Technical Report

Lake of the Woods Vacuum Sewer Evaluation

Locust Grove, VA

RAPSA 177782 | November 20, 2024

SEH

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November 20, 2024

RE: Lake of the Woods
Vacuum Sewer Evaluation
Technical Report
Locust Grove, VA
SEH No. RAPSA 177782 4.00

Mr. David Jarrell
Rapidan Service Authority
3489 Germanna Hwy
Locust Grove, VA 22508

Dear David Jarrell:

Please accept the enclosed Technical Report summarizing the Lake of the Woods vacuum sewer evaluation. This technical report includes a condition assessment of each vacuum sewer station and an analysis of recommended improvements.

We look forward to discussing the findings in this report with your staff. If you have any questions, please don't hesitate to call me at 434.996.9492 or email at twebb@sehinc.com.

Sincerely,

Thad Webb, PE
Project Manager
(Lic. VA, NH)

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Technical Report

Lake of the Woods
Vacuum Sewer Evaluation
Locust Grove, VA

SEH No. RAPSA 177782

November 20, 2024

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the Commonwealth of Virginia.

Thad Webb, PE

Date: November 18, 2024 License No.: 0402066332

Reviewed By: Fasil Yitbarek, PE Date: November 18, 2024

Short Elliott Hendrickson Inc.
400 Locust Avenue, Suite 2
Charlottesville, VA 22902-4858
434.202.3780

Executive Summary

The Lake of the Woods vacuum sewer system is an aging system that was built before modern vacuum sewer system construction standards were developed. Many of the operational and maintenance issues result from the construction methods used in the vacuum mains and cannot be fixed in an economical manner. The Rapidan Service Authority (RSA) has improved the system over time by upgrading the wastewater pumping systems, addressing leaking collection tanks throughout the system, optimizing operational procedures, and installing remote monitoring of the vacuum stations. Although the Authority has done an admirable job extending the life of the infrastructure and making in-house improvements to optimize the system, a comprehensive upgrade is needed. The following issues remain which must be addressed to maintain the existing level of service and reduce the frequency of sanitary sewer overflows:

1. The aging infrastructure requires replacement. The condition of the building systems is deteriorating at some of the stations. Although the buildings have generally been well maintained, certain buildings are sheathed with fiberboard sheathing that does not withstand the humid pump station environment. Additionally, many of the buildings consist of CMU construction that was damaged in an earthquake approximately 10-years ago. Much of the equipment is also beyond useful life and requires replacement to maintain reliability. The electrical systems are also obsolete and require complete replacement.

2. Much of the existing vacuum system equipment is undersized for actual conditions. Although the equipment may have originally been appropriately sized for design conditions, actual field conditions in the Lake of the Woods system differ from typical modern construction standards. One effect of these differences is that more air needs to be admitted to the vacuum lines than normal to push flow towards the vacuum station, increasing the demand on the vacuum pumps. Approximately half the stations require both of the duplex vacuum pumps to operate to keep up with current flows, leaving the station with no redundant pump. Therefore, the stations do not meet code requirements for redundancy. Additionally, many of vacuum station buildings are undersized to provide adequate space for equipment maintenance and code required electrical clearances.

3. Lack of remote monitoring and controls systems limits the RSA's ability to optimize the stations and proactively address issues before the vacuum systems are overwhelmed. Enhancement of the controls and monitoring systems is the next step in increasing the reliability and resiliency of the system.

Executive Summary (continued)

Total budgetary costs for improving each of the vacuum stations in the system are summarized below, including 25% contingency, design engineering, construction engineering and inspection, legal and administrative costs, and materials testing.

Station ID	Total Probable Project Cost
A	$1,730,000
B	$1,916,000
C	$2,356,000
D	$1,345,000
E	$2,356,000
F	$2,079,000
G	$1,415,000
H	$1,415,000
I	$1,521,000
J	$2,165,000
K&L	$2,025,000
N	$1,369,000
M	$1,389,000
Remote Monitoring	$138,000
TOTAL	**$23,309,000**

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Prepared for Rapidan Service Authority

1 Introduction

The Rapidan Service Authority (RSA) owns and operates the Lake of the Woods wastewater collection system in Locust Grove, Virginia. The wastewater collection system serves the gated community of Lake of the Woods, which consists of approximately 4,260 lots surrounding the Main Lake and Keaton's Lake.

Most of the service area is served by a vacuum sewer system. Original construction of the vacuum sewer system dates to the 1960s when the Lake of the Woods community was founded. The system was owned and operated by several private companies until the RSA assumed ownership in 1987.

Over the years, the RSA has implemented improvements to maintain and improve the system. Most significantly, a 1993 pump station improvements project was constructed to upgrade each of the vacuum pumping stations. The majority of the existing infrastructure is approaching 30-years old, and rehabilitation is needed to maintain the current level of service. Additionally, significant improvements to controls and monitoring equipment have become available. Improvements to the controls and monitoring equipment are needed to make operations and maintenance staff efforts more effective and to improve the reliability of the station.

The RSA requested Short Elliot Hendrickson Inc. (SEH®) to perform condition assessments at each of the thirteen (13) central vacuum pumping stations and provide recommendations for improvements. Additionally, this evaluation includes recommendations for remote monitoring at collection chambers and vacuum mains.

2 Background

Most of service area consists of a vacuum sewer system that transports wastewater collected from the homes and businesses to 13 vacuum pumping stations. In addition to the vacuum collection system, small areas around the central vacuum stations flow by gravity. Most of the vacuum pumping stations are equipped with a Smith and Loveless suction lift pumping station to convey wastewater to a sewer interceptor or another pumping station. Two vacuum stations rely on conveyance of wastewater to an offsite lift station by gravity. Ultimately, the wastewater is conveyed to the RSA's Wilderness Wastewater Treatment Facility for treatment and disposal.

Vacuum sewer systems are an alternative method for conveying wastewater rather than relying on gravity and conventional pumping stations. A brief overview of the components of vacuum sewer system is provided below:

- Collection Chambers: Wastewater from homes and buildings flows into collection chambers, which are typically located near the source. Each collection chamber typically serves one to three houses. These chambers are equipped with pneumatic valves that open when a certain amount of wastewater is collected.
- Vacuum Mains: The collected wastewater is then transported through a network of small-diameter pipes called vacuum mains, typically 4 to 10-inch diameter. These pipes are designed to operate under partial vacuum conditions (approximately 20 to 25 inches mercury or 10 to 12 pounds per square inch gauge), which helps move the wastewater towards the vacuum station. Current construction standards for vacuum mains requires the use of a saw tooth profile that is constructed with precise grading standards. Much of the Lake of the Woods vacuum mains were constructed with outdated construction standards that utilize U-shaped sag profiles.
- Vacuum Pumping Station: All the wastewater is eventually transported to a central vacuum station. The vacuum pumps at the station create the necessary pressure differential to move the wastewater. The vacuum pumping station is also equipped with holding tanks and sewage pumping equipment to convey the wastewater to a gravity sewer interceptor or another pumping station.

Vacuum sewer systems are typically used in flat areas, areas with high groundwater tables, or places where traditional gravity-based systems would be difficult or expensive to install. They are similar in application to low pressure septic tank effluent collection systems, but can be more economical when the number of connections is high, as it is in the Lake of the Woods.

3 Previous Improvements

The Rapidan Service Authority has implemented a series of improvements to improve the reliability and efficiency of the vacuum sewer system, including the following:

- Over 58,000 feet of new or upgraded vacuum mains which included new and upgrades to the following vacuum mains:
  - Station A: 7,300’ of 6” and 8” vacuum main
  - Station B: 8,000’ of 6”, 8” and 10” vacuum main
  - Station C: 5,700’ of 6”, 8” and 10” vacuum main
  - Station D: 3,300’ of 6” vacuum main
  - Station E: 8,100’ of 6”, 8” and 10” vacuum main
  - Station F: 9,700’ of 6” and 8” vacuum main
  - Station G: 1,300’ of 6” vacuum main
  - Station H: 1,400’ of 6” vacuum main
  - Station J: 8,900’ of 6”, 8 and 10” vacuum main
  - Station K&L: 2,200’ of 8” vacuum main
  - Station N: 2,500’ of 6” vacuum main

- Conversion to gravity sewer. Certain areas near the central vacuum stations are suitable to serve with conventional gravity sewers. This work continues where possible:
  - C: 4,900 LF of 6” and 8” gravity main
  - E: 6,300 LF of 6” and 8” gravity main
- Previous Engineering Study. In 2004, the RSA, in conjunction with Virginia Department of Environmental Quality (DEQ) had an engineering study conducted by Draper Aden Associates of the vacuum sewer system serving the Lake of the Woods community. The system review performed by Draper Aden revealed the following:
  - The initial construction of the LOW vacuum sewer system relied heavily on the use of concrete collection tanks, the design of which was not specifically intended for vacuum sewer applications. The deterioration of these tanks resulted in substantial infiltration and inflow (I&I) into the vacuum sewer system and their configuration makes O&M activities difficult to perform. RSA has initiated a program to replace these tanks with a standardized collection tank system that involves the use of a fiberglass 300-gallon capacity collection tank configured with a fiberglass barrel structure that houses the vacuum valve. Many of these tanks serve more than one home and there are approximately 3,700 of these collection tanks in use with upwards of 500 tanks around the large lake itself. Concrete tanks are replaced based on condition.
  - Vacuum valves are connected to the vacuum sewer main and regulate both the admission of air and collected wastewater into the vacuum sewer system. Four different companies manufacture the vacuum valves used in the LOW vacuum sewer system as follows: Flovac, Iseki, AIRVAC®, and ITT Grinnell. The Flovac, Iseki and AIRVAC® valves are in typical use in most vacuum sewer systems in Virginia and reportedly perform well. Conversely, the ITT Grinnell valves are not in common use in Virginia and the type of valve used in the LOW vacuum sewer system is outdated. RSA adopted a policy to replace ITT Grinnell valves. Today there are fewer than 40 ITT Grinnell valves in the system, and they are being replaced with new valves as they fail.
  - A review of the vacuum sewer mains, when viewed in an overall context, depict extensive use of small diameter vacuum mains over long conveyance distances, principally in areas adjacent to the main lake. These shoreline areas represent the lowest elevations served by the vacuum sewer system. In addition, there is a significant amount of dissected terrain (i.e., hills and valleys) that requires multiple system lifts. This review also revealed the wide-ranging use of U-shaped vacuum main profiles prior to 1987 (also referred to as “sag” profiles). The use of the sag profile had been abandoned for a considerable period of time since the sag areas regularly become waterlogged and prevented adequate vacuum from reaching upstream mains and collection tanks. Design in 2004 required the use of a saw-tooth profile that is constructed using precise grade tolerances. DAA estimated that a substantial portion of the LOW vacuum sewer system is comprised of vacuum mains with sag profiles. In addition, the extensive use of small diameter vacuum mains with sag profiles only exacerbates the waterlog/vacuum problem. This vacuum sewer main review revealed that in addition to the sag profile concern, several areas of the LOW vacuum sewer system require either high system lift or multiple system lifts (in some cases both conditions exist). Historical operational data from various installations and research performed by vacuum system manufacturers resulted in

current (2004) lift parameters that commonly limit cumulative lift requirements to 13 feet. This parameter is exceeded in several instances throughout the LOW vacuum sewer system resulting in another system problem.

  - In addition to the general design configuration issues discussed above, it was determined that a substantial length of vacuum sewer main throughout the LOW community was not properly located to facilitate O&M activities. A portion of vacuum main situated along the shoreline of the main lake was installed prior to the filling of the lake. This condition has resulted in the following issues: insufficient workspace for repairs and maintenance, conflicts with private structures and landscaping, and poor accessibility due to wetlands or terrain-related obstructions.
  - The ability for O&M personnel to perform routine maintenance functions and respond to any emergency conditions can be severely hampered by the location of numerous vacuum mains. Relocation of vacuum mains is the only practical remedy for this situation and RSA has relocated many sewer lines to the front of various properties and replaced many old vacuum mains with new, larger mains. Additionally - where possible - vacuum sewer is being replaced with gravity sewer.

- Sewage pump station replacement. Eleven of the thirteen vacuum stations are equipped with a Smith and Loveless suction lift sewage pump station. The pump stations were installed in 1993 and are generally beyond the end of useful life. The RSA has implemented a pump station replacement program to prioritize and replace the pumping station equipment based on condition and frequency of required maintenance.
- Implementation of limited monitoring. The original vacuum pumping stations were provided limited local controls and telephone alarm telemetry to notify RSA staff of station malfunctions. To improve remote monitoring capabilities and enable quicker response times from maintenance staff, RSA installed cellular messenger units to provide online monitoring and alarms. The current technology used for remote monitoring is limited in capability and provides only vacuum pressure, power failure alarm, and wet well high-level alarm.

4 Existing Conditions

4.1 Connections Served and Wastewater Flows

SEH reviewed service area maps to estimate the number of homes served by each vacuum station. A summary of the number of houses and other connections served is included in Table 1. The community is substantially built out and minimal future growth is planned within the service area.

Table 1 – Summary of Connections Served

Vacuum Station ID	Number of Houses Served	Other Connections
Station A	342	Locust Grove Middle School
Station B	514	
Station C	567	Lake of the Woods Community Center
Station D	131	
Station E	598	Library, Laundromat

Station F	379	
Station G	141	
Station H	164	Lake of the Woods Golf Club
Station I	204	
Station J	388	
Station K/L	480	
Station M	131	Rt. 3 businesses
Station N	252	

The vacuum pump stations and lift stations are not equipped with wastewater flow meters. Therefore, metered water consumption was used to develop planning level flows instead of wastewater flows. This data does not include extraneous sources of flow such as Infiltration or Inflow.

Average daily flow for each vacuum station and sewage lift station are summarized in Table 2. The lift station flows are higher than the vacuum system flows due to two additional sources of flow:

1. Sources of wastewater conveyed to the lift station by gravity and/or force main.
2. Process wastewater from the vacuum pump cooling/seal water

A peaking factor of 4.0 is used to estimate peak flows in accordance with recommendations in the 10 States Standards for wastewater design. The peaking factor is used to account for variations in wastewater use over time and the effects of Inflow and Infiltration (I&I). Additional evaluation of the effects of I&I is recommended during design for equipment sizing as actual peaking factors may be higher. RSA staff indicated that the existing pumps have historically kept up with peak flows at all stations.

Table 2 – Summary of Wastewater Flow Rates

Vacuum Station ID	Average Daily Metered Water Consumption To Vacuum System, GPD	Average Daily Metered Water Consumption To Wastewater Lift Station, GPD	Peak Flow at Wastewater Lift Station (Peaking Factor 4.0), GPM	Sewage Pump Nameplate Capacity, GPM
Station A	35,816	56,708	158	275
Station B	51,784	70,254	195	240
Station C	52,866	67,169	187	135
Station D	11,327	NA		Not applicable
Station E	42,183	95,138	264	210
Station F	36,523	53,100	148	110
Station G	15,360	18,815	52	106
Station H	15,060	21,164	59	75
Station I	19,431	26,368	73	238
Station J	52,746	59,718	166	127
Station K/L	46,757	65,224	181	230
Station M	16,686	NA		Not applicable
Station N	26,207	31,317	87	240

4.2 Condition of Existing Structures and Equipment

4.2.1 Description of Typical Lake of the Woods Vacuum Station

The vacuum stations installed at Lake of the Woods are unique in their configuration. Current construction standards for new vacuum stations use a single tank under vacuum pressure to receive flows from the incoming vacuum mains and to supply the wastewater pumps that convey flow to the downstream system. In the Lake of the Woods system, the vacuum system is separated from the wastewater pumping system using a pressure Equalization Tank. Two tanks known as the Receiving Tank and Overflow Tank always remain under vacuum conditions. The Equalization Tank operates in cycles. During the fill cycle, a 2” line connects it to the vacuum pumps and places it under vacuum pressure. During the dump cycle, the 2” line vents to atmosphere; and the tank equalizes with atmospheric pressure. The pressure swing is controlled by 2” actuated ball valves. Check valves upstream and downstream of the Equalization Tank control the wastewater flow during each cycle. When the tank is under vacuum pressure, it is hydraulically connected to the Receiving Tank; and wastewater flows freely into the EQ tank. When it is under atmospheric pressure, the EQ tank is hydraulically connected to a downstream wet well; and wastewater flows by gravity into the pumping station. Tank level is monitored by level probes. Level probes in the overflow tank provide vacuum pump protection. Level probes in the EQ tank control the fill and dump cycles. Air lines connecting the vacuum pumps to the various tanks are freeze protected using heat trace tape.

The vacuum pumps consist of liquid ring pumps (SC model by Nash) of various capacities. Each pump is supplied with a continuous supply of potable water for single pass cooling and sealing. The pumps consume approximately 5 gallons per minute of water. An air/water separator

removes water from the discharge. The water discharges to the wastewater pumping station by gravity via a floor drain. Limited controls are provided for the vacuum pumps, including limited pump protective circuits. Due to the limited nature of automatic and lack of remote controls, the vacuum pumps are typically run in hand at the local control panel, which requires RSA staff to visit the station in person to make operational changes.

Wastewater pumping at each station is provided by a suction lift Smith and Loveless packaged pumping station mounted on top of a wetwell. Each lift station is equipped with a bypass connection. Two stations (D and M) flow by gravity to a downstream lift station and do not require the wetwell and wastewater pumping portion of the station.

Controls and monitoring at each station is limited. A brief description of the various instruments available at each station is provided below:

- Vacuum pressure is monitored locally at the vacuum pump suction piping and at the various tanks. Vacuum levels are also monitored remotely via a Cattron Messenger system, discussed below.
- As noted above, water level in the vacuum tanks is monitored with level probes in the various wastewater tanks for control purposes, but the information is not made available to the operators.
- Cooling water for the vacuum pumping station is monitored using a pressure switch at each vacuum pump. Loss of pressure locks out the vacuum pump. Long term water use is monitored by a water meter.
- Loss of station power is monitored and is available remotely via the Cattron Messenger system.
- Wetwell high level is monitored via a float system and is alarmed locally and remotely via the Cattron Messenger system.
- Lights are provided to confirm power to the heat trace lines.

Remote monitoring of the station is provided by a cellular messaging unit known as the Cattron Messenger. Remote monitoring is limited to the three signals noted above. These signals report to an online platform, which sends alarms as configured to RSA staff. RSA staff can also log in to the platform to view vacuum levels at each station. Remote control of the stations is not provided.

Each station is provided with a simple mulch bed odor control unit. Discharge from each vacuum pump is directed to the bottom of the mulch bed. Discharge air passes through the mulch for odor treatment.

4.2.2 Overview of Existing Equipment and Condition

SEH and RSA staff performed site visits to each of the 13 vacuum stations on April 2, 3, and 4, 2024. SEH performed visual inspections of each structure and piece of equipment. Existing equipment is summarized in Table 3.

Existing Vacuum Station Structures and Equipment

Station	Vacuum Pump Model	Receiving Tank Dimensions	Overflow Tank Dimensions	Equalization Tank Dimensions	Building Inside Dimensions	Wet Well Dia.
A	SC5	6'-0”x9'-0”	6'-0”x9'-0”	42"x98"	15'-0”x19'-6"	8'-0”
B	SC5	6'-0”x9'-0”	6'-0”x9'-0”	54"x94"	17'-0”x14'-0”	6'-11"
C	SC5	6'-0”x9'-0”	6'-0”x9'-0”	54"x94"	21’-0”x20’-0”	6'-0”
D	SC2	6'-0”x9'-0”	6'-0”x9'-0”	54"x94"	12'-0”x10'-4"	No wet well
E	SC5	6'-0”x10'-0”	6'-0”x9'-0”	54"x80"	16'-0”x14'-0”	6’-6”
F	SC5	6'-0”x10'-0”	6'-0”x10'-0”	54"x84"	15'-6"x18'-9"	7'-0”
G	SC2	6'-0”x11'-0”	6'-0”x9'-0”	54"x96"	10'-9"x8'-9"	5'-0”
H	SC2/SC3	6'-0”x10'-0”	6'-0”x10'-0”	54"x84"	19'-6"x18'-6"	6’-6”
I	SC3	6'-0”x9'-0”	no over flow tank	54"x94"	12'-8"x11'-10"	5'-0”
J	SC5	6'-0”x10'-0”	6'-0”x10'-0”	54"x84"	10'-0”x12'-0”	6'-6”
K & L	SC5	6'-0”x10'-0” (typ. of 2)	none	54"x84"	13'-6"x16'-0”	8'-0”
M	SC2	6'-0”x10'-0”	no over flow tank	54"x84"	8'-0”x10'-0”	No wet well
N	SC3	6'-0”x10'-0”	6'-0”x10'-0”	54"x84"	8’-0”x12’-0”	6’-6”

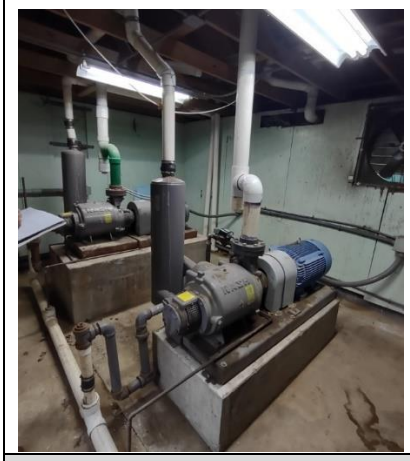
A brief summary of key observations at each station condition is provided in Table 4 below.

Table 3 – Summary of Condition Assessment Key Observations

Vacuum Station ID	Condition Assessment Key Observations
Station A 	• The station was upgraded in 2009-2010 during construction of the Locust Grove Middle School, which discharges wastewater to the sewage pumping station via a dedicated forcemain. • The building consists of CMU and slab on grade construction with brick veneer. Interior is faced with plywood. Building is generally in acceptable condition for continued use. • Building footprint is adequate to house proposed SC7 vacuum pumps and controls with appropriate clearances. • Vacuum system requires both pumps to run continuously, which provides no redundancy. Both vacuum pumps replaced in approximately 2008. • Sewage pump station was replaced in approximately 2008. Condition is acceptable for continued use. • Concrete wetwell is coated with an epoxy liner. • Odor control unit was recently (<10 years) replaced with stand-alone biofilter in fiberglass basin.

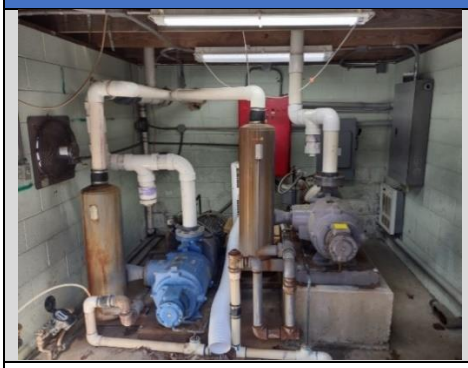
Vacuum Station ID	Condition Assessment Key Observations
	• Electrical systems were replaced in approximately 2008 and appear to be in acceptable condition. May require replacement due to upsizing equipment. • A 100kW generator is provided to power the station.
Station B  	• The building consists of CMU block slab on grade with brick veneer. Building is in acceptable condition for rehabilitation and continued use. Building footprint is smaller than desired to house SC7 vacuum pumps and controls, but could be used with reduced clearances or by locating some electrical equipment in outdoor enclosures. • Odor control unit is attached to the building. The RSA has noted deterioration of exterior walls over time in this configuration. • Available space on the site is very limited. • Vacuum system requires both pumps to run continuously. There is inadequate redundancy. One vacuum pump was replaced in 2018. The other vacuum pump is more than 20-years old, and is beyond useful life. • One vacuum pump sits on floor (lacks concrete pedestal). • Sewage pump station is beyond useful life. One pump was replaced with a different capacity/model pump salvaged from a different pump station. Vibration/slamming observed on startup. • Wet well is approximately 15' from the edge of the lake and is built in to sloped bank. Access from wooden platform is limited. • Concrete wetwell exhibits concrete degradation with exposed aggregate. • Electrical systems are beyond useful life and require replacement. • A plug for portable generator is provided.
Station C	• The building consists of CMU block below grade. CMU exhibits step cracking. Building was damaged during an earthquake (>10 years ago). Buried reinforcement was installed outside to stabilize CMU. • Building consists of wood framing above grade with brick veneer. Wood framing particle board sheathing is in poor condition (water/humidity damage) and requires replacement. • Access to remove/replace pumps is difficult. Interior stairs do not meet current building codes.

