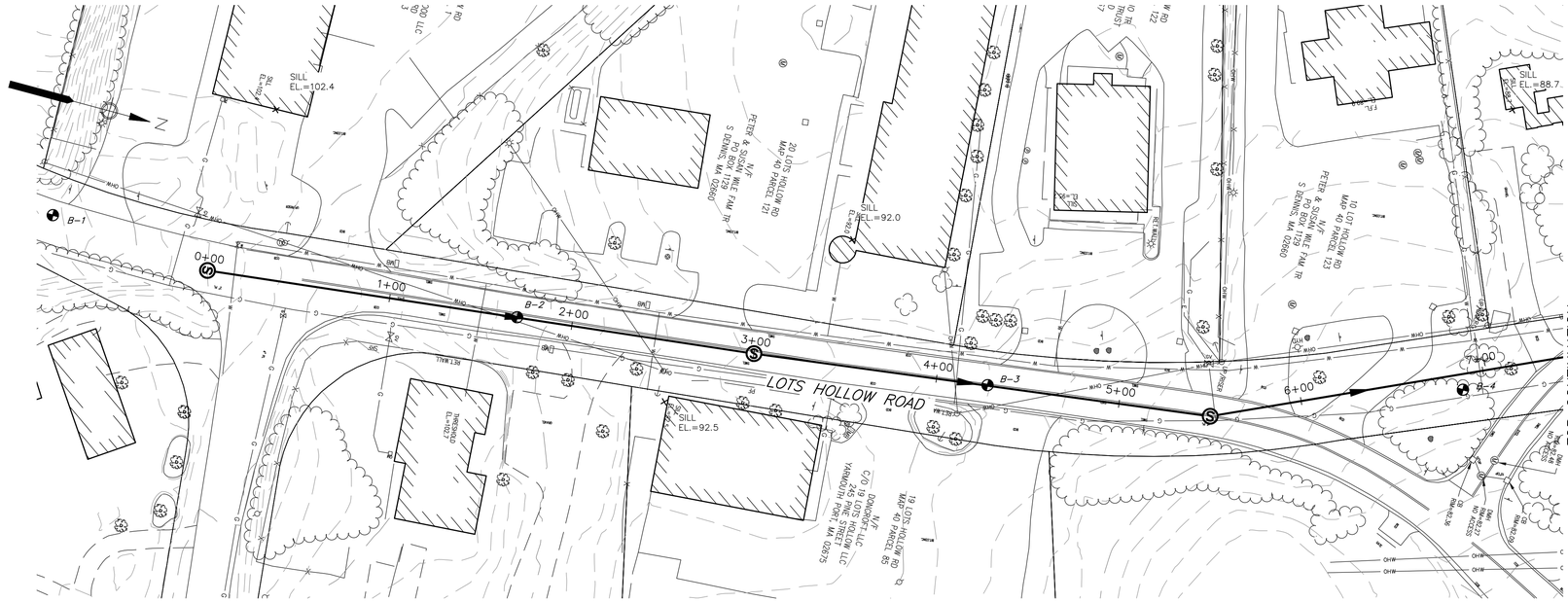
PLAN AND PROFILE SEWER CRANBERRY HIGHWAY V

SHEET NUMBER

01 C-105

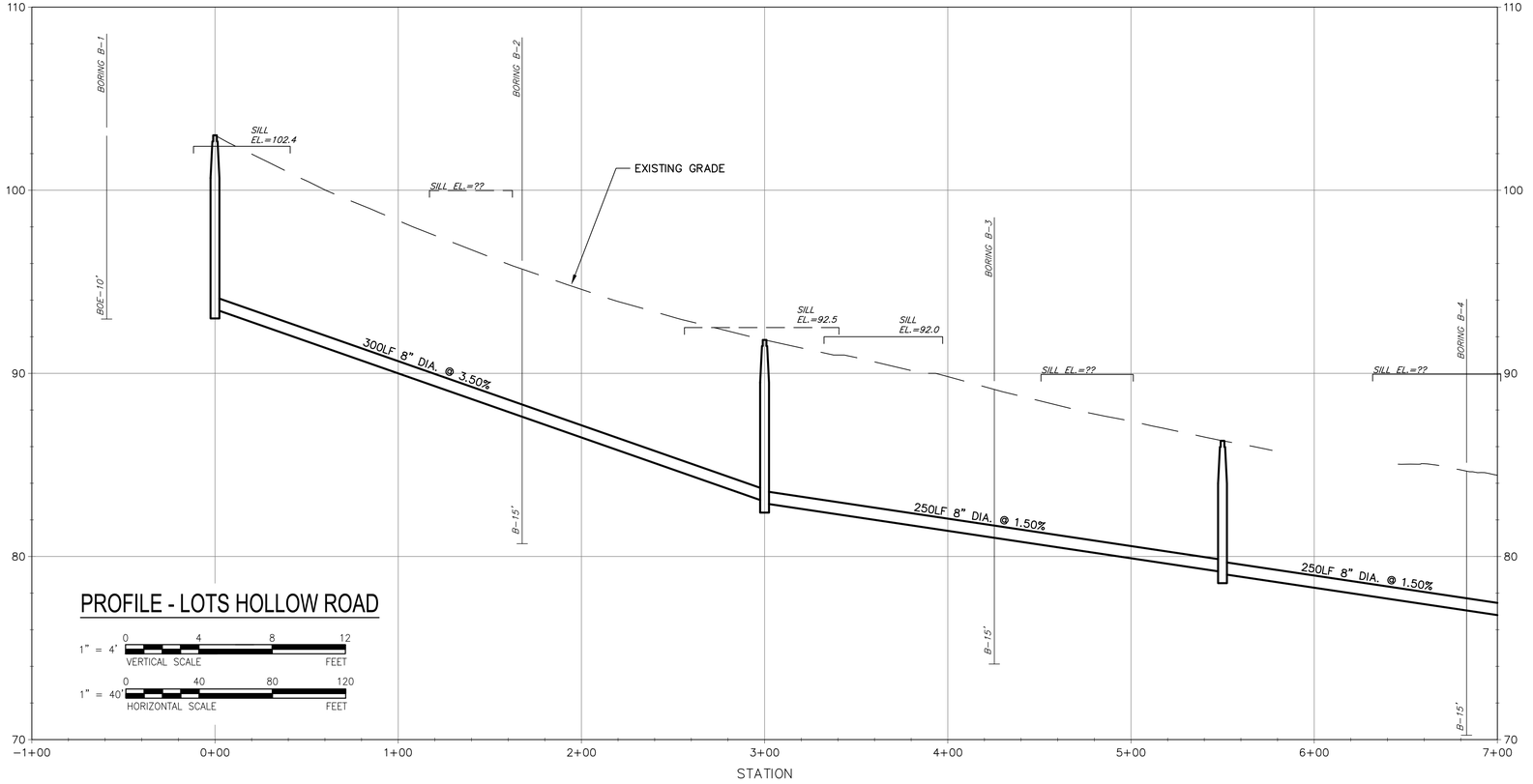
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PLAN - LOTS HOLLOW ROAD

SCALE: 1"=40'



PROFILE - LOTS HOLLOW ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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www.aecom.com

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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

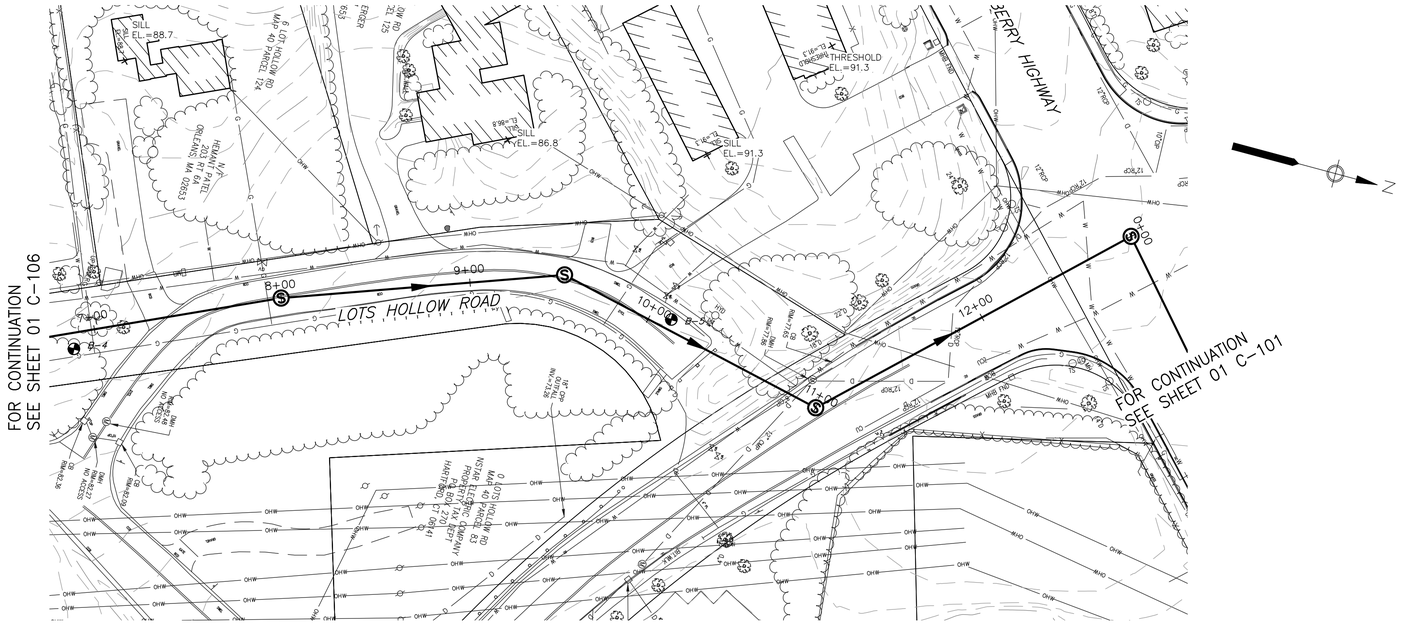
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SHEET TITLE

PLAN AND PROFILE SEWER LOTS HOLLOW RD I

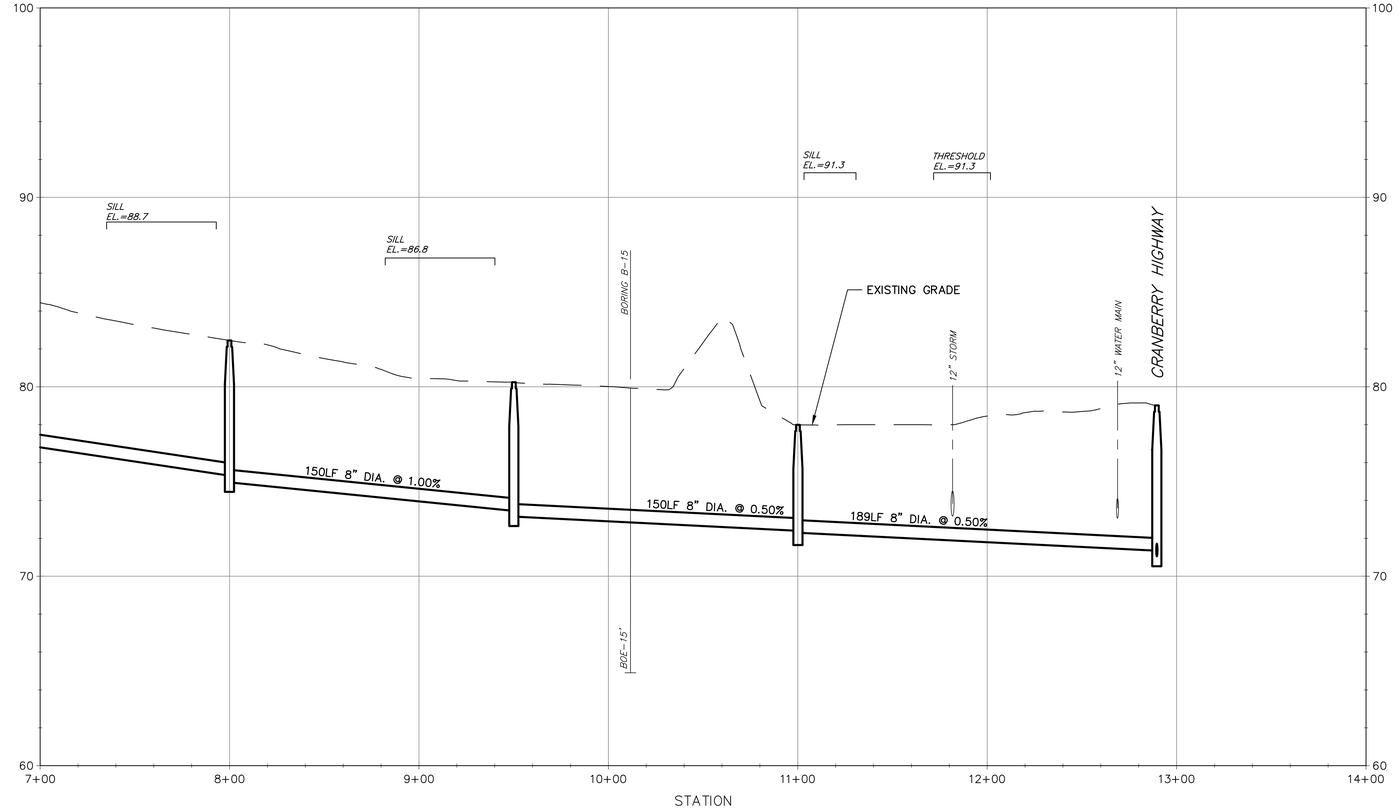
SHEET NUMBER

01 C-106



PLAN - LOTS HOLLOW ROAD

SCALE: 1"=40'



PROFILE - LOTS HOLLOW ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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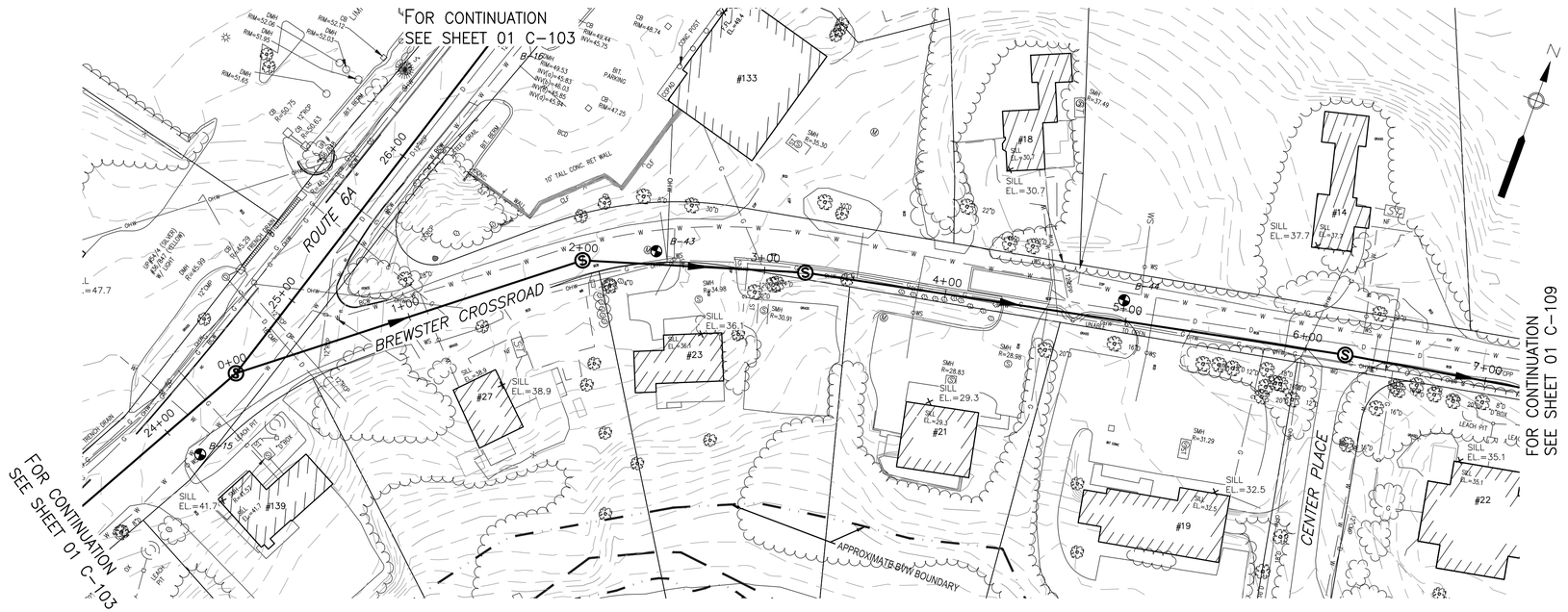
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SHEET TITLE

PLAN AND PROFILE SEWER
LOTS HOLLOW ROAD II

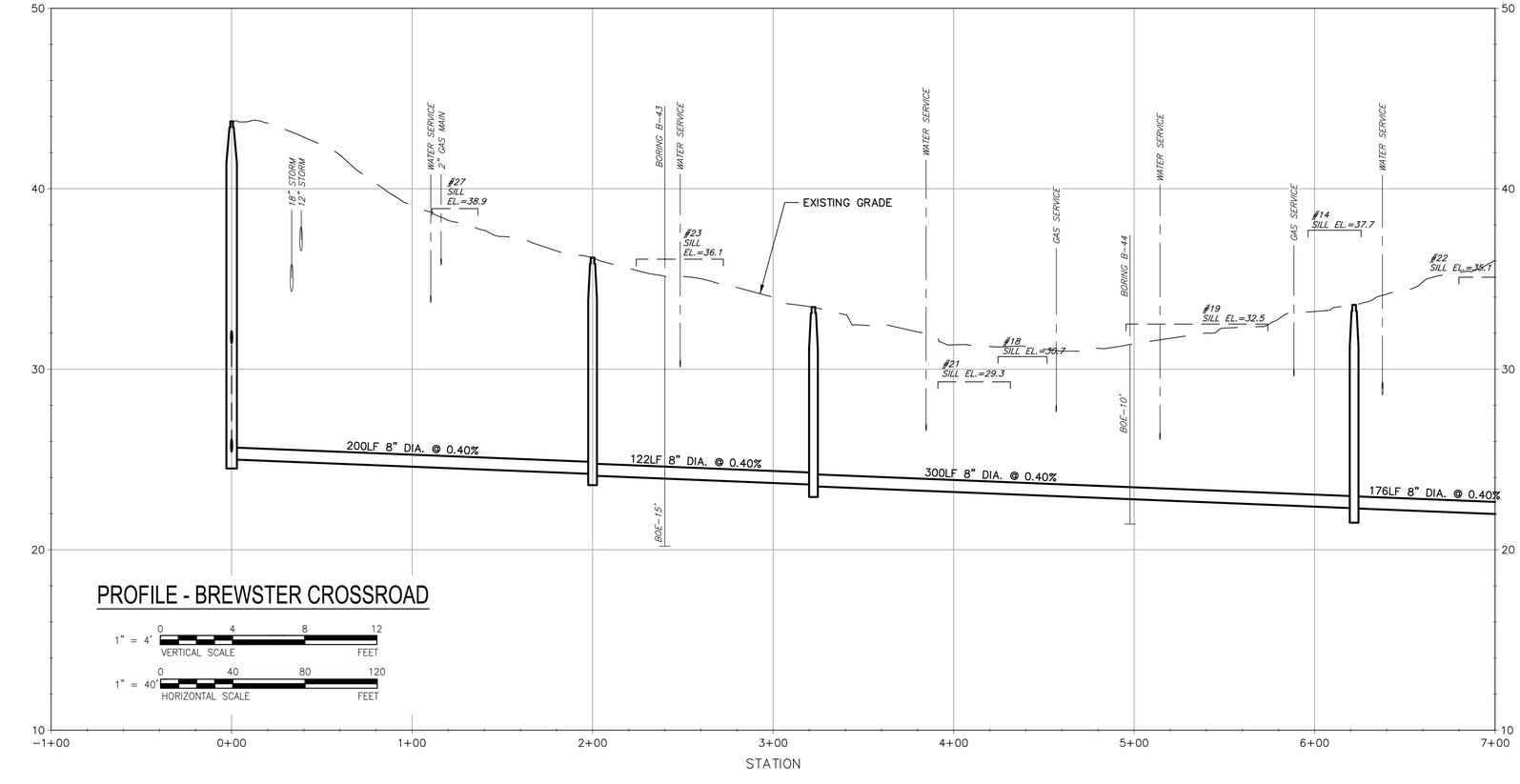
SHEET NUMBER

01 C-107



PLAN - BREWSTER CROSSROAD

SCALE: 1"=40'



PROFILE - BREWSTER CROSSROAD

1" = 4' 0 4 8 12 VERTICAL SCALE FEET

1" = 40' 0 40 80 120 HORIZONTAL SCALE FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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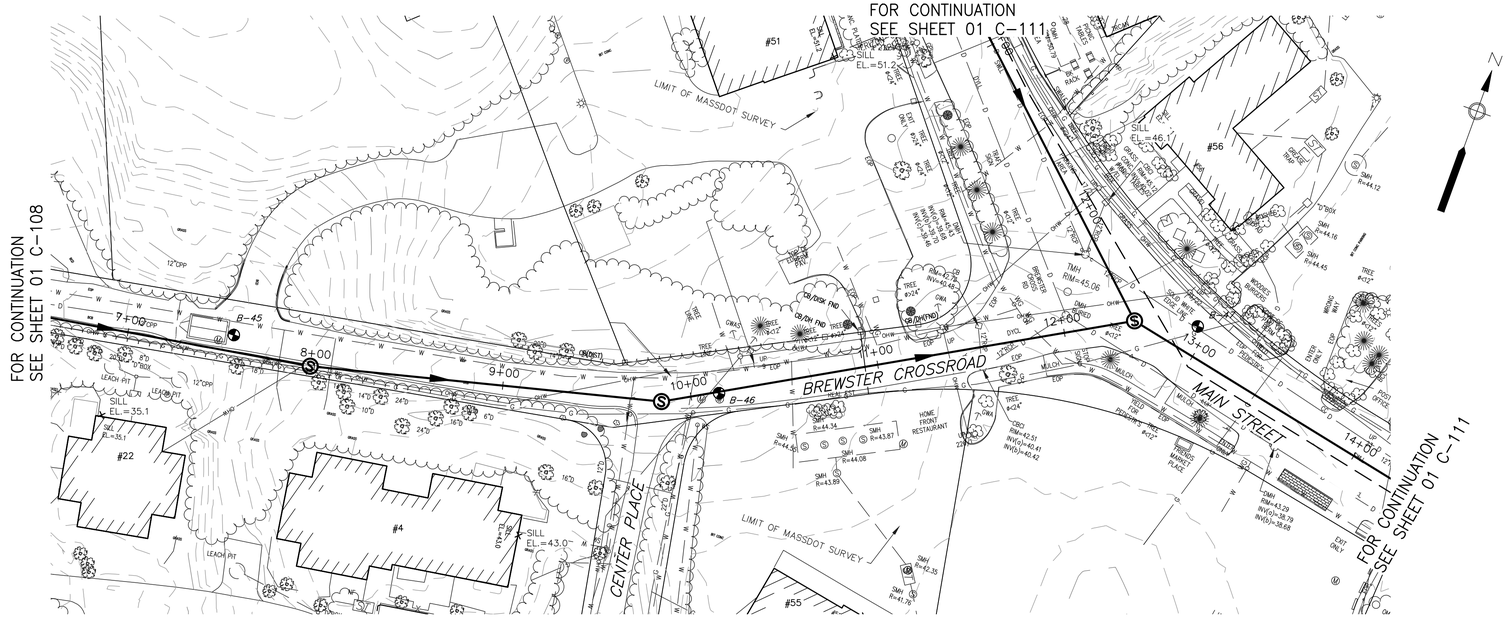
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SHEET TITLE

