

Pressure System Design Report

For

Pine Tree LLC

Holden, MA

August 18, 2021



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Sent VIA Email

RE: Holden Pine Tree, LLC, Holden, MA

Dear Susan:

This preliminary design analysis examines the use of the E/One Pressure Sewer System for your project. E/One is celebrating over 50 years of installation and O&M experience along with considerable research and development leading to continuous product and system improvements. E/One remains the worldwide industry standard and industry leader in the pressure sewer technology. The unique characteristics of the E/One Pressure Sewer approach provides not only a technical solution, but also an economic advantage to be realized with low up front and O&M costs.

System Analysis

We have used the plan information your office provided to prepare this report for 4 units to connect to the gravity manhole at Station 20+00.

Our design follows highly vetted and tested hydraulic practices. We use the Rational Method for calculating system conditions of flow velocity, head-loss, and ultimate total dynamic head or TDH for pump operations. We use a very predictable pump output with Semi-positive displacement pumps capable of operating at a wide range of variable head conditions under a predictable output.

**Head Loss Calculations
 From Modified Hazen - Williams Formula**

$$H_f = .2083 \left[\left(\frac{100}{C} \right)^{1.852} \times \frac{q^{1.852}}{d^{4.8655}} \right]$$

$$V = .3208 \frac{q}{A}$$

$$A = \frac{d^2 \pi}{4} = \text{cross-sectional flow, sq. in.}$$

$$C = 150$$

$$q = \text{flow in gallons per minute}$$

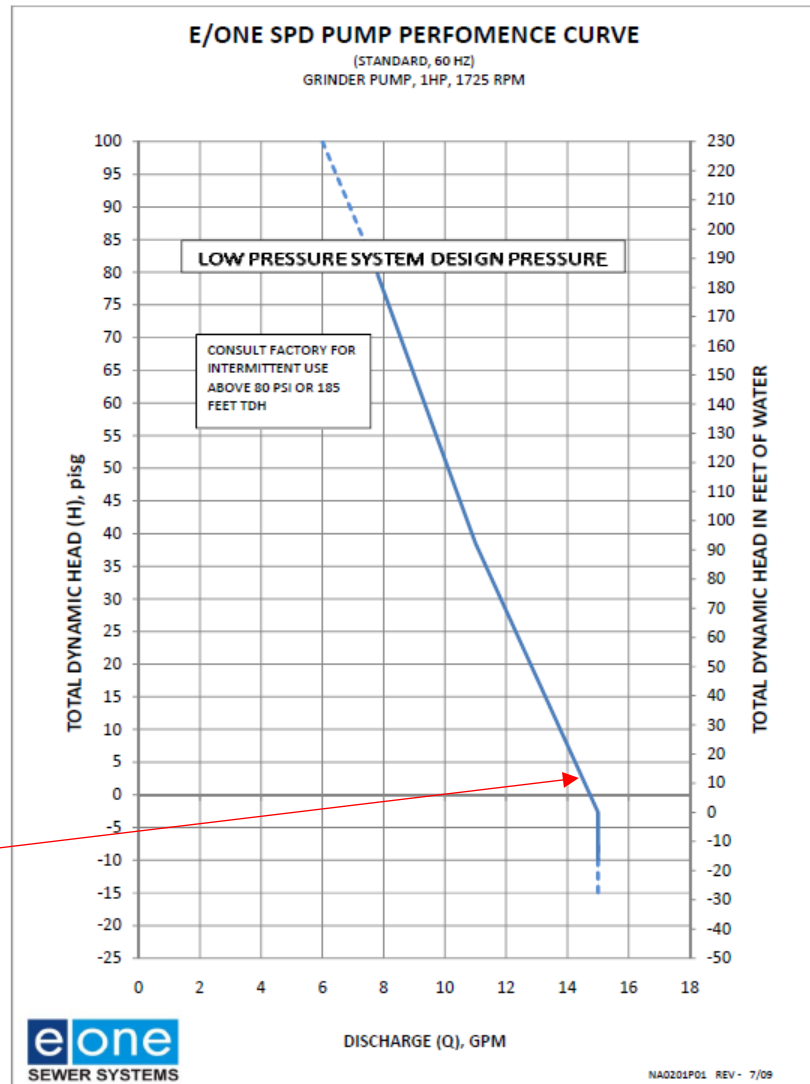
$$d = \text{I.D. of pipe in inches} =$$

$$[\text{average O.D.} - (2 \times \text{min. wall thickness})]$$

Computations are based on the Modified Hazen-Williams formula for friction loss, using calculations of cross-sectional area and flow rate to determine pipe sizes that create "self-cleaning" velocities of 2.0 fps or higher. A "C" factor of 150, SDR 11 HDPE pipe and/or SDR 11 HDPE are used in this report.