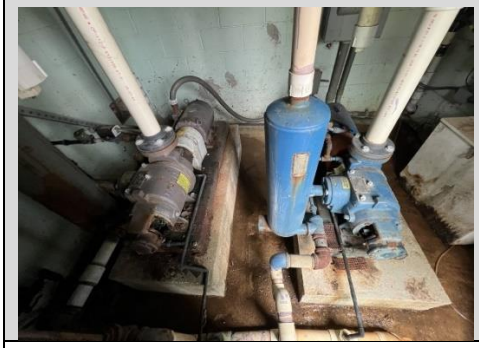
Vacuum Station ID	Condition Assessment Key Observations
 	• Building relies on duplex sump pumps to remove groundwater and vacuum pump cooling/seal water. Sump pump failure would flood the station. Floor flood alarms not present. • Vacuum system requires both pumps to run continuously, no redundancy. One vacuum pump was replaced in 2018. The other vacuum pump was replaced in 2019. Both pumps run loud, moderate/poor condition considering age <10 years. • Sewage pump station is beyond useful life. One pump was replaced with a different capacity/model pump salvaged from a different pump station. • Significant infiltration observed into wetwell (10 gpm) • Electrical systems (except generator) are beyond useful life and require replacement. • A 125 kW generator was installed in 2018.
Station D  	• The building consists of a partially buried CMU and slab construction with brick veneer. Building is generally in acceptable condition for continued use. • Building footprint is adequately sized for existing equipment but does not provide space for increasing the vacuum pump size and housing electrical control panels. • The existing building is in the 100-year floodplain (Zone AE). • Vacuum system operates with both pumps on, no redundancy. One pump was installed in 2008 and the other was installed in 2018. Both pumps exhibit corrosion of the of the pump housing. • Odor control unit was recently (<10 years) replaced with stand-alone biofilter in fiberglass basin. The odor control unit lacks a drain. • Electrical systems are beyond end of useful life. • A portable generator plug is provided to power the station during power outages.
Station E	• The building consists of CMU & slab on grade with brick veneer. Building exterior exhibits step cracking. The interior is faced with plywood in poor condition.

Vacuum Station ID	Condition Assessment Key Observations
 	• The building footprint is too small to house proposed vacuum pumps and electrical/control panels. • Odor control unit is attached to the building. The RSA has noted deterioration of exterior walls over time in this configuration. • Vacuum system requires both pumps to run continuously, no redundancy. Both vacuum pumps are more than 20-years old, and are beyond useful life. • Sewage pump station is beyond useful life. • Concrete wetwell exhibits concrete degradation with exposed aggregate. • Electrical systems are beyond useful life and require replacement. • A plug for portable generator is provided and a portable generator is connected to the transfer switch.
Station F  	• The building consists of CMU and slab on grade construction with brick veneer. Building is in acceptable condition. • Building footprint is adequate to house proposed vacuum pumps and controls. • Vacuum system requires both pumps to run continuously, no redundancy. One vacuum pumps was installed in 2008, and one is in excess of 20 years old. Both pumps are nearing/beyond end of useful life. • Sewage pump station is approximately 30-years old & is beyond useful life. • Concrete wetwell exhibits concrete degradation with exposed aggregate. • Odor control unit was recently (<10 years) replaced with stand-alone biofilter in fiberglass basin. • Electrical systems (except generator) are beyond useful life and require replacement. • A 100kW generator is provided.
Station G	• The building consists of CMU and slab on grade construction with brick veneer. Building is generally in acceptable condition for continued use.

Vacuum Station ID	Condition Assessment Key Observations
 	• Building footprint is not adequately sized to provide required clearances for existing or proposed equipment and electrical panels. The current configuration does not provide enough space to safely perform maintenance tasks on the equipment. • Vacuum system operates with one pump on and one pump in standby. Both pumps were installed in 2001 and are beyond end of useful life. • Sewage pump station equipment was replaced in 2014. The motor, upper volute, impeller, and mechanical seal of the old pumps were maintained. An epoxy coating was applied to the wet well. • Odor control unit is attached to the building. The RSA has noted deterioration of exterior walls over time in this configuration. • Electrical systems are beyond end of useful life and code required clearances are not provided. • A portable generator plug is provided to power the station during power outages.
Station H  	• The building consists of CMU block below grade. CMU exhibits step cracking. Building was reportedly damaged during an earthquake (>10 years ago). Buried reinforcement was installed outside and lag bolted to the foundation wall to stabilize the CMU. • Building consists of wood framing above grade with brick veneer. Wood framing particle board sheathing is in poor condition (water/humidity damage) and requires replacement. • Building footprint is adequately sized to provide required clearances for existing and proposed equipment and electrical panels. However, access to remove/replace pumps is difficult. Interior stairs do not meet current building codes. • Building relies on duplex sump pumps to remove groundwater and vacuum pump cooling/seal water. Sump pump failure would flood the station. Floor flood alarms not present. • Vacuum system was originally equipped with duplex SC2 pumps. However, the SC2 pump does not keep up with peak flows and one was replaced with SC3 model in 2022. The remaining SC2 model was installed in 2001 and is beyond end of useful life. • Sewage pump station equipment was replaced recently. An epoxy coating was applied to the wet well.

Vacuum Station ID	Condition Assessment Key Observations
	• Electrical systems are beyond end of useful life and code required clearances are not provided. • A portable generator plug is provided to power the station during power outages.
Station I  	• The building consists of CMU and slab on grade construction with brick veneer. Building is generally in acceptable condition for continued use. • Building footprint is slightly smaller than desired to house SC3 vacuum pumps and controls, but could be used with reduced clearances or by locating some electrical equipment in outdoor enclosures. • Vacuum system operates with one pump on and one pump in standby. One pump is more than 20-years old, exhibits heavy corrosion, and is beyond useful life. The other pump appears to be a newer model but is missing nameplate. The newer pump is in moderate condition (slight rattle and whine). • Sewage pump station equipment is beyond end of useful. Piping and steel frame heavily corroded. Pumps rebuilt in 2011. • Concrete wetwell concrete is exhibits corrosion, concrete spalling, and root intrusion. • Odor control unit is a stand-alone biofilter in CMU block basin. Structure appears to be near end of useful life. • Electrical systems are beyond end of useful life. • A portable generator plug is provided to power the station during power outages.
Station J 	• The building consists of CMU and slab on grade construction with brick veneer. CMU exhibits minor step cracking. Building is generally in acceptable condition for continued use. • Building footprint is inadequate to house existing SC5 vacuum pumps and proposed SC7 vacuum pumps and controls with appropriate clearances. • Odor control unit is attached to the building. The RSA has noted deterioration of exterior walls over time in this configuration. • Vacuum system requires both pumps to run continuously, no redundancy. One vacuum pumps was installed in 2011, and one is in excess of 20 years old. Pumps are nearing/beyond end of useful life. • Sewage pump station is approximately 30-years old & is beyond useful life. Pump motors were rebuilt in 2011. • Concrete wetwell exhibits concrete degradation with exposed aggregate. • Electrical systems (except generator) are beyond useful life and require replacement.

Vacuum Station ID	Condition Assessment Key Observations
	• A 200A transfer switch is provided to allow a portable generator to power the station is provided.
Station K/L  	• The building consists of a partially buried CMU and slab structure with brick veneer. Minor step cracking is evident in CMU and exterior reinforcement is installed to stabilize the structure. Moderate cracking of the base slab is visible. Water damage/mold to the roof sheathing and rafters is present, but the leaking roof appears to have been repaired. • Access to the building is down a flight of concrete stairs. The floor slab is below grade and the building drain is shared with the stairwell drain, which was clogged during the site visit. • Building footprint is inadequate to house proposed SC7 vacuum pumps and controls with appropriate clearances. • Vacuum system requires both pumps to run continuously, no redundancy. One vacuum pumps was installed in 2018 and is generally in fair condition other than minor corrosion to the housing. The other vac pump is in excess of 20 years old and is beyond end of useful life. • The vacuum system is configured differently from other stations. Each vacuum pump serves dedicated receiving/equalization tanks and portion of the collection system. The vacuum pumps do not back each other up. Overflow tanks are not provided. • One of the receiving tanks exhibited a leaking corroded/failed weld. • Sewage pump station base plate, piping, valves, and lower pump unit (volute) were replaced in 2016. Original pump motors/upper pump unit were retained and were rebuilt in 2011. Pump control panel is also original construction (1990s). • Wet well epoxy liner is in adequate condition. • Odor control unit was recently (<10 years) replaced with stand-alone biofilter in fiberglass basin. • Electrical systems (except generator) are beyond useful life and require replacement. • A 125 kW backup generator was installed in 2013.

Vacuum Station ID	Condition Assessment Key Observations
Station M  	• The building consists of slab on grade with CMU block walls. • One of the double doors is corroded and does not open. • The roof consists of light wood trusses and asphalt shingles • Building footpint is too small to provide required clearances for existing and proposed equipment and electrical panels. • Vacuum system is equipped with duplex SC2 pumps. Both vacuum pumps are at least 20 years old and are beyond end of useful life. • The vacuum system check valves are installed above grade. Fiberglass insulation is wrapped around the valves to protect from freezing. • A new odor control unit is provided (less than 5 years old). • The station is not equipped with an overflow tank. RSA staff noted that the single receiving tank is inadequately sized for the current flows. • Electrical systems are beyond end of useful life and code required clearances are not provided. • A portable generator plug is provided to power the station during power outages.
Station N  	• The building consists of CMU and slab on grade construction with brick veneer. Building is generally in acceptable condition for continued use. • Building footprint does not provide adequate clearances around equipment for proper maintenance. Any additional electrical/controls panels would need to be located in outdoor enclosures. • Odor control unit is attached to the building. The RSA has noted deterioration of exterior walls over time in this configuration. • Vacuum system operates with one pump on and one pump in standby. Both pumps are more than 20-years old and are beyond the end of useful life. • The pipe connecting the equalization tank to the wet well was leaking, and the check valve vault was full of scum. • Sewage pump station equipment was replaced in 2022. • Concrete wetwell concrete was rehabilitated and coated with epoxy liner in 2022. • Electrical systems are beyond end of useful life. • A portable generator plug is provided to power the station during power outages.

4.2.3 Condition and Priority Ratings

Each vacuum station was scored on the following criteria to guide project prioritization. Scoring criteria and a brief description of how the station was scored are provided in Table 5 below. Each rating is added together to determine the overall station rating. Generally, stations with higher scores should be prioritized for improvement before stations with lower scores, except where other circumstances which are not captured in the rating exist.

Detailed condition ratings for each existing station are provided in Appendix A. An average score is presented in Table 6 below. Note that the average score is a general indication of existing condition used for prioritizing the station upgrades. The condition of specific buildings and equipment vary at each site. Certain items at a particular site may be close to failure and not reflected in the overall score. Refer to Appendix A to review condition ratings for each item at each station.

Table 4 – Condition and Priority Rating Criteria

Grade	Condition	Description
Number of homes served		
1	Fewer than 150 homes	Tend to have smaller flows and managing flows during station failures is more feasible using portable equipment and vacuum trucks than the stations serving larger populations.
2	Between 150 and 250 homes	Tend to have moderate flows and managing flows during station failures is more feasible using portable equipment and vacuum trucks than the stations serving larger populations.
3	More than 250 homes	Tend to have larger flow volumes. Managing flows during station failures is less feasible than other stations.
Condition of existing building and equipment		
1	Very Good	Sound physical condition. Asset likely to perform adequately without major work for 25 years or more.
2	Good	Acceptable physical condition; minimal short-term failure risk but potential for deterioration in long-term (10 years plus). Only minor work required (if any).
3	Fair	Significant deterioration evident; failure unlikely within next 2 years but further deterioration likely and major replacement likely within next 10 years. Minor components or isolated sections of the asset need replacement or repair now but asset still functions safely at adequate level of service. Work required but asset is still serviceable.
4	Poor	Failure likely in short-term. Likely need to replace most or all of asset within 2 years. No immediate risk to health or safety but works required within 2 years to ensure asset remains safe. Substantial work required in short-term, asset barely serviceable.
5	Very Poor	Failed or failure imminent. Immediate need to replace most or all of asset. Health and safety hazards exist which present a possible risk to public safety or asset cannot be serviced/operated without risk to personnel. Major work or replacement required urgently.

Grade	Condition	Description
Current redundancy		
1	Redundant pump is available	Two vacuum pumps installed and run in duty / standby configuration
2	No redundant pump is available	Two vacuum pumps installed. Both are required to be duty pumps to keep up with current flows.
3	Current Vacuum System undersized	Two vacuum pumps installed. Typical configuration inadequate to keep up with current flows. This category only applies to Station K/L which requires a special configuration to convey flows.
Setback to surface water		
1	More than 150’	Sanitary overflows from structures more than 150 feet from surface waters are less likely to impact the lake.
2	75’ – 150’	
3	Less than 75’	Sanitary overflows from structures less than 75 feet from surface waters are more likely to impact the lake.

Table 5 – Vacuum Station Rating

Station ID	Number of Homes Served	Existing Condition	Current Redundancy	Surface Water Setback	Total Rating
Station A	3	2.4	2	3	10.4
Station B	3	2.8	2	3	10.8
Station C	3	3	2	3	11
Station D	1	2.8	2	3	8.8
Station E	3	2.8	2	2	9.8
Station F	3	2.8	2	3	10.8
Station G	1	2.4	1	3	7.4
Station H	2	2.6	2	3	9.6
Station I	2	2.8	1	1	6.8
Station J	3	2.8	2	3	10.8
Station K&L	3	2.6	3	2	10.6
Station M	1	2.9	1	1	5.9
Station N	2	2.2	1	3	8.2

5 Vacuum Station Evaluation

5.1 Basis of Design

As was identified from the condition assessment at each site, there are a variety of deficiencies at the vacuum stations. If not addressed, the operation of the vacuum stations will be impacted, and reliability will worsen over time. To simplify planning and standardize equipment across the

system, each of the 13 stations has been categorized into three alternatives based on number of connections and existing vacuum pumping equipment, as defined in Table 7. Design criteria for each of the alternatives is described in the following sections.

Table 6 – Vacuum Station Categorization

Alternative Name	Stations Included	Number of Connections	Existing Vacuum Pump Model Number
Small	D, M, G	Less than 150	SC2
Medium	H, I, N	150 to 250	SC3
Large	A, B, C, E, F, J, L&K, P	More than 250	SC5

5.1.1 Vacuum Tank Sizing

Current construction techniques for typical vacuum pump systems uses one vacuum tank at each site. The typical configuration divides the single tank into three zones. The bottom third of the tank remains filled to provide flooded suction for the wastewater pumps, the middle third of the tank provides active storage for wastewater flows, and the upper third of the tank typically remains empty to provide overflow and vacuum buffering capacity. The active storage of the tank is sized to limit wastewater pump starts to 12 starts per hour or fewer.

The Lake of the Woods vacuum system uses an alternative configuration with a combination of tanks at vacuum and atmospheric pressure. Three vacuum tanks are provided at each site in the Lake of the Woods system, consisting of the Receiving Tank, Overflow Tank, and Equalization Tank. The Receiving Tank and Equalization Tank provide the active wastewater storage. The Overflow Tank provides overflow and vacuum buffering capacity. Volume associated with maintaining flooded suction of the wastewater pumps is provided in the atmospheric wetwell.

The active storage in the Lake of the Woods vacuum system operates in batch configuration. During the fill cycle, influent wastewater fills the Receiving and Equalization Tanks. During the dump cycle, the volume of the Equalization Tank discharges to the wetwell. The Equalization Tank sizes are required to limit pump starts to 12 times per hour, assuming 80% of the tank volume is used for liquid storage are summarized in Table 8. Receiving and overflow tank sizes are sized to match existing or provide additional capacity where needed.

Table 7 – Proposed Vacuum Tank Nominal Volume

Criteria	Small Station	Medium Station	Large Station
Equalization Tank Nominal Volume, gallons	950	950	1,200
Receiving Tank Nominal Volume, gallons	2,000	2,000	2,000
Overflow Tank Nominal Volume, gallons	2,000	2,000	2,000

5.1.2 Vacuum Pump Selection

Vacuum sewer pumps are typically sized based on design air flow rates based on air admittance at the collection tank vacuum valves and system vacuum requirements. However, historic deficiencies in the original construction of the system such as the U-shaped sag profile and frequency of tall lifts reduces the usefulness of conventional vacuum sewer pump design in this system. Therefore, the proposed vacuum pump sizes were sized based on RSA's knowledge and experience operating the system. The existing and proposed vacuum pump selection are summarized in Table 9 below.

Table 8 – Existing and Proposed Vacuum Pump Selection

Criteria	Small Station	Medium Station	Large Station
Existing Vacuum Pump Configuration	Model: Nash Liquid Ring SC2 1 duty / 1 standby	Model: Nash Liquid Ring SC3 1 duty / 1 standby	Model: Nash Liquid Ring SC5 2 duty / 0 standby
Proposed Vacuum Pump Configuration	Model: Nash Liquid Ring SC3 1 duty / 1 standby	Model: Nash Liquid Ring SC3 1 duty / 1 standby	Model: Nash Liquid Ring SC7 1 duty / 1 standby

Upgrade of the existing single pass cooling water system to a partial recirculation system is recommended. Partial cooling water recirculation does not require changes to the vacuum pumps and requires minimal added components.

5.1.3 Odor Control

As noted in the condition assessment for each station, the original stations were equipped with approximately 6'x6' mulch bed odor control units constructed in CMU structures attached to the control building. RSA has instituted a program to replace the original odor control structures with in-ground mulch bed odor control units in approximately 6' diameter fiberglass basins. New odor control units are recommended where the original odor control units have not yet been replaced.

5.1.4 Building Systems

The building at each site was evaluated based on current condition and whether the current building is adequately sized to accommodate the proposed vacuum pumps, electrical and controls equipment. Proposed preliminary building layouts are provided. Refer to Figure 1 for the building layout at the Small and Medium stations, and refer to Figure 2 for building layout at the Large stations. Table 10 summarizes which stations require building replacement.

The existing buildings vary in age, and are generally 30 to 60 years old. Typically, pump station buildings are assigned a 50-year lifespan for the purpose of asset management. However, some of the vacuum stations exhibit atypical factors that contributed to shortening the building lifespan. For example, some of the buildings were sheathed with moisture damage prone particle board that is not suitable for the humid environment in the vacuum pump buildings. Additionally, damage from a 2011 earthquake in nearby Mineral, Virginia, was evident as step cracking in the CMU masonry walls.

Table 9 – Summary of Proposed Building Replacement

Station ID	Building Replacement / Rehabilitation	Comment / Factors Requiring Replacement
Station A	Rehabilitation	
Station B	Rehabilitation	Suitable for continued use with reduced clearances around equipment.
Station C	Replacement	Condition, safety, reliability
Station D	Replacement	Size
Station E	Replacement	Size, condition
Station F	Rehabilitation	
Station G	Replacement	Size
Station H	Replacement	Size, condition
Station I	Rehabilitation	
Station J	Replacement	Size
Station K/L	Replacement	Size, condition, age, longevity
Station M	Replacement	Size
Station N	Replacement	Size

Slab on grade and panelized concrete walls are assumed for new buildings to facilitate rapid construction.

5.1.5 Sewage Pumping Stations

The RSA has a pump station rehabilitation program in place and is rehabilitating pump stations, as funding allows and condition requires. Each project consists of replacing the packaged suction lift Smith and Loveless (S&L) station with new equipment. Stainless steel base plates are used for longevity. Status of each station is provided in Table 11.

Table 10 – Wastewater Pumping Station Replacement Program Status

Station	In need of Rehab	Previously Rehab'd	Year Rehab'd	Notes
A		Yes	2010	
B	Yes			
C	Yes			
D	No sewage pumps present			
E	Yes			One pump rebuilt 2011
F	Yes			
G		Yes	2014	One pump rebuilt 2011, 2014 rehab maintained

Station	In need of Rehab	Previously Rehab'd	Year Rehab'd	Notes
				upper pump/motor, and control panel.
H		Yes	2022	
I	Yes			Prioritized by RSA for next replacement project
J	Yes			Pumps rebuilt in 2001
K & L		Yes	Unknown, Less than 10 years old	Pumps were not completely replaced. Both pumps run to keep up with flow
M	No sewage pumps present			
N		Yes	2022	

At RSA's request, SEH evaluated an alternative to provide additional wetwell volume or check dams at each pump station to store wastewater flows in case of wastewater pump station failure. These alternatives are not recommended because they do not address the most common sources of overflows. The most common failures are in the vacuum system, including stuck vacuum valves at the collection tanks, inundation of the vacuum mains (resulting in overflow from the collection tanks, and power failure (which results in overflows from the collection tanks, not at the vacuum stations). Improved monitoring and controls (described elsewhere in this report) better address these potential sources of failure. Overflows from the pump station wetwells are less common.

Check dams, also known as berms or levees consist of concrete or earthen structures to impound flow. These structures are typically used at wastewater sites to protect infrastructure from flood waters. They are rarely used to store sanitary sewer overflows and prevent the overflow from reaching nearby surface waters because this application has significant drawbacks, including the following:

- The structures collect rainwater, which often must drain to the pump station and add potentially significant inflow volume during storm events.
- The structures need to completely encircle the site to be effective. The LOTW vacuum station sites are too small to implement check dams without impeding access to the site for regular maintenance activities.
- In the event of a sanitary sewer overflow, the structures would cause ponding of wastewater within the site, limiting access for RSA personnel to address the root cause of the overflow, and potentially submerging equipment needed to restore normal operations.
- In the event of a sanitary sewer overflow, raw sewage would be impounded on the pumping station site. Impounded raw wastewater has the potential for attracting disease spreading vectors (such as rodents and insects).

Although installing additional wetwell volume and/or check dams is not recommended, costs are provided for reference. To estimate costs to add additional storage volume to the wetwell, it was assumed that the existing wetwell would either be replaced with a larger wet well or an

emergency overflow tank would be provided. Either option described below is estimated to cost approximately $30,000 per site, assuming sufficient space is available.

- Assuming average flows for a larger station, replacing a 6-foot diameter wetwell with a 10-foot diameter wetwell and increasing the active depth by 2 feet would add approximately 4,000 gallons of emergency storage volume, or approximately 1.5 hours of storage at dry weather flows.
- Adding an 8,000-gallon emergency storage tank would provide approximately 4 hours of storage but would consume a greater footprint (approximately 20 feet by 20 feet). Space is too limited on some of the sites to add the separate emergency storage tank. Additionally, RSA staff would be required to transfer stored wastewater from the emergency storage tank back to the wetwell after normal operations resume.

5.1.6 Electrical

All sites utilize grid power provided by Rappahannock Electric Cooperative. It is anticipated that all electrical systems would remain 3 phase, 60 hz, 230 volt.

Generally, the electrical gear at each station dates to the last major upgrade, which was approximately 30 years ago. Electrical equipment for Station A was upgraded more recently (2008). The electrical gear is beyond useful life and generally uses obsolete equipment. It is recommended to completely replace the electrical systems at each site with new equipment, including main breaker, transfer switches, panelboards, wiring and lighting systems to current code.

A summary of electrical service (main breaker) sizes for existing and proposed conditions is provided below. It is assumed that the stations requiring main breaker upgrades would also require upgrade of the utility electrical service.

Table 11 – Existing and Proposed Electrical

Site	Existing Electrical Service (AMP)	Proposed Electrical Load (AMP)	Utility Electrical Upgrade Assumed (Yes/No)
Station A	600	600	No
Station B	225	400	Yes
Station C	225	400	Yes
Station D	225	225	No
Station E	225	600	Yes
Station F	225	400	Yes
Station G	225	225	No
Station H	225	225	No
Station I	150	150	No
Station J	300	600	Yes
Station K/L	225	600	Yes
Station M	Not labeled	150	No
Station N	Not labeled	150	No

The following stations are provided with permanent generators. All other stations are equipped with plugs to power the station using a portable generator. It is assumed that each of these generators would need to be upsized to power the proposed loads. Four generators (from stations A, C, F, and L/K are suitable for continued use and should be relocated to other sites where they are sized to handle the proposed loads.