PLAN AND PROFILE SEWER BREWSTER CROSSROAD I

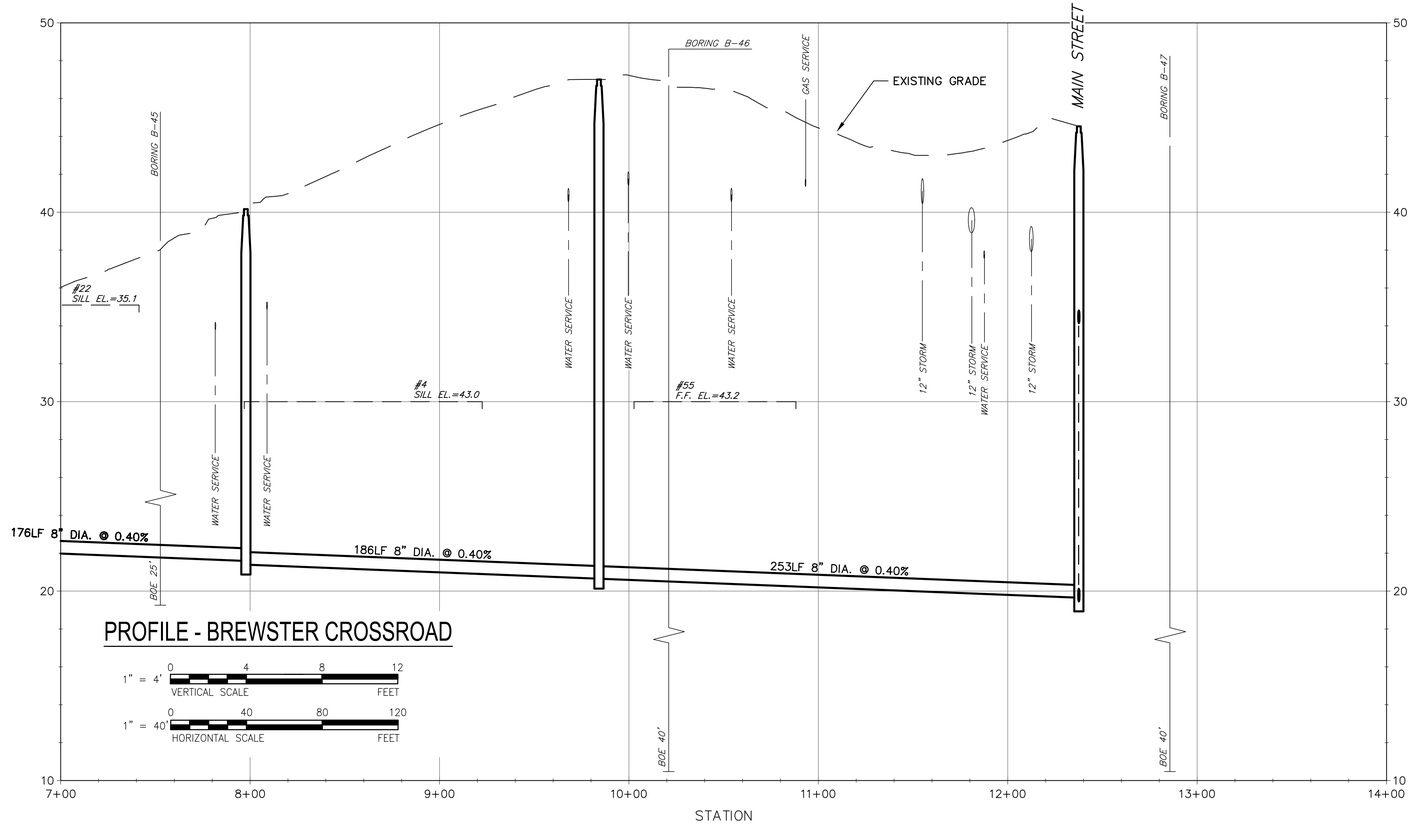
SHEET NUMBER

01 C-108



PLAN - BREWSTER CROSSROAD

SCALE: 1"=40'



PROFILE - BREWSTER CROSSROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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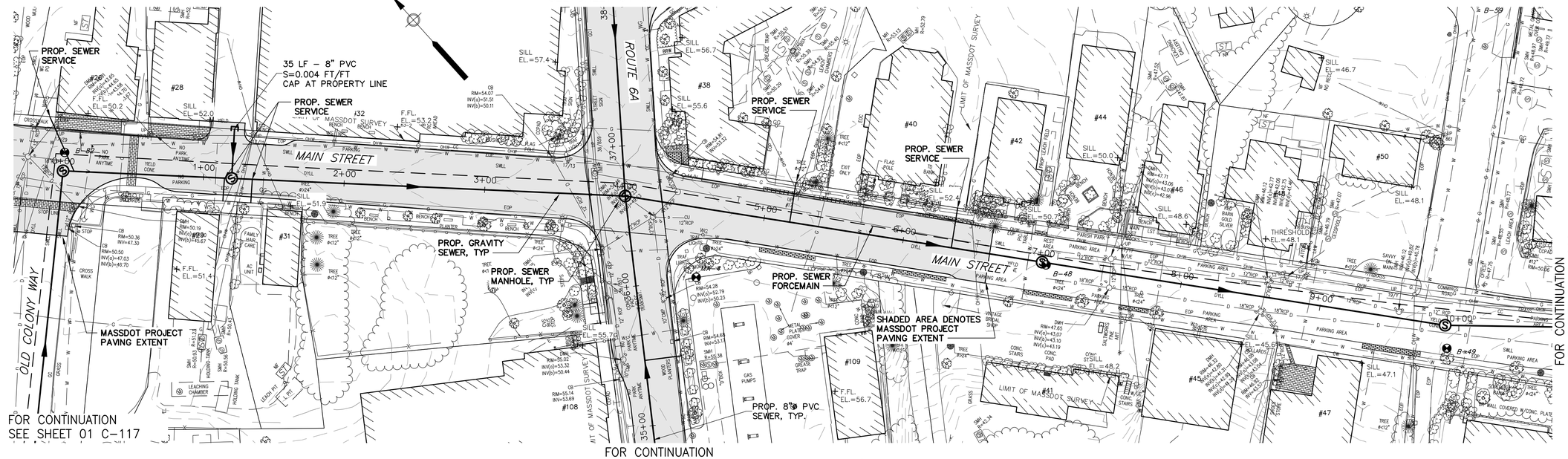
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER BREWSTER CROSSROAD II

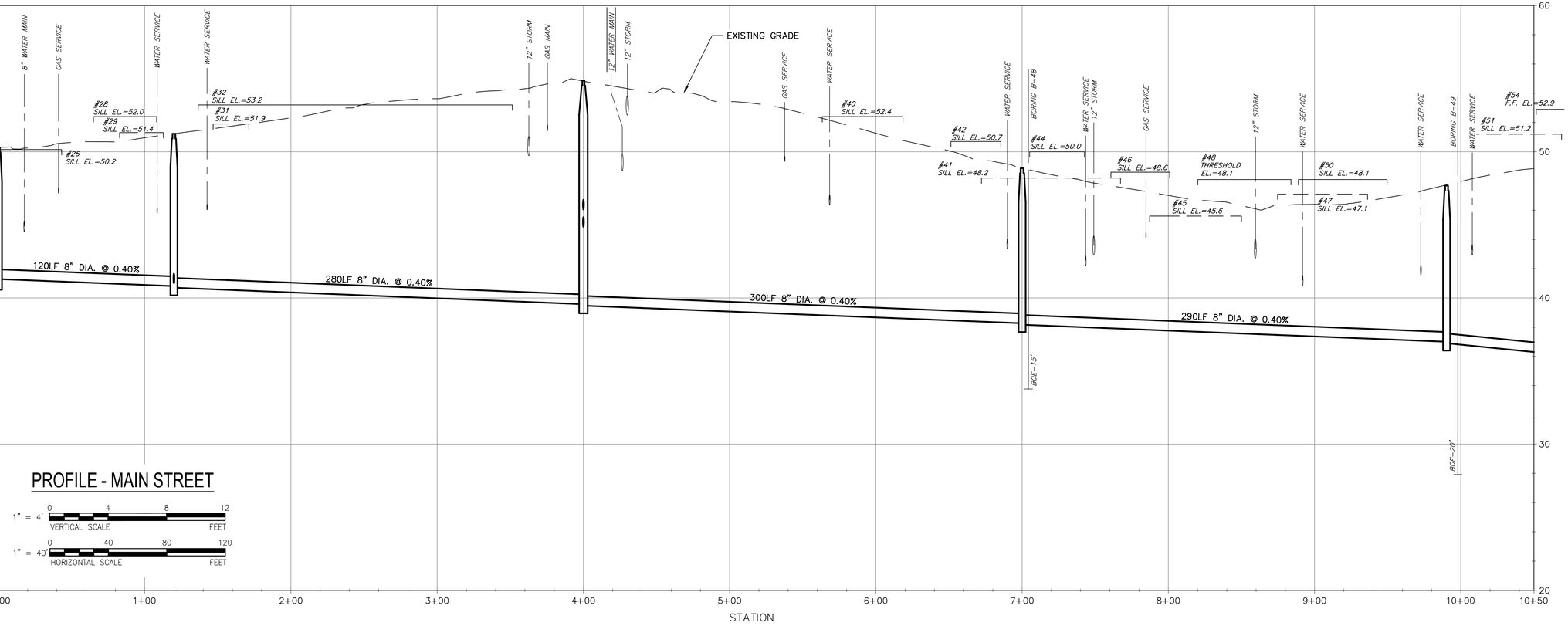
SHEET NUMBER

01 C-109



PLAN - MAIN STREET

SCALE: 1"=40'



PROFILE - MAIN STREET

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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LIMITS OF MDOT PAVING
5-19-2017

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Scale:	**AS NOTED**

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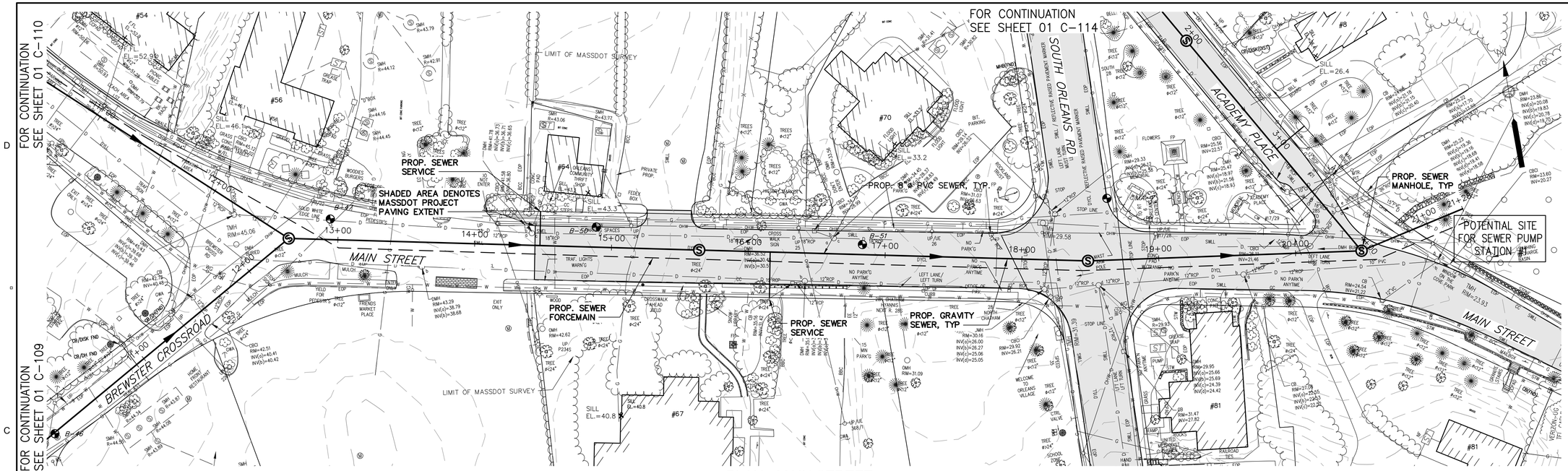
PLAN AND PROFILE SEWER MAIN STREET I

SHEET NUMBER

01 C-110

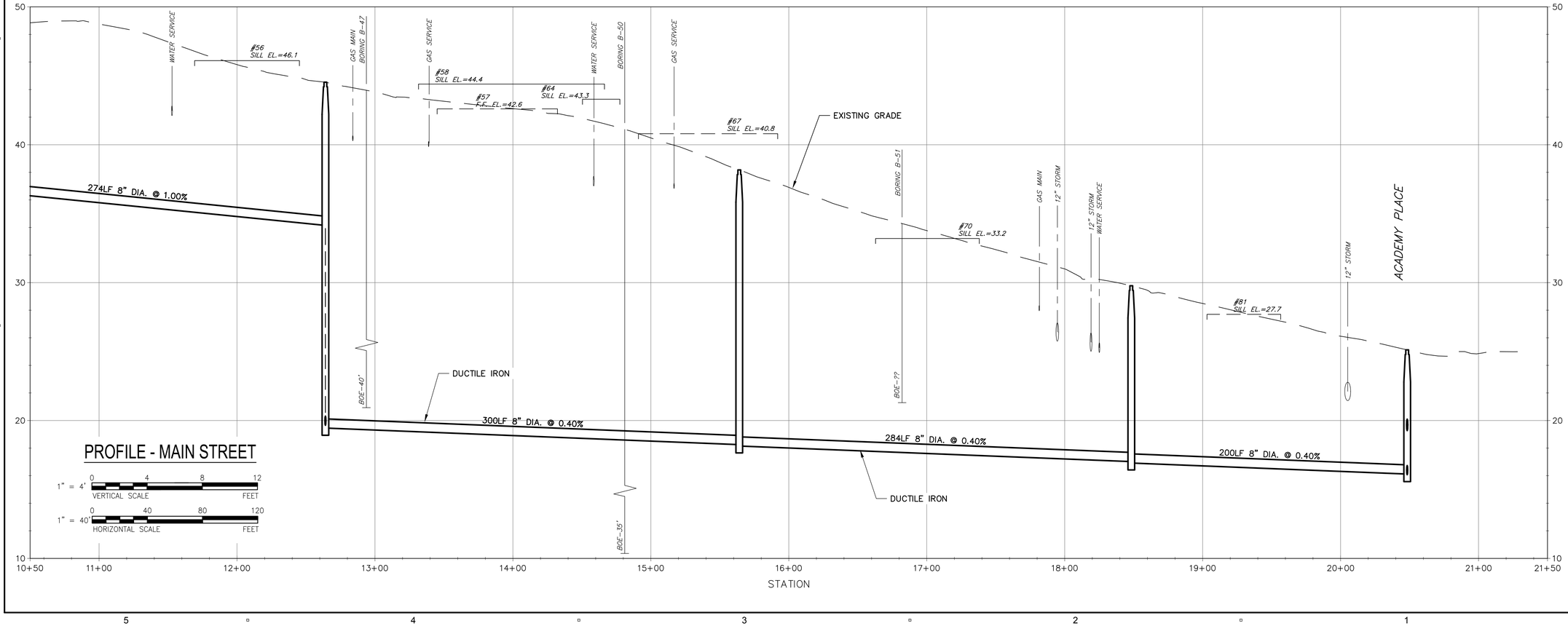
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PLAN - MAIN STREET

SCALE: 1"=40'



PROFILE - MAIN STREET

1" = 4' VERTICAL SCALE: 0, 4, 8, 12 FEET

1" = 40' HORIZONTAL SCALE: 0, 40, 80, 120 FEET

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SHEET TITLE

PLAN AND PROFILE SEWER MAIN STREET II

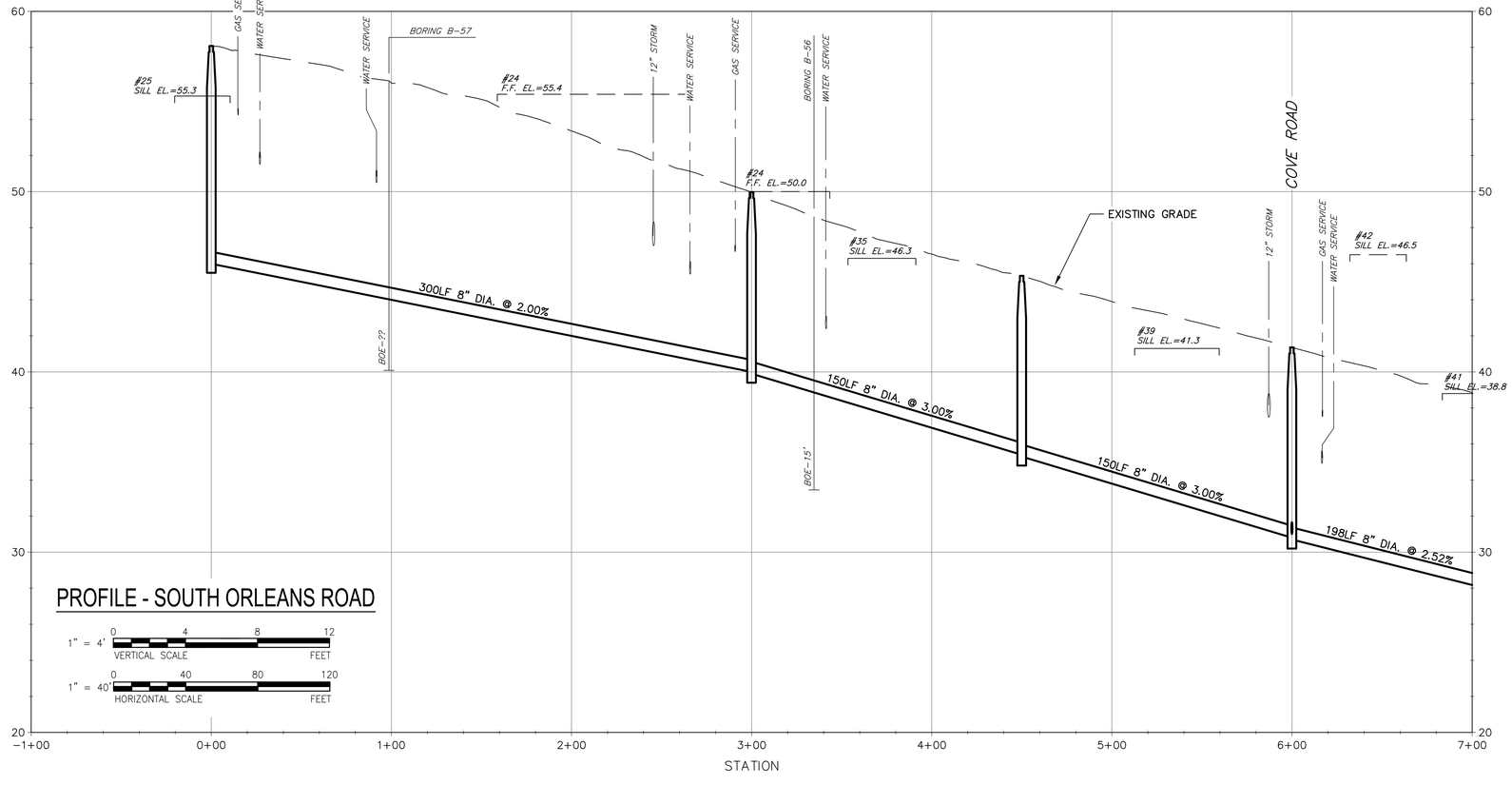
SHEET NUMBER

01 C-111



PLAN - SOUTH ORLEANS ROAD

SCALE: 1"=40'



PROFILE - SOUTH ORLEANS ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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Drawn By:	M. CURRAN
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Proj Check:	M. DONOGHUE
Date:	----
Scale:	AS NOTED

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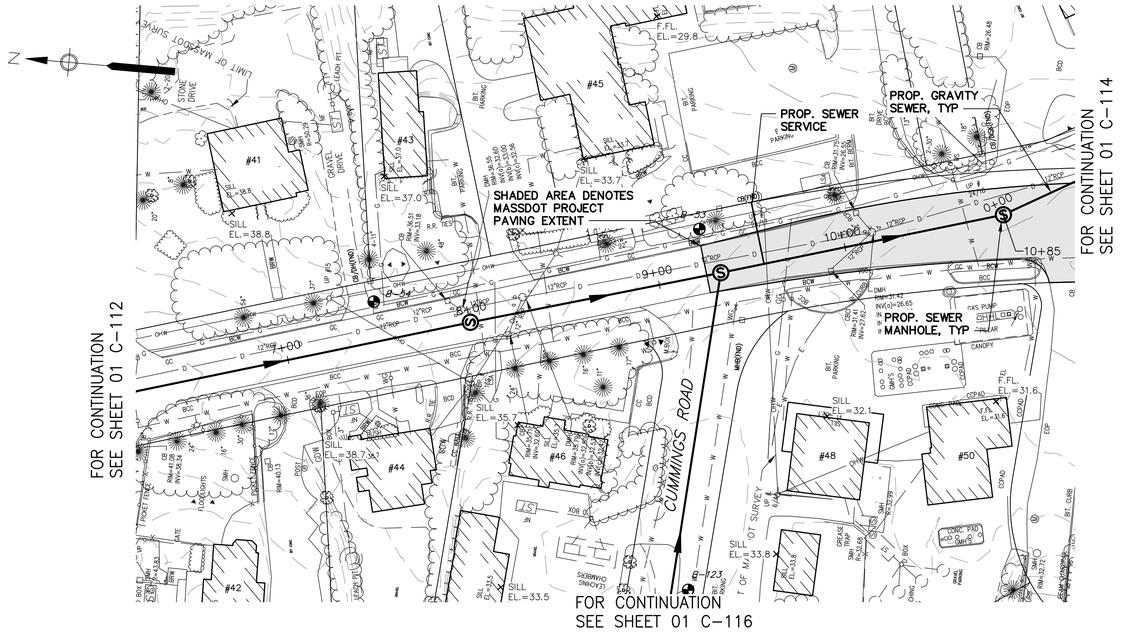
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SHEET TITLE

PLAN AND PROFILE SEWER
SOUTH ORLEANS ROAD I

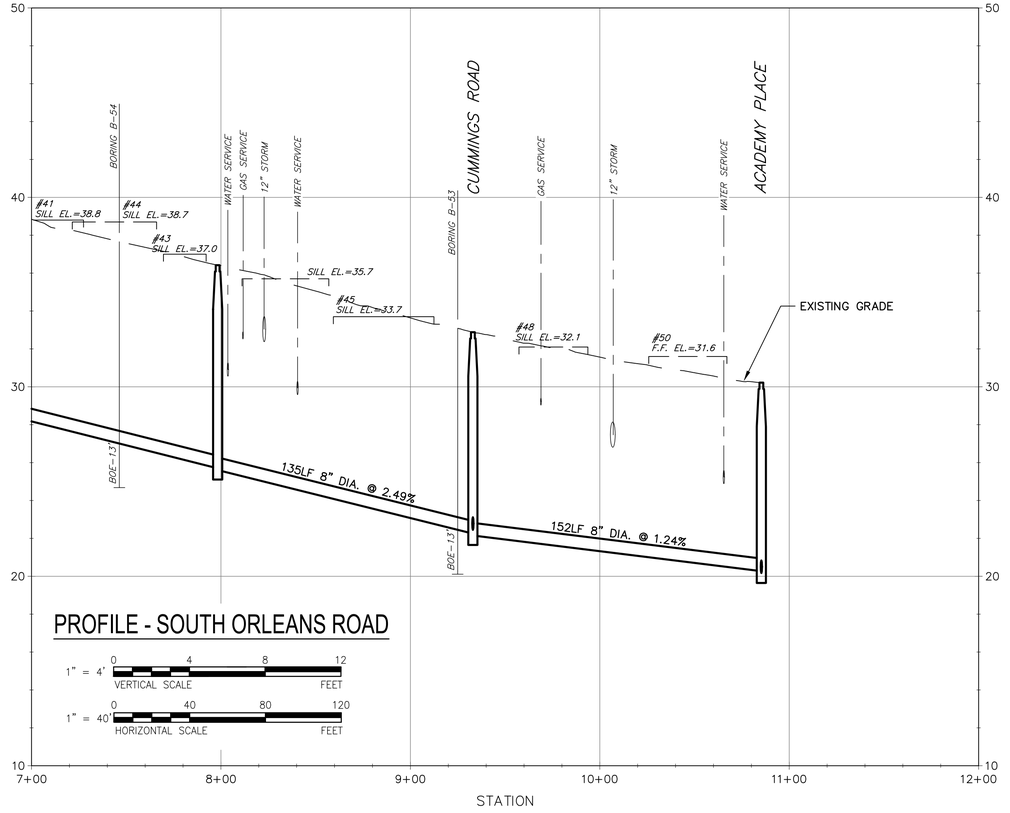
SHEET NUMBER

01 C-112



PLAN - SOUTH ORLEANS ROAD

SCALE: 1"=40'



PROFILE - SOUTH ORLEANS ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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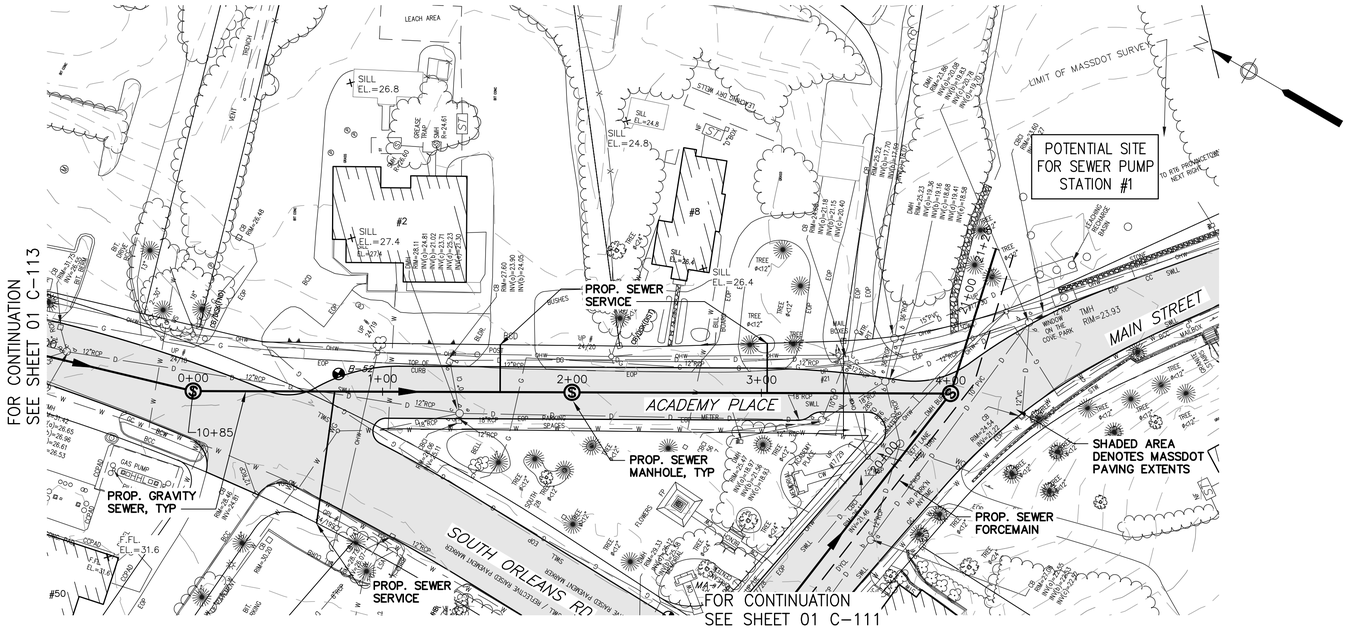
PLAN AND PROFILE SEWER SOUTH ORLEANS ROAD II