The Total Dynamic Head generated are approximately 5-feet. These conditions are primarily from friction losses with static heads of 7 feet or less.

This range is well below our pump's continuous-run rating of 185 ft, and well within its intermittent, i.e., normal, operating range. Flow velocity throughout the system meets or exceeds 2 fps. These characteristics and low retention time indicate that this will be a reliable, low-maintenance system.



Design Options

This system is designed for the four homes at the end of Pine Tree Road. As we have discussed, we can extend the pressure sewer very easily to reduce cost of deep gravity sewer in this area.

This system will work very well with very low head and low system retention time.

Our normal recommendations for valve placement are as follows: flushing connections at 1,000' to 1,500' intervals and at branch ends and junctions; isolation valves at branch junctions; and air release valves at peaks of 25 ft or more and/or at intervals of 2,000 to 2,500 ft. We recommend one terminal flushing manhole at the end of Zone # 1.

Design Flows & System Velocity

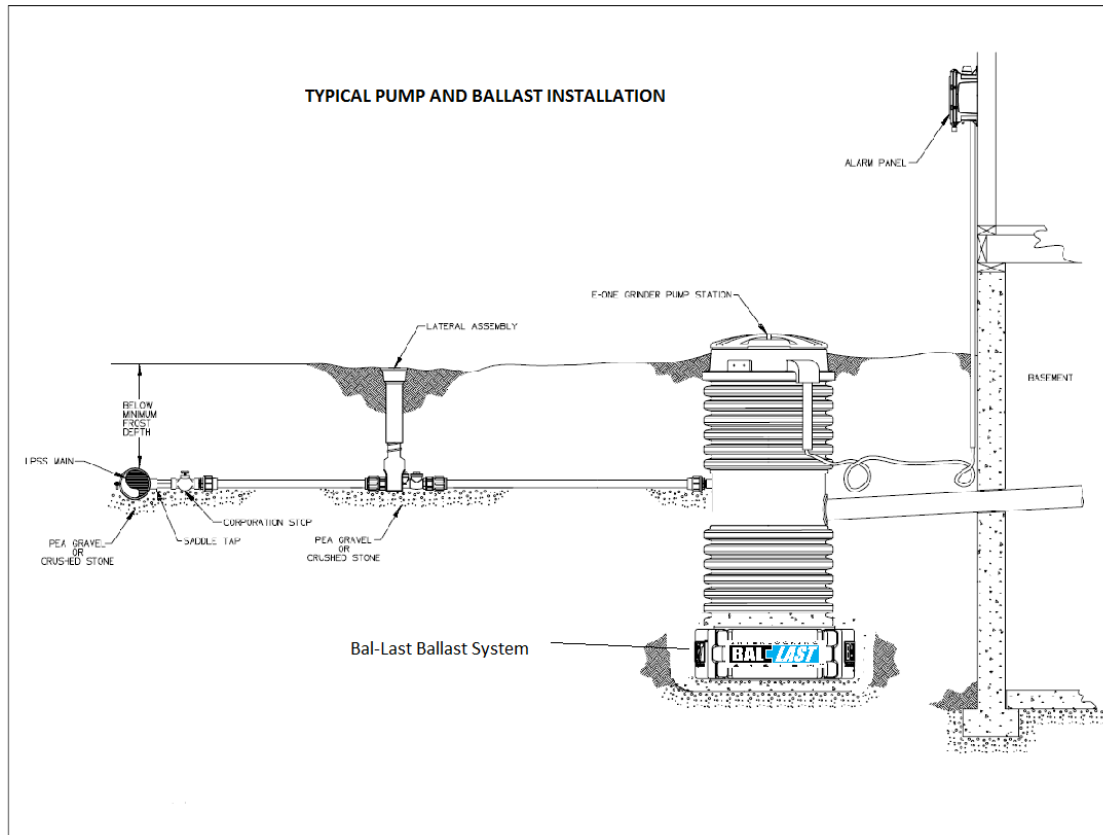
We normally use average daily flows for system designs rather than the peak design flows commonly used for gravity sewer sizing. We do this because the system is sealed, and void of inflow and infiltration commonly allowed for in gravity sewer designs.