- Station A – 100 kW generator
- Station C – 125 kW generator
- Station E – 100 kW generator, at end of useful life
- Station F – 100 kW generator
- Station L/K – 125 kW generator

5.1.7 Controls Systems

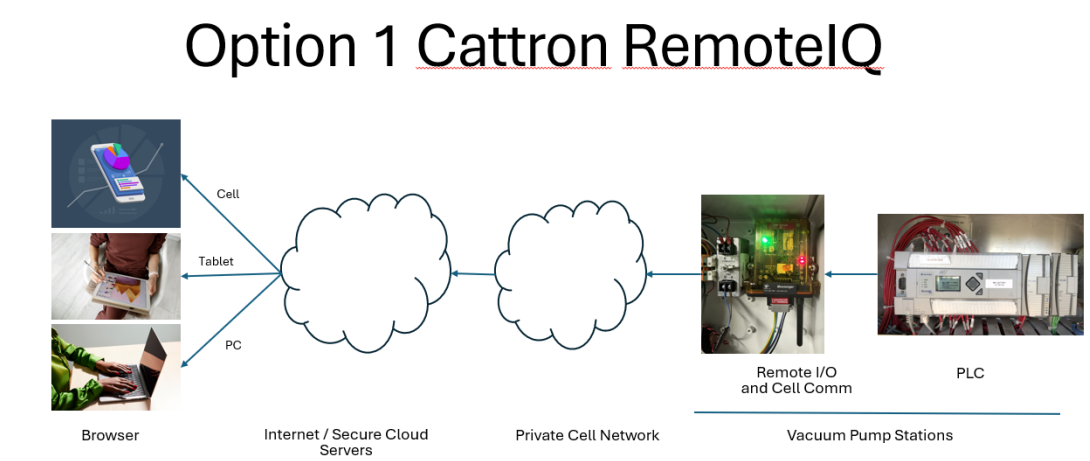
The following control system is proposed for each pump station:

- A manufacturer provided local control panel is recommended to control each pair of vacuum pumps. The vacuum pumps are recommended to be configured in lead/lag configuration at fixed speed. The pump is always on and the lag pump starts when the vacuum pressure falls below a setpoint.
- Manufacturer provided local control panel is recommended to control each pair of wastewater suction lift pumps. Existing control panels would be replaced in kind with modern equivalents.
- Addition of a cooling/seal water magnetic flowmeter for each pump is recommended to enable operators to optimize the water flowrate and avoid wasting potable water.
- The local control panels are recommended to be wired to a Programmable Logic Controller at each station and integrated to a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system is Ignition Edge based for compatibility with the Wilderness Wastewater Treatment Plant SCADA system.

5.1.8 Remote Monitoring of Vacuum Pump Stations

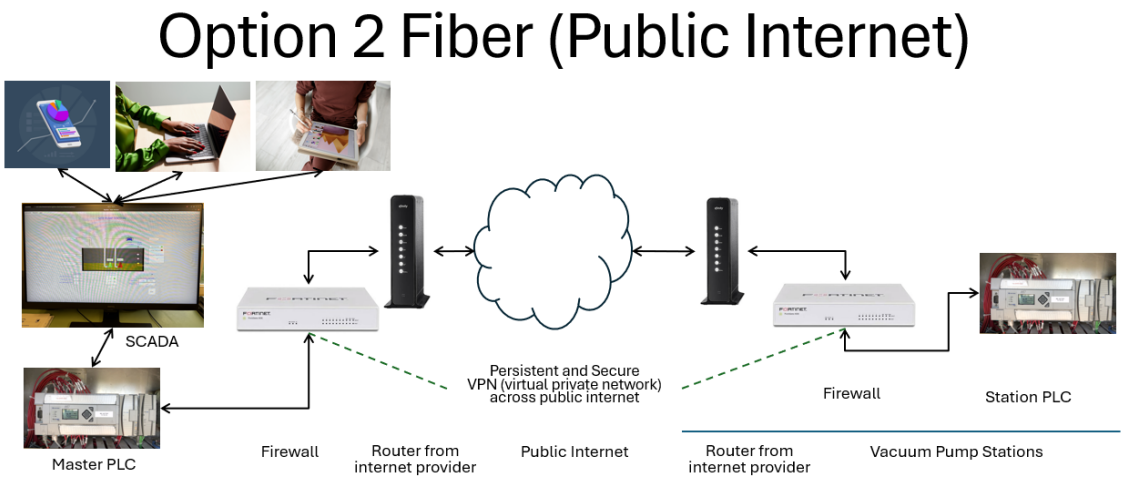
SEH evaluated three options for remote monitoring of the vacuum pump station sites, as follows:

- Option 1 – Cattron RemoteIQ: consists of upgrading the existing Cattron Messenger units with additional input/output modules. Communication is via cellular network based. The data and screens are cloud based, and the information can be accessed from anywhere. A graphic of the information flow for Option 1 is provided below:



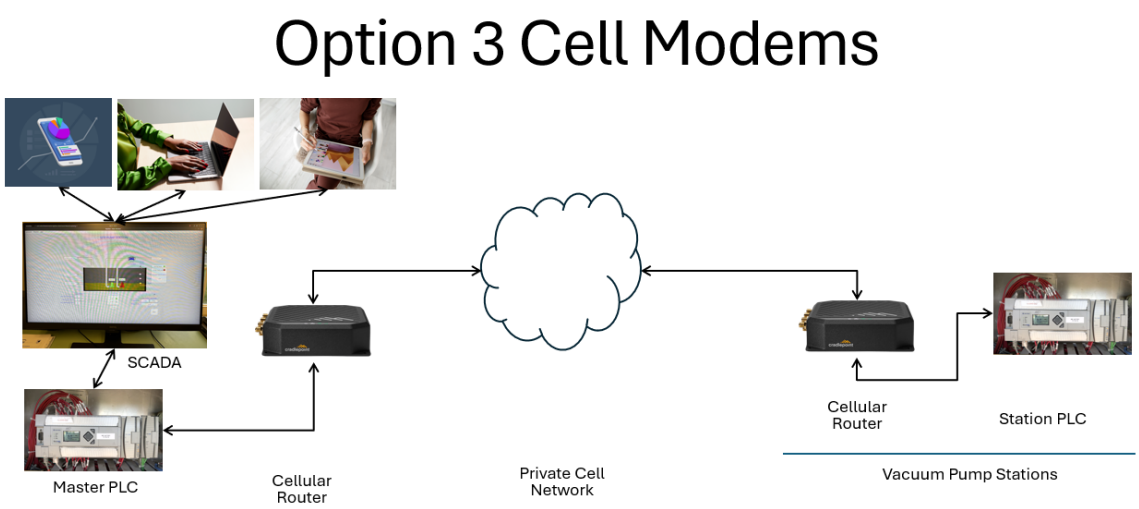
Cell communication. Cloud based data and screens. Access from anywhere. No capital cost for data server. Customizable dashboards. Alarm dial-out, text, email. No remote access to PLC program. Most expensive subscription fee. Limited data connections. Not in SCADA.

- Option 2 – Fiber (public internet): consists of running fiberoptic internet lines to each station and connecting each PLC to the master PLC at the WWTP. Security is provided by firewalls and a persistent Virtual Private Network (VPN). A graphic of the information flow for Option 2 is provided below:



Public internet. Firewall isolation with persistent VPN at each location. Master polling PLC at the plant. Monitoring and control integrated with existing SCADA system. Access from anywhere SCADA is available. Remote support of PLC program. Modest subscription fee. Unlimited data connection. SCADA screens, alarms, history, and trends.

- Option 3 – Cell Modems: Consists of setting up a private cellular network. Each vacuum station PLC would be monitored using a polling PLC at the WWTP. Monitoring and control would be integrated with existing SCADA system. A graphic of the information flow for Option 3 is provided below:



Private cell network. Master polling PLC at the plant. Monitoring and control integrated with existing SCADA system. Access from anywhere SCADA is available. Remote support of PLC program. Modest subscription fee. Controlled rate of data connection. SCADA screens, alarms, history, and trends.

A summary of the proposed work for each option is provided in Table 13 below, and estimated costs are provided in Table 14.

Table 12 – Summary of Work for Vacuum Station Telemetry

Option	Hardware and Installation	Programming Work Summary
Option 1 Cattron Remote IQ	Upgrade to current hardware, and RemoteIQ cloud visualization. Wire to PLC outputs (or wire to relays to bypass the PLC).	Integrate into cloud application, develop screens, and alarms
Option 2 FIBER (Commercial)	Fiber to pump house and control panel. Secure router at the control panel. Master PLC and secure router in the SCADA rack at the plant.	Configure routers for secure access from the plant. Program master PLC at plant to communicate with remote sites. Program existing Ignition to monitor, alarm, dial-out, historical data, trends and remote sites.
Option 3 CELL	CradlePoint or Phoenix cellular access point and private network.	Configure access points for secure private network. Program master PLC at plant to communicate with remote sites. Program existing Ignition to monitor, alarm, dial-out, historical data, trends and remote sites.

Table 13 – Cost Summary for Vacuum Station Telemetry Options

Option	Hardware and Installation Cost per Site	Total Software Cost	Programming Cost	Sites	Annual Subscription Cost per site	Total Cost per site 1 year	Cost 10 year
Option 1 Cattron Remote IQ	$4,000	$0	$10,000	13	$4,800	$76,400	$638,000
Option 2 FIBER (Commercial)	$3,000	$0	$20,000	14	$600	$31,400	$107,000
Option 3 CELL	$3,000	$0	$20,000	14	$360	$28,040	$73,400

Options 2 and 3 are approximately equivalent in cost. Further review with equipment manufacturers is needed to select the recommended option. Option 2 is used for estimating project costs because it is slightly higher.

5.2 Preliminary Site Plans

Preliminary site plans for each site are provided in Appendix C. It is noted that the preliminary site plans were based on various record drawings sets, plat information, and Geographic Information System data. Site survey was not performed. Locations of buried utilities and piping was interpreted from the record drawings and may need to be revised after survey.

Preliminary site plans show that at most of the sites inadequate space is available to construct new systems before removing the existing equipment. Purchasing neighboring lots where available is recommended. It is assumed that temporary systems will be needed to maintain wastewater flows during construction.

5.3 Holding Tank Remote Monitoring

Current remote pressure monitoring is limited to vacuum pressure at the central vacuum stations. Although this information is useful to alert RSA staff to equipment failures and inundation of the vacuum mains. The information it provides does not alert RSA staff to problems early enough to enable them to address issues in the collection system before the vacuum mains are inundated and sanitary sewer overflows have already begun. RSA identified a monitoring solution, which includes monitoring vacuum pressure at the far end of each line (particularly the longest and most issue prone lines) to provide and earlier warning system. Loss in vacuum pressure at the end of the line would alert maintenance staff to issues before they propagate throughout the system. Additionally, the system includes remote control of select vacuum valves to remotely increase air admittance at the end of the line to help push wastewater to the central vacuum station.

SEH reviewed two options for remote monitoring systems provided by two vacuum sewer equipment manufacturers, Flovac and Newterra. The Flovac proposal (Appendix B) was compatible with RSA's equipment. The Newterra technology would require replacing the vacuum valves with a different technology. This option was dismissed and will not be discussed further.

The collection tank monitoring systems consist of two components. The gateway communicates wirelessly with surrounding modules and transfers the information to a Flovac server through wired internet or cellular network. A gateway is installed at a strategic location to receive signal from surrounding modules and where it can be provided with grid power and reliable internet signal. The modules are located at strategic locations in the collection system, such as at the ends of lines or locations subject to frequent inundation that may be served by a standpipe for air admittance and pressure monitoring. Modules are battery powered and may consist of pressure monitoring or a vacuum valve with remote actuation.

RSA initiated a pilot program based on the Flovac proposal in July 2024 consisting of one gateway and approximately six modules. Budgetary costs for an expanded system covering a larger area of the Lake of the Woods system are summarized in Table 15 below. Four gateways and 100 modules are assumed. Actual coverage and the number of gateways and modules will be determined by topography, tree density, and need for modules at specific locations.

Table 14 – Vacuum Main Monitoring System Cost Opinion

Cost Item	Initial Cost	Annual Cost	10 Year Cost
Initial Equipment and Installation Per gateway	$30,000		
Gateway Power and Internet Connection		$900	
Number of gateways (assumed)	4		
Annual Subscription (per 100 modules)		$4,200	
Battery Replacement per Module (5-year battery life)		$16	
Number of Modules		100	
Total	$120,000	$5,800	$178,000
Contingency (15%)	$18,000	$870	
Total Budget (rounded)	$138,000	$7,000	$208,000

5.4 Constructability

Most of the sites are too small to construct new buildings and systems before removing the existing systems. Construction is expected to require a temporary vacuum system. Given the number of sites, it may be economical to construct a mobile temporary vacuum system that can be used at each site as it is upgraded.

6 Conclusions and Recommendations

The Lake of the Woods vacuum sewer system is an aging system that was built before modern vacuum sewer system construction standards were developed. Many of the operational and

maintenance issues result from the construction methods used in the vacuum mains, and cannot be fixed in an economical manner. The RSA has improved the system over time by upgrading the wastewater pumping systems, addressing leaking collection tanks throughout the system, optimizing operational procedures, and providing limited remote monitoring of the vacuum stations. The following issues remain, which must be addressed to maintain the existing level of service and reduce the frequency of sanitary sewer overflows:

1. The aging infrastructure requires replacement. The condition of the building systems is deteriorating at some of the stations. Although the buildings have generally been well maintained, certain buildings are sheathed with fiberboard sheathing that does not withstand the humid pump station environment. Additionally, many of the buildings consist of CMU construction that was damaged in an earthquake approximately 10-years ago. Much of the equipment is also beyond useful life and requires replacement to maintain reliability. The electrical systems are also obsolete and require complete replacement.
2. Much of the existing vacuum system equipment is undersized. Approximately half the stations require both of the duplex vacuum pumps to operate to keep up with current flows, leaving the station with no redundant pump. Additionally, many of vacuum station buildings are undersized to provide adequate space for equipment maintenance and code required electrical clearances.
3. Lack of remote monitoring and controls systems limits the RSA's ability to optimize the stations and proactively address issues before the vacuum systems are overwhelmed. Enhancement of the controls and monitoring systems is the next step in increasing the reliability and resiliency of the system.

Based on these findings, the following improvements are recommended at each site.

Station ID	Building Replacement/ Rehab	Vacuum System Replacement	S&L Pump Station Improve-ments	Odor Control Replace-ment	Electrical Replace-ment	SCADA Implemen-tation
Station A	Rehab	Yes			Yes	Yes
Station B	Rehab	Yes	Yes	Yes	Yes	Yes
Station C	Replacement	Yes	Yes	Yes	Yes	Yes
Station D	Replacement	Yes			Yes	Yes
Station E	Replacement	Yes	Yes	Yes	Yes	Yes
Station F	Rehab	Yes			Yes	Yes
Station G	Replacement	Yes		Yes	Yes	Yes
Station H	Replacement	Yes		Yes	Yes	Yes
Station I	Rehab	Yes	Yes	Yes	Yes	Yes
Station J	Replacement	Yes	Yes	Yes	Yes	Yes
Station K&L	Replacement	Yes			Yes	Yes
Station M	Replacement	Yes			Yes	Yes
Station N	Replacement	Yes		Yes	Yes	Yes

Budgetary costs for the improvements are summarized in Table 16 below. More detailed cost estimates are provided in Appendix D.

Table 15 – Budgetary Costs

Station ID	Construction Cost	Project Contingency	Design Phase Engineering	Construction Phase Engineering & Inspection	Legal/Admin/ Materials Testing/Misc.	Total Probable Project Cost
Cost Assumptions		**25%**	**12%**	**13%**	**5%**	
A	$1,116,400	$279,000	$134,000	$145,000	$56,000	$1,730,000
B	$1,235,500	$309,000	$148,000	$161,000	$62,000	$1,916,000
C	$1,510,100	$378,000	$196,000	$196,000	$76,000	$2,356,000
D	$885,500	$177,000	$123,000	$115,000	$44,000	$1,345,000
E	$1,510,100	$378,000	$196,000	$196,000	$76,000	$2,356,000

Station ID	Construction Cost	Project Contingency	Design Phase Engineering	Construction Phase Engineering & Inspection	Legal/Admin/ Materials Testing/Misc.	Total Probable Project Cost
Cost Assumptions		**25%**	**12%**	**13%**	**5%**	
F	$1,341,700	$335,000	$161,000	$174,000	$67,000	$2,079,000
G	$902,300	$226,000	$125,000	$117,000	$45,000	$1,415,000
H	$902,300	$226,000	$125,000	$117,000	$45,000	$1,415,000
I	$981,200	$245,000	$118,000	$128,000	$49,000	$1,521,000
J	$1,388,100	$347,000	$181,000	$180,000	$69,000	$2,165,000
L&K	$1,297,000	$324,000	$170,000	$169,000	$65,000	$2,025,000
M	$885,500	$221,000	$123,000	$115,000	$44,000	$1,389,000
N	$902,300	$180,000	$125,000	$117,000	$45,000	$1,369,000
TOTAL	**$14,858,000**					**$23,081,000**

6.1 Project Phasing and Capital Improvements Program

Guided by the Vacuum Station Rating system noted above and specific circumstances at several of the vacuum stations, the recommended project phasing and Capital Improvements Program is provided in Table 17.

Table 16 – 5-Year Recommended Capital Improvements Program

	FY26	FY27	FY28	FY29	FY30	TOTAL
	1. Design Station C, H, & K/L improvements. 2. Replace Station I S&L PS. 3. Implement phased collection tank monitoring and controls	1. Design Station B, E, & F improvements. 2. Construct Station C, H, & K/L improvements. 3. Implement phased collection tank monitoring and controls	1. Design Station A, D, & J improvements. 2. Construct Station B, E, & F improvements. 3. Implement phased collection tank monitoring and controls	1. Design Station G, I, M, N improvements. 2. Construct Station A, D, & J improvements. 3. Implement phased collection tank monitoring and controls	1. Construct Station G, I, M, N Improvements.	
A			$134,000	$1,596,000		
B		$148,000	$1,768,000			
C	$196,000	$2,160,000				
D			$123,000	$1,222,000		
E		$196,000	$2,160,000			
F		$161,000	$1,918,000			
G				$125,000	$1,290,000	
H	$125,000	$1,290,000				
I	$147,800			$118,000	$1,255,200	
J			$181,000	$1,984,000		
K&L	$170,000	$1,855,000				
M				$123,000	$1,266,000	
N				$125,000	$1,244,000	
Remote Monitoring	$34,500	$34,500	$34,500	$34,500		
Total	$673,400	$5,844,500	$6,318,500	$5,371,500	$5,101,200	$23,309,000

Appendix A

Vacuum Station Condition Ratings and Checklists

Summary of Condition Assessment			
Station A			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel Driveway
	2	Good	Dedicated turnaround area.
Lift Station Site	2	Good	There are no visible stress or settlement cracks in the lift station site pad.
	2	Good	The site appears to have adequate drainage with some ponding water on the site pad.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	3	Fair	Minimal site lighting is installed.
Building Conditions			
Exterior	3	Good	Minor cracking of exterior walls, louver damaged, open penetrations.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	2	Good	Entry doors are hollow metal with louver. No windows, exterior and interior hardware are in place and locking mechanism works.
Interior	4	Fair	Moderate cracking of the walls, minimal rot and penetrations missing sealant.
	4	Fair	Concrete floor shows minor cracking.
	2	Good	All interior lighting working.
Wet Well			
Top	2	Good	Steel top has begun rusting and requires cleaning/recoating.
	2	Good	Exterior of top closes and shuts properly, no signs of damage.
	2	Good	Steel hatch installed and can be locked
Interior	1	Very Good	Wet well is coated with corrosion resistant material (epoxy), infiltration stains evident at penetrations.
	3	Fair	Steel interior top of wet well shows some evidence of rust and corrosion.
	2	Good	Pipe exhibits minimal evidence of corrosion and rusting.
Receiving Tank Conditions			
	2	Good	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access is clear and rust is minimal.
	2	Good	Paint chipping on the exterior of the tank.
	2	Good	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Overflow Tank Conditions			
	2	Good	Piping and pipe insulation seem to be in tact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	2	Good	Minor paint chipping on the exterior of the tank.
	2	Good	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Equalization Tank Conditions			
	2	Good	Piping and pipe insulation seem to be in tact, no signs of leaks. Pipe insulation has been repaired with aluminum tape in certain areas
	2	Good	Manway access seems to be clear and operable.
	2	Good	Paint chipping on the exterior of the tank.
	2	Good	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	3	Fair	Housing/cover in fair condition, no signs of damage.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Cover opens freely to allow access.
Interior	4	Poor	Floor is corroded and rusting.
	3	Fair	Pipe paint peeling.
Equipment	2	Good	Pumps and valves operate with minimal vibration. Suitable for continued use. However, nearing the end of rated useful life.
Vacuum Pump Conditions			
Pump Components	4	Poor	Pumps are beyond their rated useful life.
	2	Good	Pump Housing does not show any evidence of damage.
	2	Good	Mounting plate does not show any evidence of damage
	2	Good	Pump supports do not show any evidence of damage.
	2	Good	Cables and seals are in tact and do not show any evidence of damage.
	2	Good	No vibrations coming from either pump.
	2	Good	Pump motor shows evidence of corrosion and peeling.
	2	Good	Lifting handle secured on pump and the pump has sufficient clearance for pump removal.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	4	Poor	Significant evidence of infiltration with puddles present. Valves sit in water.
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access via heavy cast iron lid.
Piping and Valves			
Piping in Wet well	3	Fair	A medium level of corrosion has developed on these pipes along with a medium level of the paint peeling away.
	2	Good	The flanged joint bolts are not corroded.
	2	Good	There are no signs of leakage from piping.
Piping in Valve Vault	2	Good	Minimal corrosion has developed on these pipes along with a paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	3	Fair	Some surface corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	4	Poor	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	2	Good	The control panel is in fair condition. It was installed in 2010.
	3	Fair	There is minor corrosion in the control panel.
Generator	2	Good	The generator was installed in last 10 years, appears to be in good condition

Average Grade: 2.4

Summary of Condition Assessment			
Station B			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel Driveway
	2	Good	Dedicated turnaround area.
Lift Station Site	2	Good	There are no visible stress or settlement cracks in the station site pad.
	2	Good	The site appears to have adequate drainage with some ponding water on the site pad.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	3	Fair	Minimal site lighting is installed.
Building Conditions			
Exterior	3	Fair	Minor cracking of exterior walls, louver damaged, open penetrations.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	2	Good	Entry doors are hollow metal with louver. No windows, exterior and interior hardware are in place and locking mechanism works.
Interior	3	Fair	Moderate cracking of the walls, minimal rot and penetrations missing sealant. Interior wall coating system is failed.
	3	Fair	Concrete floor exhibits minor cracking.
	2	Good	All interior lighting working.
Wet Well			
Top	4	Poor	Steel top has rusted and needs replacing.
	2	Good	Exterior of top closes and shuts properly, no signs of damage.
	2	Good	Steel hatch installed and can be locked
Interior	4	Poor	Wet well is uncoated. Concrete spallling evident with exposed agregate. Concrete gives way to screw driver
	3	Fair	Steel interior top of wet well shows evidence of moderate rust and corrosion.
	4	Poor	Pipe exhibits advanced corrosion and rusting.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be in tact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical probe connection to tank requires field constructed plastic shield to prevent electrical shorting.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical probe connection to tank requires field constructed plastic shield to prevent electrical shorting.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be in tact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical probe connection to tank requires field constructed plastic shield to prevent electrical shorting.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	3	Fair	Housing/cover in fair condition, Support arms exhibit rust.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	4	Poor	A wooden platform is required for access. The platform size limits the ability to maintain the pumps.
Interior	4	Poor	Floor is corroded and rusting.
	3	Fair	Pipe paint peeling.
Equipment	4	Poor	Pumps are approximately 30-years old, beyond useful life. Require replacement.
Vacuum Pump Conditions			
Pump Components	4	Poor	Pumps are more than 20-years old and are beyond useful life.
	3	Fair	Pump Housing does not show evidence of damage, other than age and surface corrosion. Pumps have been field painted.
	3	Fair	Mounting plate does not show evidence of damage, other than corrossion
	3	Fair	Pump supports do not show any evidence of damage. Pump #2 is not equipped with a support pedestal
	2	Good	Cables and seals are in tact and do not show any evidence of damage.
	3	Fair	Minimial vibrations coming from either pump.
	2	Good	Pump motor shows evidence of corrosion and peeling.
	2	Good	Lifting handle secured on pump and the pump has sufficient clearance for pump removal.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	4	Poor	Significant evidence of infiltration with puddles present.
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access hatch is heavy to access.
Piping and Valves			
Piping in Wet well	4	Poor	Pipe corrosion is advanced
	4	Poor	Pipe flanges and bolts heavily corroded.
	3	Fair	Piping has collected rags.
Piping in Valve Vault	2	Good	Minimal corrosion has developed on these pipes along with a paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	3	Fair	Some surface corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	4	Poor	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in poor condition. The controls are beyond useful life and require replacement.
	4	Poor	There is corrosion in the control panel.
Generator	2	Good	The generator was installed in last 10 years, appears to be in good condition