SHEET NUMBER

01 C-113

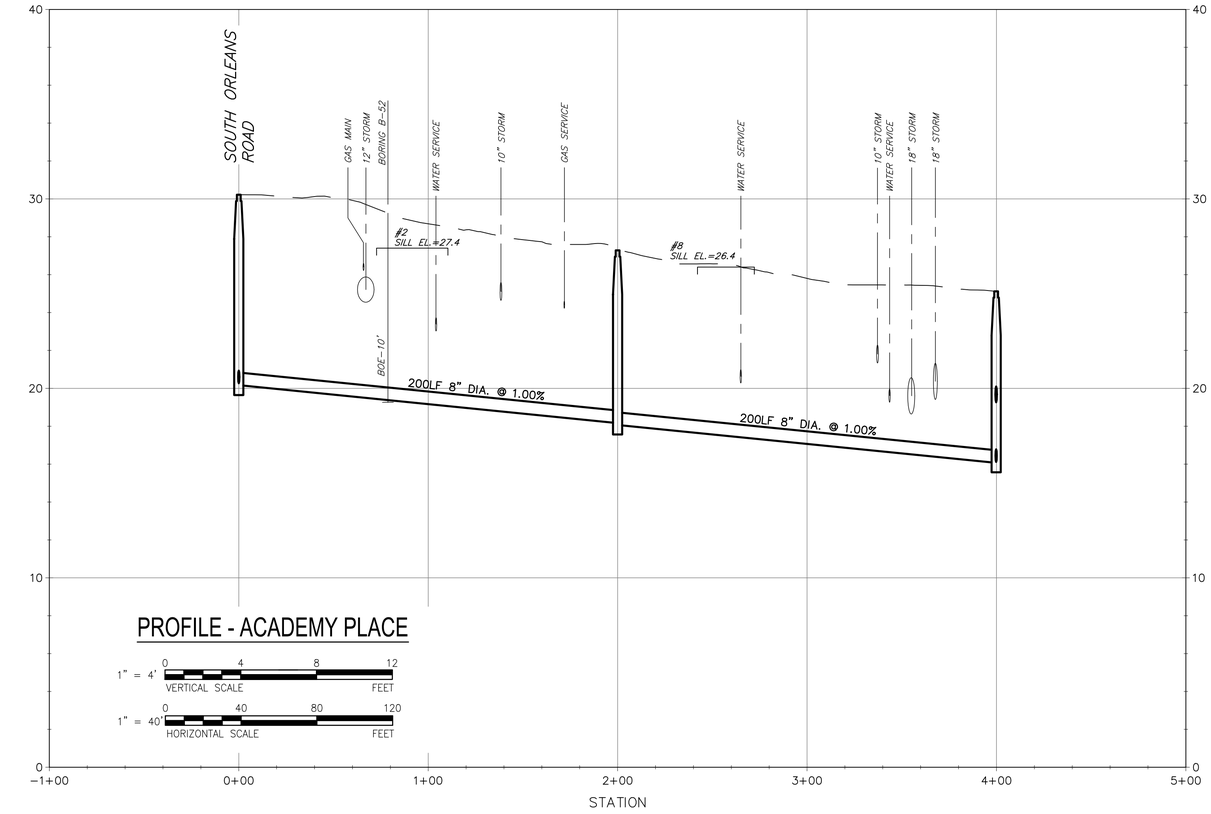
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PLAN - ACADEMY PLACE

SCALE: 1"=40'



PROFILE - ACADEMY PLACE

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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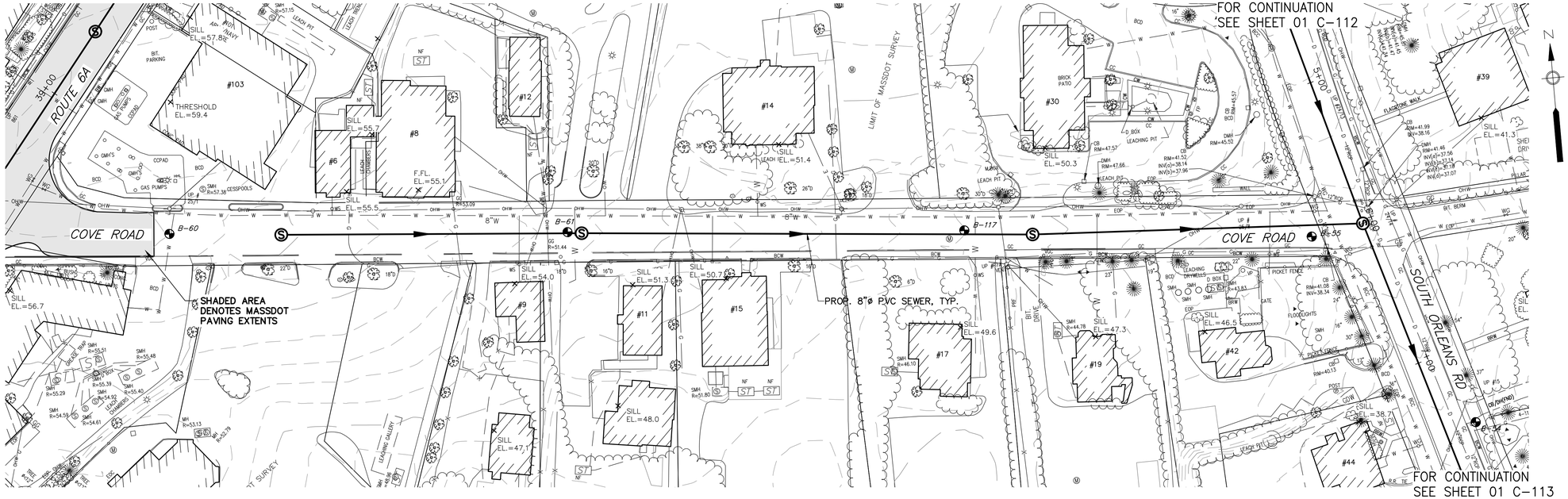
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER ACADEMY PLACE

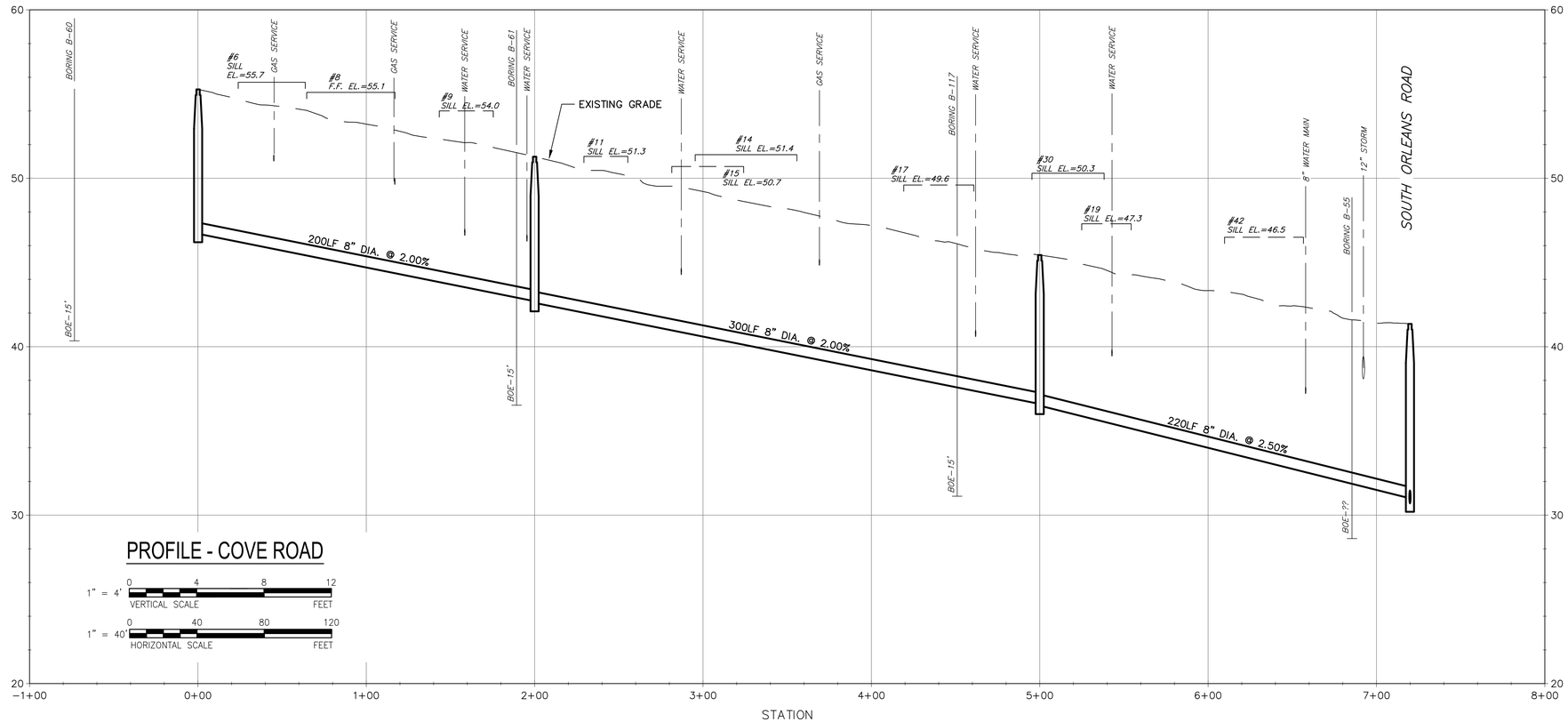
SHEET NUMBER

01 C-114



PLAN - COVE ROAD

SCALE: 1"=40'



PROFILE - COVE ROAD

1" = 4' VERTICAL SCALE: 0, 4, 8, 12 FEET

1" = 40' HORIZONTAL SCALE: 0, 40, 80, 120 FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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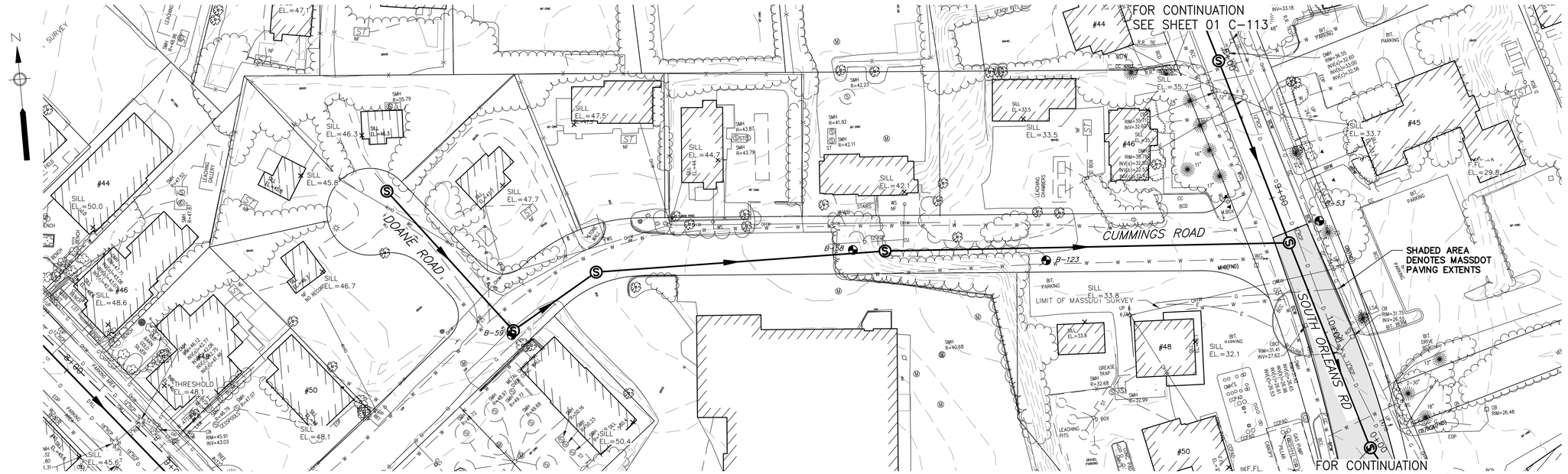
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER COVE ROAD

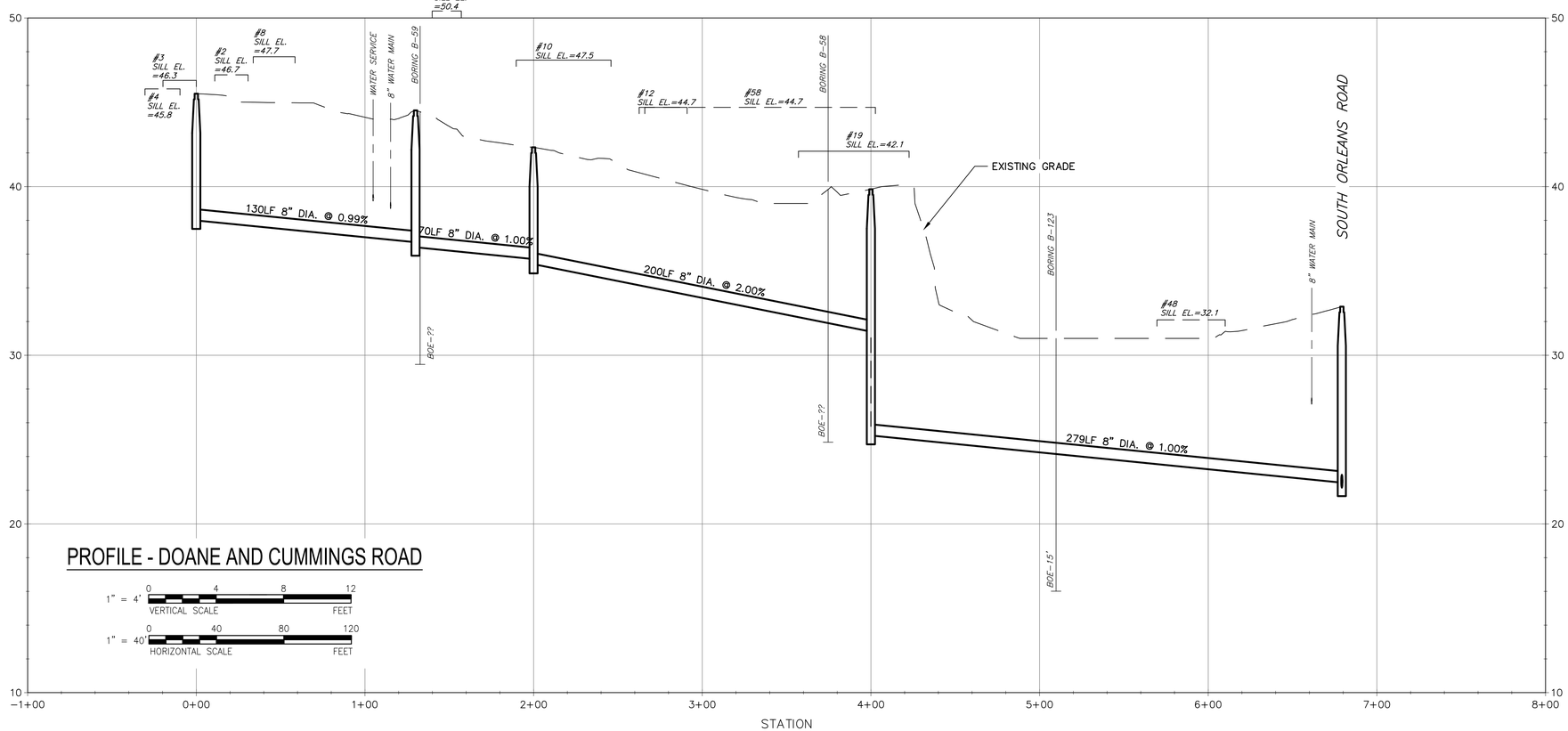
SHEET NUMBER

01 C-115



PLAN - DOANE AND CUMMINGS ROAD

SCALE: 1"=40'



PROFILE - DOANE AND CUMMINGS ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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CIVIL

SHEET TITLE

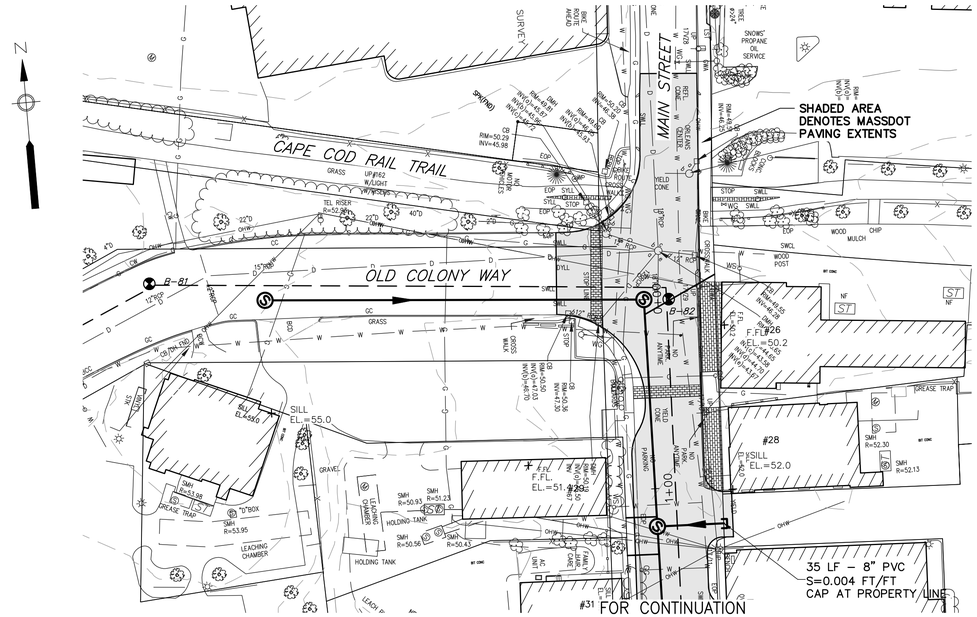
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DOANE AND CUMMINGS RD

SHEET NUMBER

01 C-116

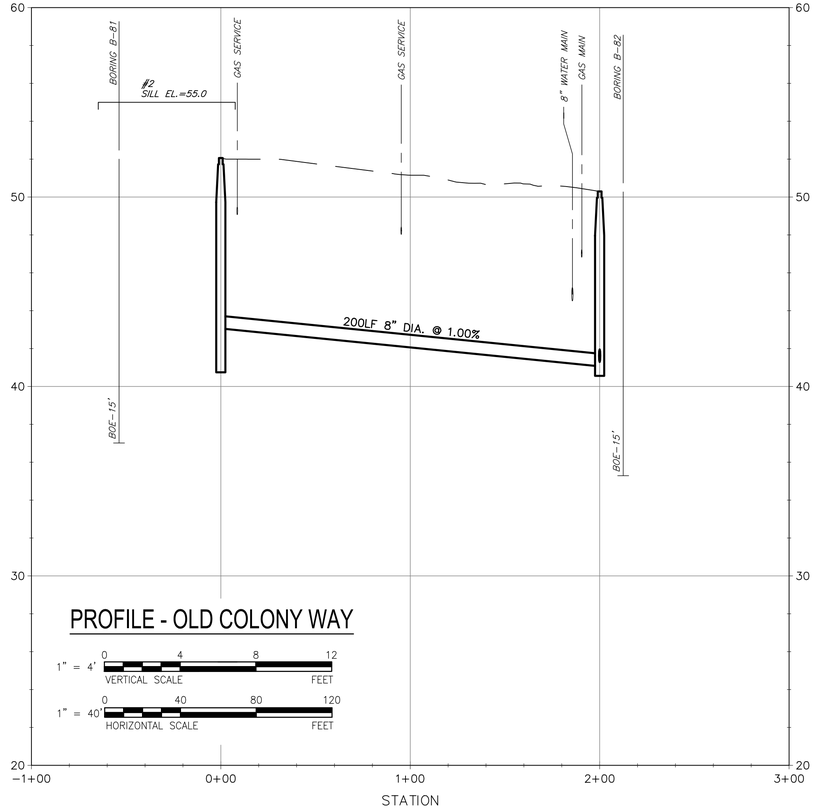
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PLAN - OLD COLONY WAY

SCALE: 1"=40'



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Downtown Area
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REGISTRATION

SKETCH PLAN SHOWING
LIMITS OF MDOT PAVING
5-19-2017

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

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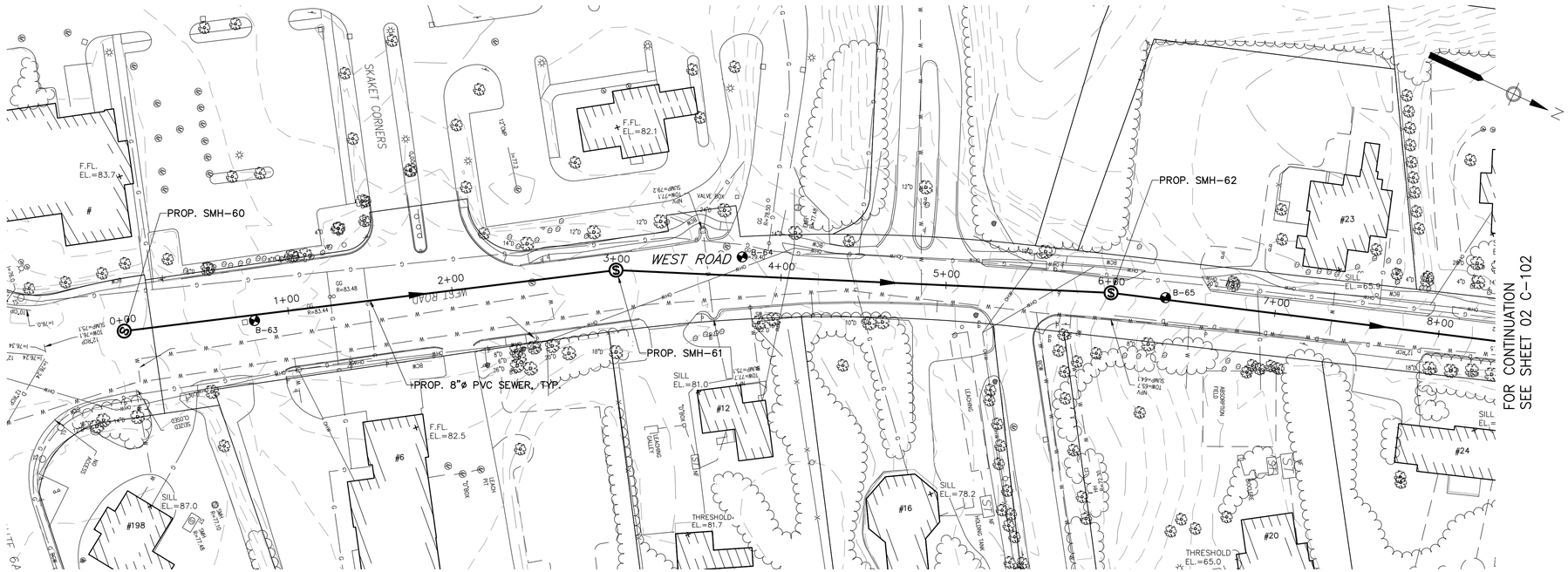
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SHEET NUMBER