We size the pipelines for the proper scouring velocity based on the pump's output which has a consistent flow rate over a wide range of head conditions. We then look at the pipeline retention time to optimize the line size for the lowest retention that will pass wastewater in a short period of time to reduce sediment in the lines and prevent odor issues. This makes for a very reliable and maintenance free wastewater collection system.

Often, we are asked to use the published "State" design values from various flow tables in order to secure approval. We can do this; but then we run the reports based on the actual predicted average flow to optimize the line size as mentioned above.

For seasonal communities we may see more flow during the peak season and then a drop off during off-season. The pump selection does not typically change regarding flushing velocity, flow rate, etc. The pump run durations will change as the flow changes. We try to be conservative with pipe sizing during off peak periods to maintain adequate fluid changes to keep the lines clear and free of odor issues.

The system retention times are very reasonable and should be trouble free under either flow condition.



This image shows the typical layout of an outdoor pump unit for single-family home use. The pump unit is furnished complete, ready for installation. The installer needs to confirm the power cord length and discharge and inlet configuration. Standard products are supplied with 32-foot power supply cable. Standard inlets are 4-inch Schedule 40 Grommets (@ zero degrees) with 1-1/4-inch discharge (@ 180 degrees). Other configurations are available.

Station covers are also available with flood tight covers and lateral venting if flood conditions are present. Please consult your distributor for more details.



Standard alarm panels are the Sentry® panel mounted outside of the home as shown in the drawing (above).

Options include emergency generator connection (see photo) and Redundant alarm Remote Sentry® panel shown. Other panel configurations are available. See the partial listing of panel options below.



• Basic Panels include circuit breaker for the pump and separate breaker for the alarm. These panels include alarm light, alarm buzzer and alarm silence button. ***All F. R. Mahony panels are equipped with dry contacts to enable the connection of the Remote Sentry® (battery powered redundant alarm panel option)***

- Standard options include auto transfer generator connection shown above. This panel provides automatic power transfer without having to open the alarm panel or having to operate any manual transfer switching. This feature can be added to the basic panel or the panels offered below.
- Popular options include the “**Protection Package**” which monitors and protects the system from:
 - Pump Run Dry Condition (Pump running out of water)
 - Pump Overpressure Condition (Closed valve)
 - Brownout Condition (Main voltage under 12% of nameplate)
 - High Liquid Level
- The “**Protect Plus**” panel features offer the same items in the “Protection Package” plus the following:
 - High & Low Amperage draw by the pump
 - High & Low voltage to the pump
 - Extended Runtime by the pump (indicating wear or excessive flow) (field adjustable settings)
 - Monitoring of:
 - Real-time Pump Voltage and Current
 - Cycles & Hours (can be reset)
 - Minimum & Maximum Amperage (can be reset)
 - Minimum, Maximum, Average, and Last Run Cycle (in minutes, can be reset)

Emergency Generator Transfer Options.

The outdoor pump units may be furnished with a receptacle for connection of emergency power supplies. The images to the right show the connection receptacle on the right side of our Sentry panels.

GENERATOR LOAD TRANSFER PROCEDURE

1. Open generator transfer switch cover.
2. Connect emergency power source (generator) to the panel by plugging it in using the properly sized connector to match the panel and generator.
Cables must be rated to 20-amp, 240-volt with L14-20 connectors.
3. Start the generator. If the portable generator is equipped with a circuit breaker, start generator with it off. Once the generator is at full power, turn the breaker on.
4. If the pump "on" level switch is calling for the pump to run, the pump will automatically start and will continue to run until the liquid level is at the "off" level.
5. If the basin is full to the "alarm" level the alarm will sound and may be silenced using the silence button described below. The pump will start, and the liquid level will be lowered to shut off the alarm light and horn (if not silenced) and will continue to pump until the water level is at the "off" level.
6. If the "on" switch is not calling for the pump to run, the system will remain functional until the liquid level is raised to the "on" level. Only when the "on" level is reached will the pump operate under normal or emergency power.
7. When normal power is restored, shut off the emergency generator supply and unplug the emergency power cord. The Access cover on the alarm panel should snap closed and remain closed under normal operation.