Average Grade: 2.8

Summary of Condition Assessment			
Station C			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel Driveway
	2	Good	Adequate space is provided for a turnaround area.
Lift Station Site	2	Good	There are some signs of stress or settlement cracks in the station site pad, near door stoop.
	3	Fair	The site appears to have minor drainiage issues. Ponding water was observed in the driveway.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	4	Poor	Minimal site lighting is installed. Lighting was not functional
Building Conditions			
Exterior	5	Very Poor	Step cracking of exterior walls, Owner reported exteior reinforcing installed after cracking initiated.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	5	Very Poor	Entry doors are hollow metal with louver, no issues noted. Interior stairs are not code compliant.
Interior	5	Very Poor	Exterior above grade wood framed walls sheathed with particle board. Exhibits moisure swelling and rot.
	5	Very Poor	Concrete floor exhibits cracking. Building infiltration and cooling water requires continous sump pump operation to avoid flooding.
	3	Fair	All interior lighting working. A mid level floor system makes lower level dark.
Wet Well			
Top	4	Poor	Steel top has rusted and needs replacing.
	2	Good	Exterior of top closes and shuts properly, no signs of damage.
	2	Good	Steel hatch installed and can be locked
Interior	5	Very Poor	Wet well is uncoated. Concrete spallling evident with exposed agregate. Water infiltrating under pressure at joint, approx. 10 gpm
	3	Fair	Steel interior top of wet well shows evidence of moderate rust and corrosion.
	4	Poor	Pipe exhibits moderate corrosion and rusting.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be in tact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be in tact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	3	Fair	Housing/cover in fair condition, Electrical conduit fraying/kinked.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Access is adequate
Interior	4	Poor	Floor is corroded and rusting. Standing water on floor.
	4	Poor	Pipe paint peeling, valves corroded.
Equipment	4	Poor	Pumps are approximately 30-years old, beyond useful life. One pump was borrowed from another pump station. Require replacement.
Vacuum Pump Conditions			
Pump Components	2	Good	One pump was replaced in 2018, the other is not marked.
	3	Fair	Pumps exibit minor corrosion. One pump has been repainted.
	2	Good	Mounting plate does not show evidence of damage, other than corrossion
	3	Fair	Both pumps are installed on pedestals. One pump is not fastened to the pedestal.
	2	Good	Cables and seals are in tact and do not show any evidence of damage.
	3	Fair	Minimial vibrations coming from either pump.
	2	Good	Pump motor shows minor evidence of corrosion and peeling.
	5	Very Poor	Pumps are on lower floor and door is at ground level. There is inadequate space/equipment in place to safely remove pumps/motors for maintenanc
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valve is partially buried, at soil air interface.
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access lid is heavy to managable for one person.
Piping and Valves			
Piping in Wet well	4	Poor	Pipe corrosion is moderate
	4	Poor	Pipe flanges and bolts heavily corroded.
	3	Fair	Piping has collected rags.
Piping in Valve Vault	3	Fair	Moderate corrosion has developed on these pipes along with a paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	3	Fair	Some surface corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	4	Poor	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in poor condition. The controls are beyond useful life and require replacement.
	4	Poor	There is corrosion in the control panel.
Generator	2	Good	The generator is 2018 vintage, appears to be in good condition

Average Grade: 3.0

Summary of Condition Assessment			
Station D			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	3	Fair	Gravel Driveway, significant ponding observed
	3	Fair	Dedicated turnaround area. Shares driveway with adjacent park.
Lift Station Site	2	Good	There are no visible stress or settlement cracks in the lift station site pad.
	2	Good	The site appears to have adequate drainage with some ponding water on the site pad.
	5	Very Poor	Based on available FEMA flood maps, the site is located within the 100-year floodplain.
	4	Poor	Exterior lighting installed but not functional
Building Conditions			
Exterior	3	Fair	Minor cracking of exterior walls, louver damaged, open penetrations.
	3	Fair	Roofing system is wood trusses with asphalt shingles. In fair condition, moderate defects noted
	2	Good	Entry doors are hollow metal with louver. No windows, exterior and interior hardware are in place and locking mechanism works.
Interior	4	Poor	Moderate cracking of the walls, minimal rot and penetrations missing sealant.
	3	Fair	Concrete floor shows minor cracking.
	2	Good	All interior lighting working.
Wet Well			
Top		Non-existent	
		Non-existent	
		Non-existent	
Interior		Non-existent	
		Non-existent	
		Non-existent	
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access is clear and rust is minimal.
	3	Fair	Paint chipping on the exterior of the tank.
	4	Poor	Electrical components show evidene of loose connection or frayed wires. Require plastic shield to avoid shorting.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access is clear and rust is minimal.
	3	Fair	Paint chipping on the exterior of the tank.
	4	Poor	Electrical components show evidene of loose connection or frayed wires. Require plastic shield to avoid shorting.
Interior			Not Accessed
Equalization Tank Conditions			
	2	Good	Piping and pipe insulation seem to be in tact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	2	Good	Minimal paint chipping on the exterior of the tank.
	2	Good	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top		Non-existent	
		Non-existent	
		Non-existent	
		Non-existent	
Interior		Non-existent	
		Non-existent	
Equipment		Non-existent	
Vacuum Pump Conditions			
Pump Components	4	Poor	Pumps are beyond their rated useful life. Ran very hot. Pumps were passing cooling water to the odor control unit, which is a sign of internal wear.
	3	Fair	Pump Housing does not show any evidence of damage. Dirty
	2	Good	Mounting plate does not show any evidence of damage
	2	Good	Pump supports do not show any evidence of damage.
	3	Fair	Cables and seals are partially intact. Some wires not in conduit.
	2	Good	Some vibration coming from either pump.
	2	Good	Pump motor shows evidence of corrosion and peeling.
	2	Good	Lifting handle secured on pump and the pump has sufficient clearance for pump removal.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valves sit at the soil air interface. Minimal ponding present in vaults.
Access Hatch	2	Good	Frames and covers are intact.
	3	Fair	Access via heavy cast iron lid.
Piping and Valves			
Piping in Wet well		Non-existent	
		Non-existent	
		Non-existent	
Piping in Valve Vault		Non-existent	
		Non-existent	
		Non-existent	
Plug Valves		Non-existent	
		Non-existent	
		Non-existent	
Check Valves		Non-existent	
		Non-existent	
		Non-existent	
Bypass		Non-existent	
Electrical/Controls			
Control Panel	4	Poor	The control panel is beyond useful life and requires replacement
	4	Poor	There is corrosion in the control panel.
Generator	2	Good	There is not generator. A generator plug is provided for temporary power.

Average Grade: 2.8

Summary of Condition Assessment			
Station E			
Pump station assessment	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	3	Fair	Partly asphalt and part gravel, evidence of pooling in the driveway.
	NA	NA	No turnaround area.
Site conditions	3	Fair	Building has minor cracking on exterior walls, Louvers damaged and open penetrations.
	2	Good	The site appears to have adequate drainage with slight evidence of ponding in the driveway.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	3	Fair	Site light is installed. Lighting in the front works, lighting on the side of the building is missing bulbs
Building Conditions			
Exterior	3	Fair	Minor cracking of exterior walls, louver damaged, open penetrations.
	3	Fair	Roofing system in decent condition , rotting of fascia in the back of the building.
	2	Good	Entry doors are hollow metal with no windows, exterior and interoior hardware are in place and locking mechanism works.
Interior	3	Fair	Moderate cracking of the walls, some rot and penetrations missing sealant.
	3	Fair	Concrete floor shows minor cracking.
	2	Good	All interior lighting working.
Wet Well			
Top	4	Poor	Steel top has rusted and needs replacing.
	2	Good	Exterior of top closes and shuts properly, no signs of damage.
	2	Good	Steel hatch installed and can be locked
Interior	3	Fair	Exposed aggregate, minor damage, staining and spalling.
	3	Fair	Steel interior top of wet well shows evidence of moderate rust and corrosion.
	4	Fair	Pipe showing moderate evidence of corrosion and rusting.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be in tact, no signs of leaks.
	3	Fair	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be in tact, no signs of leaks.
	3	Fair	Manway access seems to be clear and operable.
	3	Fair	Minor paint chipping on the exterior of the tank.
	3	Fair	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be in tact, no signs of leaks. Pipe insulation has been repaired with aluminum tape in certain areas
	3	Fair	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	3	Fair	Housing/cover in fair condition, no signs of damage.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Cover opens freely to allow access.
Interior	4	Poor	Floor is corroded and rusting.
	3	Fair	Pipe paint peeling.
Equipment	3	Fair	No name plate on pump 2. Pumps are beyond useful life, but no damage is evident
Vacuum Pump Conditions			
Pump Components	4	Poor	Pumps are beyond their rated useful life.
	2	Good	Pump Housing does not show any evidence of damage.
	2	Good	Mounting plate does not show any evidence of damage
	2	Good	Pump supports do not show any evidence of damage.
	2	Good	Cables and seals are in tact and do not show any evidence of damage.
	2	Good	No vibrations coming from either pump.
	2	Good	Pump motor shows evidence of corrosion and peeling.
	2	Good	Lifting handle secured on pump and the pump has sufficient clearance for pump removal.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	minor evidence of infiltration of water from site runoff.
Access Hatch	2	Good	Frames and covers are not cracked.
	2	Good	Access hatch is light weight material.
Piping and Valves			
Piping in Wet well	4	Poor	A substantial level of corrosion has developed on these pipes along with a substantial level of the paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	3	Fair	There are no signs of leakage from piping.
Piping in Valve Vault	3	Fair	A mediume level of corrosion has developed on these pipes along with a medium level of the paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	4	Poor	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	4	Poor	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	4	Poor	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	4	Poor	The flanged joint bolts are corroded and some missing
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel enclosure is in poor condition. Painted steel, PVC conduit. Control panel is beyond useful life.
	4	Poor	There is corrosion in the control panel.
Generator	4	Poor	The generator is currently in working condition but is beyond useful life.

Average Grade: 2.8

Summary of Condition Assessment			
Station F			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel Driveway owned by and shared with HOA
	2	Good	Adequate space is provided for a turnaround area.
Lift Station Site	2	Good	There are no signs of stress or settlement cracks in the station site pad,
	3	Fair	The site appears to have minor drainiage issues. Ponding water was observed in the behind building.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	4	Poor	No site lighting is installed.
Building Conditions			
Exterior	3	Fair	Brick veneer walls in adequate condition, minor to moderate cracking observed.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	2	Good	Entry doors are hollow metal with louver, no issues noted.
Interior	2	Good	Interior walls covered with plywood. Exibits delamination.
	3	Fair	Concrete floor exhibits cracking. Signfiicant levels of water on floor from seal/cooling water.
	3	Fair	Only one interior light works.
Wet Well			
Top	4	Poor	Steel top has rusted and needs replacing.
	2	Good	Exterior of top closes and shuts properly, minimal signs of damage.
Interior	3	Fair	Wet well is uncoated. Concrete spallling evident with exposed agregate.
	3	Fair	Steel interior top of wet well shows evidence of moderate rust and corrosion.
	4	Poor	Pipe exhibits advanced corrosion and rusting. Evidence of previous pipe failure and repair is evident.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	4	Poor	Paint chipping on the exterior of the tank. Corrosion evident
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical connections to tank compromised, and plastic shield needed to reduce shorting.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	4	Poor	Housing/cover in poor condition, rust and corrosion is moderate.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Access is adequate
Interior	4	Poor	Floor is corroded and rusting.
	3	Fair	Pipe paint peeling, valves corroded.
Equipment	4	Poor	Pumps are approximately 30-years old, beyond useful life. Require replacement. Motor whine observed.
Vacuum Pump Conditions			
Pump Components	4	Poor	One pump was replaced in 2008, the other is not marked. Mechanical seal failed on one pump.
	3	Fair	One pump exibits minor corrosion. One pump has moderate corrosion.
	2	Good	Mounting plate for one pump exibits minor corrosion. One pump has moderate corrosion.
	3	Fair	One pump is installed on a pedestals and one is on the floor.
	2	Good	Cables and seals are intact and do not show any evidence of damage.
	4	Poor	Pump 2 is in poor condition and requires replacement. The replacement pump is on hand at the station.
	2	Good	Pump motors shows minor evidence of corrosion and peeling.
	2	Good	Lifting handle secured on pump and the pump has sufficient clearance for pump removal.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valve is partially buried, at soil air interface.
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access lid is bolted down fiberglass.
Piping and Valves			
Piping in Wet well	4	Poor	Pipe corrosion is moderate/heavy
	4	Poor	Pipe flanges and bolts heavily corroded.
	3	Fair	Some grease observed near normal water level
Piping in Valve Vault	3	Fair	Moderate corrosion has developed on these pipes along with paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	3	Fair	Some surface corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	3	Fair	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in poor condition. The controls are beyond useful life and require replacement.
	4	Poor	There is corrosion in the control panel.
Generator	1	Very Good	The generator is 2023 vintage, appears to be in good condition

Average Grade: 2.8

Summary of Condition Assessment			
Station G			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel driveway
	3	Fair	Note enough space is provided for a turnaround area.
Lift Station Site	2	Good	There are no signs of stress or settlement cracks in the station site pad,
	3	Fair	The site has some drainage and errosion issues. Inadequate ground cover.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	3	Fair	Minimal site lighting is installed.
Building Conditions			
Exterior	2	Good	Brick veneer walls in adequate condition, attached odor control unit needs to be removed.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	2	Good	Entry doors are hollow metal with louver, no issues noted.
Interior	2	Good	Interior walls are CMU, no issues noted.
	2	Good	No issues with slab noted except minor ponding on floor
	2	Good	Interior lighting adequate
Wet Well			
Top	2	Good	Steel top recently replaced (2014) with stainless steel base slab. Condition is good.
	2	Good	Exterior of top closes and shuts properly, minimal signs of damage.
Interior	2	Good	Wet well is coated with corrosion resistantant epoxy liner.
	2	Good	Steel interior is in good condition.
	2	Good	Pipe is in good condition.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	4	Poor	Paint chipping on the exterior of the tank. Corrosion evident
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical connections to tank compromised, and plastic sheild needed to reduce shorting.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	2	Good	Housing/cover in good condition, rust and corrosion is moderate.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Access is adequate
Interior	2	Good	Floor is in good condition.
	2	Good	Piping and valves in good condition. Coatings intact.
Equipment	4	Poor	Pump lower units replaced ~10 years ago. Pump upper unit/motor original to 1990s upgrade. Last rebuilt 2011. Beyond useful life
Vacuum Pump Conditions			
Pump Components	4	Poor	Pump 1 was replaced in 2001, the other is not marked. Pump 1 heavily corroded. Both pumps are beyond useful life.
	3	Fair	One pump exibits minor corrosion. One pump has moderate corrosion.
	2	Good	Mounting plate for one pump exibits minor corrosion. One pump has moderate corrosion.
	3	Fair	One pump is installed on a pedestals and one is on the floor.
	2	Good	Cables and seals are in tact and do not show any evidence of damage.
	4	Poor	Both pumps are beyond useful life.
	3	Fair	Pump motors shows moderate evidence of corrosion and peeling.
	4	Good	Inadequate clearance to adequately maintain pumps
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valve is partially buried, at soil air interface.
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access lid is bolted down fiberglass.
Piping and Valves			
Piping in Wet well	2	Good	Pipe condition is good.
	2	Good	Pipe condition is good.
	2	Good	Few signs of grease or infiltration noted.
Piping in Valve Vault	2	Good	Few signs of corrosion noted on pipe body
	2	Good	The flanged joint bolts are not corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	2	Good	Few signs of valve corrosion noted
	2	Good	The flanged joint bolts are not corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	2	Good	Few signs of valve corrosion noted
	2	Good	The flanged joint bolts are not corroded.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in poor condition. The controls are beyond useful life and require replacement. Clearances are inadequate
	4	Poor	There is corrosion in the control panel.
Generator	2	Good	A generator plug is provided to connect emergency power.

Average Grade: 2.4

Summary of Condition Assessment			
Station H			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel Driveway
	2	Good	Adequate space is provided for a turnaround area.
Lift Station Site	2	Good	There are no signs of stress or settlement cracks in the station site pad.
	3	Fair	The site appears to have minor drainage issues. Driveway directs water towards building
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain
	4	Poor	Minimal site lighting is installed. Lighting was not functional
Building Conditions			
Exterior	5	Very Poor	Step cracking of below grade exterior CMU walls, Owner reported exteior reinforcing installed after cracking initiated.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	5	Very Poor	Entry doors are hollow metal with louver, no issues noted. Interior stairs are not code compliant
Interior	5	Very Poor	Exterior above grade wood framed walls sheathed with particle board. Exhibits moisure swelling and rot
	5	Very Poor	Concrete floor exhibits cracking. Building infiltration and cooling water requires continous sump pump operation to avoid flooding
	3	Fair	All interior lighting working. A mid level floor system makes lower level dark.
Wet Well			
Top	2	Good	Stainless Steel base frame construction, good condition
	2	Good	Exterior of top closes and shuts properly, no signs of damage.
	2	Good	Steel hatch installed and can be locked
Interior	2	Good	Wet well is coated with corrosion resistant epoxy liner
	2	Good	Steel interior top of wet well shows no evidence of rust and corrosion.
	2	Good	Pipe exhibits minor corrosion and rusting. 4" diameter forcemain only
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	2	Good	Minor paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	2	Good	Minor paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	2	Good	Housing/cover in good condition.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Access is adequate
Interior	2	Good	Floor is in good condition. Minor standing water on floor.
	2	Good	Pipe and valve in good condition.
Equipment	4	Poor	Pump lower units replaced ~10 years ago. Pump upper unit/motor original to 1990s upgrade. Last rebuilt 2011. Beyond useful life
Vacuum Pump Conditions			
Pump Components	4	Poor	One pump was replaced in 2013, the other is older but not marked. Pumps are not the same size (one SC2, one SC3). SC2 does not keep up with flows and is not used.
	2	Good	Pumps exibit minor corrosion.
	2	Good	Mounting plate does not show evidence of damage, other than corrossion
	3	Fair	Both pumps are installed on pedestals.
	3	Fair	Cables and seals are intact and do not show any evidence of damage. One motor terminal box open.
	3	Fair	Minimial vibrations coming from either pump.
	2	Good	Pump motor shows minor evidence of corrosion and peeling.
	5	Very Poor	Pumps are on lower floor and door is at ground level. There is inadequate space/equipment in place to safely remove pumps/motors for maintena
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valve is partially buried, at soil air interface. Ponding was observed in one valve vault
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access lid is heavy to managable for one person.
Piping and Valves			
Piping in Wet well	2	Good	Pipe corrosion is minimal
	2	Good	Pipe flange corrosion is minimal
	2	Good	Little evidence of grease/rags
Piping in Valve Vault	2	Good	Pipe corrosion is minimal
	2	Good	Pipe flange corrosion is minimal
	2	Good	There are no signs of leakage from piping.
Plug Valves	2	Good	Valve condition is good.
	2	Good	Valve flange condition is good.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	2	Good	Valve condition is good.
	2	Good	Valve flange condition is good.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in acceptable condition. The controls are beyond useful life and require replacement
	4	Poor	There is corrosion in the control panel.
Generator	4	Poor	A generator plug is provided for emergency power. The plug is not adequately supported.

Average Grade: 2.6

Summary of Condition Assessment			
Station I			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel driveway
	3	Fair	Inadequate space is provided for a turnaround area.
Lift Station Site	2	Good	There are no signs of stress or settlement cracks in the station site pad,
	3	Fair	The site appears to have minor drainiage issues. Ponding water was observed near the wet well.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	4	Poor	Minimal site lighting is installed. It was not functional
Building Conditions			
Exterior	2	Good	Brick veneer walls in adequate condition.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	2	Good	Entry doors are hollow metal with louver, no issues noted.
Interior	2	Good	Interior walls consist of CMU
	3	Fair	Concrete floor exhibits cracking.
	3	Fair	Two interior lights provided in working order.
Wet Well			
Top	5	Very Poor	Steel top has rusted and needs replacing.
	2	Good	Exterior of top closes and shuts properly, minimal signs of damage.
Interior	3	Fair	Wet well is uncoated. Concrete spallling evident with exposed agregate. Roots intruding
	4	Poor	Steel interior top of wet well shows evidence of moderate rust and corrosion. Needs to be cleaned.
	5	Very Poor	Pipe exhibits advanced corrosion and rusting.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	4	Poor	Paint chipping on the exterior of the tank. Corrosion evident
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical connections to tank compromised, and plastic shield needed to reduce shorting.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	4	Poor	Housing/cover in poor condition, rust and corrosion is moderate.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Access is adequate
Interior	4	Poor	Floor is corroded and rusting. Leaves and pine needles present on floor.
	3	Fair	Pipe paint peeling, valves corroded.
Equipment	4	Poor	Pumps are approximately 30-years old, beyond useful life. Require replacement. One pump was rebuilt in 2011
Vacuum Pump Conditions			
Pump Components	4	Poor	One pump was replaced prior to 2001, the other is missing nameplate. Pump 1 is heavily corroded at end bearing.
	3	Fair	Pump 1 mounting plate heavily corroded.
	2	Good	Mounting plate for one pump exibits minor corrosion. One pump has moderate corrosion.
	3	Fair	One pump is installed on a pedestals and one is on the floor.
	2	Good	Cables and seals are intact and do not show any evidence of damage.
	4	Poor	Pump 2 exhibits rattle and motor whines.
	2	Good	Pump motors shows minor evidence of corrosion and peeling.
	2	Good	Lifting handle secured on pump and the pump has sufficient clearance for pump removal.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valves are submerged in water. One check valve exibits evidence of leaking. Replacment needed.
Access Hatch	2	Good	Frames and covers are not cracked.
	2	Good	Access lide is steel cover
Piping and Valves			
Piping in Wet well	4	Poor	Pipe corrosion is moderate/heavy
	4	Poor	Pipe flanges and bolts heavily corroded.
	3	Fair	Some grease observed near normal water level
Piping in Valve Vault	3	Fair	Moderate corrosion has developed on these pipes along with paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	3	Fair	Some surface corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	3	Fair	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in poor condition. The controls are beyond useful life and require replacement.
	4	Poor	There is corrosion in the control panel.
Generator	2	Good	A generator plug is provided for emergency power.

Average Grade: 2.8

Summary of Condition Assessment			
Station J			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	The station shares a parially paved/partially gravel drive with a boat ramp.
	2	Good	Adequate space is provided for a turnaround area.
Lift Station Site	2	Good	There are no signs of stress or settlement cracks in the station site pad,
	3	Fair	The site appears to have minor erosion issues/lack of cover.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	3	Fair	Minimal site lighting is installed. One of three lights was functional
Building Conditions			
Exterior	2	Good	Brick veneer walls in adequate condition.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	3	Fair	Entry doors are hollow metal with louver. Dinged up but functional.
Interior	3	Fair	Interior walls consist of CMU, with some cracked joints
	2	Good	Concrete floor exhibits minimal cracking.
	3	Fair	Two interior lights provided in working order.
Wet Well			
Top	5	Very Poor	Steel top has rusted and needs replacing.
	2	Good	Exterior of top closes and shuts properly, minimal signs of damage.
Interior	3	Fair	Wet well is uncoated. Concrete spallling evident with exposed agregate. Roots intruding
	4	Poor	Steel interior top of wet well shows evidence of moderate rust and corrosion. Needs to be cleaned.
	5	Very Poor	Pipe exhibits advanced corrosion and rusting.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	4	Poor	Paint chipping on the exterior of the tank. Corrosion evident
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Overflow Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical connections to tank compromised, and plastic shield needed to reduce shorting.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	4	Poor	Housing/cover in poor condition, rust and corrosion is advanced.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Access is adequate
Interior	4	Poor	Floor is corroded and rusting.
	3	Fair	Pipe paint peeling, valves corroded.
Equipment	4	Poor	Pumps are approximately 30-years old, beyond useful life. Require replacement. Both pumps were rebuilt in 2011
Vacuum Pump Conditions			
Pump Components	4	Poor	Pump 2 was replaced in 2001, Pump 1 in 2011. Pump 2 is heavily corroded and worn.
	3	Fair	Both mounting plates heavily corroded.
	3	Fair	
	3	Fair	Pump 1 is installed on the floor.
	2	Good	Cables and seals are intact and do not show any evidence of damage.
	4	Poor	Pump 2 exhibits loud vibration.
	3	Fair	Pump motors shows minor evidence of corrosion and peeling.
	4	Poor	Lifting handle secured on pump. Inadequate access provided to maintain pumps.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valve is partially buried, at soil air interface. Ponding was observed in one valve vault
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access lid is fiberglass top
Piping and Valves			
Piping in Wet well	4	Poor	Pipe corrosion is moderate/heavy
	4	Poor	Pipe flanges and bolts heavily corroded.
	3	Fair	Some grease observed near normal water level
Piping in Valve Vault	3	Fair	Moderate corrosion has developed on these pipes along with paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of leakage from piping.
Plug Valves	3	Fair	Some surface corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	3	Fair	A substantial level of corrosion has developed on these valves along with a substantial level of paint peeling away.
	3	Fair	The flanged joint bolts are corroded.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in poor condition. The controls are beyond useful life and require replacement.
	2	Good	There is corrosion in the control panel.
Generator	2	Good	A generator plug and transfer switch is provided for emergency power.