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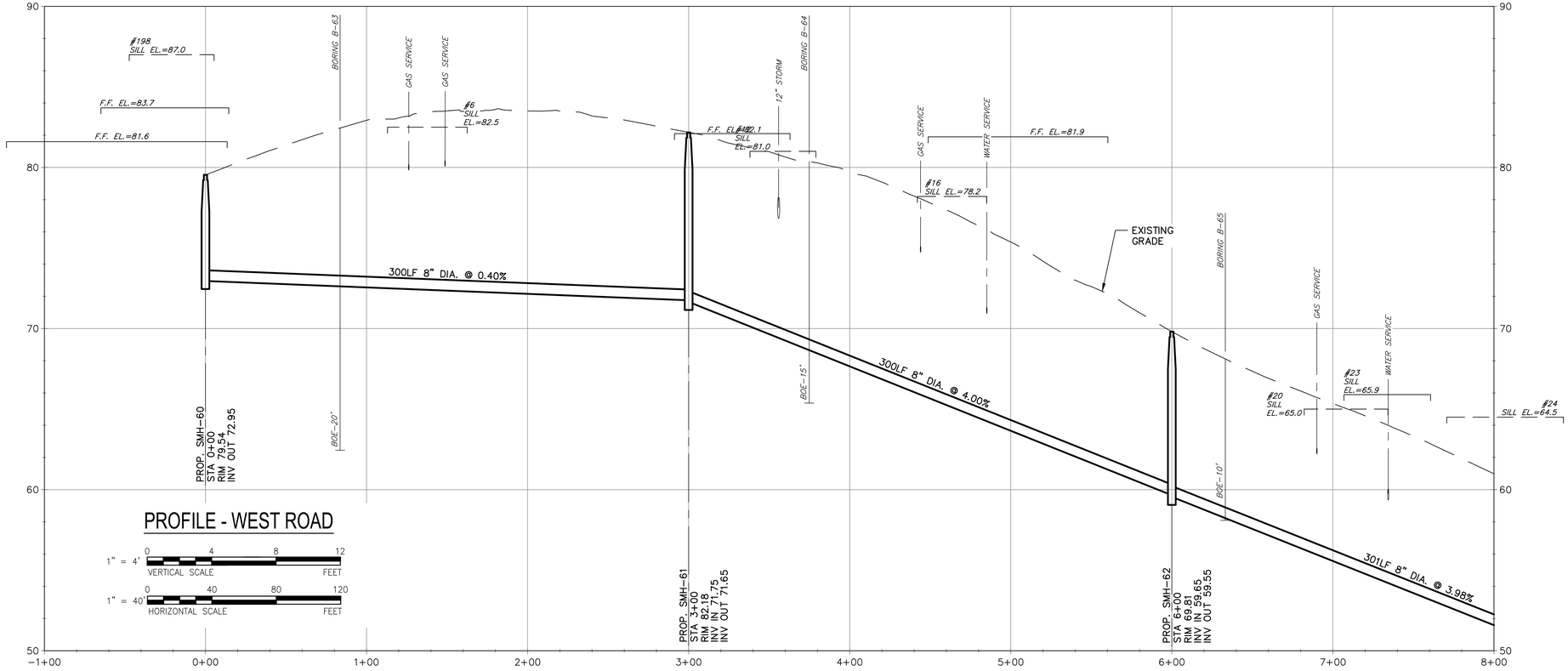
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PLAN - WEST ROAD

SCALE: 1"=40'



PROFILE - WEST ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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Proj Check:	M. DONOGHUE
Date:	----
Scale:	AS NOTED

DISCIPLINE

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SHEET TITLE

PLAN AND PROFILE SEWER
WEST ROAD I

SHEET NUMBER

02 C-101

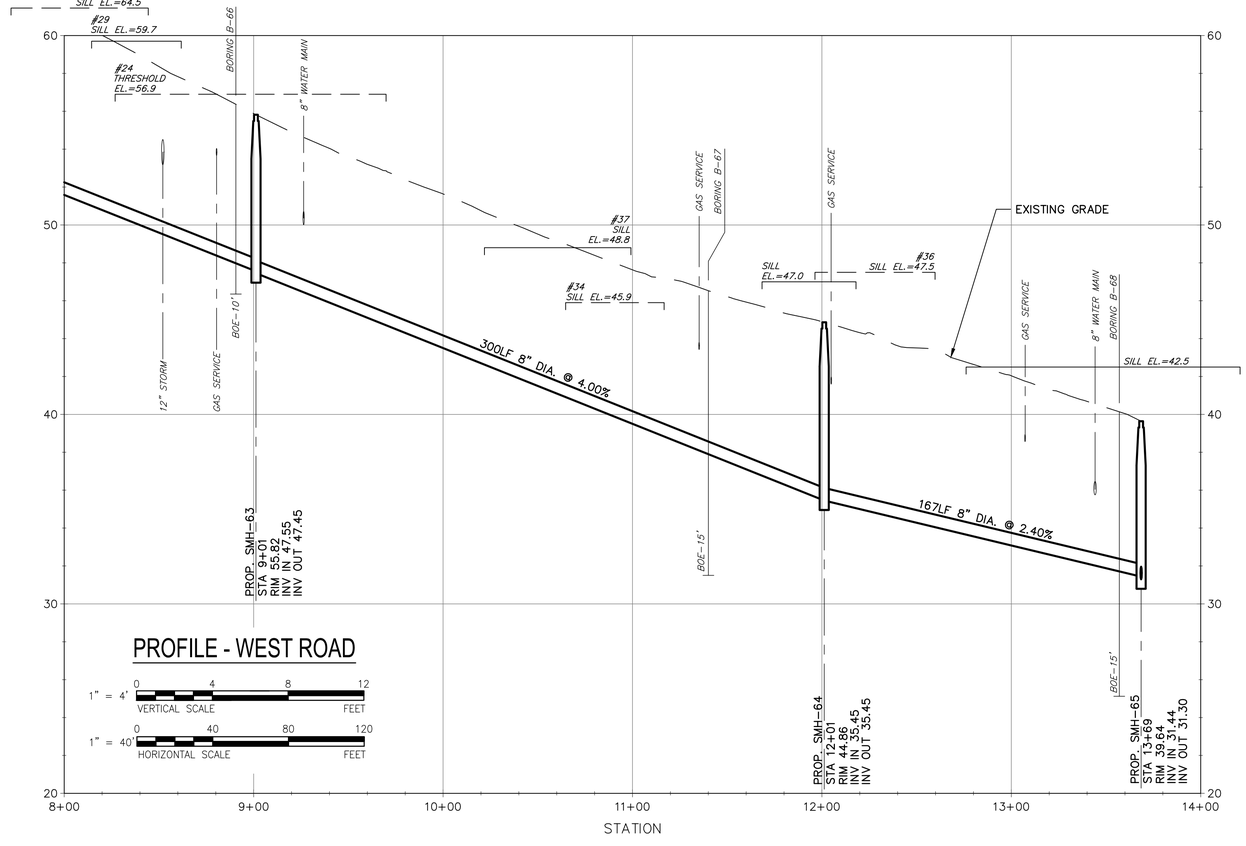
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PLAN - WEST ROAD

SCALE: 1"=40'



PROFILE - WEST ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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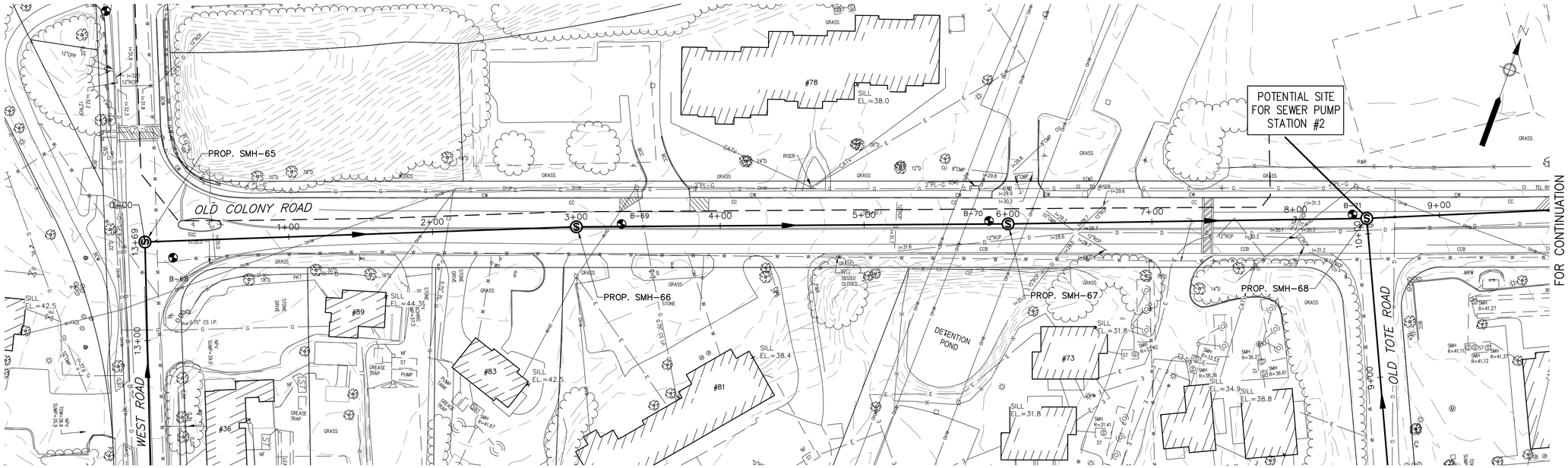
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WEST ROAD II

SHEET NUMBER

02 C-102

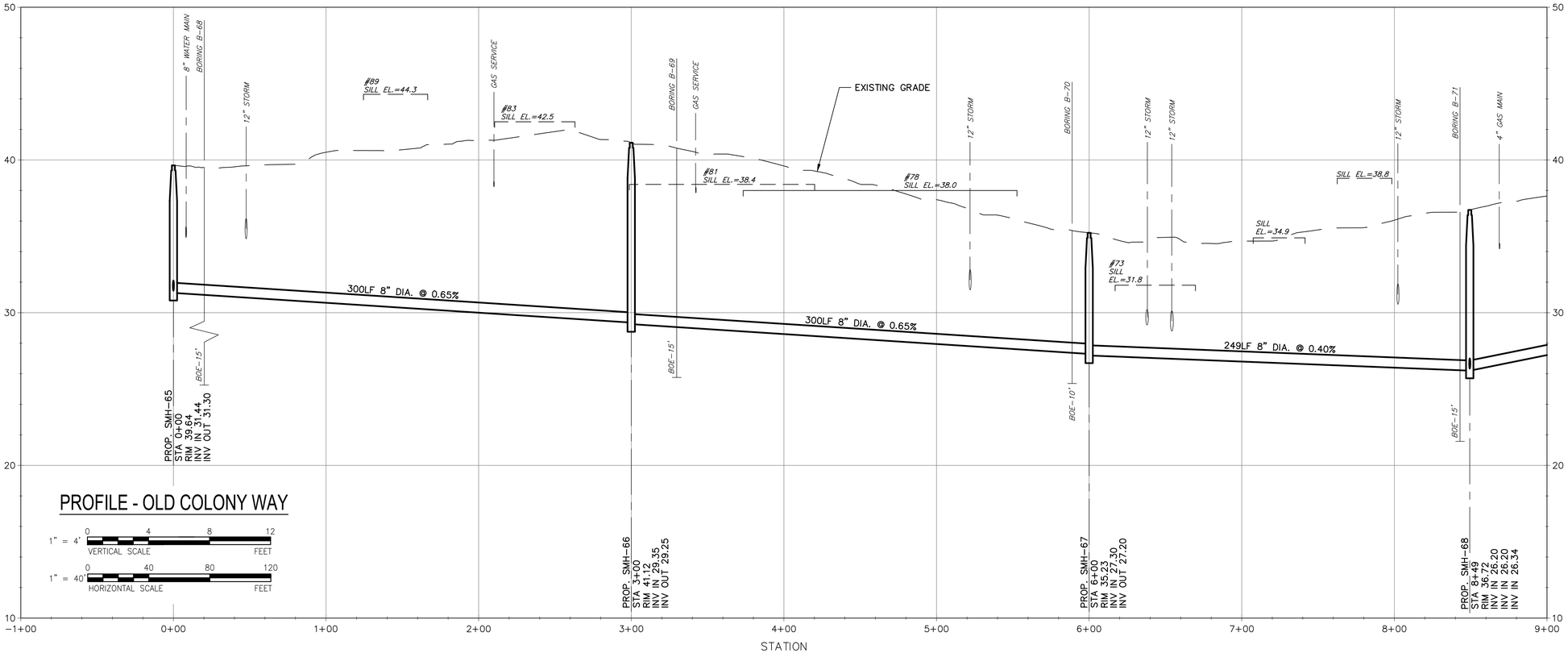
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PLAN - OLD COLONY WAY

SCALE: 1"=40'



PROFILE - OLD COLONY WAY

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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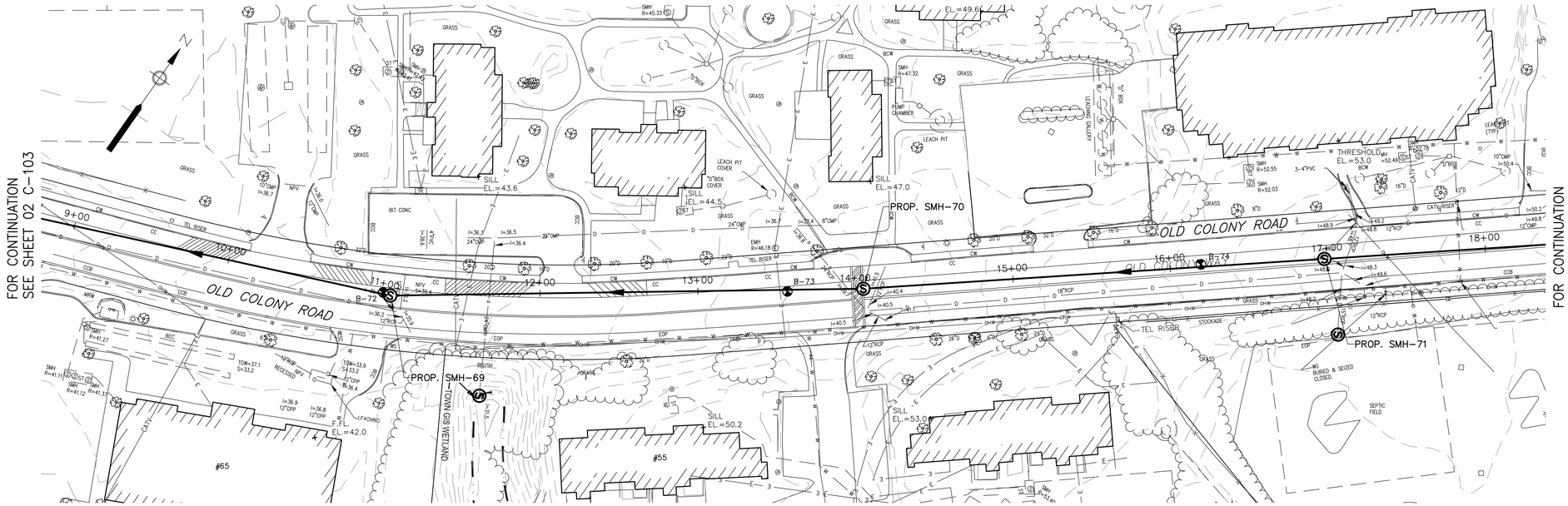
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER
OLD COLONY WAY I

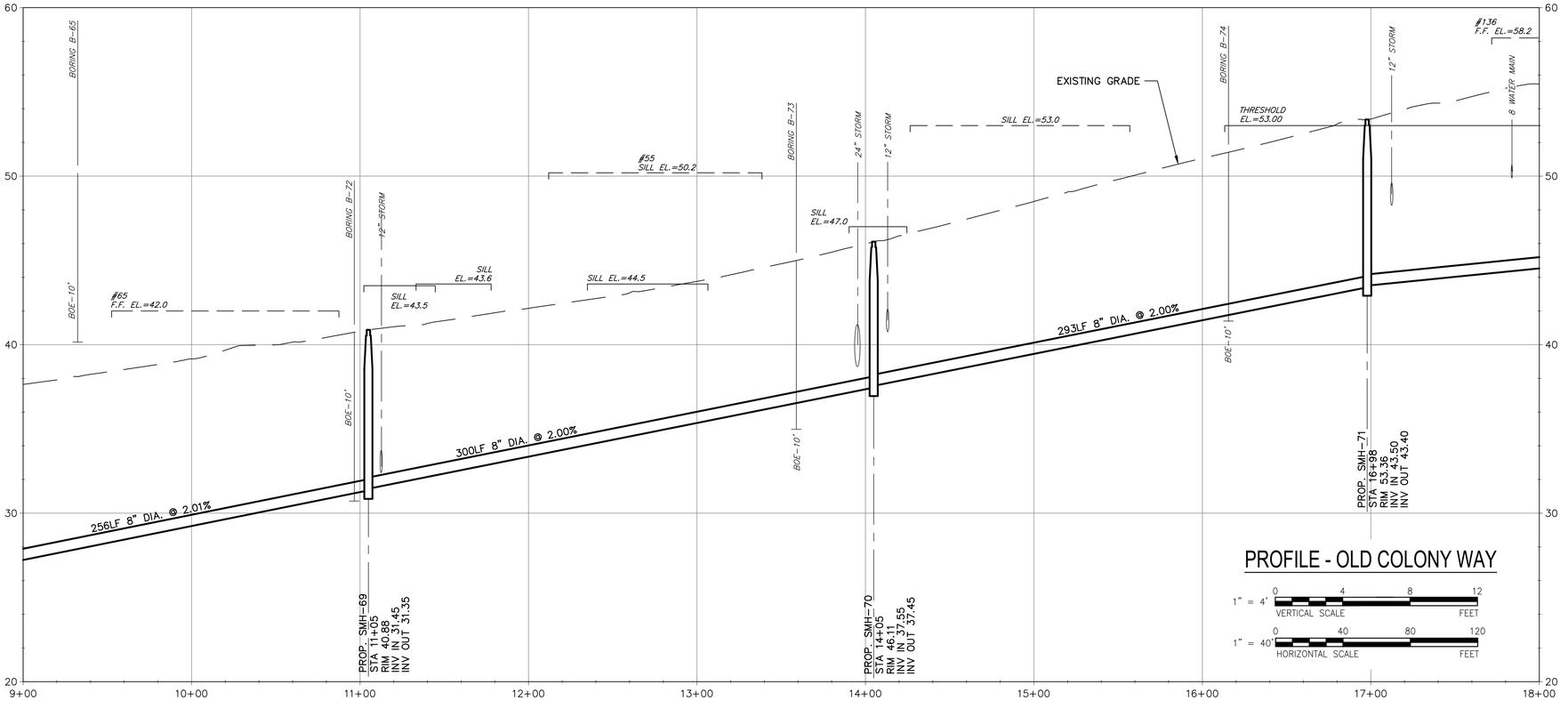
SHEET NUMBER

02 C-103



PLAN - OLD COLONY WAY

SCALE: 1"=40'



PROFILE - OLD COLONY WAY

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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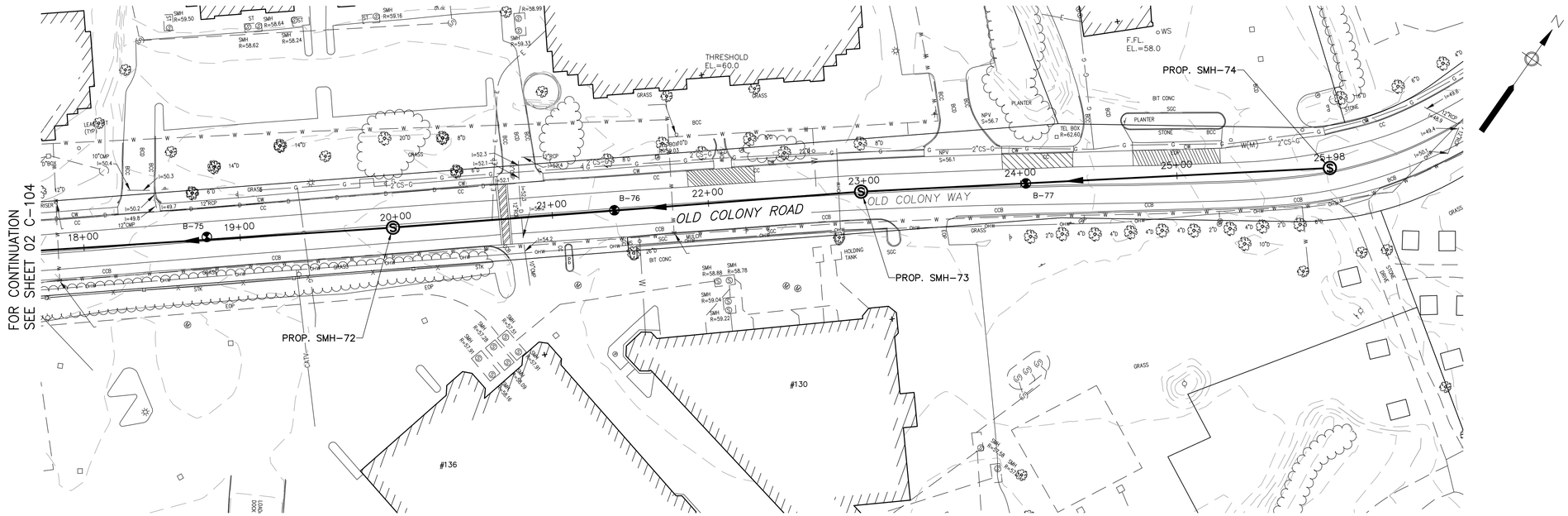
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PLAN AND PROFILE SEWER
OLD COLONY WAY II

SHEET NUMBER

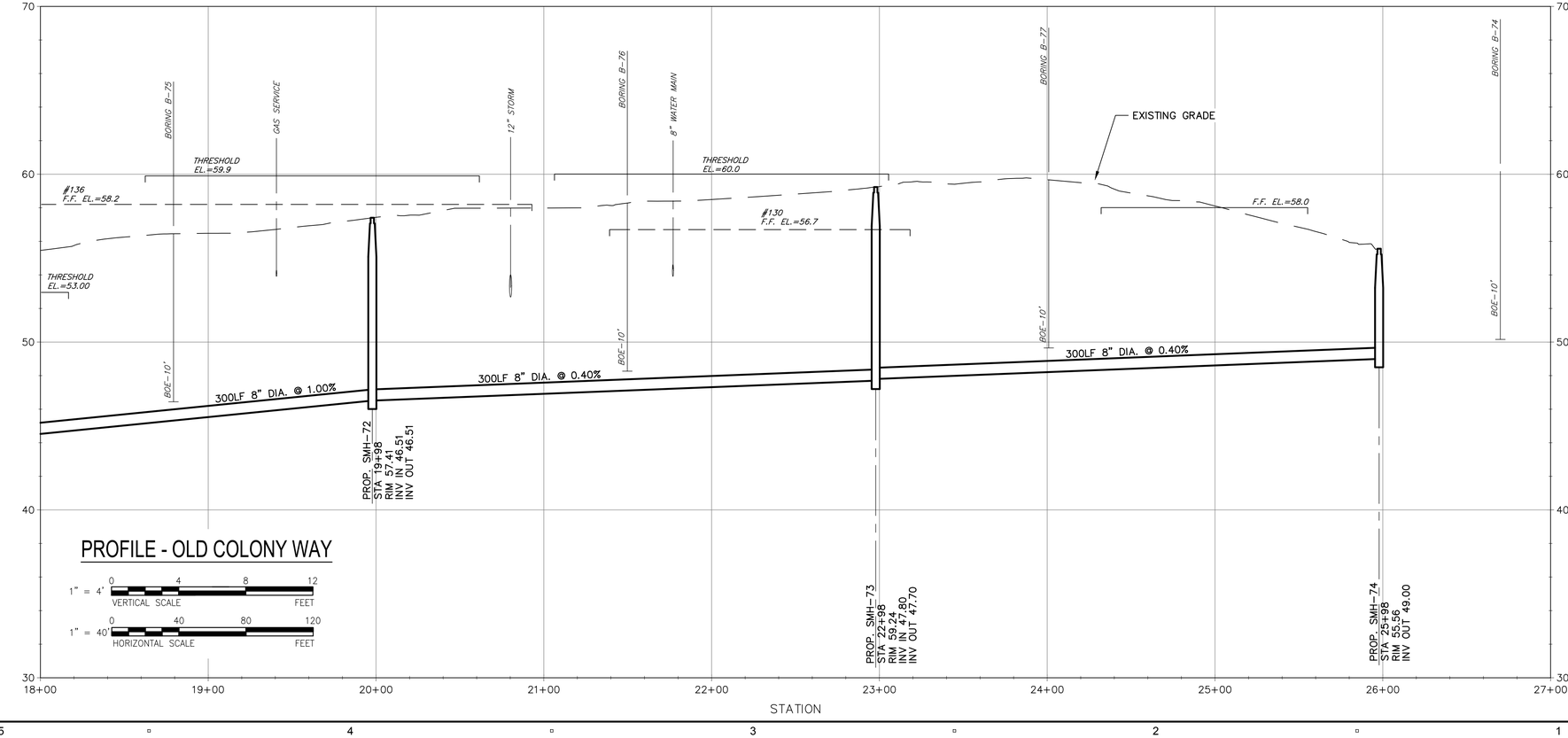
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PLAN - OLD COLONY WAY

SCALE: 1"=40'



PROFILE - OLD COLONY WAY

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

Project Management Initials: Designer: Checked: Approved:

Last saved by: CURRANM(2017-05-15) Last Plotted: 2017-06-21
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Proj Check:	**M. DONOGHUE**
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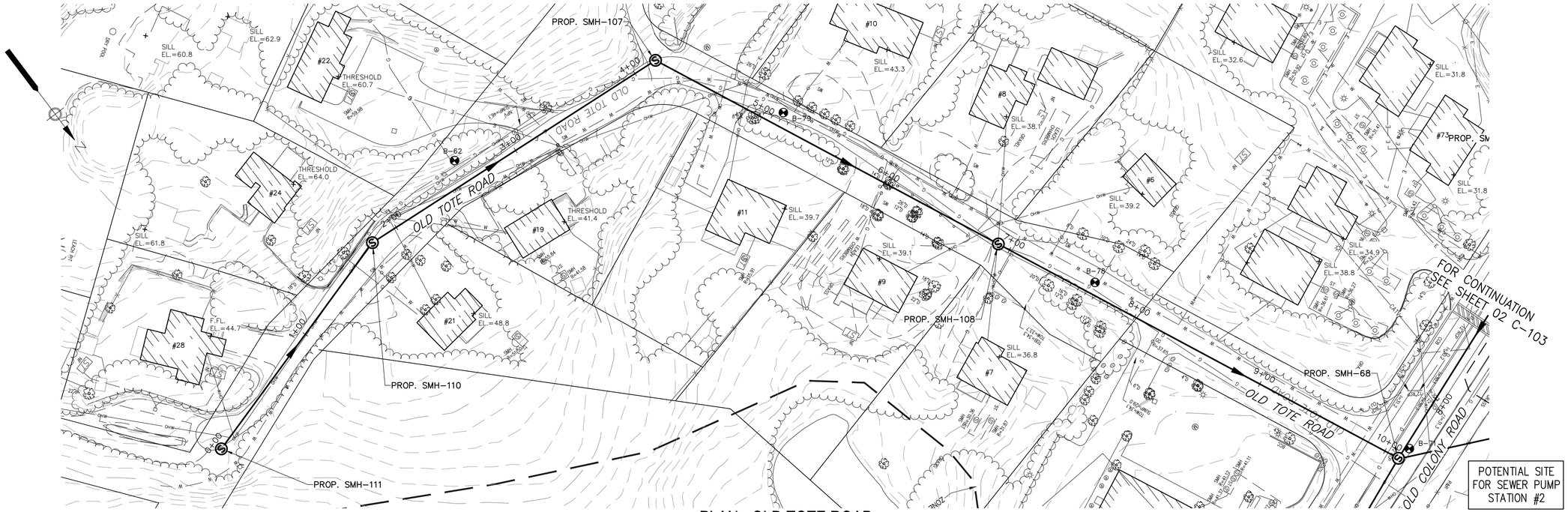
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SHEET TITLE

PLAN AND PROFILE SEWER OLD COLONY WAY III

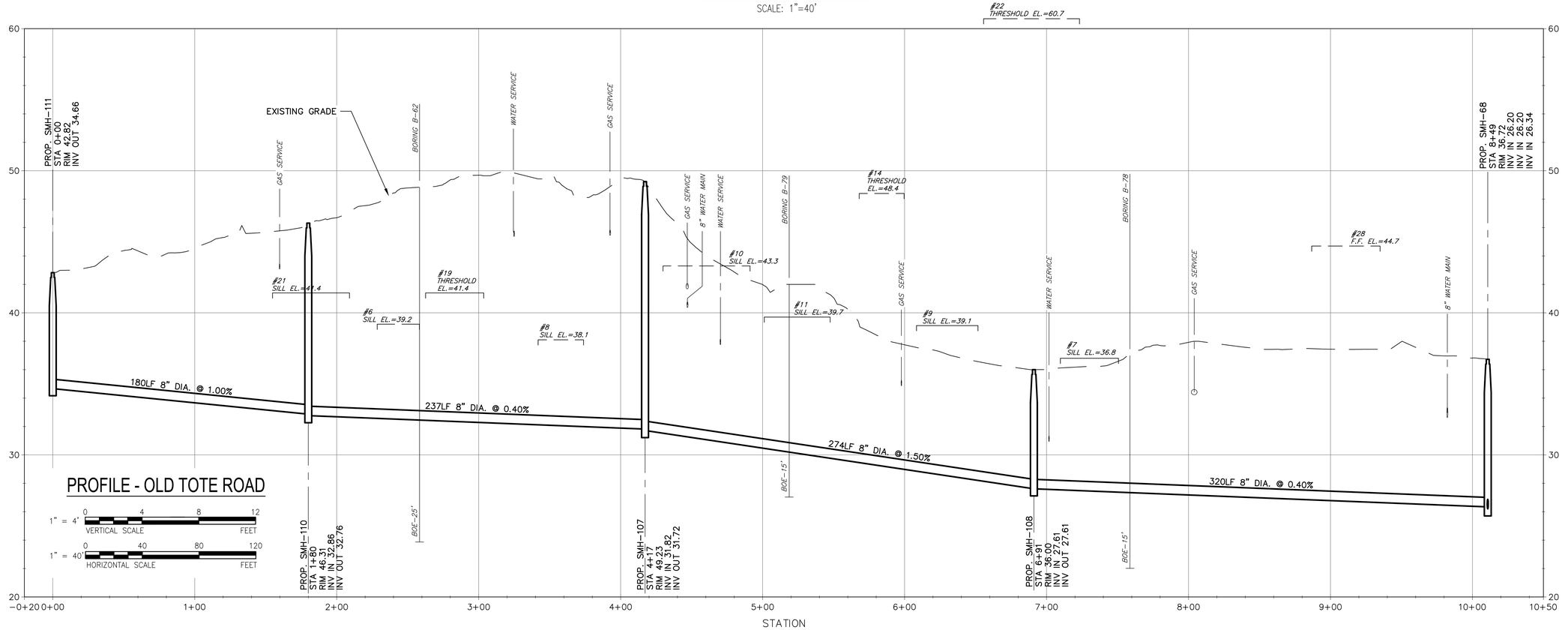
SHEET NUMBER

02 C-105



PLAN - OLD TOTE ROAD

SCALE: 1"=40'



PROFILE - OLD TOTE ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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Designed By:	M. CURRAN
Drawn By:	M. CURRAN
Dept Check:	T. PARECE
Proj Check:	M. DONOGHUE
Date:	----
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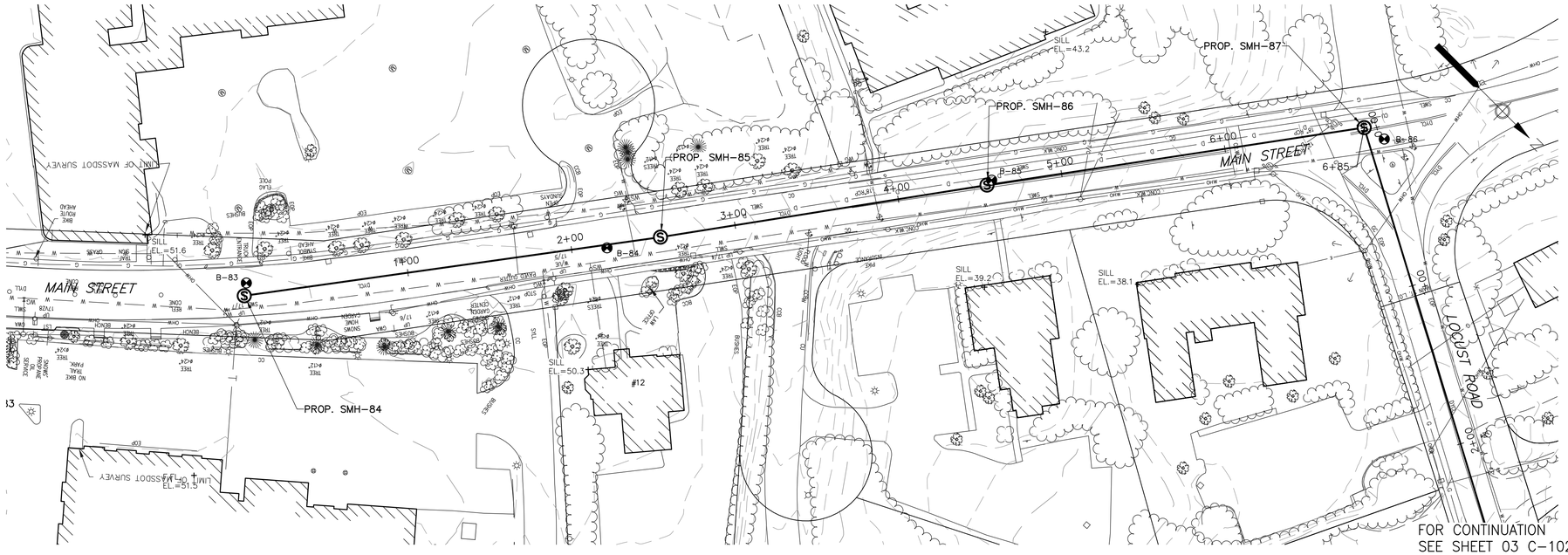
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PLAN AND PROFILE SEWER OLD TOTE ROAD

SHEET NUMBER

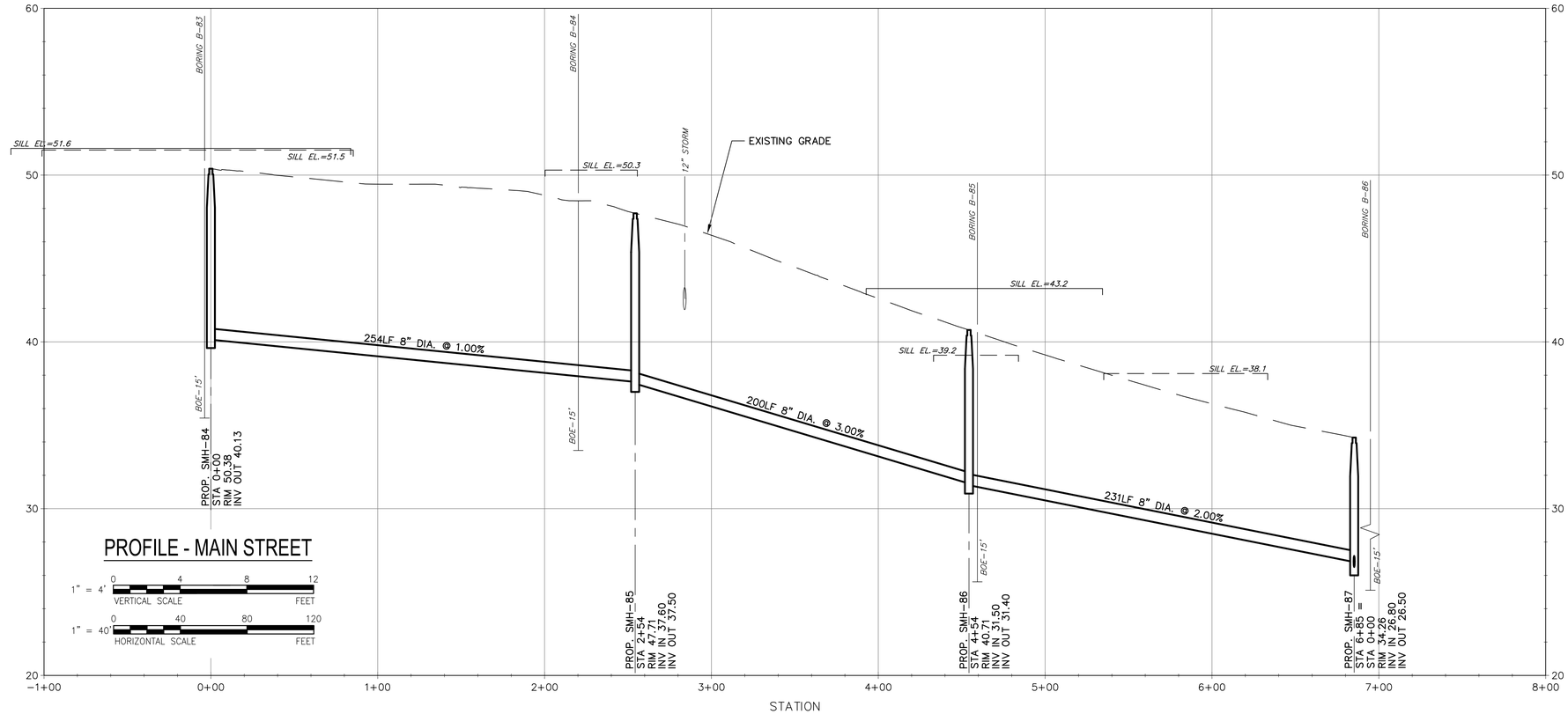
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PLAN -MAIN STREET

SCALE: 1"=40'



PROFILE - MAIN STREET

1" = 4' 0 4 8 12 VERTICAL SCALE FEET

1" = 40' 0 40 80 120 HORIZONTAL SCALE FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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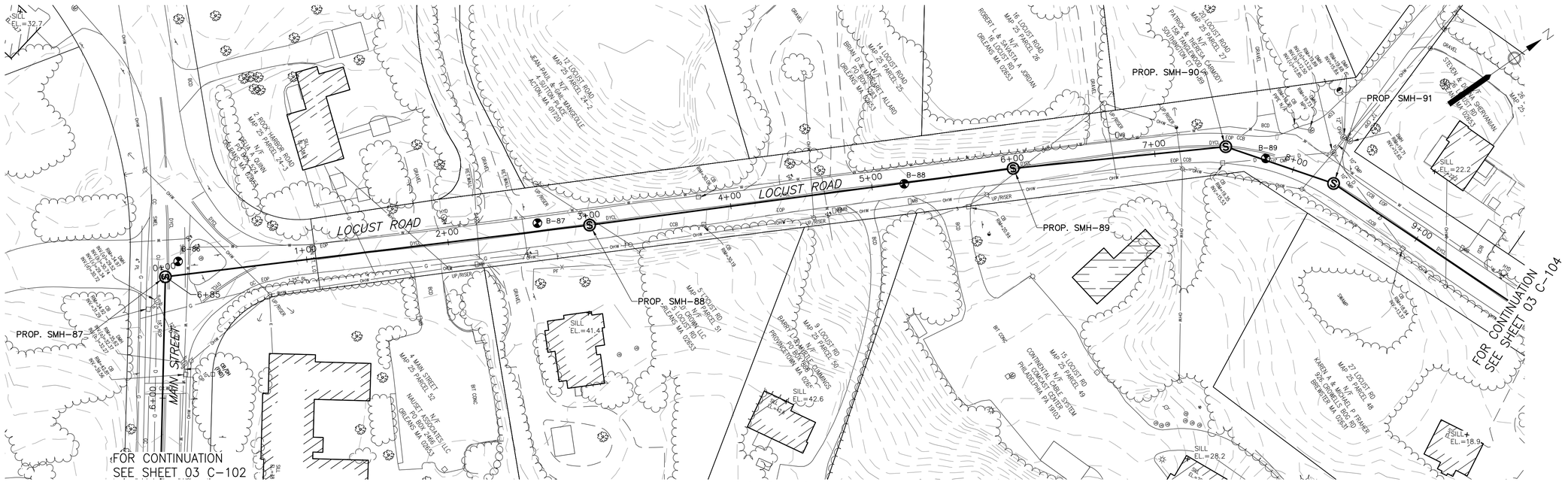
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER OLD COLONY WAY & MAIN ST

SHEET NUMBER

03 C-101



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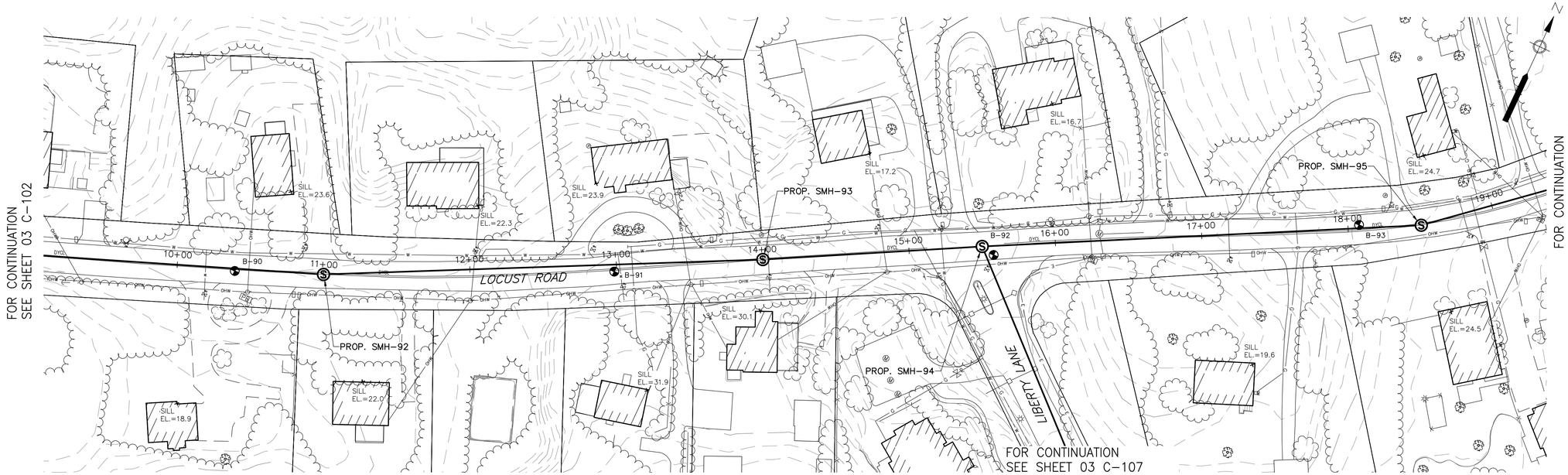
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER
LOCUST ROAD I

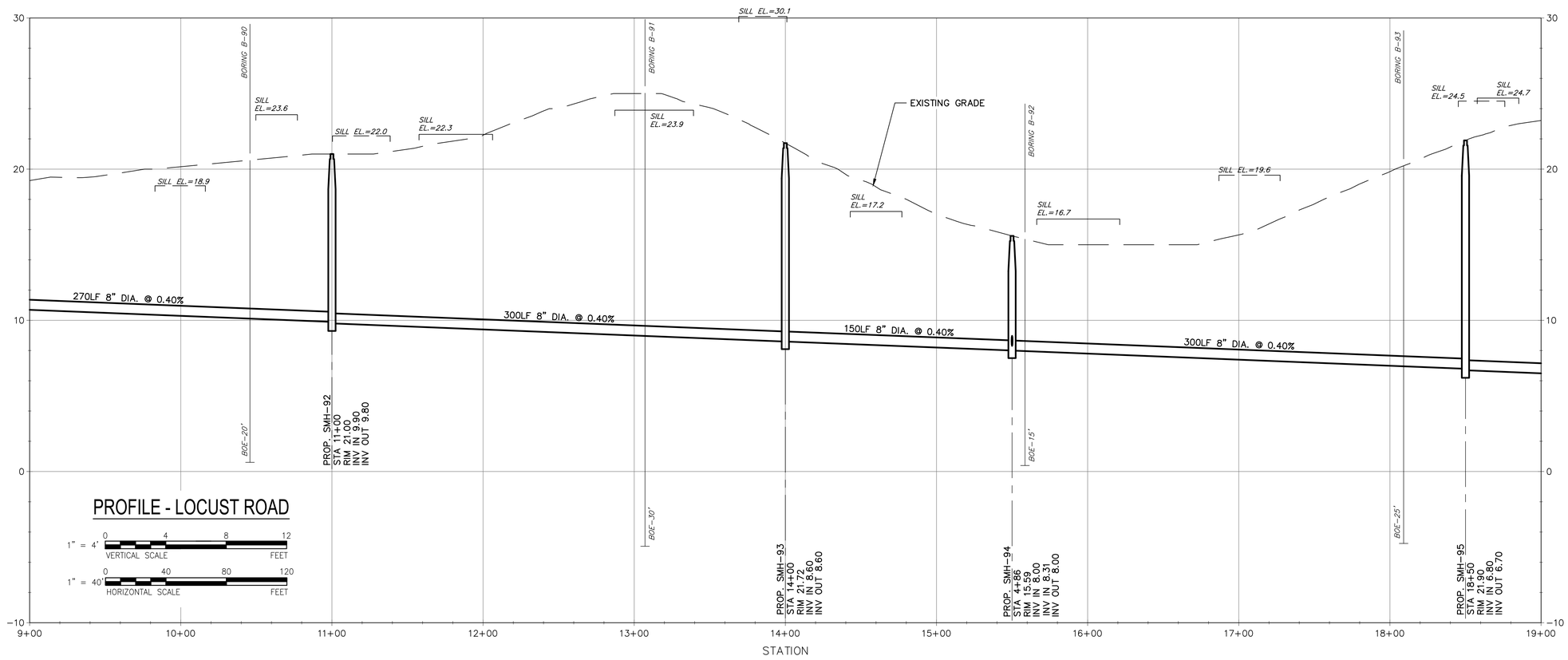
SHEET NUMBER

03 C-103



PLAN - LOCUST ROAD

SCALE: 1"=40'



PROFILE - LOCUST ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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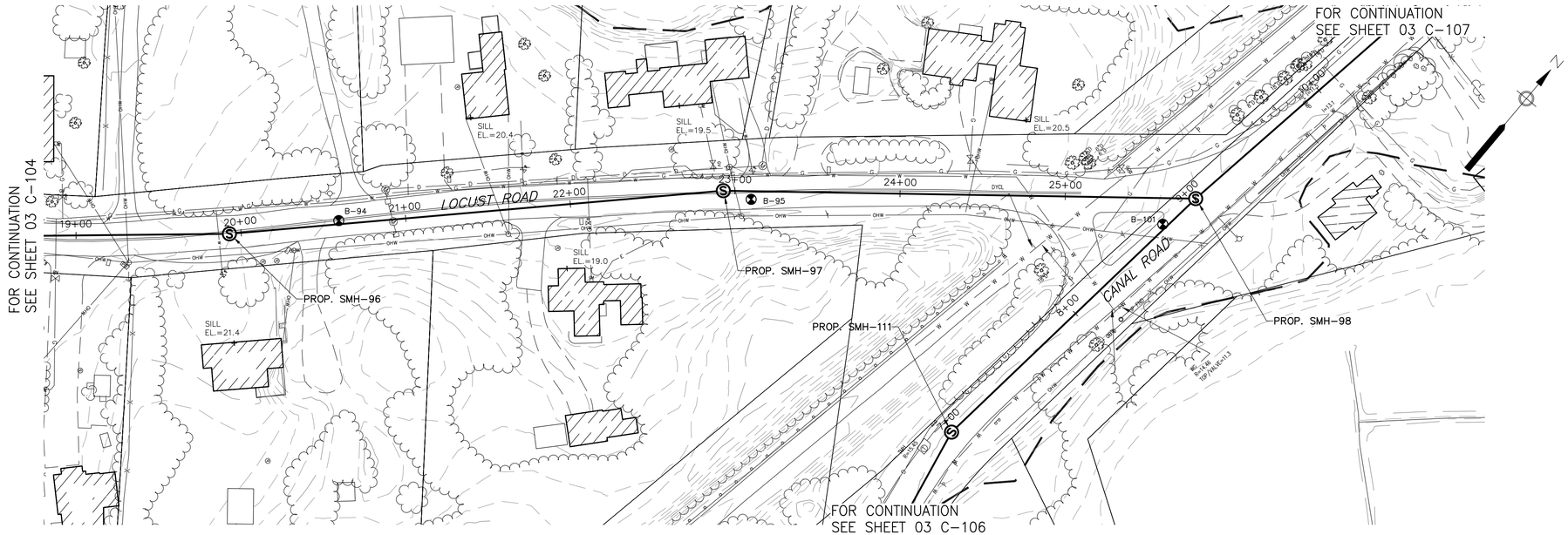
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SHEET TITLE

PLAN AND PROFILE SEWER LOCUST ROAD II

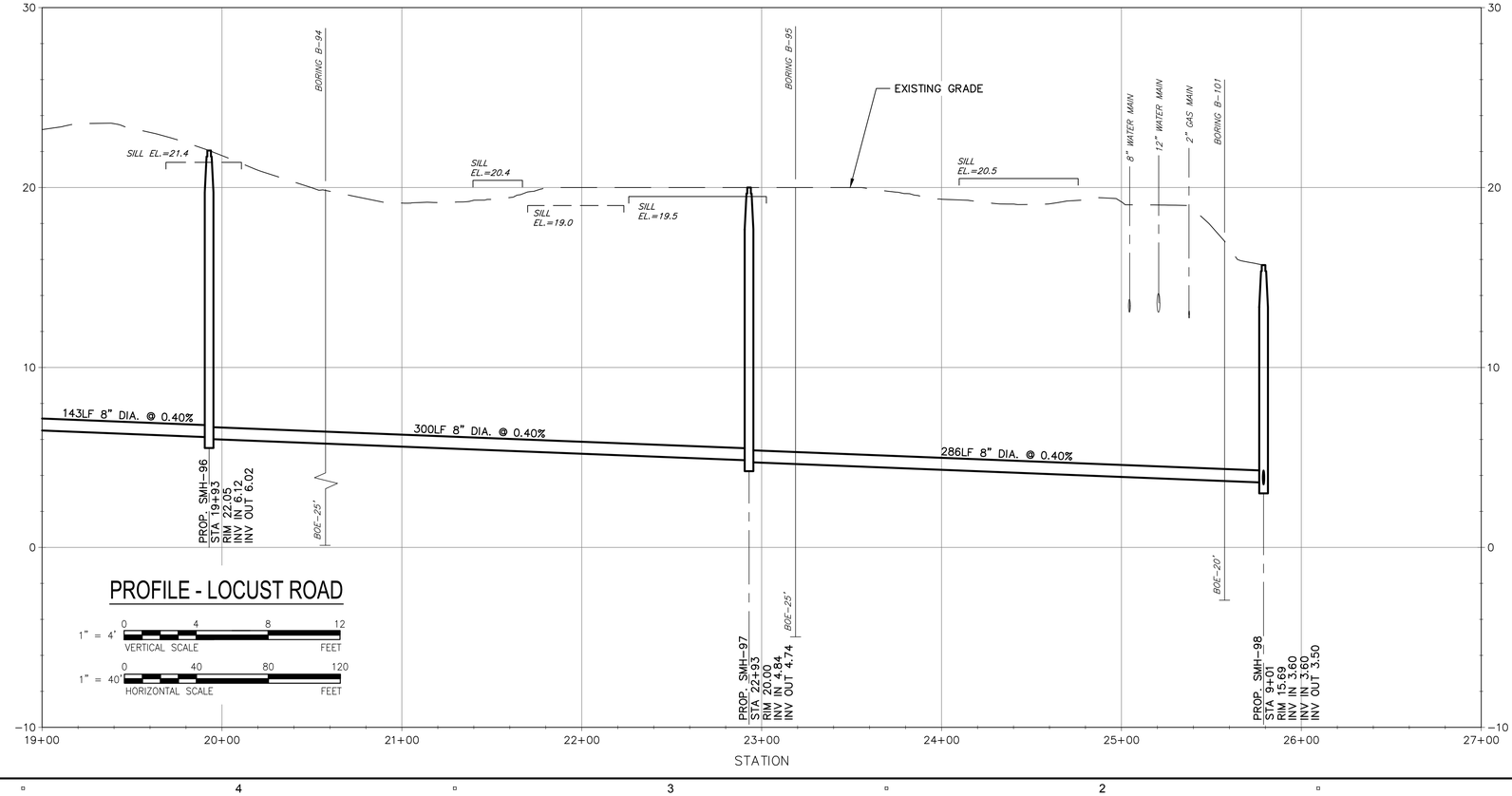
SHEET NUMBER

03 C-104



PLAN - LOCUST ROAD

SCALE: 1"=40'