(no operator assistance shall be required to switch from one mode to the other. Manual transfer switches shall not be acceptable alternatives. Automatic transfer capability is required so the mode cannot be inadvertently left in the generator position after pumping down the station in generator mode as is the case with a manual transfer switch).



Pump models may be the DH071-93 (standard height) for outdoor use or the Model IH091 indoor unit. Both products are UL listed NSF and CSA certified and Massachusetts Plumbing Board Accepted.

Model DH071-93 Outdoor Pump With Bal-Last™

The outdoor model is complete - ready for installation and connection to exterior plumbing and power supply. This unit is fully tested for operation and factory leak tested. No assembly is required and there are no floats to adjust. The pump is furnished complete with the alarm panel and direct bury power supply cable. Standard cable length is 32 feet with 50, 75, and 100 and up to 150-foot cables available. (See Alarm Panel options above)



Other station configurations are available for higher flow requirements. Please contact us for more information. Additional information may be found at www.eone.com

Appurtenances

- Service Laterals and Check Valves

Common practice in pressure sewers requires the ability to isolate each lot with a corporation stop off the main and service lateral kit to the lot line. E/One now requires that each pump connection be isolated with a combination curb stop/redundant check valve.

E/One has developed a true wastewater rated check valve which is built into our stainless-steel lateral kit shown in this report. These components are rated to 235 psi and with standard connection fittings rated to 150 psi. These items are included in the budget analyses and shown in this report.

We strongly advise against the use of waterworks check valves as they are not rated for sewage environments. We do not like to recommend brass due to concerns for corrosion. **WEF Manual of Practice FD-12, Second Edition**, page 45 speaks to the limited success of brass or bronze alloys.

“Besides corrosion considerations, brass is subject to de-alloying, while some bronze, such as 85-5-5, will give better performance. The terms *brass* and *bronze* are used loosely, despite having different meanings; the engineer is advised to evaluate these materials with caution.”

We have also seen PVC body check valves with pressure rating to 150 psi that do not have the same rating for back pressure on the check valve. This can result in damage to the check valve and pumping issues as the check valve disc can become dislodged under pressure and then become a line obstruction.

- Corporation Stops/ Mainline Connections

Connections to the main pressure line do not require WYE type fittings. We commonly use a TEE or saddle connection. We isolate each connection to the main line with a stainless-steel corporation valve in the same manner used for other utilities such as gas and water services.

We recommend that the service laterals connect to the mainline and do not need to enter a cleanout manhole or other structure. These connections are very similar to a connection of a water service connection to a water or gas main.

The image below is an example of the proper connection of a pressure sewer service to a pressure sewer main line.



Budget Notes

Costs of pipeline excavation and pump installation are best obtained from sources in your region. We have used a simple dig-lay and backfill budget without surface restoration. You may be better able to determine these costs. I prefer to start with budget numbers up front to give you adequate information for planning purposes.

The pump panel options will dictate the final price of these stations.

I am looking forward to working with you on this and future projects. Please contact me if you have any questions or require additional information. We can furnish electronic copies of details and specifications on your request.