Average Grade: 2.8

Summary of Condition Assessment			
Station L&K			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	The station has a dedicated gravel driveway. Connects to HOA owned driveway.
	2	Good	Adequate space is provided for a turnaround area.
Lift Station Site	2	Good	There are no signs of stress or settlement cracks in the station site pad,
	2	Good	The site dhas minor drainage issues. Ponding observed in driveway turnaround
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	4	Poor	Minimal site lighting is installed on building. Not functional
Building Conditions			
Exterior	2	Good	Brick veneer walls in adequate condition. Partially bermed construction.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	4	Poor	Entry doors are hollow metal with louver. Access is down a stairwell. Stairwell drain was plugged.
Interior	3	Fair	Interior walls consist of CMU, with some cracked joints
	3	Fair	Concrete floor exhibits moderate cracking.
	3	Fair	Two interior lights provided in working order.
Wet Well			
Top	2	Good	Steel top recently replaced with stainless steel base slab. Condition is good.
	2	Good	Exterior of top closes and shuts properly, minimal signs of damage. One support leg not connected.
Interior	2	Good	Wet well is coated with corrosion resistantant epoxy liner.
	2	Good	Steel interior of top is in good condition.
	2	Good	Pipe is in good condition.
Receiving Tank Conditions			
	5	Very Poor	Piping and pipe insulation seem to be intact. Two receiving tanks installed. One has failed weld seam.
	2	Good	Manway access seems to be clear and operable.
	5	Very Poor	Paint chipping on the exterior of the tank. Corrosion eviditent cause of failed weld.
	2	Good	Electrical connections to tank intact.
Interior			Not Accessed
Overflow Tank Conditions			
	5	Very Poor	Not installed. Overflow tank had to be reconfigured as separate Receiving tank to keep up with flow.
Interior			Not Accessed
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks. Two tanks in parallel are needed.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	3	Fair	Electrical connections to tank intact.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	2	Good	Housing/cover in good condition, rust and corrosion is moderate.
	2	Good	Cover Securely attached to wet well.
	2	Good	Pad lock on the cover.
	2	Good	Access is adequate
Interior	2	Good	Floor is in good condition.
	2	Good	Piping and valves in good condition. Coatings intact.
Equipment	4	Poor	Pumps are approximately 30-years old, beyond useful life. Require replacement. Both pumps were rebuilt in 2011
Vacuum Pump Conditions			
Pump Components	4	Poor	Pump 1 was replaced in 2018, Pump 2 age is unknown. Both pumps are heavily corroded and worn.
	3	Fair	Both pump housings in ok condition except near mechanical seal and bearings.
	3	Fair	Both mounting plates heavily corroded.
	2	Good	Both pumps installed on pedestals.
	2	Good	Cables and seals are intact and do not show any evidence of damage.
	4	Poor	Pump L exhibits loud vibration. Both pumps run all time. No redundancy
	3	Fair	Pump motors shows evidence of corrosion and peeling.
	4	Poor	Inadequate access provided to remove pumps from station for maintenance.
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	3	Fair	Valve is partially buried, at soil air interface. Ponding was observed in one valve vault
Access Hatch	2	Good	Frames and covers are not cracked.
	3	Fair	Access lid is fiberglass top
Piping and Valves			
Piping in Wet well	2	Good	Pipe corrosion is minimal
	2	Good	Pipe flange corrosion is minimal
	2	Good	Little evidence of grease/rags
Piping in Valve Vault	2	Good	Pipe corrosion is minimal
	2	Good	Pipe flange corrosion is minimal
	2	Good	There are no signs of leakage from piping.
Plug Valves	2	Good	Valve condition is good.
	2	Good	Valve flange condition is good.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	2	Good	Valve condition is good.
	2	Good	Valve flange condition is good.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	5	Very Poor	The control panel is in poor condition. There is evidence the control panel caught fire and was repaired.
	2	Good	There is corrosion in the control panel and evidence of fire.
Generator	2	Good	The generator is 2013 vintage, appears to be in good condition

Average Grade: 2.6

Summary of Condition Assessment			
Station M			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	3	Fair	Gravel driveway, significant erosion observed
	3	Fair	Dedicated driveway but minimal area due to driveway grade.
Lift Station Site	2	Good	There are no visible stress or settlement cracks in the lift station site pad.
	2	Good	The site appears to have adequate drainage. The area behind the site is depressed/wet.
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	3	Fair	Exterior lighting installed but not functional
Building Conditions			
Exterior	3	Fair	Minor cracking of exterior walls, open penetrations.
	2	Good	Roofing system is wood trusses with asphalt shingles. In fair condition, minor defects noted
	2	Good	Entry doors are hollow metal with louver. Doors are rusted only one opens.
Interior	3	Fair	Minor cracking of the walls, minimal rot and penetrations missing sealant. Interior pain in poor condition.
	2	Good	Concrete floor exhibits minor cracking. Water on floor.
	4	Poor	Interior lights not working.
Wet Well			
Top		Non-existent	
		Non-existent	
		Non-existent	
Interior		Non-existent	
		Non-existent	
		Non-existent	
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access is clear and rust is minimal.
	3	Fair	Paint chipping on the exterior of the tank.
	4	Poor	Electrical components show evidene of loose connection or frayed wires. Require plastic shield to avoid shorting.
Interior			Not Accessed
Overflow Tank Conditions			
	5	Very Poor	Not installed, receiving tank undersized to not have an overflow tank installed.
Interior			Not Accessed
Equalization Tank Conditions			
	2	Good	Piping and pipe insulation seem to be in tact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	2	Good	Minimal paint chipping on the exterior of the tank.
	2	Good	Electrical components show evidene of loose connection or frayed wires.
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top		Non-existent	
		Non-existent	
		Non-existent	
		Non-existent	
Interior		Non-existent	
		Non-existent	
Equipment		Non-existent	
Vacuum Pump Conditions			
Pump Components	4	Poor	Pumps are beyond their rated useful life. Both more than 20 years old.
	3	Fair	Pump housing exhibits corrosion.
	3	Fair	Mounting plates corroded
	2	Good	Pump supports do not show any evidence of damage.
	3	Fair	Cables and seals are intact. Some corrosion on conduit.
	3	Fair	Pumps show signes of heavy wear
	2	Good	Pump motor shows evidence of corrosion and peeling.
	4	Poor	Inadequate clearnance for pump maintenance
Valve Vault			
Interior	4	Poor	Equalization tank check valves installed above grade and wrapped in insulation. No valve vault present.
Access Hatch	4	Poor	Access requires cutting into the fiberglass insulation and wrapping with new fiberglass.
Piping and Valves			
Piping in Wet well		Non-existent	
		Non-existent	
		Non-existent	
Piping in Valve Vault		Non-existent	
		Non-existent	
		Non-existent	
Plug Valves		Non-existent	
		Non-existent	
		Non-existent	
Check Valves		Non-existent	
		Non-existent	
		Non-existent	
Bypass			
Electrical/Controls			
Control Panel	4	Poor	The control panel is beyond useful life and requires replacement. Code required clearances are not provided.
	4	Poor	There is corrosion in the control panel.
Generator	2	Good	There is not generator. A generator plug is provided for temporary power.

Average Grade: 2.9

Summary of Condition Assessment			
Station N			
Lift Station Asset	**Grade**	**Condition**	**Description**
Site Conditions			
Access Driveway	2	Good	Gravel driveway
	3	Fair	Inadequate space is provided for a turnaround area off the roadway.
Lift Station Site	2	Good	There are no signs of stress or settlement cracks in the station site pad,
	2	Good	The site appears to have minor drainiage issues. Driveway directs water towards building
	2	Good	Based on available FEMA flood maps, the site is not located within the 100-year floodplain.
	3	Fair	Minimal site lighting is installed and is functional
Building Conditions			
Exterior	2	Good	Brick veneer walls in adequate condition.
	2	Good	Roofing system is wood trusses with asphalt shingles. In good condition, minimal defects noted
	2	Good	Entry doors are hollow metal with louver, no issues noted.
Interior	3	Fair	Interior walls consist of CMU, paint is peeling.
	3	Fair	Concrete floor exhibits gap at building perimeter in places
	2	Good	Two interior lights provided in working order.
Wet Well			
Top	1	Very Good	Steel top recently replaced with stainless steel base slab. Condition is good.
	1	Good	Exterior of top closes and shuts properly, minimal signs of damage. One support leg not connected.
Interior	2	Good	Wet well is coated with corrosion resistantant epoxy liner.
	1	Very Good	Steel interior of top is in good condition.
	1	Very Good	Pipe is in good condition.
Receiving Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	4	Poor	Paint chipping on the exterior of the tank. Corrosion evident
	2	Good	Electrical connections to tank leak. Plastic bottle rain shield installed by RSA staff.
Interior			Not Accessed
Overflow Tank Conditions			
	5	Very Poor	Not present, but is needed
Interior			
Equalization Tank Conditions			
	3	Fair	Piping and pipe insulation seem to be intact, no signs of leaks.
	2	Good	Manway access seems to be clear and operable.
	3	Fair	Paint chipping on the exterior of the tank.
	2	Good	Electrical connections to tank intact
Interior			Not Accessed
Suction Lift Pump Station Conditions			
Top	1	Very Good	Housing/cover in good condition, rust and corrosion is moderate.
	1	Very Good	Cover Securely attached to wet well.
	1	Very Good	Pad lock on the cover.
	1	Very Good	Access is adequate
Interior	1	Very Good	Floor is in good condition.
	1	Very Good	Piping and valves in good condition. Coatings intact.
Equipment	1	Very Good	Pumps are nearly new.
Vacuum Pump Conditions			
Pump Components	4	Poor	One pump was replaced in 2001, the other is missing nameplate.
	3	Fair	Both pump housings are caked in dirt.
	2	Good	Each pump mild rust on mounting plate.
	2	Good	Both pumps are installed on pedestals.
	2	Good	Cables and seals are intact and do not show any evidence of damage.
	4	Poor	The pump that was running exhibited motor whine.
	2	Good	Pump motors shows minor evidence of corrosion and peeling.
	3	Good	Lifting handle secured on pump and the pump has mimimal clearance for pump removal/maintannce
Valve Vault			
Interior	2	Good	Valve vault is not coated.
	5	Very Poor	Valves are submerged in water. One check valve exibits evidence of leaking. Replacment needed.
Access Hatch	2	Good	Frames and covers are not cracked.
	2	Good	Access lid is steel cover
Piping and Valves			
Piping in Wet well	2	Good	Pipe corrosion is minimal
	2	Good	Pipe flange corrosion is minimal
	2	Good	Little evidence of grease/rags
Piping in Valve Vault	2	Good	Pipe corrosion is minimal
	2	Good	Pipe flange corrosion is minimal
	2	Good	There are no signs of leakage from piping.
Plug Valves	2	Good	Valve condition is good.
	2	Good	Valve flange condition is good.
	2	Good	There are no signs of external leakage from the valves.
Check Valves	2	Good	Valve condition is good.
	2	Good	Valve flange condition is good.
	2	Good	There are no signs of external leakage from the valves.
Bypass	1	Very Good	
Electrical/Controls			
Control Panel	4	Poor	The control panel is in poor condition. The controls are beyond useful life and require replacement.
	4	Poor	There is corrosion in the control panel.
Generator	3	Fair	A generator plug is provided for emergency power.

Average Grade: 2.2

Appendix B

FLOVAC Collection System Monitoring Proposal

Wireless Monitoring System

Rapidan Service Authority, VA

Clients: Rapidan Service Authority

Date: September 2023

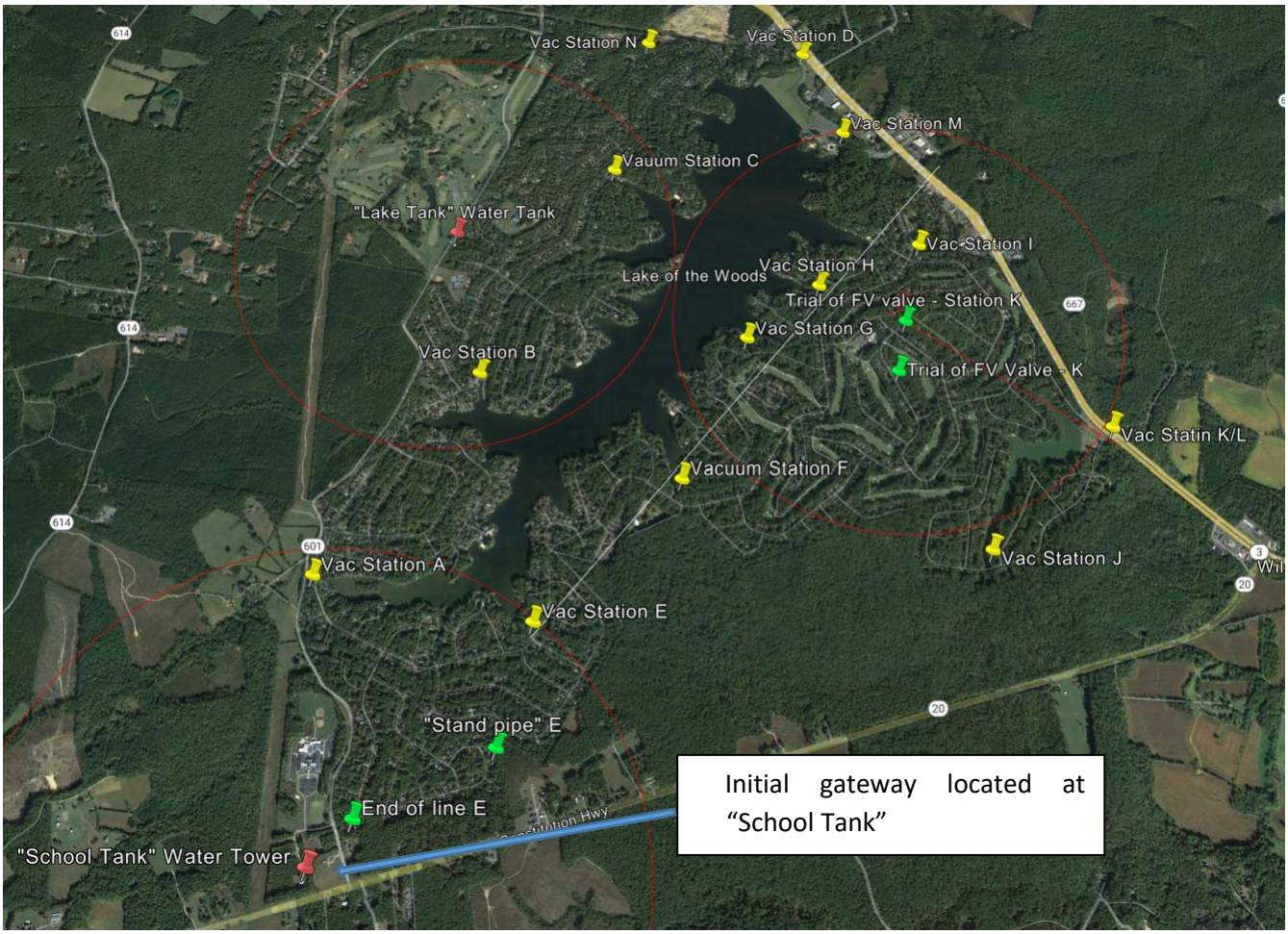
Contents

1) Executive Summary

FLOVAC has been approached by the Rapidan Service Authority to evaluate the feasibility of implementing a wireless monitoring system for the valve pits within the vacuum sewer network. Such system will provide a 24/7 status report of those valve pits, including: (i) detection of abnormal conditions in the vacuum valves; (ii) record of valves open/close cycles; (iii) alarm for valves stuck open; (iv) alarm for wastewater high-level in the tanks; and (v) reading of vacuum level at valves, allowing operators to respond quickly to any callouts and have a proactive approach to system maintenance. The system also offers an automatic air inlet system, which automatically reads the pressure differential between the end of vacuum mains and the vacuum tank and injects air at key locations of the vacuum network to clear the lines.

FLOVAC's Smart Monitoring System uses a LoRaWan communication protocol, which allows for much greater range of its wireless signal, eliminating the need for repeaters. FLOVAC also uses cloud-based software, which allows for visualization and control of the system anywhere with an internet connection on desktops, laptops, tablets, and smartphones. In a recent presentation of its Smart Monitoring System, FLOVAC and the Rapidan Service Authority team have discussed the implementation of a gateway to allow for the monitoring and collections of data at any point within a select collection area. To that effect, FLOVAC has viewed the area intended for the installation of its Smart Monitoring System and based on information provided by Rapidan Service Authority and obtained onsite has prepared the following proposal.

2) Vacuum Sewer System Layout



The red circle(s) indicate conservative estimated signal ranges from the initial gateway, and potential future gateways, mounted on existing infrastructure. Additional gateways can be added to increase service area.

3) Wireless Monitoring System Overview

FLOVAC's Wireless Monitoring System provides a 24/7 status report of the vacuum sewer system, detecting abnormal conditions in the vacuum valves, sewer collection network and vacuum stations, allowing the operators to respond quickly to any callouts and have a proactive approach to system maintenance.

One of the most important features of FLOVAC's System is its two-way or bi-directional communication, allowing for seamless communication interaction between all devices in the system.

FLOVAC's System is capable of monitoring the following items:

- Valve stuck open
- Valve open/close cycles (allowing detection of unwanted storm or ground water infiltration)
- Last opening time log for potential valve not opening signal
- Vacuum pressure in vacuum lines
- Automatic air injection with remote valve control (open/closed)
- Alarms
- Alerts via SMS / e-mail or both
- Battery or solar operated
- Integration with existing SCADA systems

FLOVAC's System also features the following benefits:

- No need for external power supply (batteries included)
- Battery life up to 5 years
- Wireless operating range up to 3 miles
- Lora Wan protocol allows for many different modules to operate within the same system, up to 30,000
- Universal module for many different sensors, once a pit has a module vacuum sensors and AAI controller can be moved around as the client see fit to help improve their system.

FLOVAC's Wireless Monitoring System is compatible with most vacuum sewer systems provided by other major suppliers, allowing it to be integrated into existing and new systems. Since the system is battery powered and communication between all devices is made through a wireless protocol, there is no need for expensive infrastructure. The system is developed in different layers, making it easily customizable according to the client's preferences.

4) Network Layout

4.1) Network Lora Wan

Lora Wan is a new, private and spread-spectrum modulation technique which allows data transmission at extremely low data-rates to very long ranges. LoRa Wan is a Low Power Wide Area Network (LPWAN) specification intended for wireless battery-operated Things in a regional, national or global network. Lora Wan targets key requirements of Internet of Things such as secure bi-directional communication, mobility and localization services. The Lora Wan specification provides seamless interoperability among smart Things without the need of complex local installations and gives back the freedom to the user, developer, businesses enabling the roll out of Internet of Things.

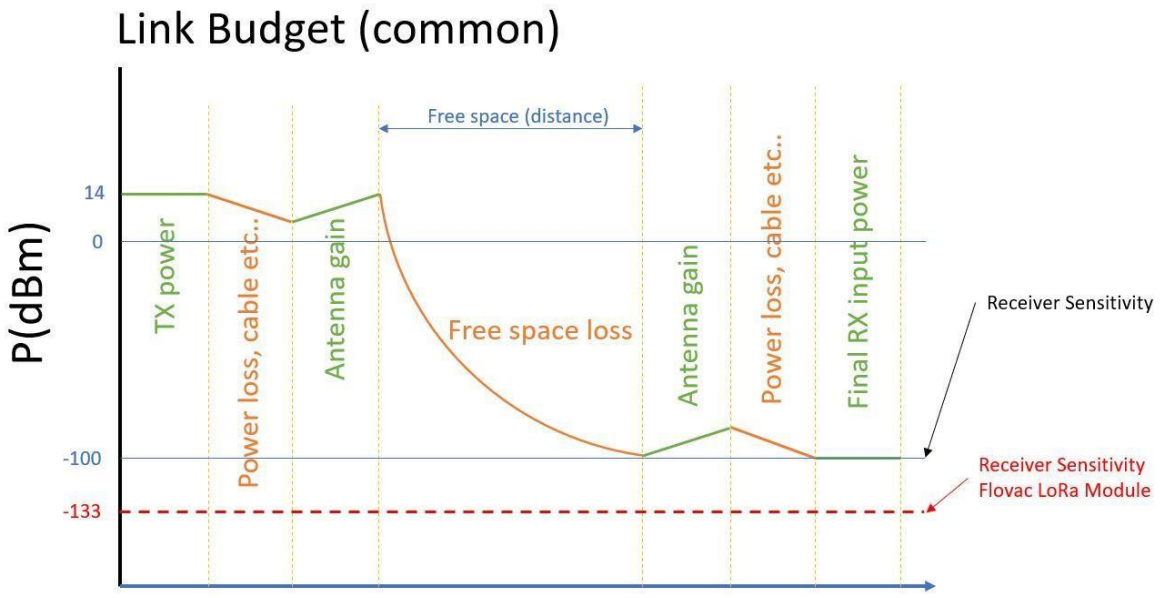


Figure 1 Sensitivity of the Flovac LoRaWan Module

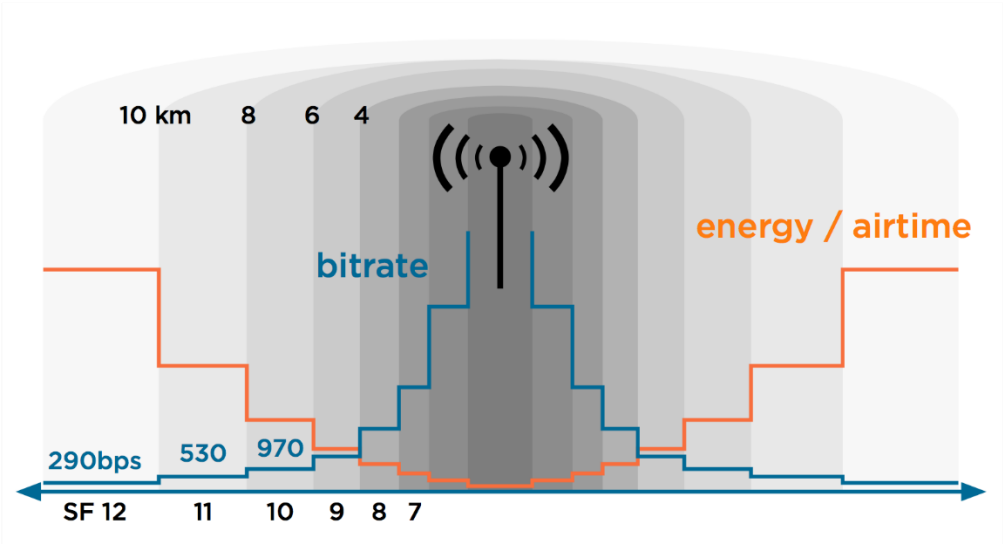


Figure 2 Distance vs Energy vs Bitrate

FLOVAC's FMS supports different frequencies for each country where the system is to be installed. Modules automatically connect to the closest gateway, which can cover an area of up to 3 miles. In larger areas, multiple gateways could be installed to increase the coverage area. The gateway is connected to the WAN by default, through a GPRS/GSM connection or a local ethernet connection. The gateway only communicates through a secure server, which collects and sorts all data collected from the modules into databases.