PROFILE - LOCUST ROAD

1" = 4' VERTICAL SCALE: 0, 4, 8, 12 FEET

1" = 40' HORIZONTAL SCALE: 0, 40, 80, 120 FEET

Project Management Initials: Designer:____ Checked:____ Approved:____

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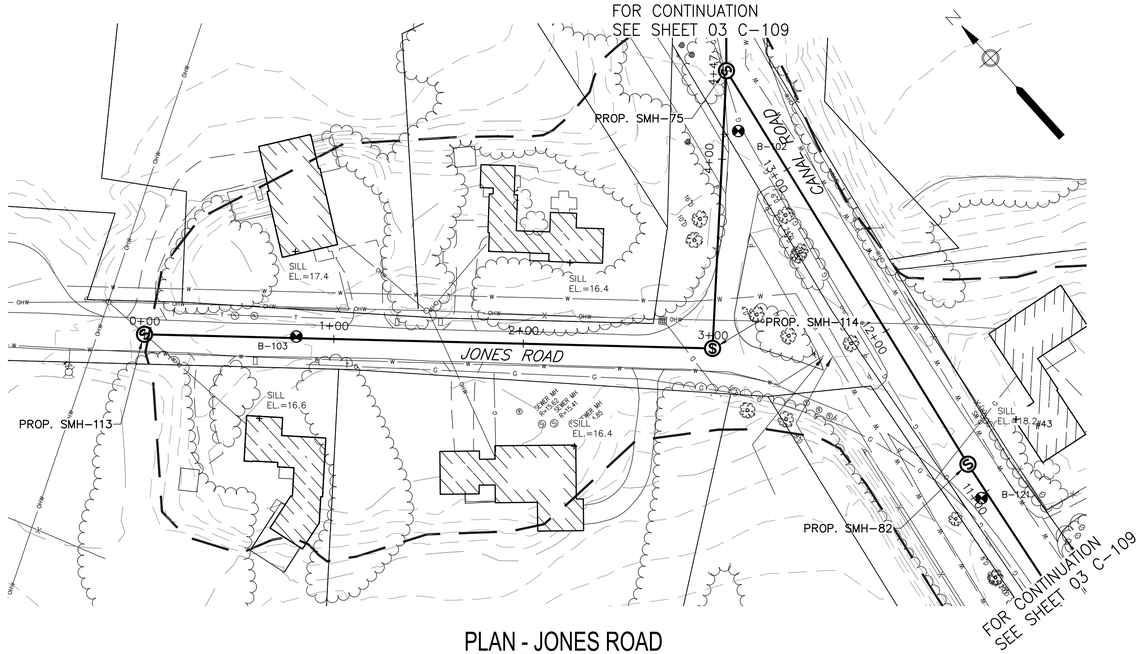
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SHEET TITLE

PLAN AND PROFILE SEWER
LOCUST ROAD III

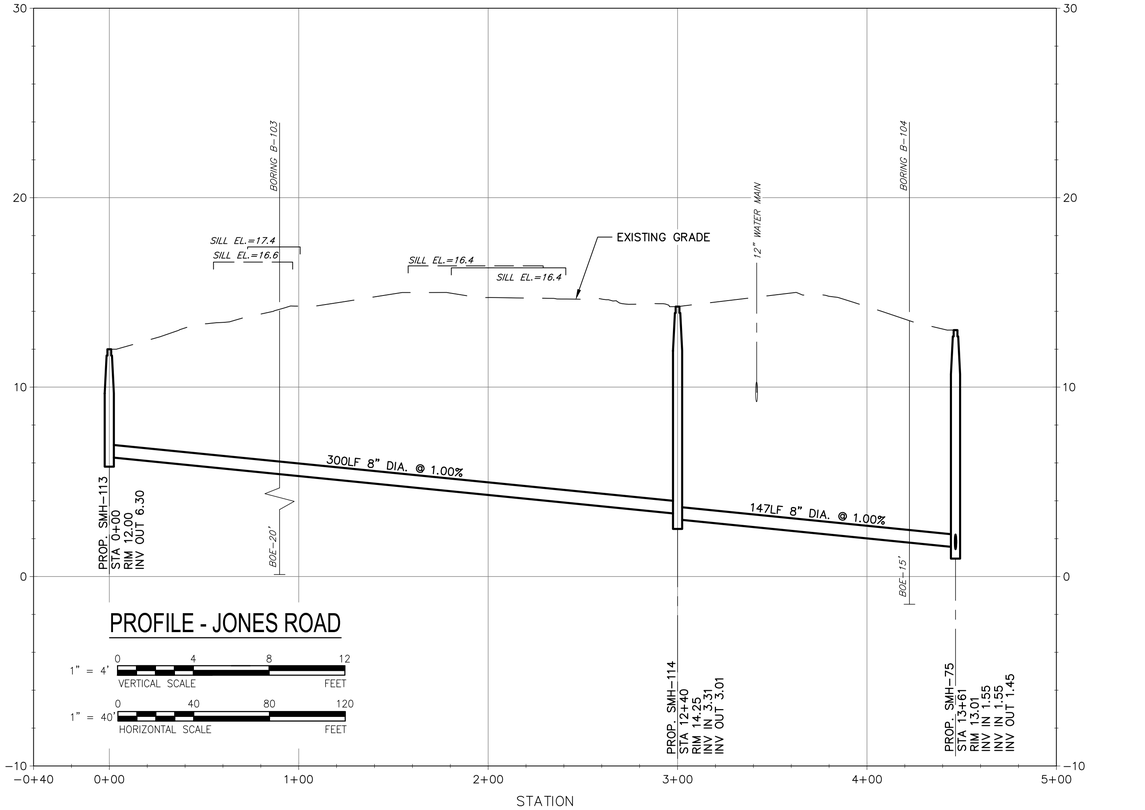
SHEET NUMBER

03 C-105



PLAN - JONES ROAD

SCALE: 1"=40'



PROFILE - JONES ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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

DISCIPLINE

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SHEET TITLE

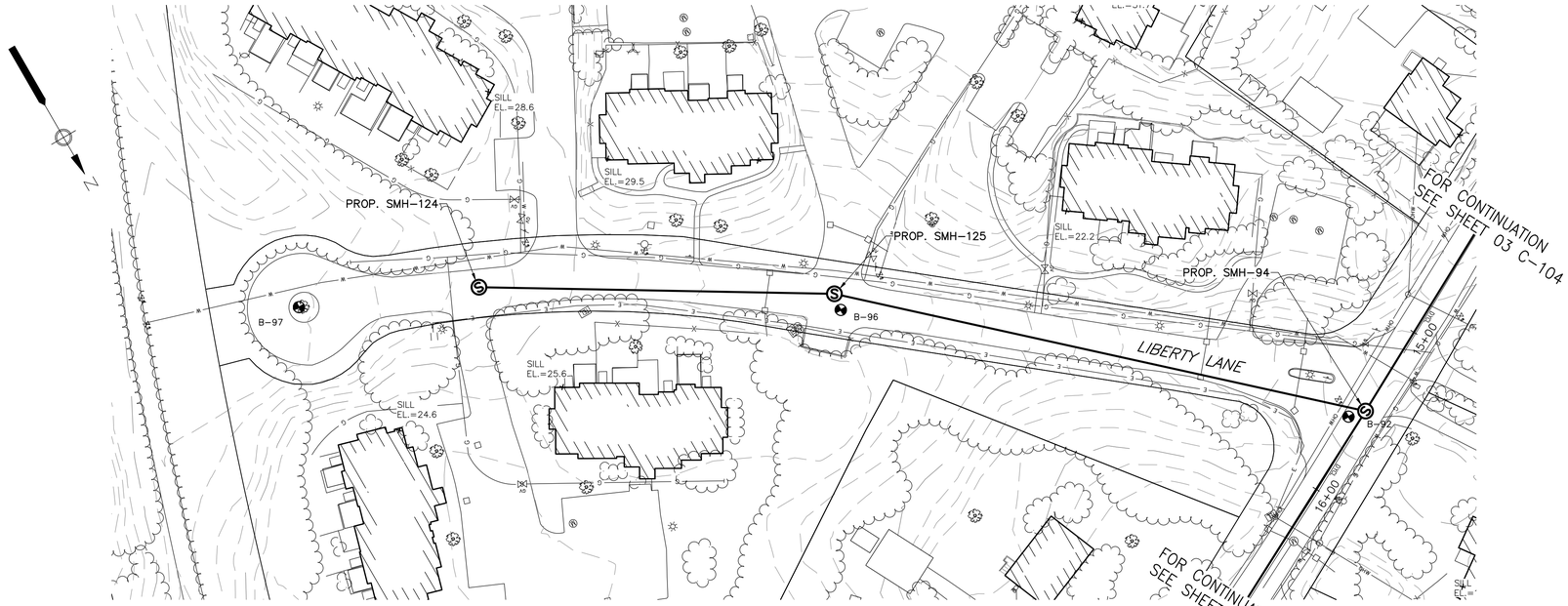
PLAN AND PROFILE SEWER
JONES ROAD

SHEET NUMBER

03 C-106

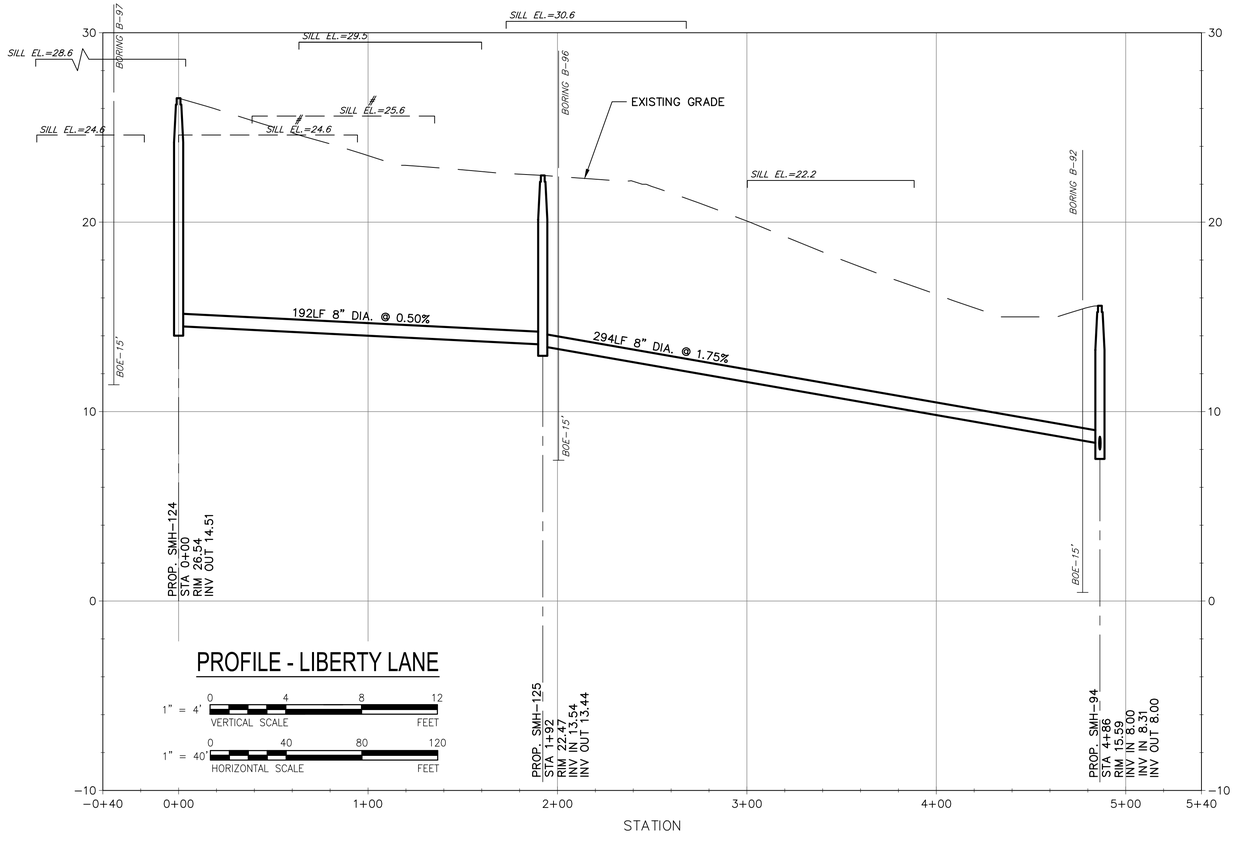
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PLAN - LIBERTY LANE

SCALE: 1"=40'



PROFILE - LIBERTY LANE

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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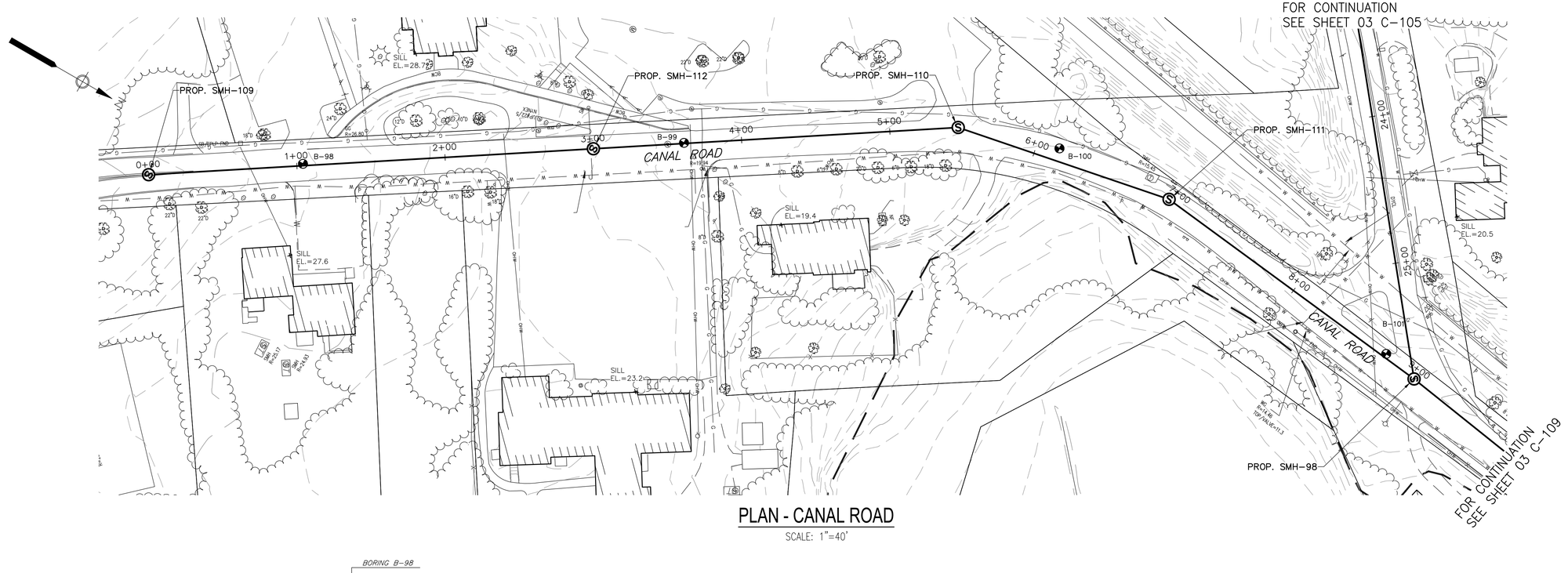
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SHEET TITLE

PLAN AND PROFILE SEWER
LIBERTY LANE

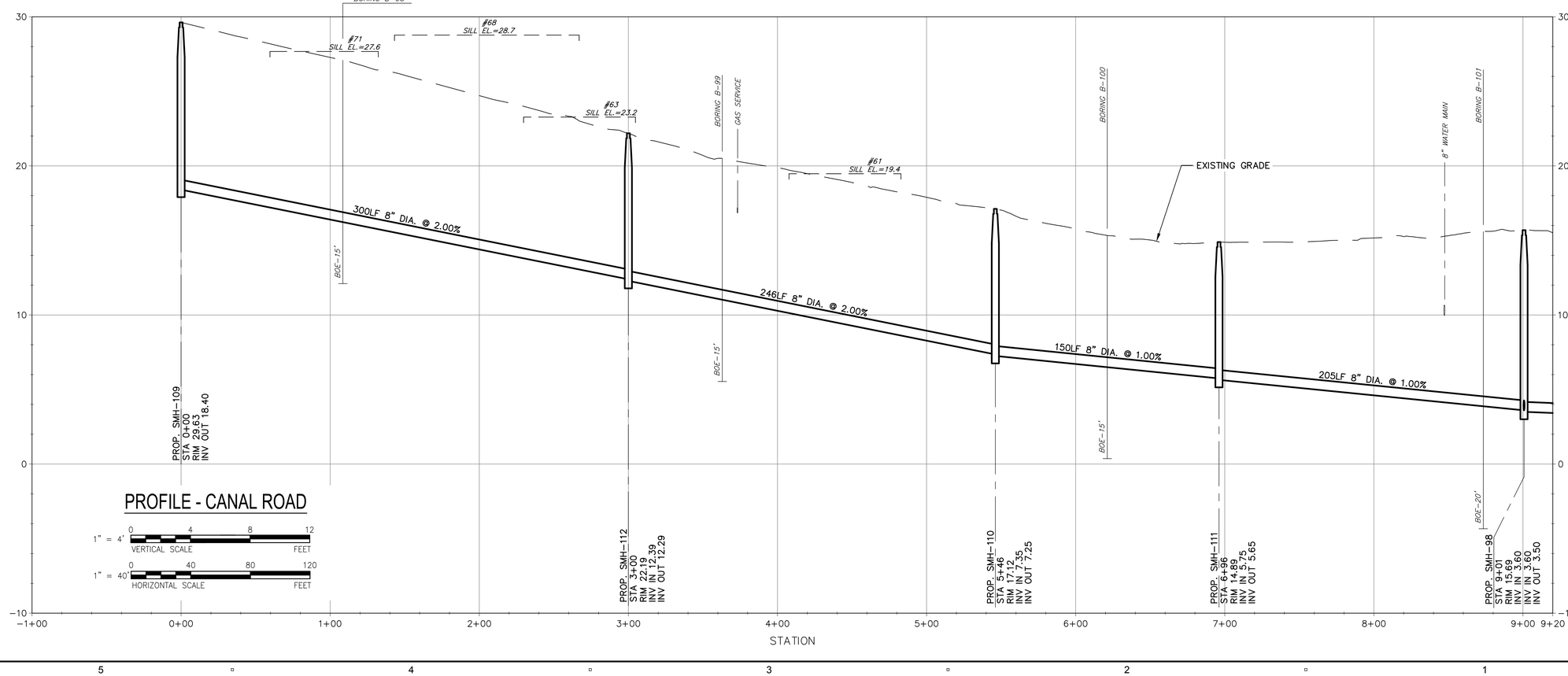
SHEET NUMBER

03 C-107



PLAN - CANAL ROAD

SCALE: 1"=40'



PROFILE - CANAL ROAD

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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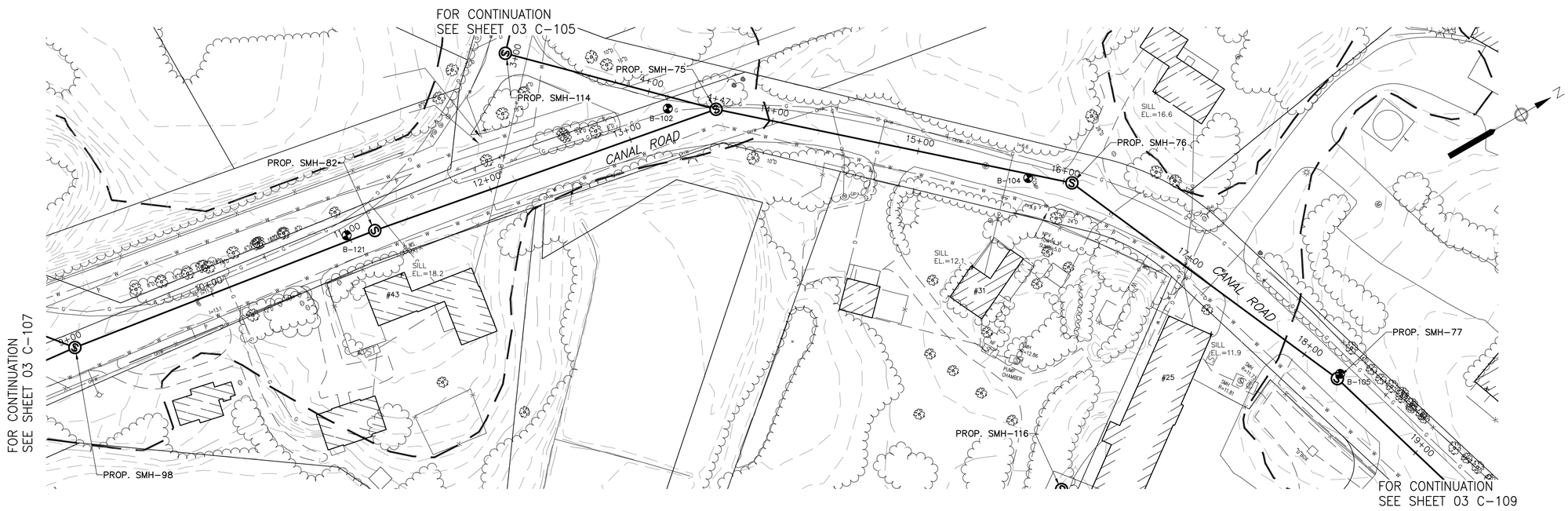
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SHEET TITLE

PLAN AND PROFILE SEWER CANAL ROAD I

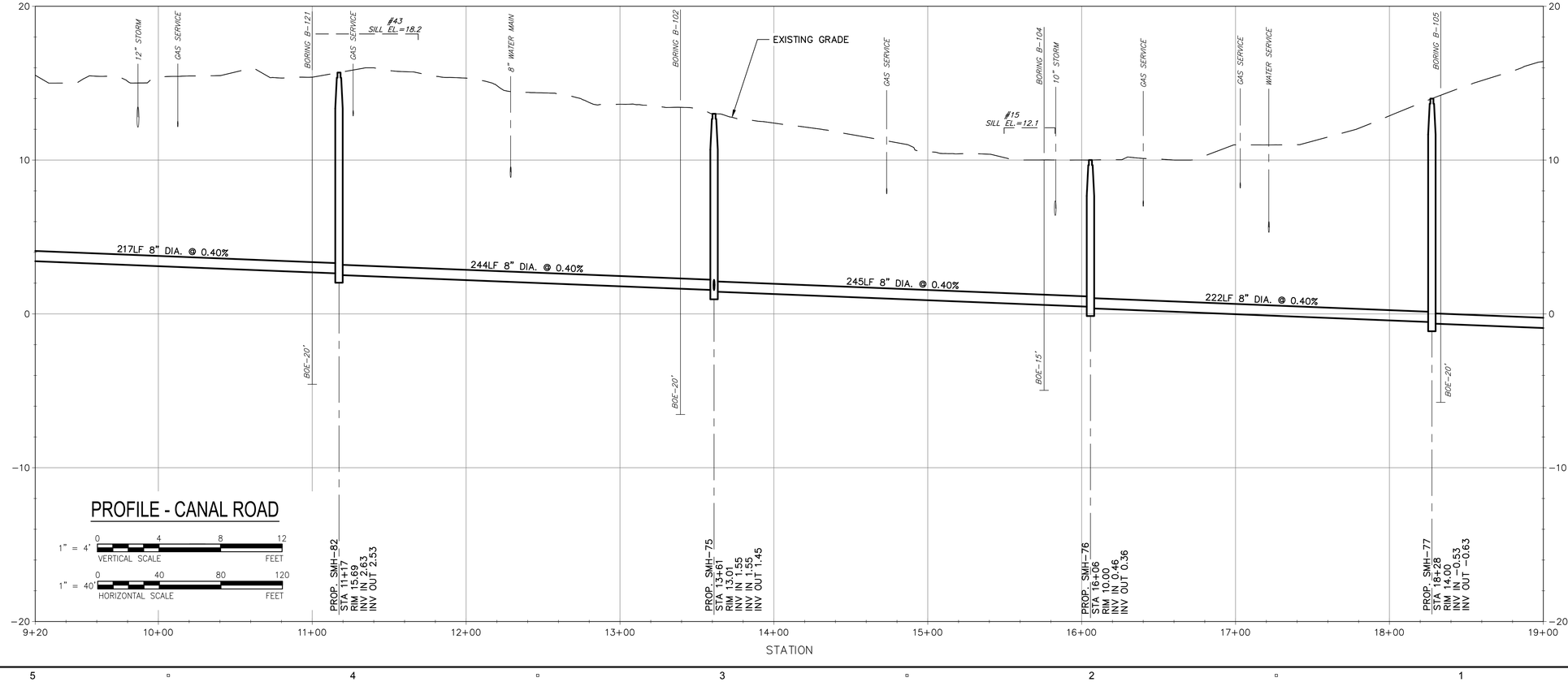
SHEET NUMBER

03 C-108



PLAN - CANAL ROAD

SCALE: 1"=40'