Best regards,

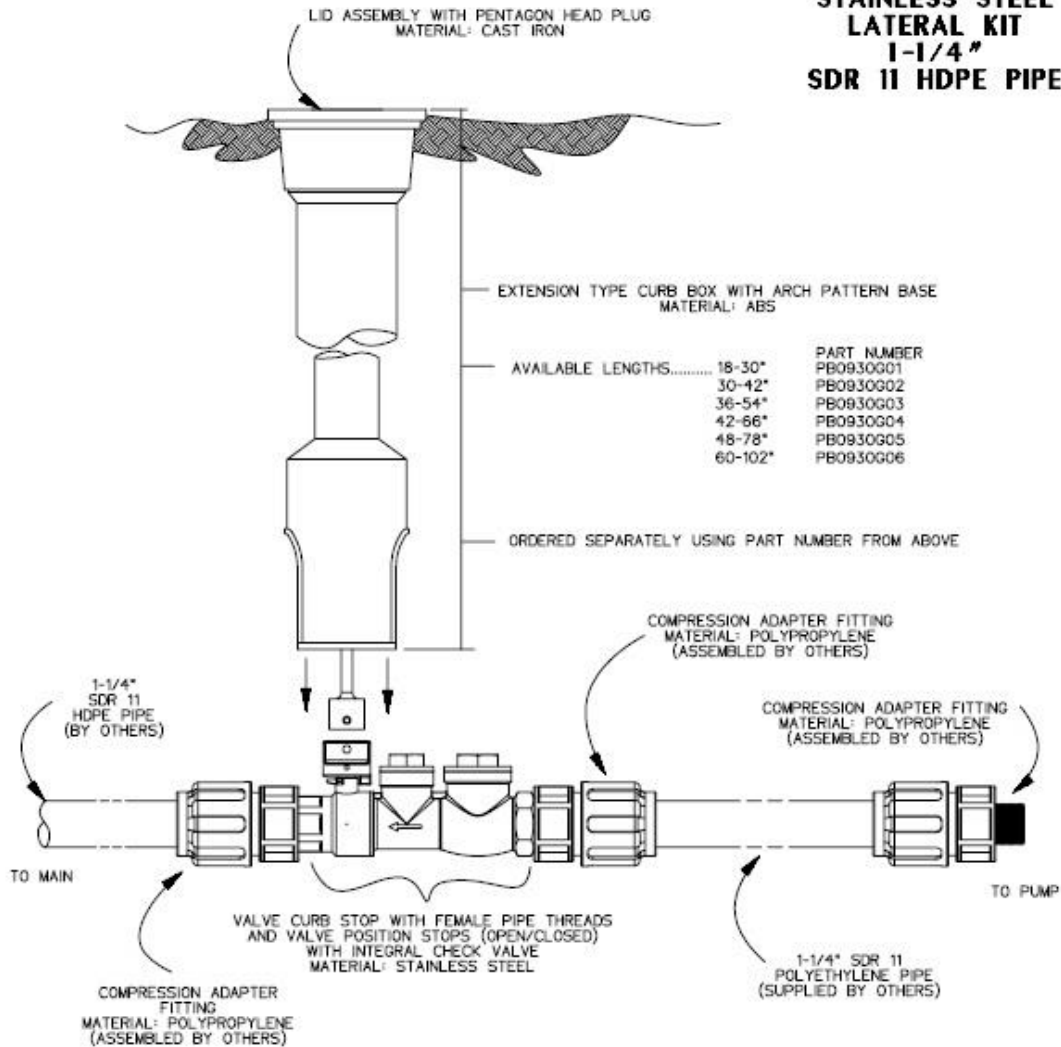
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Enclosures