4.2) WAN / LAN Network Connections

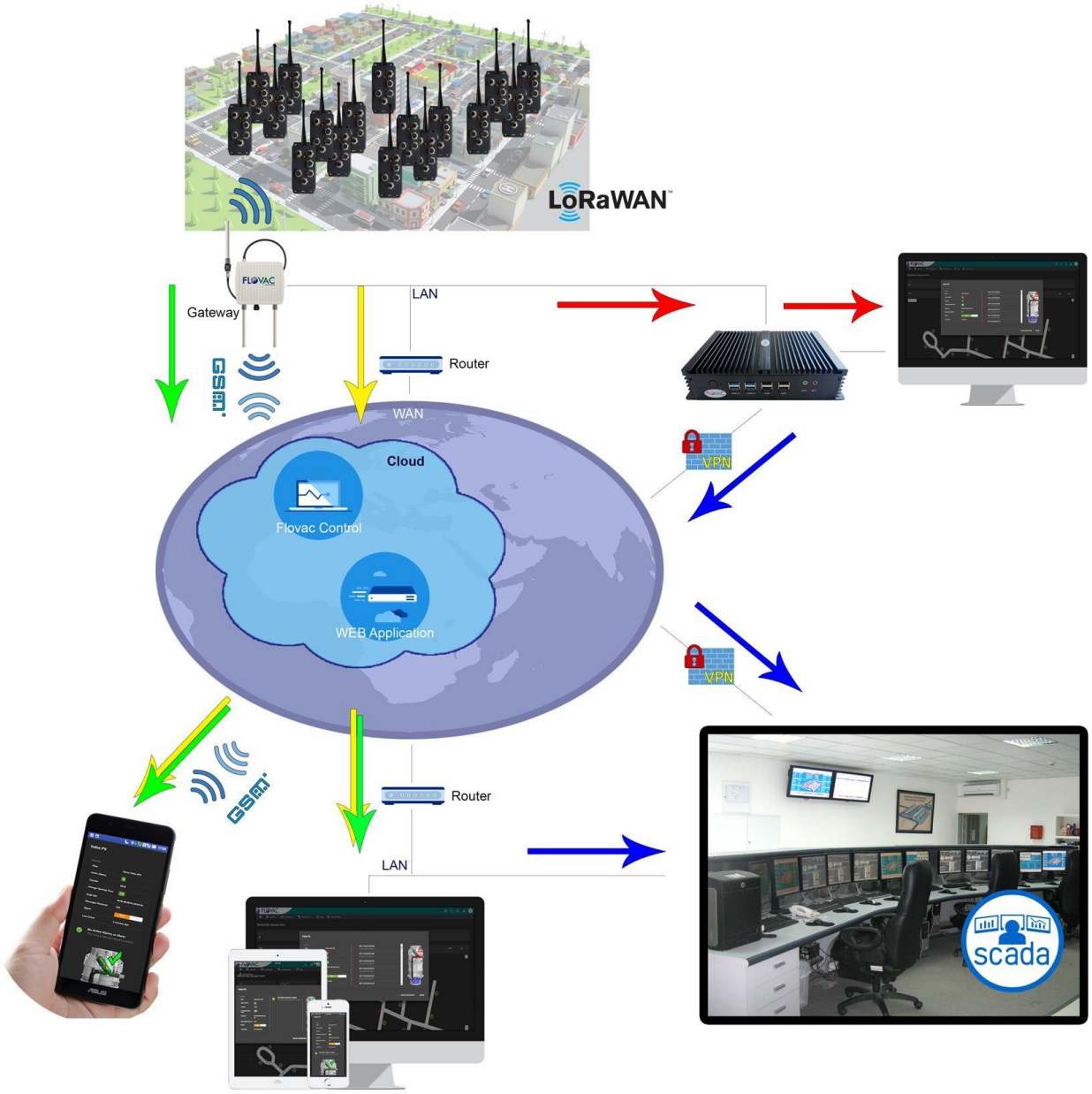


Figure 3 Network Examples

Green Routing: Most flexible. Gateway only needs power and can be placed anywhere in the area, with the best LoRaWan network performance.

Yellow Routing: Less flexibility. Gateway needs power and wired ethernet connection to internet for cloud hosting. Placement of the gateway at the best spot could be impacted by power and wired internet connection requirements, sometimes requiring the installation of a second gateway to cover the entire monitoring area.

Red Routing: Less flexibility. Gateway requirements are the same as the Yellow Routing. Cloud hosting will not be used, requiring an IPC computer and screen to be installed at the same location as the gateway to host the monitoring software and data on a local network.

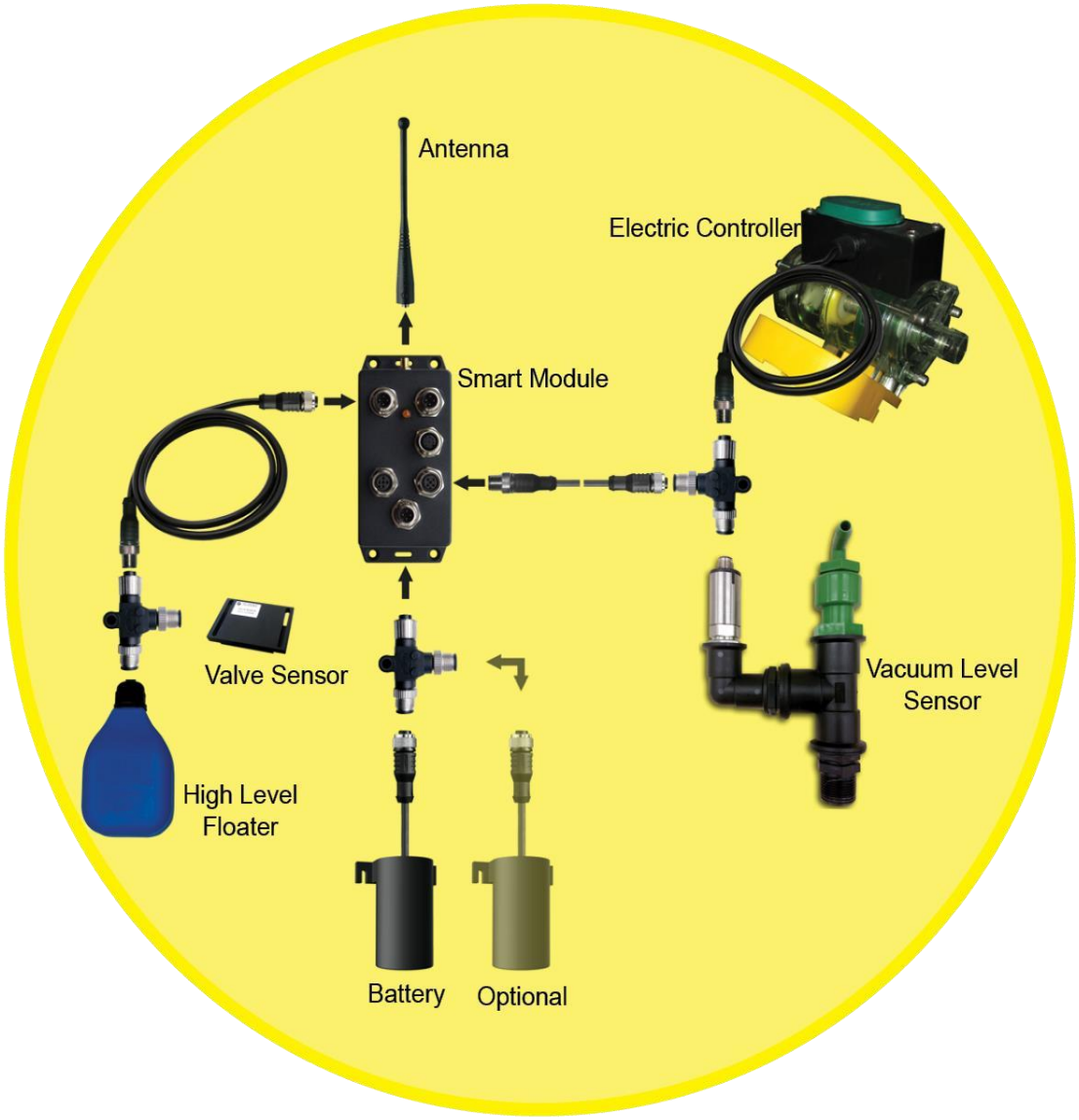
Blue Routing: Optional. Custom made depending on the local network condition.

4.3) Gateway

The FLOVAC gateway communicates wirelessly with the monitoring modules in the field. All information received from the modules is transferred to the FLOVAC control server through GPRS/GSM or by wired LAN (figure 3). The best spot to install a gateway is in the center of the coverage area and preferably serviced by a backup generator. The gateway needs power 100-240VAC-1A and ethernet connection when the GSM function is not utilized. Large coverage areas may require multiple gateways.

4.4) Smart Modules

FLOVAC has developed a smart Lora Wan module specifically for vacuum sewage monitoring. Our module is powered by 3.6 volt batteries and can be custom programmed to handle many different I/O's. The module is IP68 weatherproof rated and can be installed outside or inside the valve pit (installation inside the valve pit may require a shorter distance between the module and the gateway).



Flovac Valve Module Configuration Table

Configuration Parameter	Default value	Description
Heartbeat Time	3600 seconds	Time the module will send a message with current openings, average opening time.
Vacuum Time	900 seconds	Time the module will measure the vacuum.
Vacuum Setpoint	30	If vacuum is below setpoint, module will enable low vacuum alarm.
Vacuum Delay	180 seconds	Delay before module will enable low vacuum alarm.
Floater Delay	10 seconds	Delay before module will enable high level alarm
Valve Alarm Delay	60 seconds	Delay before module will enable valve error alarm.
Maximum Open Time	15 seconds	If the valve opens longer then this value, the module will send an alert.
Minimum Open Time	3 seconds	If the valve opens less then this value, the module will send an alert.
Transfer Retries	5 times	Times the module will retry a transfer when no acknowledge was received from gateway.
Join Retries	5 times	Times the module will retry to join a gateway.

Valve Module Message Table

Message Name	Format
Heartbeat	0,(Current Counter),(Average Open Time)
Vacuum Level	1,(Vacuum Level)
Alarm	2,(Alarm Type), (Enabled/Disabled)
Alert	3,(Alert Type),(Value 1)

Valve Module Alarm Types

Alarm Name	Alarm Description
Low Vacuum Alarm	When vacuum is below setpoint for x time.
High Level Alarm	When floater is high for x time.
Valve not closing Alarm	Valve is not closing for x time.

Valve Module Alert Types

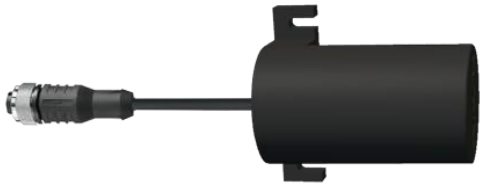
Alert Name	Alert Description
Openings time to long	Opening time exceeded the configurated maximum open time.
Openings time to short	Opening time exceeded the configurated minimum open time.
Failed Transfers	Times the module failed to transfer a message when first message was successful.

5) Components/Sensors

5.1) Battery

Every module is powered by battery by default. The battery life depends on the transmit rate, and in a default configuration the battery can power the module for up to 5 years. When additional sensors are installed such as vacuum sensors or electrical controllers requiring greater power consumption, the use of additional battery packages is recommended.

Battery is completely sealed and IP68 weatherproof rated.

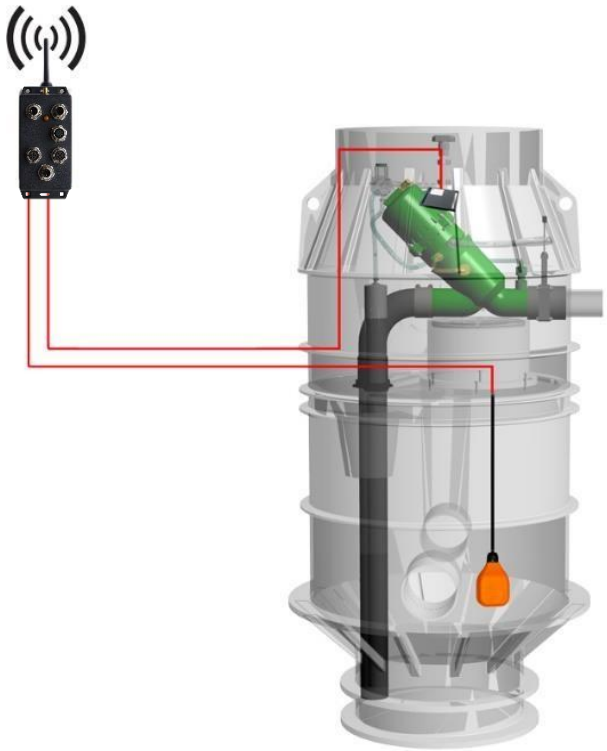


5.2) Valve Sensor

The valve sensor is mounted on the vacuum valve inside the collection pit. Every change of state of the valve (open/close) will awake the module to start monitoring the status of the valve.

5.3) High Level Sensor

The high level sensor floating switch generates an early warning alarm every time that the sewer level in the collection pit exceeds a preset condition, so the operators can take the appropriate action.

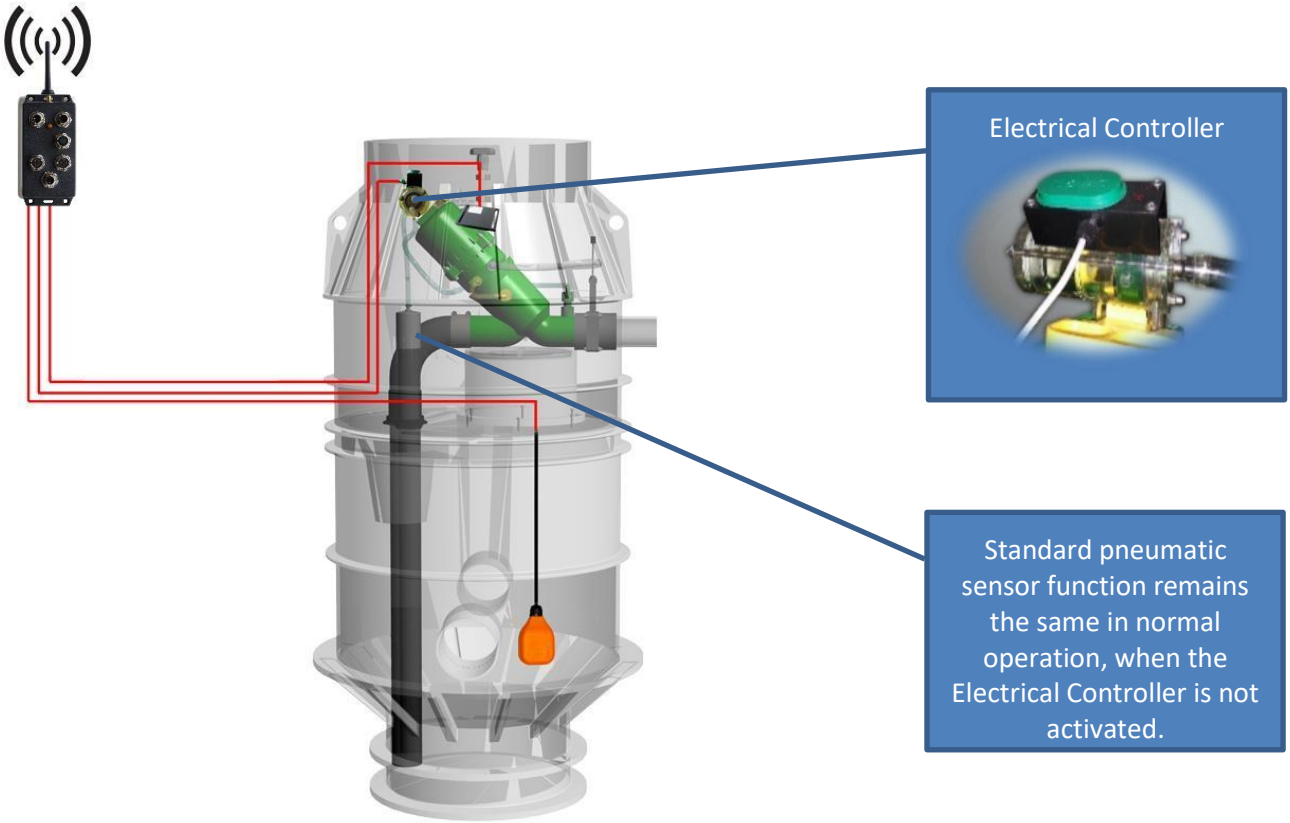


5.4) Vacuum Level Sensor

The vacuum level sensor measures the vacuum pressure at the collection pit at predetermined intervals (intervals could be configured according to client's requirements). In addition to showing the vacuum level on the visualization screen, the system could also be configured to generate an alarm when the vacuum level drops below a pre-determined set point. The vacuum level sensor is required for the Automatic Air Injection System (AAIS).

5.5) Electrical Controller

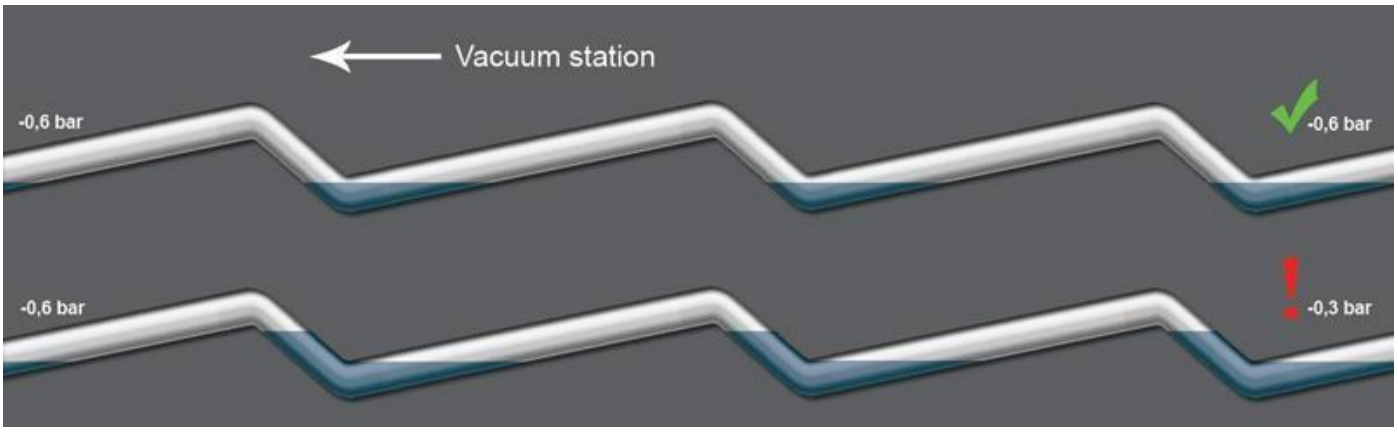
The electrical controller allows the vacuum valve to be opened by a remote command. The valve open command can be send manually or automatically by the FLOVAC control system. The electrical controller is required for the Automatic Air Injection System (AAI), which generates an automatic valve open command through the AAI algorithm.



6) Automatic Air Injection System (AAIS)

In some areas of the vacuum sewer network, vacuum levels can drop below their optimal operation condition, adversely affecting the proper function of the valves.

Low vacuum levels can be caused by a variety of factors, including wrong valve time settings, excessive external infiltration into the system, extensive line stretches without any connections, design and construction flaws, etc.



Vacuum valves need a minimum of -5 inHg to open, however this minimum pressure might not be enough to allow sufficient air to enter the system to avoid water logging.

To solve this problem FLOVAC has developed an Automatic Air Injection System (AAIS). The AAIS can prevent vacuum levels dropping below the minimum -5 inHg, as it will let in air automatically when vacuum level drops below -8 inHg or any other pressure level setup by operations.

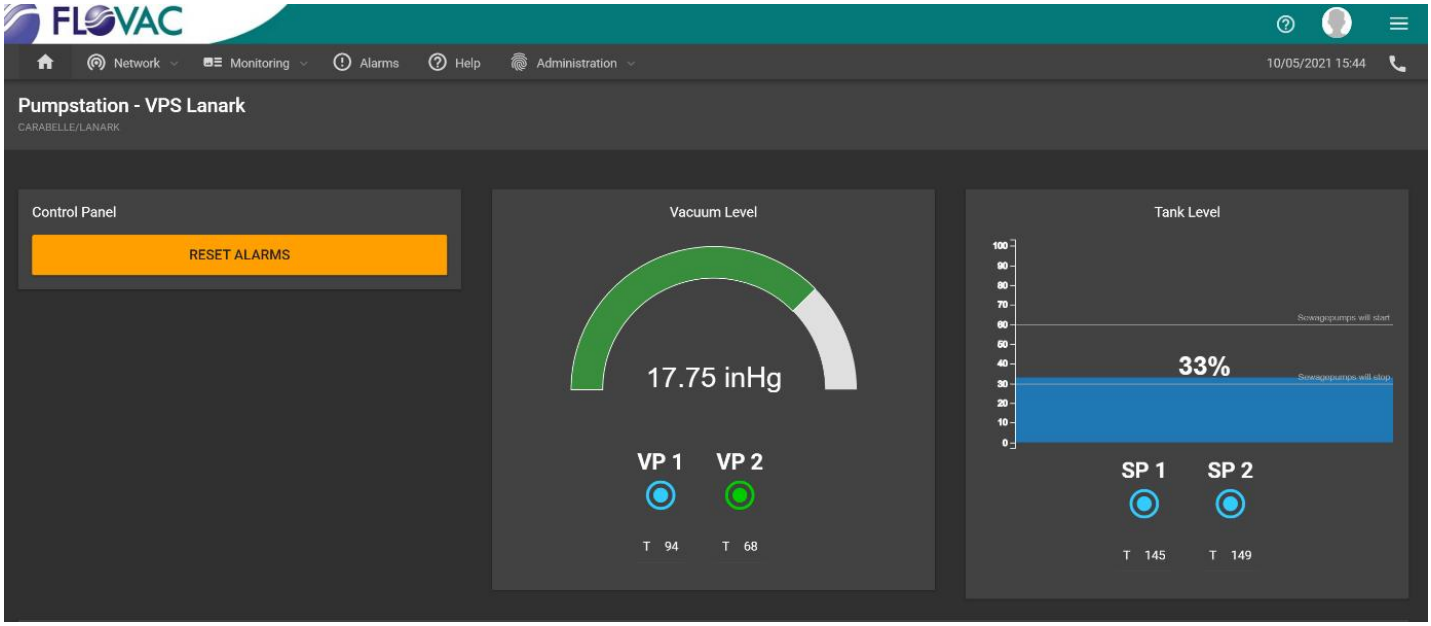
In a conventional standalone system, the vacuum level is checked only at a specific point in the sewer collection network and does not consider the vacuum level at the vacuum station. The disadvantage of ignoring the vacuum level at the vacuum station is the possibility to inject air into the system even when there is not enough vacuum level at the vacuum station, which will further deplete the vacuum level in the system.

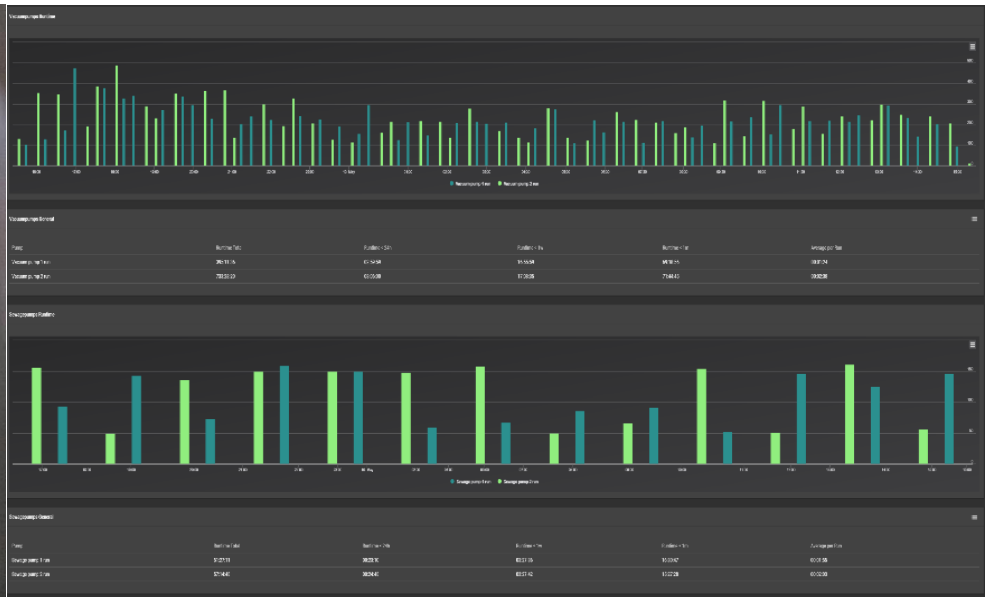
FLOVAC's AAIS was developed to, in addition to the vacuum level at a specific point in the sewer collection network, consider the vacuum level at the vacuum station, taking advantage of its two-way or bi-directional communication capability to evaluate all available parameters and fine tune the amount of air required for optimal operation of the system. Furthermore, the AAIS is installed by simply replacing the valve controller with FLOVAC's electrical controller, thus not requiring any additional valves and/or valve pits.