PROFILE - CANAL ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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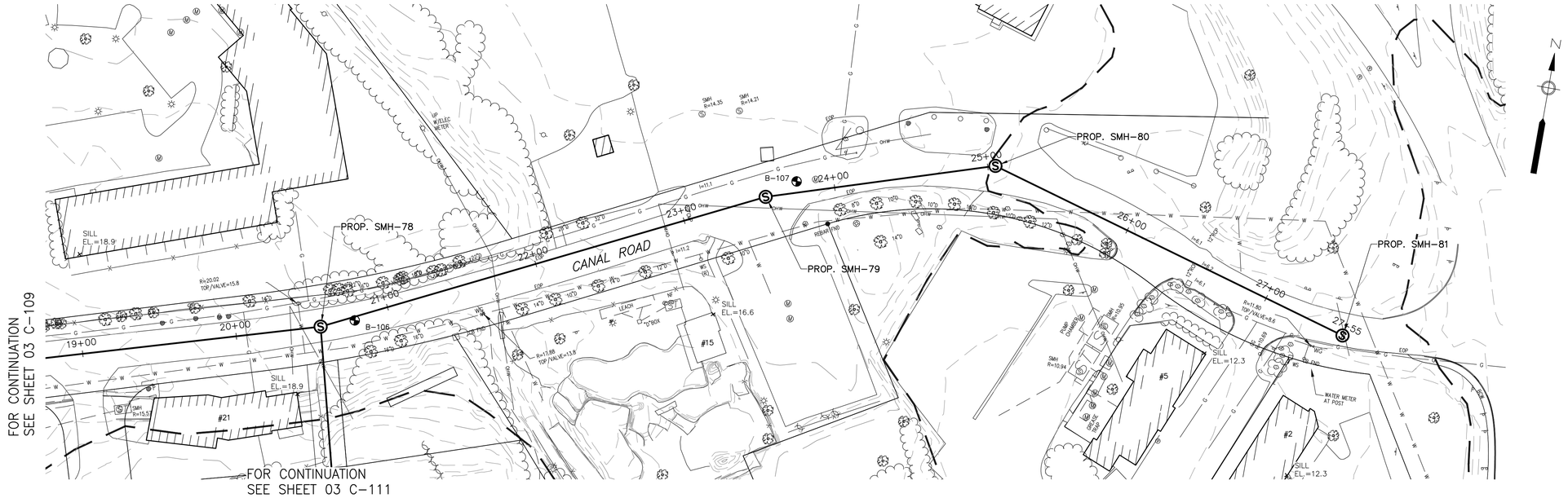
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SHEET TITLE

PLAN AND PROFILE SEWER CANAL ROAD II

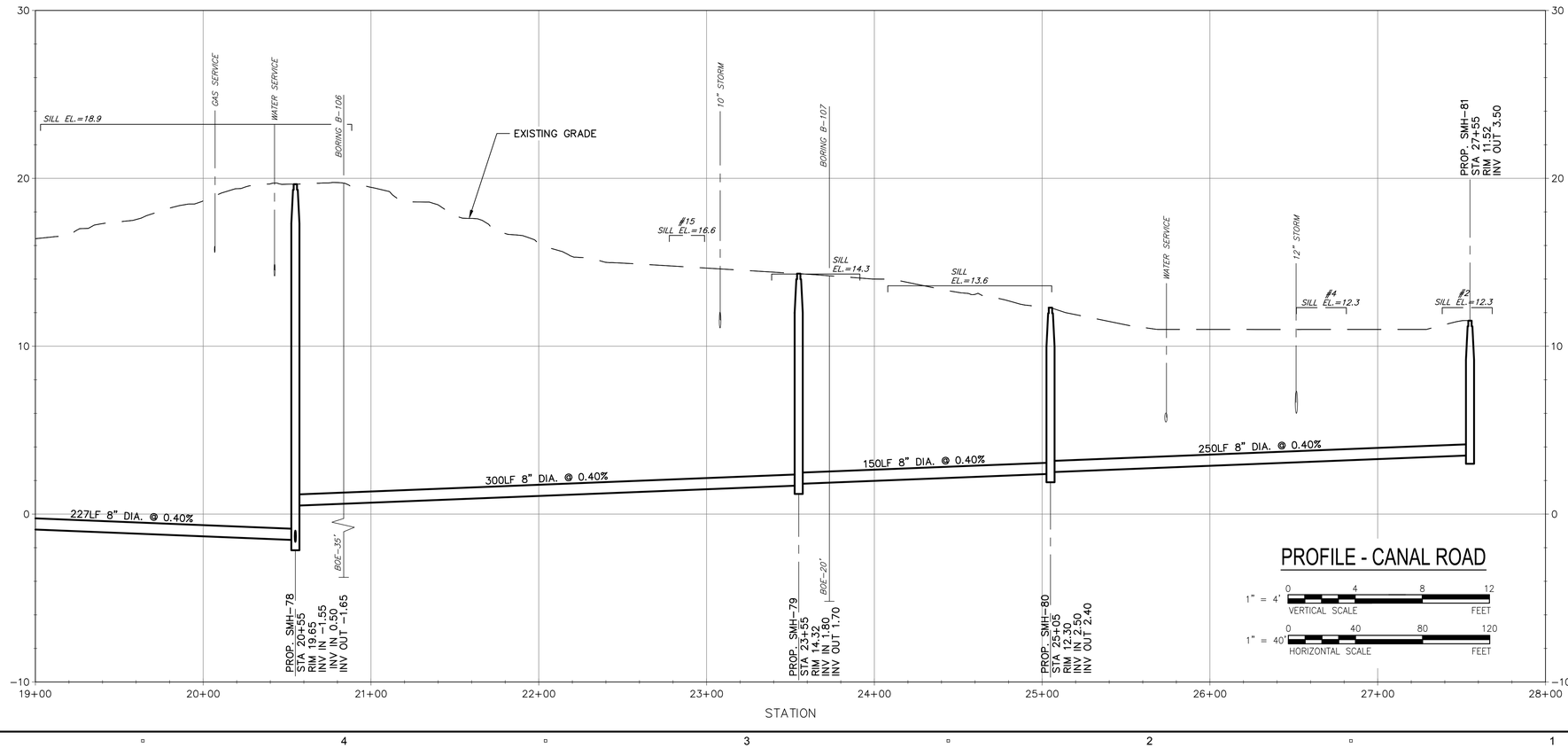
SHEET NUMBER

03 C-109



PLAN - CANAL ROAD

SCALE: 1"=40'



PROFILE - CANAL ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

Project Management Initials: Designer:____ Checked:____ Approved:____

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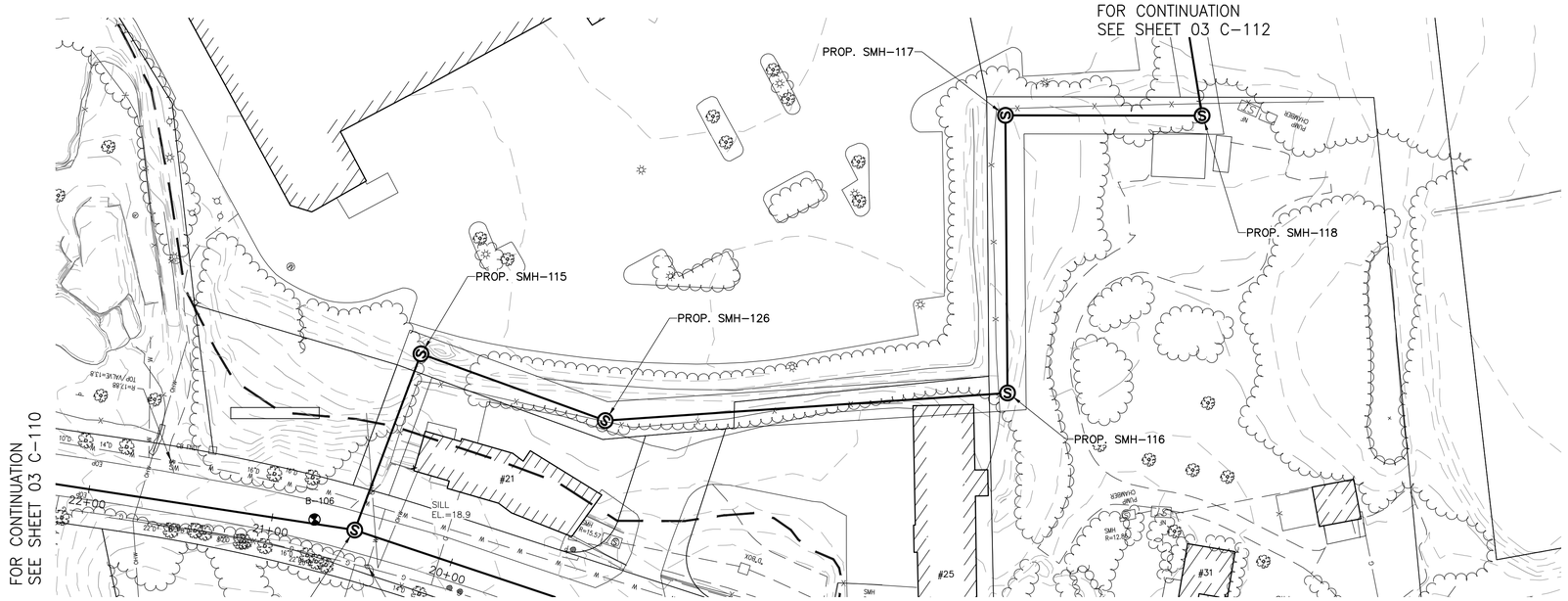
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SHEET TITLE

PLAN AND PROFILE SEWER
CANAL ROAD III

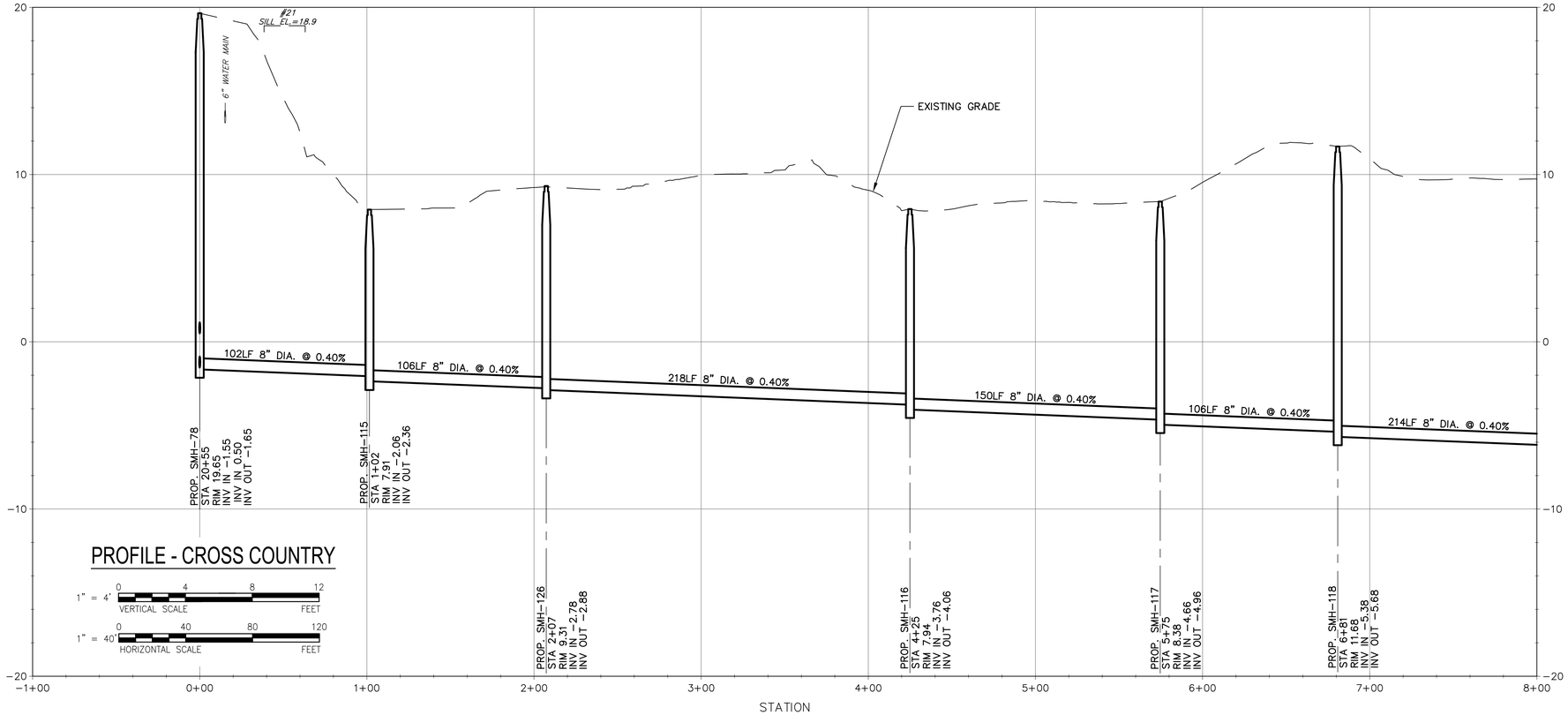
SHEET NUMBER

03 C-110



PLAN - CROSS COUNTRY

SCALE: 1"=40'



PROFILE - CROSS COUNTRY

1" = 4' VERTICAL SCALE: 0, 4, 8, 12 FEET

1" = 40' HORIZONTAL SCALE: 0, 40, 80, 120 FEET

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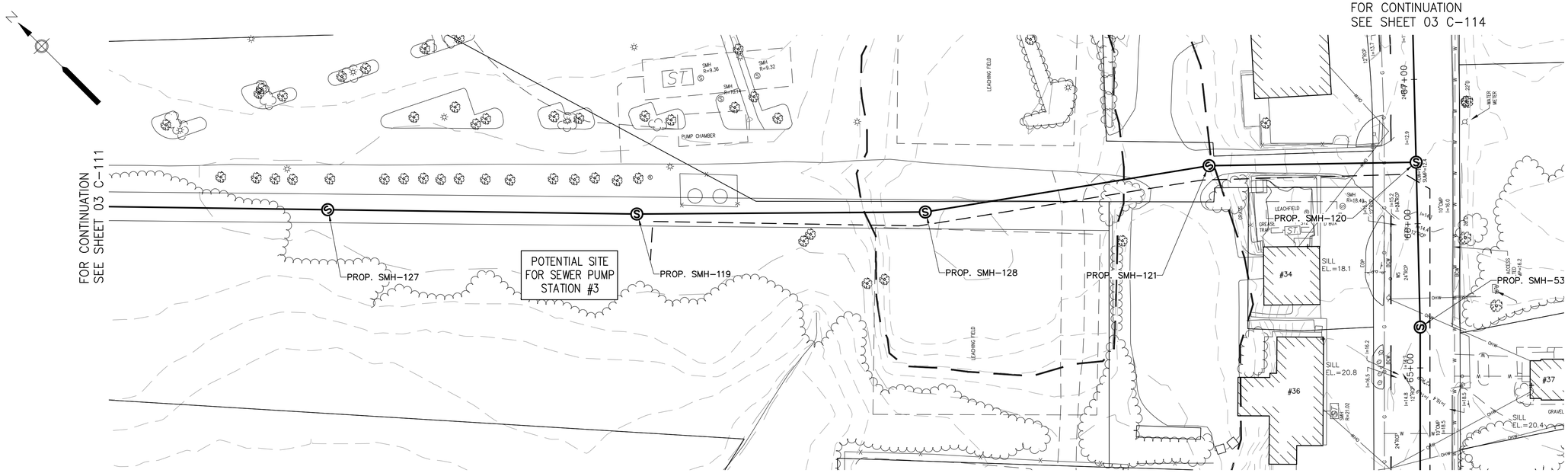
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SHEET TITLE

PLAN AND PROFILE SEWER
CROSS COUNTRY I

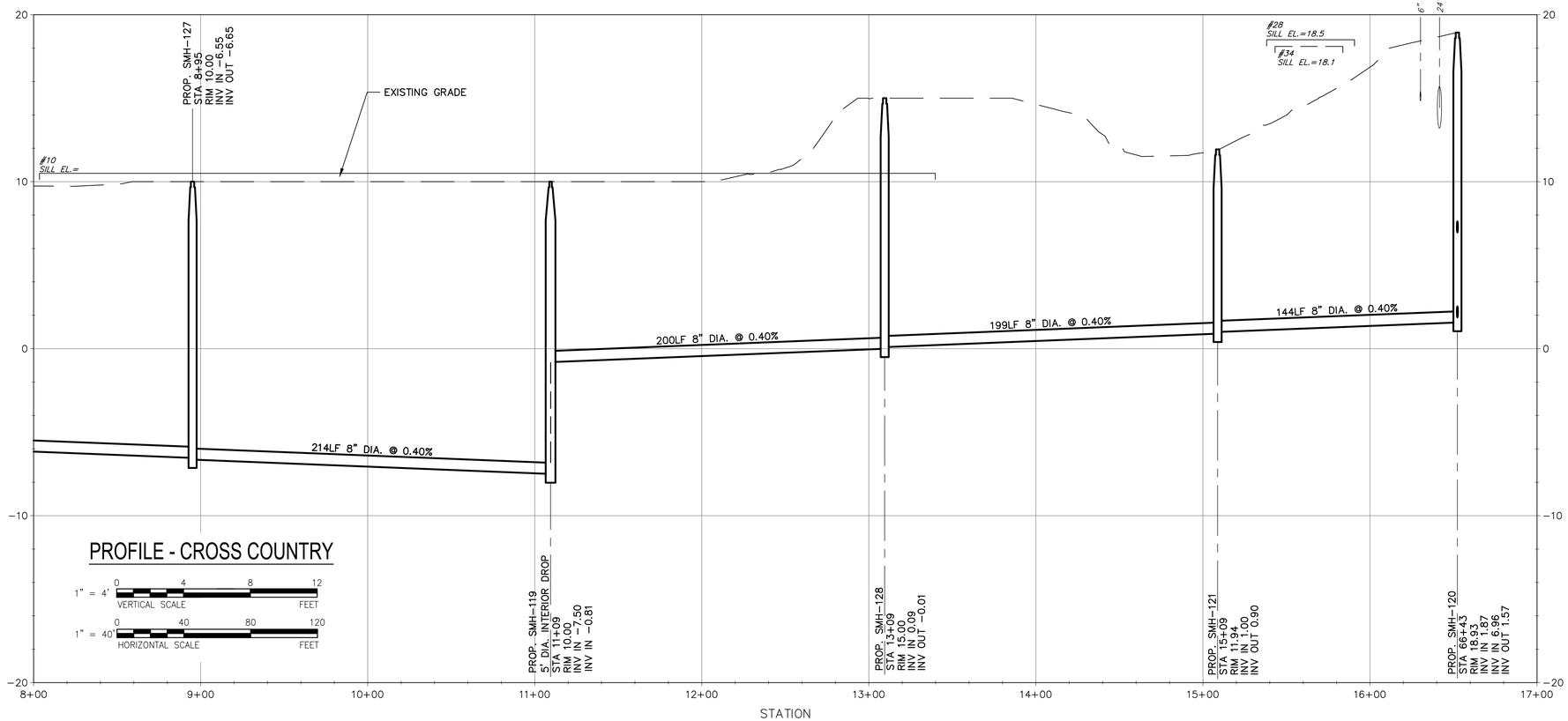
SHEET NUMBER

03 C-111



PLAN - CROSS COUNTRY

SCALE: 1"=40'



PROFILE - CROSS COUNTRY

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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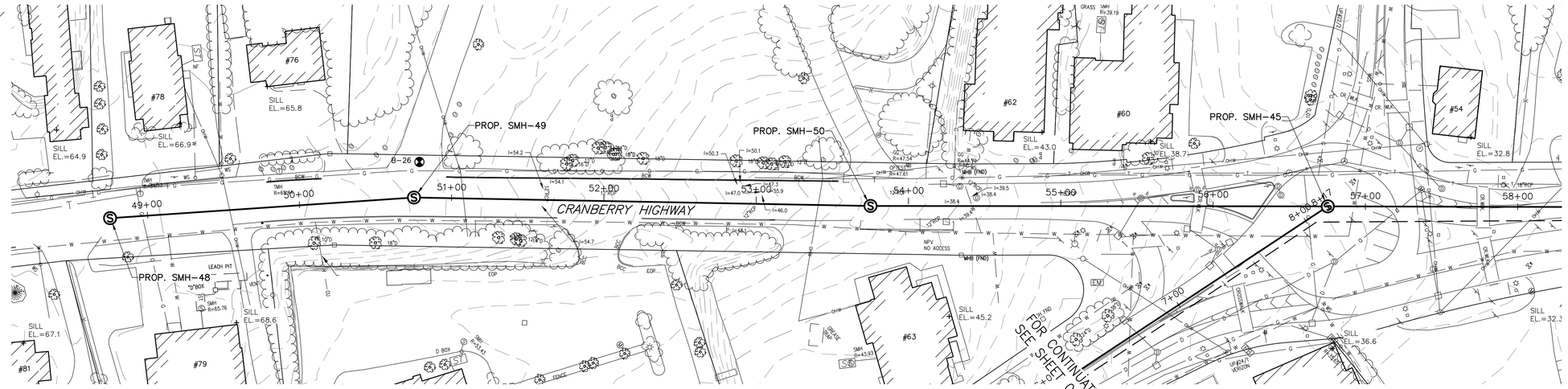
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SHEET TITLE

PLAN AND PROFILE SEWER
CROSS COUNTRY II

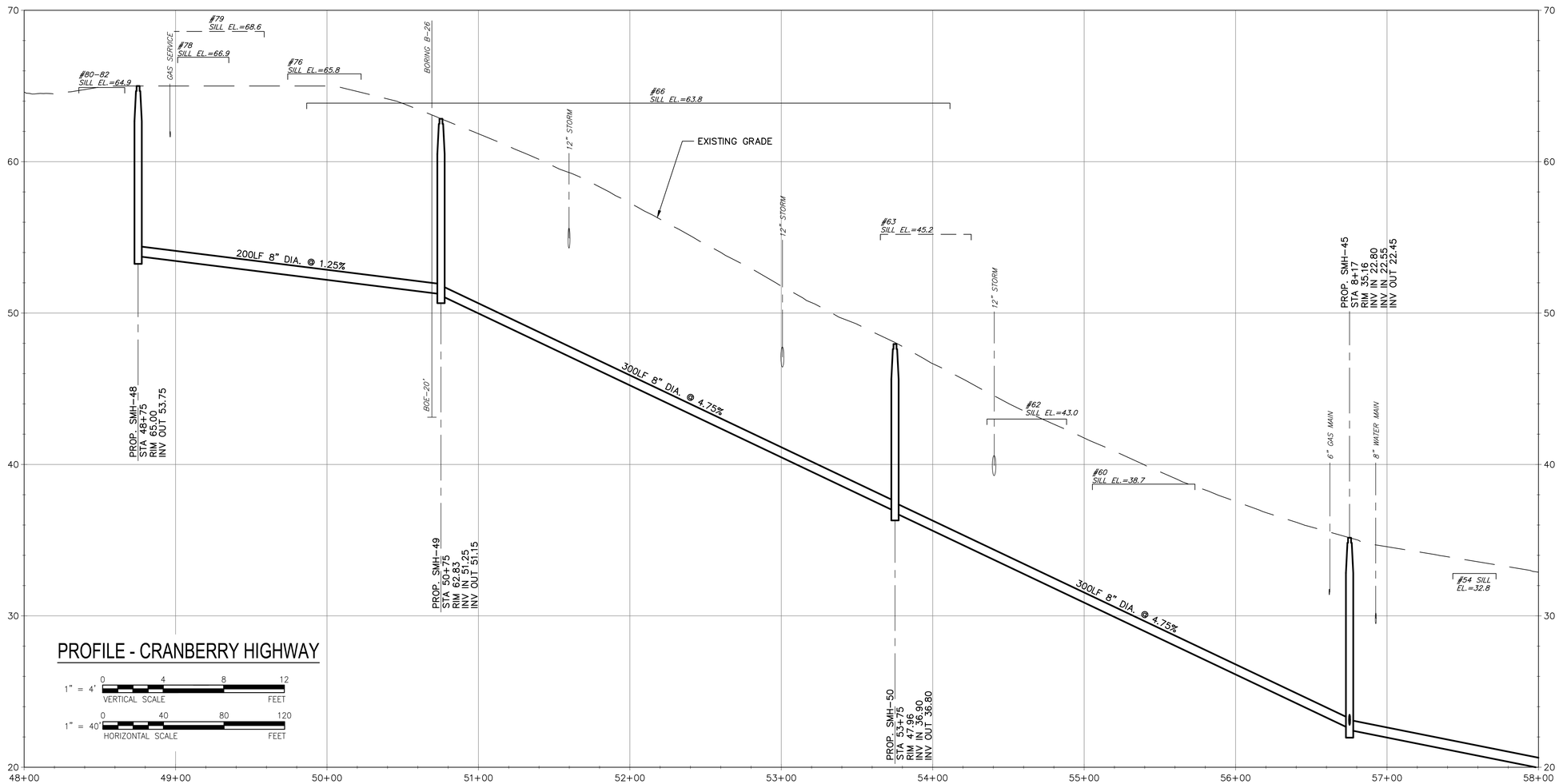
SHEET NUMBER

03 C-112



PLAN - CRANBERRY HIGHWAY

SCALE: 1"=40'