**STAINLESS STEEL
 LATERAL KIT
 1-1/4"
 SDR 11 HDPE PIPE**



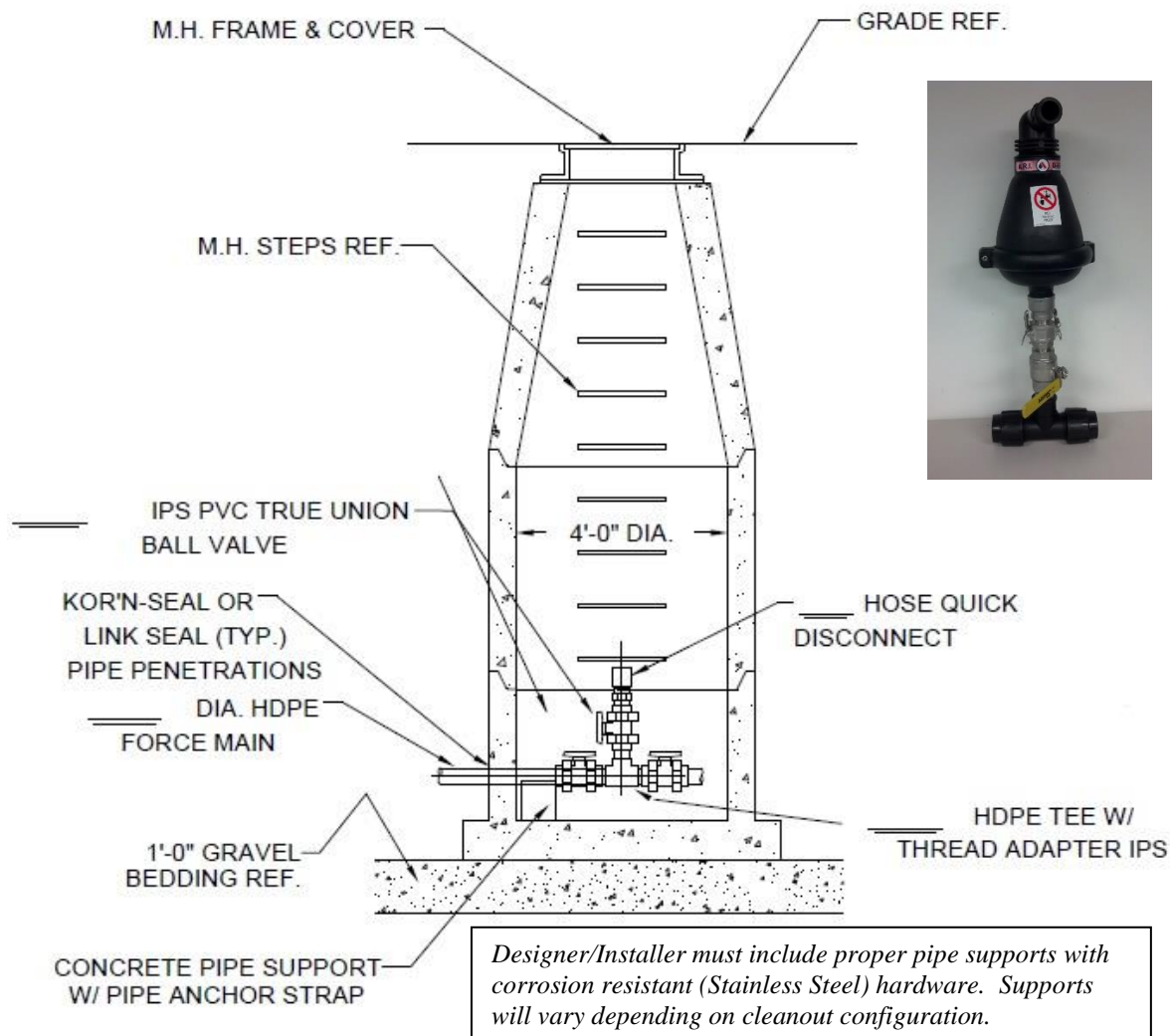
NOTES:

1. SS CURB STOP/CHECK VALVE AND FITTINGS ARE PROVIDED SEPARATELY, TO BE ASSEMBLED BY OTHERS
2. TO ASSEMBLE, APPLY A DOUBLE LAYER OF TEFLON TAPE, AND A LAYER OF PIPE DOPE (SUPPLIED BY OTHERS) TO THE THREADS ON THE PLASTIC FITTINGS AND INSTALL PER THE MANUFACTURER'S INSTRUCTIONS
3. ASSEMBLY IS TO BE PRESSURE TESTED (BY OTHERS)
4. ASSEMBLY IS TO BE USED WITH SDR11 HDPE PIPE
5. TO ORDER SS LATERAL KIT, USE PART NUMBER NCO193G01
6. CURB BOX IS TO BE ORDERED SEPARATELY, SEE ABOVE

KIT PARTS ARE NOT ASSEMBLED

SGS	DN	11/02/11	A	3/16
DR BY	CHK'D	DATE	ISSUE	SCALE
eone SEWER SYSTEMS				
STAINLESS STEEL LATERAL KIT 1-1/4" SDR 11 HDPE PIPE				
NA0330P02				

Example of Typical Cleanout Detail (Optional Air/Vacuum Valve shown –right)



Cleanout detail can be modified to match typical installation needs. Inline shut offs may be added to isolate flow direction. Image shown is flow through cleanout. These structures can be terminal end of line cleanouts, or junction cleanouts as may be required. Optional air and vacuum relief valves may be added when required. Air and Vacuum relief manholes must be vented to atmosphere for proper function.