7) Vacuum Station Monitoring (optional)

Flovac offers a wide range of vacuum station design, control, and monitoring. Options range from panel design to control you vacuum station through connecting existing PLC's or older relay and timer panels. This enables the Rapidan Service Authority to see in Realtime events at the vacuum station. In certain applications, control can be allowed to make changes to station parameters.

Reporting includes Vacuum pump run times, Sewerage pump run times, Tank level as a percentage, vacuum level. Additional I/O's are available on request.





8) Wireless Monitoring System Proposal

8.1) Proposed System Description and Features

This proposal includes the supply and installation of FLOVAC Smart Monitoring devices (smart modules, battery packs, valve sensors and high-level sensors) for 6 vacuum valve pits within the designated sections of Rapidan Service Authority vacuum sewer system serviced by Vacuum station “E” and areas of a “A” if desired. Those monitoring devices will be connected to FLOVAC’s Lora Wan through a gateway installed at the water Tower. Also included 1 vacuum sensor at the VPS “E” vacuum tank and 6 vacuum pressure sensors for deployment in the collection network. The FLOVAC software and system database will be hosted on FLOVAC’s secure cloud, which allows for remote support and software updates, in addition to remote access by authorized operations personnel on mobile smartphones and tablets.

8.2) Price

FLOVAC is prepared to offer its introductory Smart Monitoring System in accordance with the specifications and wireless monitoring equipment described above, including instillation, to Rapidan Service Authority for $30,000.00 (Thirty Thousand Dollars)

There is normally a $500 monthly fee for the Cloud Hosting of FLOVAC’s software and databank. Flovac is prepared to waive this fee for the first year, from commissioning date. After one year a monthly charge of $350 per month will resume up to 100 modules. The above costs refer to the entire collection system(s), Not per gateway.

It should be noted that for future expansion as of this proposal. An FMS monitoring module including battery, valve sensor, high level float and cables costs $850 per unit (without pressure sensor) or $1400 per unit (with pressure sensor). The gateway installed during work outlined in this proposal is intended to provide signals for all future connections of monitoring modules in the initial red circle indicated on the map above. Thus, making future monitoring “plug and play”. Given the density of trees further analysis will take place for gateway layout before expansion.

8.3) Payment Terms

- 30% at Proposal Acceptance
- 30% at Equipment Delivery
- 30% at Installation Completion
- 10% at Commissioning and System Acceptance by Rapidan Service Authority

8.4) Special Conditions

Rapidan Service Authority preparatory scope of work:

At water tower (indicated on google earth image above):

- Coordinate mounting of the gateway on the water tower. Power supply will also be needed withing 30 feet of the gateway. It is strongly suggested the power supply is serviced by a backup generator.

At the valve Pits

- Install pedestal, if not present already. Needs to have hinged grille or removable lid. These will be housing the module, antenna, and battery. (Flovac pedestals **are** included in this proposal)
- Run a 2"or greater flexible conduit from the upper pit chamber to the pedestal (see images below) PVC can also be used so long as sweeping bends are used. The communication wires will be running through this. (Conduit or PVC to be supplied by Flovac). This arrangement may not be possible at all valve pits and Flovac will work through this with the city to come up with the best solution.
- Run 2-inch sensor pipe to sump for pressure type level sensor

Modified Fiberglass Valve pit with valve sensor, and high-level float routed through sensor tube/ clean out coupling.

Vacuum sensor screws directly into vacuum line

Flovac Pedestal housing dedicated air inlet (candy cane), monitoring equipment, and remote mounting of controller(optional). Solar ready.

Example of a pedestal that has been used in the past to house monitoring equipment where there was no dedicated air terminal or existing pedestal. (not solar compatible).

General:

- Verify the condition of the magnets on the existing valves and replace the ones that are rusted or damaged. Testers and training will be provided to ensure correct positioning.

FLOVAC installation scope of work:

- Provide detailed information for Rapidan Service Authority preparatory scope of work.
- Supply cable gland assemblies, and associated rubber grommets for the installation of the floating switches and or pressure sensors.
- Supply valve sensors, high level sensors (floating switches) or pressure switches, modules and antennas for standard PE pit monitoring.
- Install the monitoring devices in the standard pits and pedestals (including supplying and installing the required cables).
- Provide the gateway for install on the water tower (including supplying the ethernet power cable an needed equipment).
- Start-up and test the system.
- Provide training to RAPIDAN SERVICE AUTHORITY's operators.

9) Summary

We at FLOVAC are very pleased to have the opportunity to assist the RAPIDAN SERVICE AUTHORITY in the pursuit of continuously improving the operation and reliability of its sewerage collection system. We are confident that the proposed Smart Monitoring System will allow Rapidan Service Authority managers, supervisors and operators to have real time information from each Collection Pit/ and Vacuum Valves being monitored, allowing for immediate identification of any faults, abnormalities and alarms, indicating the precise location where preventive and/or corrective measures must be taken.

Michael Pringle
Director of Operations
www.flovac.com

Appendix C

Preliminary Site Plans

EXISTING

- BUILDING
- PROPERTY LINE (GIS)
- PERMANENT EASEMENT
- SANITARY SEWER
- SANITARY FORCEMAIN (FM)
- SANITARY VACUUM SEWER (VM)
- OVERHEAD WIRE, POLE AND GUY WIRE

N

800 0 800

scale 400 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project	RAPSA 177782
Checked By	
Drawn By	

Project Status	Issue Date
PROGRESS PRINTS	08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

OVERALL LAYOUT

G001

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", DB 251, PG 532, PREPARED BY B. CALVIN BURNS, DATED 9/10/1970.

KEYNOTES: (1)

1. REHABILITATE EXISTING BUILDING, INCLUDING REPAINTING INTERIOR, PATCHING BRICK VENEER AT EXISTING ODOR CONTROL BIOFILTER AND SEALING UNUSED HOLES.
2. REPLACE VACUUM PUMPS WITH LARGER SC-7 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE EXISTING OVERFLOW TANK IN KIND WITH STAINLESS STEEL TANKS.
5. REPLACE EXISTING EQUALIZATION TANK IN KIND WITH STAINLESS STEEL TANKS.
6. REPLACE ELECTRICAL & CONTROL SYSTEMS.
7. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- < — SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- TO BE REPLACED
- NEW STRUCTURE

N

scale 10 0 10 20 feet 5

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

Project Status: PROGRESS PRINTS
Issue Date: 08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION A -
PRELIMINARY SITE PLAN

C001

SITE NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT B) ACCESS AREA SECTION 9 LAKE OF THE WOODS", DB 251, PG 533, PREPARED BY B. CALVIN BURNS, DATED 9/10/70.

KEYNOTES: (1)

1. REHABILITATE EXISTING BUILDING, INCLUDING REPAINTING INTERIOR, PATCHING BRICK VENEER AT EXISTING ODOR CONTROL BIOFILTER AND SEALING UNUSED HOLES.
2. DEMOLISH EXISTING ODOR CONTROL BIOFILTER.
3. CONSTRUCT NEW ODOR CONTROL BIOFILTER.
4. REPLACE EXISTING VACUUM PUMPS WITH LARGER SC-7 PUMPS.
5. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
6. REPLACE EXISTING OVERFLOW TANK IN KIND WITH STAINLESS STEEL TANKS.
7. REPLACE EXISTING EQUALIZATION TANK IN KIND WITH STAINLESS STEEL TANKS.
8. REPLACE EXISTING SUCTION LIFT WASTEWATER PUMPING STATION.
9. REHABILITATE EXISTING WET WELL, INCLUDING NEW EPOXY LINING SYSTEM.

CONSTRUCTION SEQUENCING NOTES:

1. CONSIDER CONSTRUCTING A TEMPORARY VACUUM SYSTEM FROM TANKS/PIPING SALVAGED FROM OTHER VACUUM PUMP STATIONS TO ENABLE NEW TANKS/PIPING TO BE REPLACED WITHIN THE CURRENT LAYOUT TO ACCOMMODATE SITE CONSTRAINTS.

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- TO BE REPLACED
- NEW STRUCTURE

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

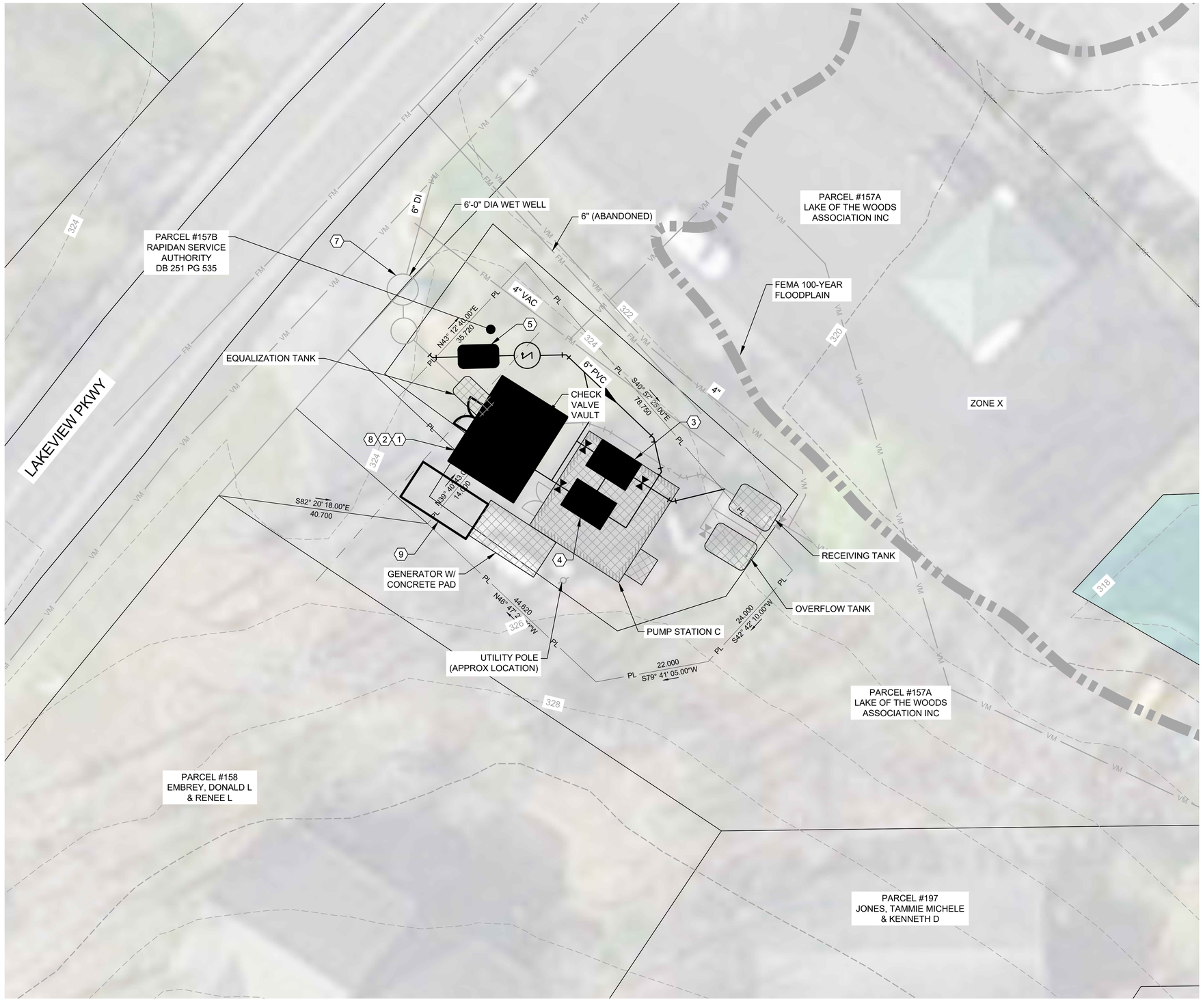
Project Status PROGRESS PRINTS
Issue Date 08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION B - PRELIMINARY SITE PLAN

C002



SITE NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT C) ACESS AREA SECTION 10 LAKE OF THE WOODS", DB 251, PG 534, PREPARED BY B. CALVIN BURNS, DATED 9/10/1970.

KEYNOTES: (1)

1. REPLACE EXISTING BUILDING WITH SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH LARGER SC-7 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE VACUUM OVERFLOW TANK WITH STAINLESS STEEL TANK.
5. REPLACE EQUALIZATION TANK WITH STAINLESS STEEL TANK.
6. REPLACE SUCTION LIFT SEWAGE PUMPING STATION.
7. REHABILITATE WET WELL WITH EPOXY LINING SYSTEM.
8. REPLACE ELECTRICAL & CONTROL SYSTEMS.
9. REPLACE EXISTING GENERATOR AND GENERATOR PAD WITH NEW GENERATOR AND GENERATOR PAD THAT IS ADEQUATELY SIZED TO PROVIDE NEW ELECTRICAL LOADS.

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

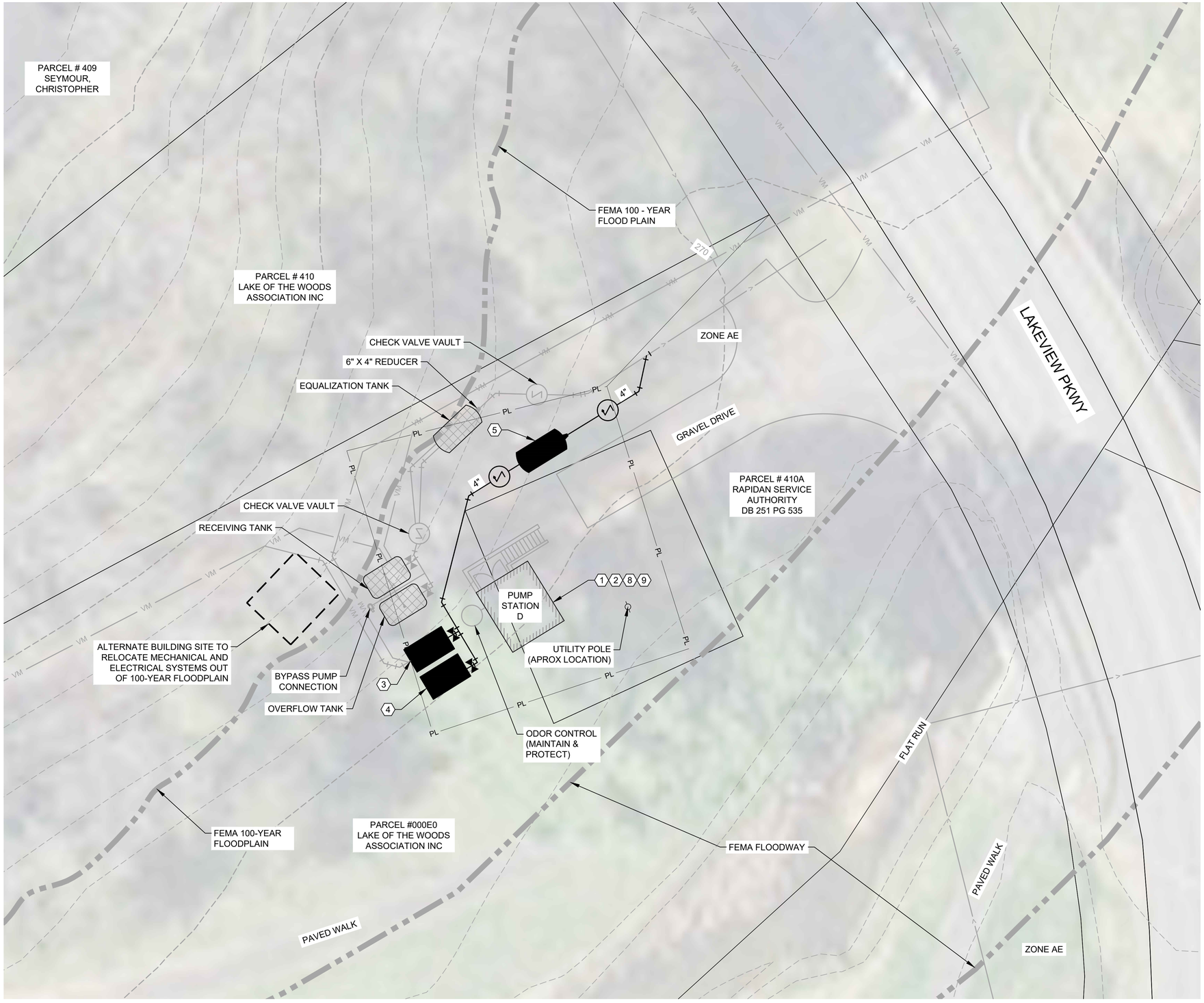
Project Status: PROGRESS PRINTS
Issue Date: 08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION C -
PRELIMINARY SITE PLAN

C003



NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT PART OF DAM & MARINA AREA (UTILITY LOT D) LAKE OF THE WOODS", DB 251, PG 535 PREPARED BY B. CALVIN BURNS, DATED 9/10/1970.

KEYNOTES: (1)

1. REHABILITATE EXISTING BUILDING, INCLUDING REPAINTING INTERIOR, PATCHING BRICK VENEER AT EXISTING ODOR CONTROL BIOFILTER AND SEALING UNUSED HOLES.
2. REPLACE VACUUM PUMPS WITH LARGER SC-3 PUMPS.
3. REPLACE EXISTING RECEIVING TANK IN KIND WITH STAINLESS STEEL TANK.
4. REPLACE EXISTING OVERFLOW TANK IN KIND WITH STAINLESS STEEL TANK.
5. REPLACE EXISTING EQUALIZATION TANK IN KIND WITH STAINLESS STEEL TANK.
6. REPLACE EXISTING VACUUM LIFT SEWAGE PUMPING STATION.
7. REHABILITATE EXISTING WET WELL WITH EPOXY LINING SYSTEMS.
8. REPLACE ELECTRICAL & CONTROL SYSTEMS.
9. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- < — SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- TO BE REPLACED
- NEW STRUCTURE
- ALTERNATE BUILDING LOCATION

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project	RAPSA 177782
Checked By	
Drawn By	

Project Status	Issue Date
PROGRESS PRINTS	08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION D -
PRELIMINARY SITE PLAN

C004

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT E) ACCESS AREA SECTION 5 LAKE OF THE WOODS" DB 251, PG 536, PREPARED BY B. CALVIN BURNS, DATED 9/10/1970.

KEYNOTES: (1)

1. REPLACE EXISTING BUILDING WITH SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH LARGER SC-7 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE VACUUM OVERFLOW TANK WITH STAINLESS STEEL TANK.
5. REPLACE EQUALIZATION TANK WITH STAINLESS STEEL TANK.
6. REPLACE VACUUM LIFT SEWAGE PUMPING STATION.
7. REHABILITATE WET WELL WITH EPOXY LINING SYSTEM.
8. REPLACE EXISTING ODOR CONTROL BIOFILTER
9. REPLACE ELECTRICAL AND CONTROL SYSTEMS.
10. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).
11. PROVIDE NEW CONCRETE GENERATOR PAD.

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- TO BE REPLACED
- NEW STRUCTURE

N

scale 10 0 10 20 feet 5

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

Project Status
PROGRESS PRINTS

Issue Date
08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION E -
PRELIMINARY SITE PLAN

C005

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) ACCESS AREA SECTION 2 LAKE OF THE WOODS" DB 251, PG 537, PREPARED BY B. CALVIN BURNS, DATED 9/10/1970.

KEYNOTES: (1)

1. REHABILITATE EXISTING BUILDING, INCLUDING REPAINTING INTERIOR, PATCHING BRICK VENEER AT EXISTING ODOR CONTROL BIOFILTER AND SEALING UNUSED HOLES.
2. REPLACE VACUUM PUMPS WITH LARGER SC-7 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE EXISTING OVERFLOW TANK IN KIND WITH STAINLESS STEEL TANKS.
5. REPLACE EXISTING EQUALIZATION TANK IN KIND WITH STAINLESS STEEL TANKS.
6. REPLACE EXISTING SUCTION LIFT WASTEWATER PUMPING STATION.
7. REHABILITATE EXISTING WET WELL, INCLUDING NEW EPOXY LINING SYSTEM.
8. REPLACE ELECTRICAL & CONTROL SYSTEMS.
9. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- TO BE REPLACED
- NEW STRUCTURE

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

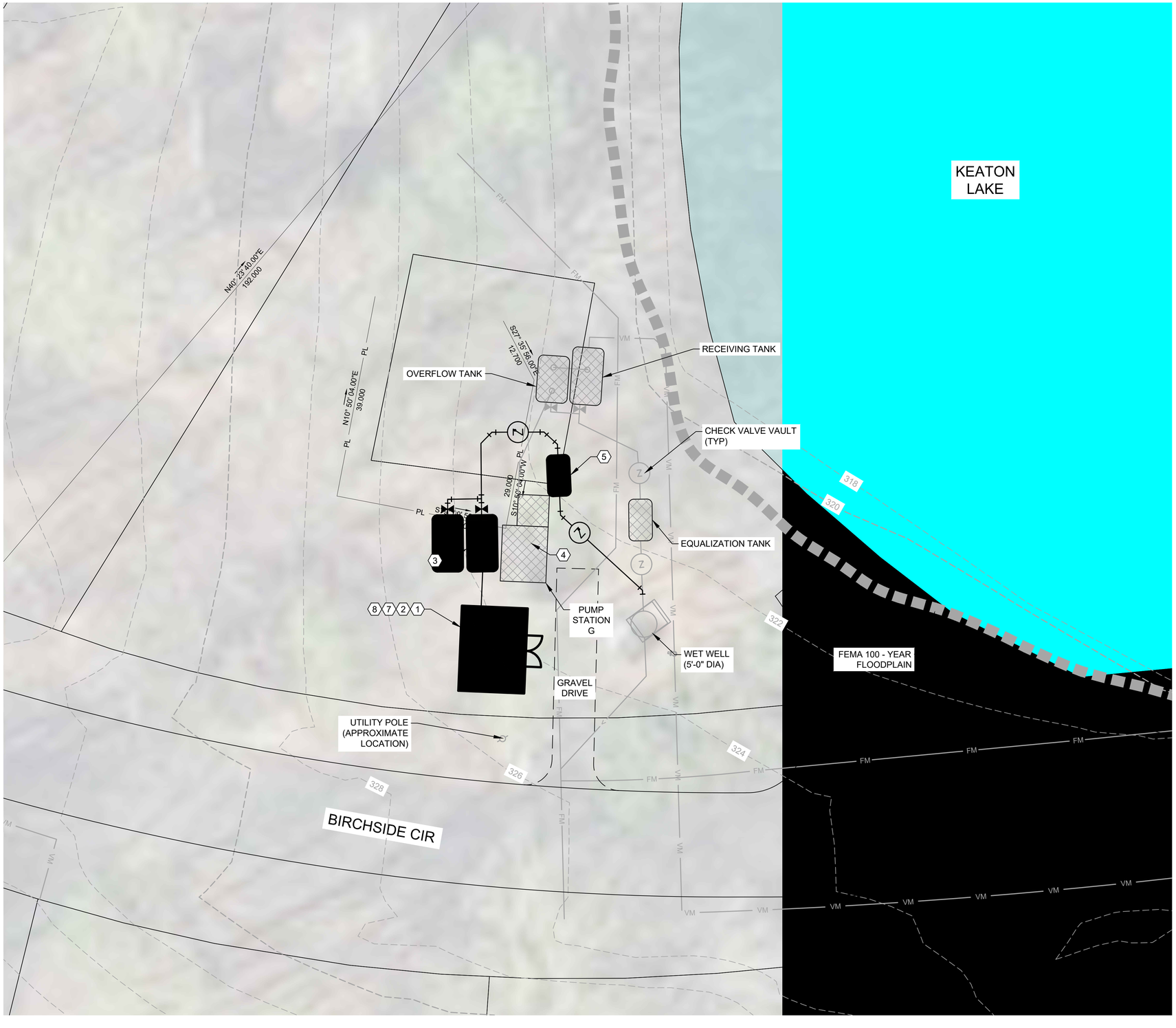
SEH Project	RAPSA 177782
Checked By	
Drawn By	
Project Status	Issue Date
PROGRESS PRINTS	08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION F -
PRELIMINARY SITE PLAN

C006



NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN * TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", PREPARED BY B. CALVIN BURNS, DATED SEPT.10, 1970.