PROFILE - CRANBERRY HIGHWAY

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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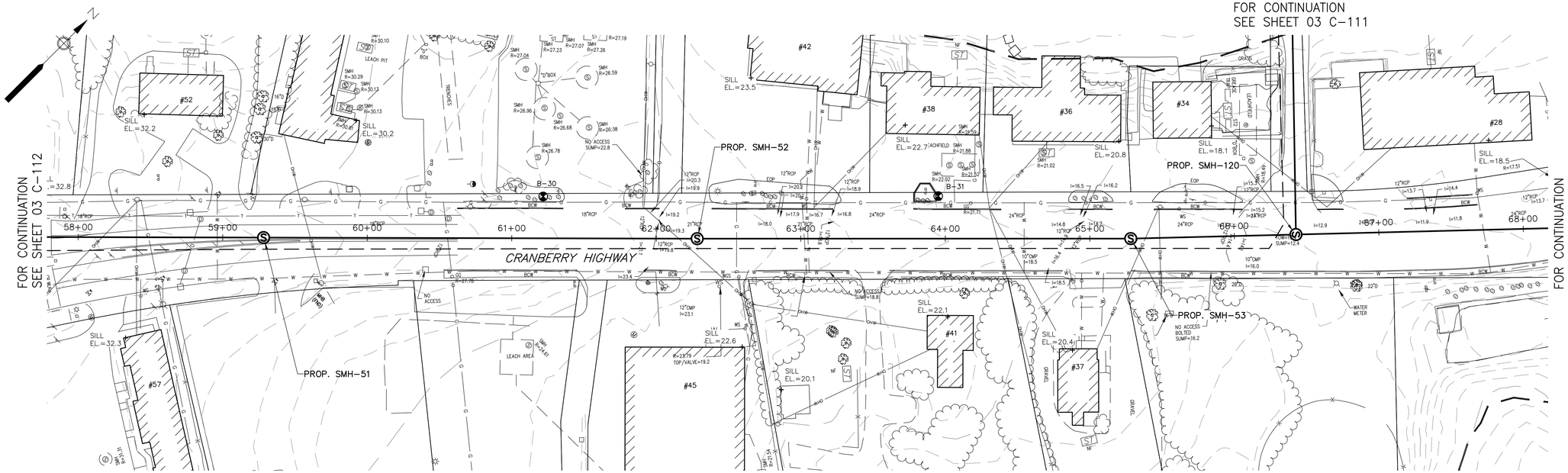
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SHEET TITLE

PLAN AND PROFILE SEWER
CRANBERRY HIGHWAY I

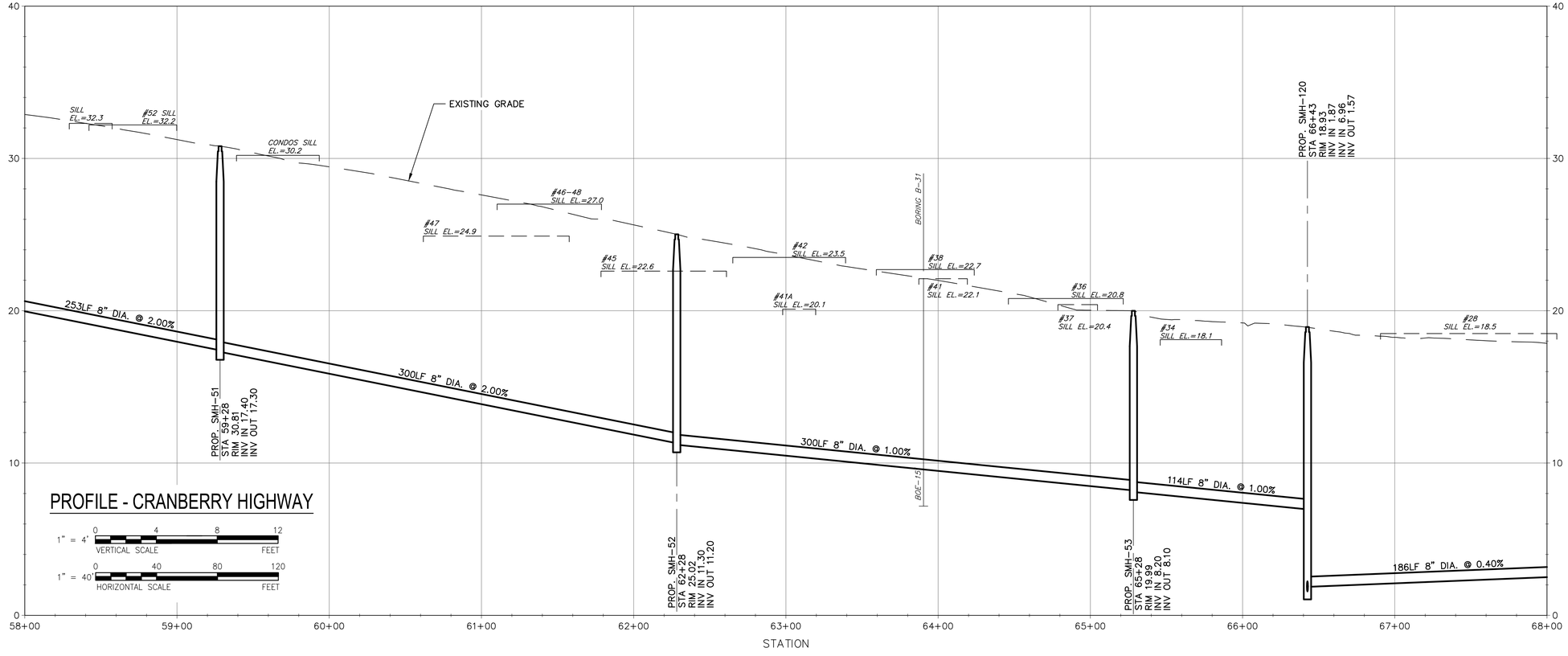
SHEET NUMBER

03 C-113



PLAN - CRANBERRY HIGHWAY

SCALE: 1"=40'



PROFILE - CRANBERRY HIGHWAY

1" = 4' VERTICAL SCALE 0 4 8 12 FEET

1" = 40' HORIZONTAL SCALE 0 40 80 120 FEET

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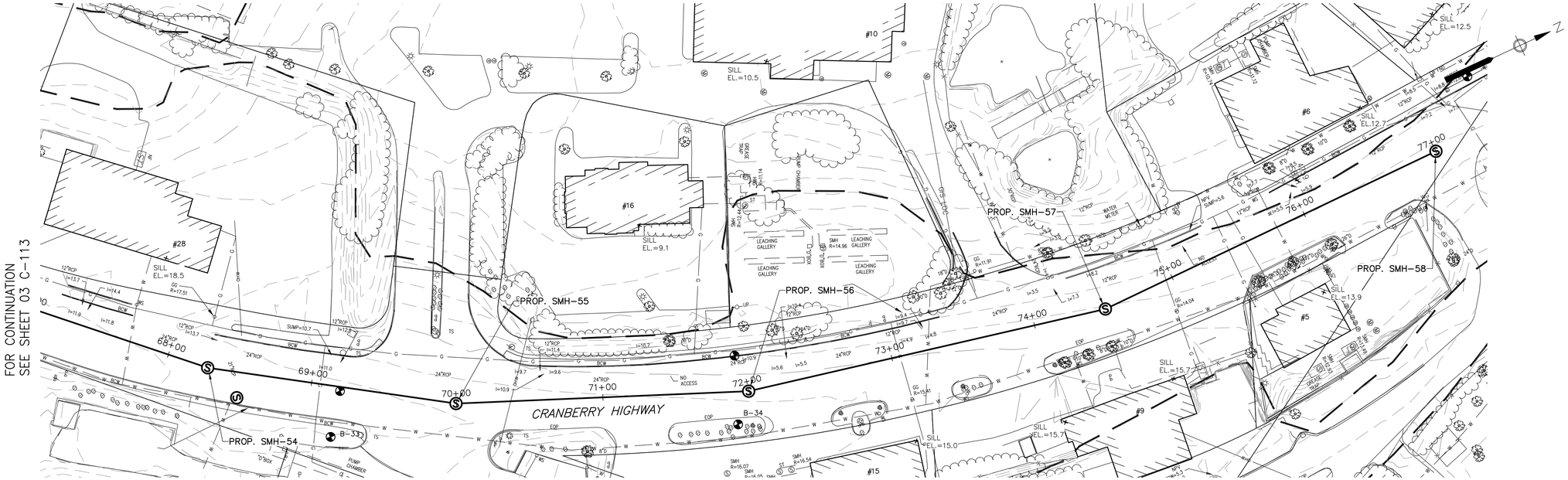
CIVIL

SHEET TITLE

PLAN AND PROFILE SEWER
CRANBERRY HIGHWAY II

SHEET NUMBER

03 C-114



PLAN - CRANBERRY HIGHWAY

SCALE: 1"=40'



PROFILE - CRANBERRY HIGHWAY

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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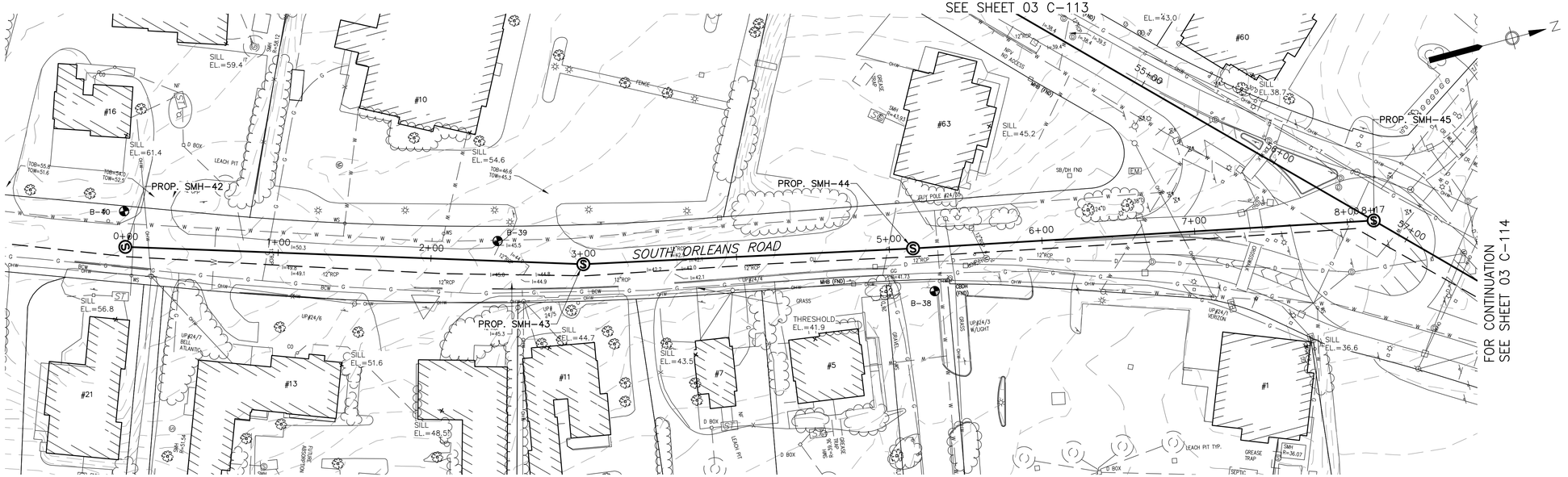
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SHEET TITLE

PLAN AND PROFILE SEWER
CRANBERRY HIGHWAY III

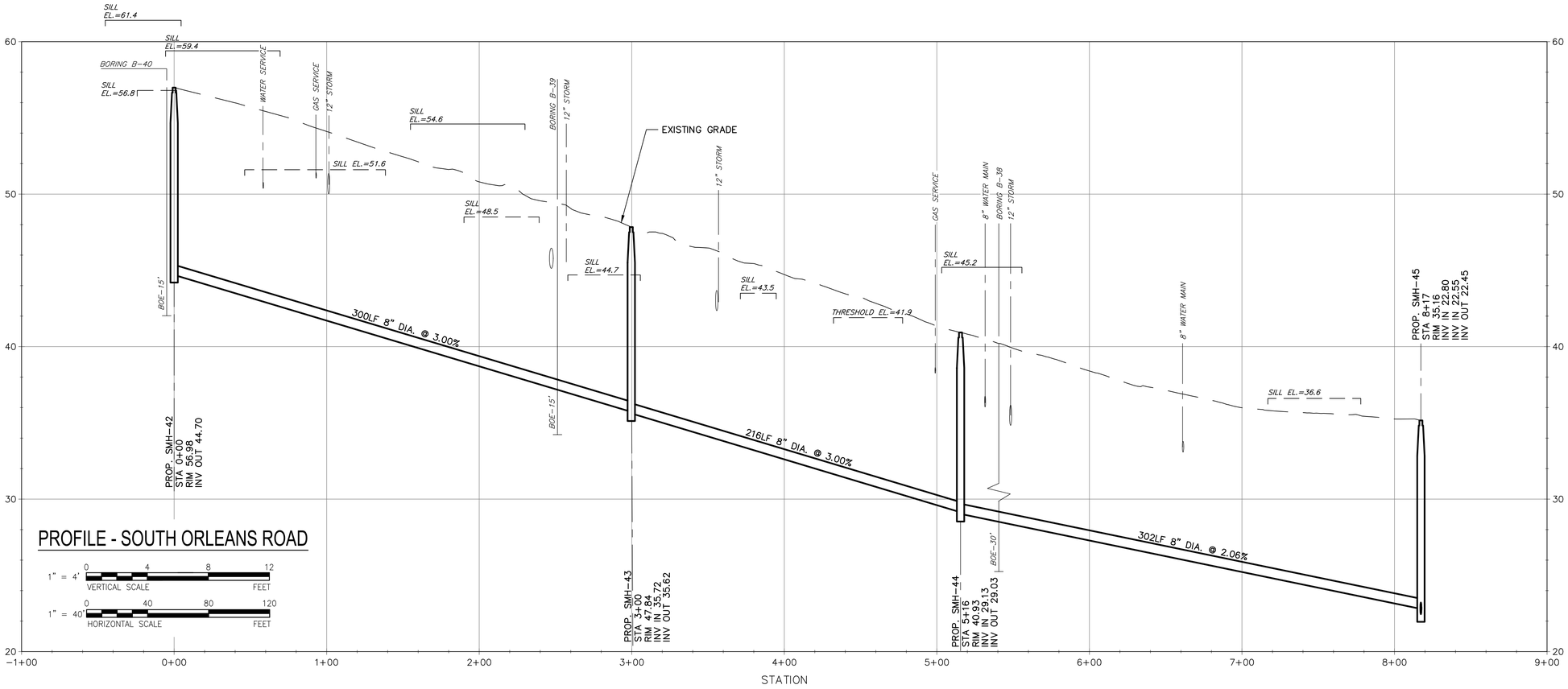
SHEET NUMBER

03 C-115



PLAN - SOUTH ORLEANS ROAD

SCALE: 1"=40'



PROFILE - SOUTH ORLEANS ROAD

1" = 4' VERTICAL SCALE (0, 4, 8, 12 FEET)

1" = 40' HORIZONTAL SCALE (0, 40, 80, 120 FEET)

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SHEET TITLE

PLAN AND PROFILE SEWER
SOUTH ORLEANS RD

SHEET NUMBER

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Appendix G

Downtown Area Collection System Life Cycle Cost Analysis

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Town of Orleans, MA
FY 2016 Water Quality and Wastewater Planning
Collection System Comparison for Downtown Area

Description	Unit	Unit Cost	Single System GS		Single System STEG		Single System LPS		Single System VS		Single System STEP		Hybrid System Hybrid (GS and LPS)		Hybrid System Hybrid (GS and STEP) 100% Tank Replacement	
Gravity Sewer	L.F.	$ 125	29,500	$ 3,687,500									29,500	$ 3,687,500	29,500	$ 3,687,500
Force Main	L.F.	$ 120	10,000	$ 1,200,000	17,500	$ 2,100,000	2,300	$ 276,000	15,000	$ 1,800,000	2,300	$ 276,000	7,500	$ 900,000	7,500	$ 900,000
Low Pressure Sewer	L.F.	$ 100					29,500	$ 2,950,000					2,200	$ 220,000		
Vacuum Sewer	L.F.	$ 110							29,500	$ 3,245,000						
STEP Force Main	L.F.	$ 100									29,500	$ 2,950,000			2,200	$ 220,000
STEG Sewer	L.F.	$ 125			29,500	$ 3,687,500										
Submersible Pump Station	Each	$ 275,000	2	$ 550,000	2	$ 550,000										
Wet Pit /Dry Pit Pump Station	Each	$ 468,000														
Custom Pump Station	Each	$ 585,000	3	$ 1,755,000	3	$ 1,755,000	1	$ 585,000			1	$ 585,000	3	$ 1,755,000	3	$ 1,755,000
Vacuum Pump Station	Each	$ 860,000							5	$ 4,300,000						
Gravity Sewer - Private Property	Each	$ 7,800	331	$ 2,581,800									263	$ 2,051,400	263	$ 2,051,400
Low Pressure Sewer - Private Property	Each	$ 12,000					331	$ 3,972,000					52	$ 624,000		
Vacuum Sewer - Private Property	Each	$ 10,250							331	$ 3,392,750						
STEP - Private Property	Each	$ 16,400									331	$ 6,173,150			52	$ 969,800
STEG - Private Property	Each	$ 7,800			331	$ 3,326,550										
Subtotal				$ 9,774,300		$ 11,419,050		$ 7,783,000		$ 12,737,750		$ 9,984,150		$ 9,237,900		$ 9,583,700
Mobilization and Demobilization		5.0%		$ 488,715		$ 570,953		$ 389,150		$ 636,888		$ 499,208		$ 461,895		$ 479,185
Subtotal				$ 10,263,015		$ 11,990,003		$ 8,172,150		$ 13,374,638		$ 10,483,358		$ 9,699,795		$ 10,062,885
Overhead and Profit		22.0%		$ 2,257,900		$ 2,637,800		$ 1,797,900		$ 2,942,400		$ 2,306,300		$ 2,134,000		$ 2,213,800
Subtotal				$ 12,520,915		$ 14,627,803		$ 9,970,050		$ 16,317,038		$ 12,789,658		$ 11,833,795		$ 12,276,685
Contingency - "High"		25.0%		$ 3,130,200		$ 3,657,000		$ 2,492,500		$ 4,079,300		$ 3,197,400		$ 2,958,400		$ 3,069,200
Construction Total				$ 15,651,115		$ 18,284,803		$ 12,462,550		$ 20,396,338		$ 15,987,058		$ 14,792,195		$ 15,345,885
Town Administration and Engineering																
Town Administration		5.0%		$ 2,032,600		$ 2,164,200		$ 873,100		$ 2,269,800		$ 1,049,400		$ 1,489,600		$ 1,517,300
Engineering - Planning/Consultation		5.0%		$ 782,600		$ 914,200		$ 623,100		$ 1,019,800		$ 799,400		$ 739,600		$ 767,300
Engineering - Design		10.0%		$ 1,565,100		$ 1,828,500		$ 1,246,300		$ 2,039,600		$ 1,598,700		$ 1,479,200		$ 1,534,600
Engineering - Construction		15.0%		$ 2,347,700		$ 2,742,700		$ 1,869,400		$ 3,059,500		$ 2,398,100		$ 2,218,800		$ 2,301,900
Total Estimated Project Cost				**$ 22,379,115**		**$ 25,934,403**		**$ 17,074,450**		**$ 28,785,038**		**$ 21,832,658**		**$ 20,719,395**		**$ 21,466,985**
Annual Operation and Maintenance Cost																
Operations	Hrs.	$ 65	3,380	$ 219,700	3,380	$ 219,700	2,340	$ 152,100	3,380	$ 219,700	2,340	$ 152,100	2,860	$ 185,900	2,860	$ 185,900
Utilities, Chemicals, etc.	Ea.	$ 40,000	5	$ 200,000	5	$ 200,000	1	$ 40,000	5	$ 200,000	1	$ 40,000	3	$ 120,000	3	$ 120,000
Clean and TV - GS	L.F.	$ 5	7,375	$ 36,875	7,375	$ 36,875	-	$ -	-	$ -	-	$ -	7,375	$ 36,875	7,375	$ 36,875
Clean and TV - Pressure Pipes	L.F.	$ 2	10,000	$ 20,000	17,500	$ 35,000	31,800	$ 63,600	44,500	$ 89,000	31,800	$ 63,600	9,700	$ 19,400	9,700	$ 19,400
Private Property - Pumps/Valves	Ea.	$ 125	-	$ -	-	$ -	331	$ 41,375	331	$ 41,375	331	$ 41,375	52	$ 6,500	52	$ 6,500
On-Site System Pump Out	Ea.	$ 133	-	$ -	331	$ 44,133	-	$ -	-	$ -	331	$ 44,133	-	$ -	52	$ 6,933
Annual Replacement Costs																
Allowance - Pump Stations	Ea.	$ 33,367	5	$ 166,835	5	$ 166,835	1	$ 33,367	5	$ 166,835	1	$ 33,367	3	$ 100,101	3	$ 100,101
Private Property - Pumps/Valves	Ea.	$ 2,500	-	$ -	-	$ -	17	$ 41,375	17	$ 41,375	17	$ 41,375	3	$ 6,500	3	$ 6,500
Annual Monitoring Costs																
Allowance - Pump Stations	Ea.	$ 2,500	5	$ 12,500	5	$ 12,500	1	$ 2,500	5	$ 12,500	1	$ 2,500	3	$ 7,500	3	$ 7,500
Private Property - Pumps/Valves	Ea.	$ 130	-	$ -	-	$ -	331	$ 43,030	331	$ 43,030	331	$ 43,030	52	$ 6,760	52	$ 6,760
Total Estimated Annual Cost				**$ 655,910**		**$ 715,043**		**$ 417,347**		**$ 813,815**		**$ 461,480**		**$ 489,536**		**$ 496,469**
Estimated Present Value				**$ 32,137,000**		**$ 36,572,000**		**$ 23,283,000**		**$ 40,893,000**		**$ 28,699,000**		**$ 28,002,000**		**$ 28,853,000**
Rate:		3.0%											Difference			$ (851,000)
No. of Periods:		20														

Land Purchase per Acre		$	250,000
On-Site System Pump Out	Number of Years		3
	Cost Per Pump Out	$	400
	Cost per Year	$	133
Annual Monitoring Costs	Number per Hours		2
	Cost per Hour	$	65
	Cost per Year	$	130

Town of Orleans, MA
Water Quality and Wastewater Planning
STEP and LPS Unit Price Comparison

Description	STEP - Simplex Pump System		STEP - Duplex Pump System		Low Pressure Sewer
	Orenco Proposal	Adjusted Proposal	Orenco Proposal	Adjusted Proposal	Marion MA
Pump Out and Abandon Septic Tank	$0	$750	$0	$750	$750
New Septic Tank (1,000 gallons)	$1,250	$0	$1,250	$0	$0
Access Equipment (2 ft and 4 ft Burial Depth)	$382	$382	$382	$382	$0
New Septic Tank (1,500 gallons)	$0	$1,750	$0	$1,750	$0
STEP Pumping Equipment	$1,433	$1,433	$2,363	$2,363	$2,750
10-Year Warranty	$25	$25	$50	$50	$50
Control Panel (Non-Telemetry)	$450	$450	$1,266	$1,266	$750
Lateral and Connection (Ball Valve and Check Valve)	$1,000	$0	$1,000	$0	$0
Connection (Ball Valve and Check Valve)	$0	$250	$0	$250	$250
Piping (75 LF at $25)	$0	$1,875	$0	$1,875	$1,875
Electrical (Service Upgrade Not Included)	$0	$750	$0	$750	$750
Installation Estimate (60% of Materials)	$2,109	$4,149	$3,156	$5,212	$3,855
Shipping Estimate (10% of Materials, Not Including Tank)	$351	$0	$526	$0	$0
Shipping Estimate	$0	$767	$0	$944	$718
Site Restoration	$0	$1,000	$0	$1,000	$750
Unit Price Totals	$7,000	$13,581	$9,993	$16,591	$12,498
Unit Price Used		$13,600		$16,600	$12,500

Marion, MA Private Property Betterments

Neighborhood	Converse	Berry	Dexter	Totals
Total	$1,607,895	$1,137,047	$1,249,804	$3,994,746
Number of Connections	194	133	156	483
Average	$8,288	$8,549	$8,012	$8,271

2006 Costs. Use 3 percent per year to bring costs to 2017 which equals $11450.