KEYNOTES:

1. REPLACE EXISTING BUILDING WITH SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH SC-3 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE VACUUM OVERFLOW TANK WITH STAINLESS STEEL TANK.
5. REPLACE EQUALIZATION TANK WITH STAINLESS STEEL TANK.
6. REPLACE SUCTION LIFT SEWAGE PUMPING STATION.
7. REHABILITATE WET WELL WITH EPOXY LINING SYSTEM.
8. REPLACE ELECTRICAL & CONTROL SYSTEMS.
9. REPLACE EXISTING GENERATOR WITH NEW GENERATOR THAT IS ADEQUATELY SIZED TO PROVIDE NEW ELECTRICAL LOADS.

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- < — SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

Project Status
PROGRESS PRINTS

Issue Date
08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION G -
PRELIMINARY SITE PLAN

C007

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN * TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", PREPARED BY B. CALVIN BURNS, DATED SEPT.10, 1970.

KEYNOTES: (1)

1. REPLACE EXISTING BUILDING WITH SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH SC-3 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE VACUUM OVERFLOW TANK WITH STAINLESS STEEL TANK.
5. REPLACE EQUALIZATION TANK WITH STAINLESS STEEL TANK.
6. REPLACE ELECTRICAL & CONTROL SYSTEMS.
7. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- < — SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project	RAPSA 177782
Checked By	
Drawn By	

Project Status	Issue Date
PROGRESS PRINTS	08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION H -
PRELIMINARY SITE PLAN

C008

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", PREPARED BY B. CALVIN BURNS, DATED SEPT.10, 1970.

KEYNOTES: (1)

1. REHABILITATE EXISTING BUILDING, INCLUDING REPAINTING INTERIOR, PATCHING BRICK VENEER AT EXISTING ODOR CONTROL BIOFILTER AND SEALING UNUSED HOLES.
2. REPLACE VACUUM PUMPS WITH SC-3 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE EXISTING OVERFLOW TANK IN KIND WITH STAINLESS STEEL TANKS.
5. REPLACE EXISTING EQUALIZATION TANK IN KIND WITH STAINLESS STEEL TANKS.
6. REPLACE ELECTRICAL & CONTROL SYSTEMS.
7. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).
8. REPLACE ODOR CONTROL BIOFILTER.

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

scale 10 0 10 20 feet (5)

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project	RAPSA 177782
Checked By	
Drawn By	
Project Status	Issue Date
PROGRESS PRINTS	08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION I -
PRELIMINARY SITE PLAN

C009

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN * TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", PREPARED BY B. CALVIN BURNS, DATED SEPT.10, 1970.

KEYNOTES:

1. REPLACE EXISTING BUILDING WITH SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH LARGER SC-7 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE VACUUM OVERFLOW TANK WITH STAINLESS STEEL TANK.
5. REPLACE EQUALIZATION TANK WITH STAINLESS STEEL TANK.
6. REPLACE ODOR CONTROL BIOFILTER.
7. REPLACE ELECTRICAL & CONTROL SYSTEMS.
8. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- S — SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

scale 10 5 0 10 20 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

Project Status: PROGRESS PRINTS
Issue Date: 08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION J -
PRELIMINARY SITE PLAN

C010

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN & TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", PREPARED BY B. CALVIN BURNS, DATED SEPT.10, 1970.

KEYNOTES: (1)

1. REPLACE EXISTING BUILDING WITH LARGER SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH LARGER SC-7 PUMPS TO HANDLE DEMAND WITH ONE VACUUM PUMP (PROVIDES REDUNDANT VACUUM PUMP).
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE EXISTING RECEIVING TANK IN KIND WITH STAINLESS STEEL TANK.
5. REPLACE EXISTING OVERFLOW TANK IN KIND WITH STAINLESS STEEL TANK.
6. REPLACE EXISTING EQUALIZATION TANK IN KIND WITH STAINLESS STEEL TANKS.
7. REPLACE ELECTRICAL AND CONTROL SYSTEMS.
8. RELOCATE EXISTING OVERHEAD ELECTRICAL LINE.
9. NEW GENERATOR PAD.

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

scale 10 0 10 20 feet (5)

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS

ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project	RAPSA 177782
Checked By	TWW
Drawn By	WSW

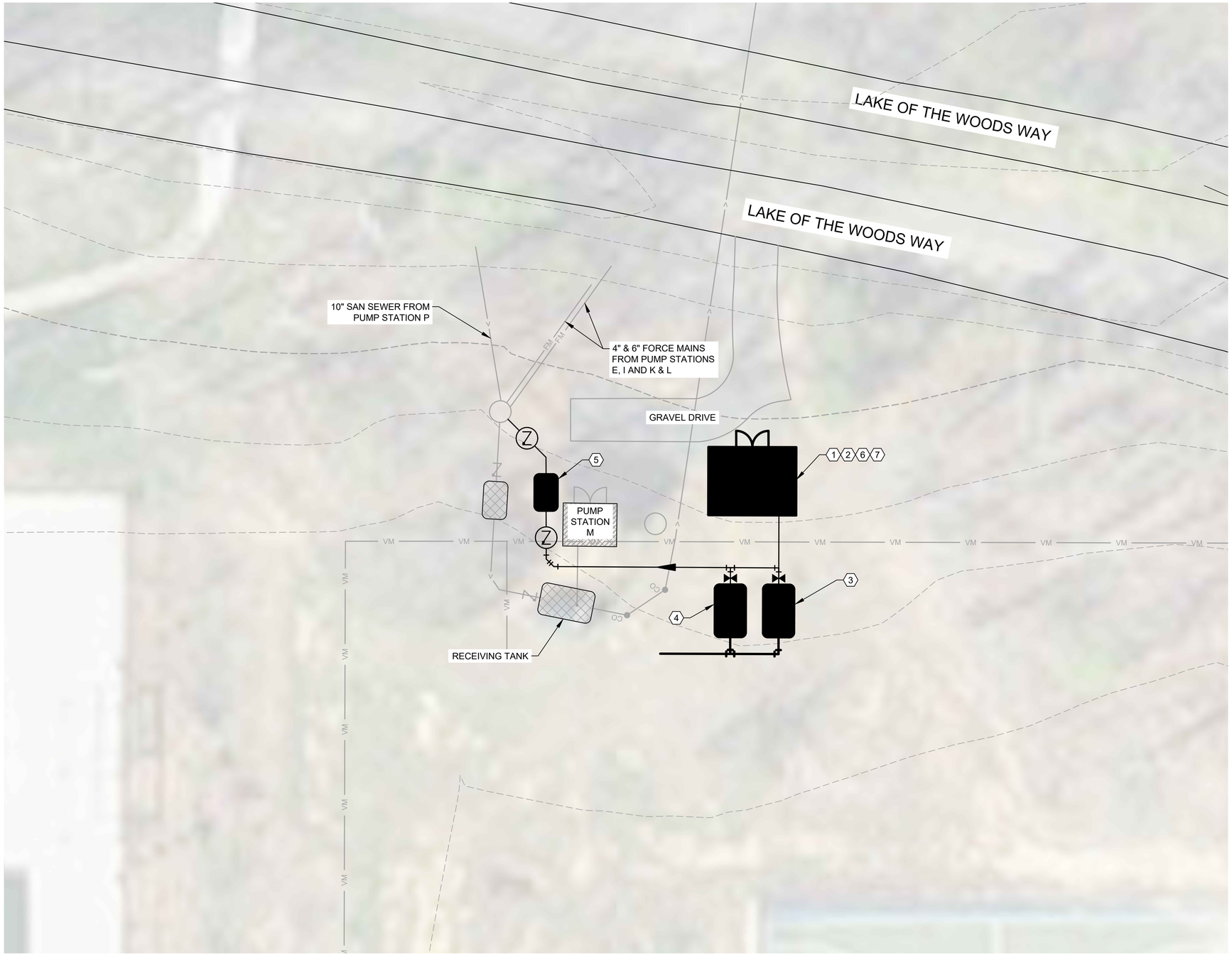
Project Status	Issue Date
PROGRESS PRINTS	08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION K & L - PRELIMINARY SITE PLAN

C011



NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN * TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", PREPARED BY B. CALVIN BURNS, DATED SEPT.10, 1970.

KEYNOTES: (1)

1. REPLACE EXISTING BUILDING WITH SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH SC-3 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE VACUUM OVERFLOW TANK WITH STAINLESS STEEL TANK.
5. REPLACE EQUALIZATION TANK WITH STAINLESS STEEL TANK.
6. REPLACE ELECTRICAL & CONTROL SYSTEMS.
7. REPLACE EXISTING GENERATOR WITH NEW GENERATOR THAT IS ADEQUATELY SIZED TO PROVIDE NEW ELECTRICAL LOADS.

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

Project Status: PROGRESS PRINTS
Issue Date: 08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION M - PRELIMINARY SITE PLAN

C012

NOTES:

1. THE LOCATIONS OF EXISTING UTILITIES, STRUCTURES AND APPURTENANCES ARE BASED ON RECORD DRAWINGS ENTITLED "13 NEW PUMP STATIONS RAPIDAN SERVICE AUTHORITY", PREPARED BY BENGTSON, DeBELL, ELKIN * TITUS, LTD., DATED 5/25/90 ALONG WITH UNTITLED RECORD DRAWINGS THAT WERE PREPARED FOR THE SERVICE AUTHORITY. ALL UTILITIES, STRUCTURES, ETC. SHOWN ARE APPROXIMATE AND MAY NOT BE COMPLETE.
2. PROPERTY LINES SHOWN ARE FROM ORANGE COUNTY GIS.
3. THE PROPERTY LINES SHOWN WHERE THE PUMP STATION RESIDES WERE FROM PLAT ENTITLED "PLAT (UTILITY LOT A) LOT 1 SECTION 7 LAKE OF THE WOODS", PREPARED BY B. CALVIN BURNS, DATED SEPT.10, 1970.

KEYNOTES: (1)

1. REPLACE EXISTING BUILDING WITH SLAB ON GRADE BUILDING.
2. REPLACE VACUUM PUMPS WITH SC-3 PUMPS.
3. REPLACE VACUUM RECEIVING TANK WITH STAINLESS STEEL TANK.
4. REPLACE VACUUM OVERFLOW TANK WITH STAINLESS STEEL TANK.
5. REPLACE EQUALIZATION TANK WITH STAINLESS STEEL TANK.
6. REPLACE ODOR CONTROL BIOFILTER.
7. REPLACE ELECTRICAL & CONTROL SYSTEMS.
8. PROVIDE IMPROVED REMOTE MONITORING & CONTROL (SCADA).

LEGEND

- PL — PROPERTY LINE (PLAT)
- PROPERTY LINE (GIS)
- BUILDING
- < — SANITARY SEWER
- FM — FORCE MAIN
- VM — VACUUM MAIN
- UTILITY POLE
- XWD — FENCE
- GUARDRAIL
- TO BE DEMOLISHED/REMOVED
- NEW STRUCTURE

N

10 0 10 20
scale 5 feet

SEH

NOT FOR CONSTRUCTION

Project Owner
RAPIDAN SERVICE AUTHORITY
4258 GERMANNA HWY
LOCUST GROVE, VA 22508

RAPIDAN SERVICE AUTHORITY
LAKE OF THE WOODS VACUUM SEWER IMPROVEMENTS
ORANGE COUNTY
LOCUST GROVE, VIRGINIA

SEH Project RAPSA 177782
Checked By
Drawn By

Project Status: PROGRESS PRINTS
Issue Date: 08/22/2024

REVISION SCHEDULE

REV. #	DESCRIPTION	DATE

PUMP STATION N - PRELIMINARY SITE PLAN

C013

Appendix D

Preliminary Opinons of Cost

LAKE OF THE WOODS VACUUM SEWER EVALUATION
PRELIMINARY OPINION OF PROBABLE COST
RAPIDAN SERVICE AUTHORITY
LOCUST GROVE, VIRGINIA
September 8, 2024

Station ID	Building Replacement	Building Rehab	Vacuum System Replacement	S&L Pump Station Improvements	Odor Control System Replacement	Electrical Improvements	Generator Improvements	Utility Electrical Upgrade	SCADA, Instrumentation, and Controls	General Civil Site Work	Mobilization	Contractor OH&P	Construction Cost	Project Contingency	Design Phase Engineering	Construction Phase Engineering & Inspection	Legal/Admin/Materials Testing/Misc.	Total Probable Project Cost
"Large" Stations - Serves >300 houses, Currently Equipped with SC5 Vacuum Pumps																		
Cost Assumptions	$ 127,600	Varies	$ 667,100	$ 151,300	$ 12,800	$ 40,000	$ 104,000	$ 25,000	$ 60,300	**10% of Civil/ Struct/Arch**	**5%**	**12%**		**25%**		**13%**	**5%**	
A		$10,000	$667,100			$40,000	$104,000		$60,300	$68,000	$47,000	$120,000	**$1,116,400**	$279,000	$134,000	$145,000	$56,000	**$1,730,000**
B		$10,000	$667,100	$151,300	$12,800	$40,000		$25,000	$60,300	$84,000	$53,000	$132,000	**$1,235,500**	$309,000	$148,000	$161,000	$62,000	**$1,916,000**
C	$127,600		$667,100	$151,300	$12,800	$40,000	$104,000	$25,000	$60,300	$96,000	$64,000	$162,000	**$1,510,100**	$378,000	$196,000	$196,000	$76,000	**$2,356,000**
E	$127,600		$667,100	$151,300	$12,800	$40,000	$104,000	$25,000	$60,300	$96,000	$64,000	$162,000	**$1,510,100**	$378,000	$196,000	$196,000	$76,000	**$2,356,000**
F		$10,000	$667,100	$151,300		$40,000	$104,000	$25,000	$60,300	$83,000	$57,000	$144,000	**$1,341,700**	$335,000	$161,000	$174,000	$67,000	**$2,079,000**
J	$127,600		$667,100	$151,300	$12,800	$40,000		$25,000	$60,300	$96,000	$59,000	$149,000	**$1,388,100**	$347,000	$181,000	$180,000	$69,000	**$2,165,000**
K&L	$127,600		$667,100			$40,000	$104,000	$25,000	$60,300	$79,000	$55,000	$139,000	**$1,297,000**	$324,000	$170,000	$169,000	$65,000	**$2,025,000**
"Medium" Stations - Serves 200-300 houses, Currently Equipped with SC3 Vacuum Pumps																		
Cost Assumptions	$106,900		$503,600	$147,800	$12,800	$30,000			$63,000	**10% of Civil/ Struct/Arch**	**5%**	**12%**		**25%**		**13%**	**5%**	
I		$10,000	$503,600	$147,800	$12,800	$30,000			$63,000	$67,000	$42,000	$105,000	**$981,200**	$245,000	$118,000	$128,000	$49,000	**$1,521,000**
N	$106,900		$503,600		$12,800	$30,000			$63,000	$62,000	$39,000	$85,000	**$902,300**	$226,000	$125,000	$117,000	$45,000	**$1,415,000**
"Small" Stations - Serves <200 houses, Currently Equipped with SC2 Vacuum Pumps																		
Cost Assumptions	$106,900		$503,600	$147,800	$12,800	$30,000			$63,000	**10% of Civil/ Struct/Arch**	**5%**	**12%**		**25%**		**13%**	**5%**	
D	$106,900		$503,600			$30,000			$63,000	$61,000	$38,000	$83,000	**$885,500**	$221,000	$123,000	$115,000	$44,000	**$1,389,000**
G	$106,900		$503,600		$12,800	$30,000			$63,000	$62,000	$39,000	$85,000	**$902,300**	$226,000	$125,000	$117,000	$45,000	**$1,415,000**
H	$106,900		$503,600		$12,800	$30,000			$63,000	$62,000	$39,000	$85,000	**$902,300**	$226,000	$125,000	$117,000	$45,000	**$1,415,000**
M	$106,900		$503,600			$30,000			$63,000	$61,000	$38,000	$83,000	**$885,500**	$221,000	$123,000	$115,000	$44,000	**$1,389,000**
TOTAL													**$14,858,000**					**$23,171,000**

Lake of the Woods Vaccum Sewer Evaluation **Date:** 09/13/24
PRELIMINARY ENGINEER'S ESTIMATE OF COST OF IMPROVEM **Time:** 16:27
SEH No. 177782

Return to Cover Sheet

PRELIMINARY ENGINEER'S ESTIMATE OF COST OF IMPROVEMENTS FOR STRUCTURE (01):

Notes:
Please use the weight factor table located to the right of the cost estimate table
(1) Weight factor accounts for Miscellaneous Materials for Installation, Location, and/or Contractor Overhead/Profit
(2) If possible, identify taxes separately.
(3) Estimate Labor with either "Unit Cost" cost or "Labor Factor"

SUMMARY	TOTAL	% OF TOTAL
TOTAL COST FOR WORK	########	100%
CIVIL SITE IMPROVEMENTS	VARIES	#VALUE!
BUILDING REPLACEMENT	$ 127,600	11%
PROCESS - VACUUM SYSTEM	$ 667,100	60%
PROCESS - SEWAGE PUMPING SYSTEM	$ 151,300	14%
PROCESS - EMERGENCY STORAGE TANK	$ 57,600	5%
PROCESS - ODOR CONTROL SYSTEM	$ 12,800	1%
ELECTRICAL IMPROVEMENTS	$ 40,000	4%
SCADA, INSTRUMENTATION AND CONTROLS	$ 60,300	5%

Current Date	June 2024
Current CCI ENR Index	12,556
CCI Index Correction	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	MATERIAL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	CIVIL SITE IMPROVEMENTS									**#VALUE!**	
1	General Civil Site Work (10% of construction estimate)	1	LS	VARIES	1.00	#VALUE!			#VALUE!	#VALUE!	
2						$ -		$ -	$ -	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	BUILDING REPLACEMENT									**$ 127,596.26**	
3	Demolition of old Building	1	LS	$ 10,000.00	1.00	$ 10,000.00			$ 10,000.00	$ 10,000.00	
4	Footing Excavations and Grading	1	LS	$ 5,700.00	1.00	$ 5,700.00			$ 5,700.00	$ 5,700.00	2 days x 10 hours x 3 man crew x $45/hr + $150/hr for equipment
5	Concrete for Footings	10.2	CY	$ 1,800.00	1.00	$ 18,309.33			$ 1,800.00	$ 18,309.33	MEDFO 174290 CDBG EST.
6	Concrete for Slab on Grade	7.2	CY	$ 1,800.00	1.00	$ 12,916.93			$ 1,800.00	$ 12,916.93	MEDFO 174290 CDBG EST.
7	Exterior walls (Precast CMU wall panels)	550	SF	$ 65.00	1.00	$ 35,750.00			$ 65.00	$ 35,750.00	GRANT 172213 90% Est, Checked against Smith-Midland
8	Roofing stystem (Metal Truss w/ Shingles)	300	SF	$ 60.00	1.30	$ 23,400.00			$ 78.00	$ 23,400.00	GRANT 172213 90% Est, Checked against Smith-Midland
9	Interior Paint	550	SF	$ 5.00	1.10	$ 3,025.00			$ 5.50	$ 3,025.00	MEDFO 174290 CDBG EST.
10	Lighting Fixtures	3	EA	$ 150.00	1.10	$ 495.00			$ 165.00	$ 495.00	MEDFO 174290 CDBG EST.
11	Double Leaf Doors	1	EA	$ 6,250.00	1.00	$ 6,250.00			$ 6,250.00	$ 6,250.00	GRANT 172213 90% Est
12	Vent Fan	1	EA	$ 750.00	1.00	$ 750.00			$ 750.00	$ 750.00	GRANT 172213 90% Est
13	Unit Heater	1	EA	$ 1,000.00	1.00	$ 1,000.00			$ 1,000.00	$ 1,000.00	GRANT 172213 90% Est
14	Misc. Electrical	1.00	LS	$ 10,000.00	1.00	$ 10,000.00			$ 10,000.00	$ 10,000.00	
15						$ -			$ -	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	PROCESS - VACUUM SYSTEM									**$ 667,049.64**	
16	Duplex Vacuum Pump (SC7) w/ Control Panel	1	LS	$ 171,837.00	1.25	$ 214,796.25	1.15	$ 32,219.44	$ 247,015.69	$ 247,015.69	Quote from Gardner Denver Nash, June 13, 2024
17	4" SCH80 PVC - at/above grade	50	LF	$ 11.00	1.30	$ 715.00	1.30	$ 214.50	$ 18.59	$ 929.50	Grainger.com
18	6" SCH80 PVC - at/above grade	100	LF	$ 26.30	1.30	$ 3,419.00	1.30	$ 1,025.70	$ 44.45	$ 4,444.70	Grainger.com
19	4" SCH80 PVC 45 Bend	2	EA	$ 76.09	1.30	$ 197.83	1.30	$ 59.35	$ 128.59	$ 257.18	Grainger.com
20	6" SCH80 PVC 45 Bend	2	EA	$ 93.95	1.30	$ 244.27	1.30	$ 73.28	$ 158.78	$ 317.55	Grainger.com
21	Misc Fittings	1	LS	$ 500.00	1.00	$ 500.00	1.30	$ 150.00	$ 650.00	$ 650.00	
22	Receiving Tank	1	EA	$ 81,000.00	1.25	$ 101,250.00	1.25	$ 25,312.50	$ 126,562.50	$ 126,562.50	Quote from Reco USA
23	Overflow Tank	1	EA	$ 100,000.00	1.25	$ 125,000.00	1.25	$ 31,250.00	$ 156,250.00	$ 156,250.00	Quote from Reco USA
24	Equalization Tank	1	EA	$ 58,800.00	1.25	$ 73,500.00	1.25	$ 18,375.00	$ 91,875.00	$ 91,875.00	Quote from Reco USA
25	Swing Check Valve	1	EA	$ 1,062.81	1.20	$ 1,275.38	1.15	$ 191.31	$ 1,466.68	$ 1,466.68	
26	Hinge Check Valve	1	EA	$ 1,062.81	1.20	$ 1,275.38	1.15	$ 191.31	$ 1,466.68	$ 1,466.68	
27	Precast Concrete Valve Vault	2	EA	$ 270.00	1.20	$ 648.00	1.15	$ 97.20	$ 372.60	$ 745.20	
28	2" Actuated True Ball Valves	2	EA	$ 1,091.95	1.20	$ 2,620.68	1.40	$ 1,048.27	$ 1,834.48	$ 3,668.95	USABlueBook, Asahi Actuated Ball Valve
29	Vacuum line insulation and heat trace	50	LF	$ 20.00	1.00	$ 1,000.00	1.40	$ 400.00	$ 28.00	$ 1,400.00	
30	Bypass Pumping	1	LS	$ 30,000.00	1.00	$ 30,000.00			$ 30,000.00	$ 30,000.00	
31						$ -		$ -	$ -	$ -	
32						$ -		$ -	$ -	$ -	
33						$ -		$ -	$ -	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	PROCESS - SEWAGE PUMPING SYSTEM									**$ 151,250.00**	
34	Wet Well Coating	450	SF	$ 25.00	1.00	$ 11,250.00			$ 25.00	$ 11,250.00	Assumes 16 VF of 6' dia. Wetwell
35	Package Pumping Station	1	LS	$ 140,000.00	1.00	$ 140,000.00			$ 140,000.00	$ 140,000.00	Email from Lynn Clements
53						$ -			$ -	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	PROCESS - EMERGENCY STORAGE TANK									**$ 57,502.86**	
54	Precast concrete storage tank - 8,000 gal	2	EA	$ 14,000.00	1.25	$ 35,000.00	1.25	$ 8,750.00	$ 21,875.00	$ 43,750.00	https://sheaconcrete.com/wp-
55	Excavation	222	CY	$ 35.00	1.00	$ 7,777.78			$ 35.00	$ 7,777.78	
56	Structural aggregate	10	CY	$ 40.00	1.00	$ 400.00			$ 40.00	$ 400.00	
57	4" PVC Pipe - buried	40.00	LF	$ 61.50	1.25	$ 3,075.08			$ 76.88	$ 3,075.08	
58	Frame and Cover	4.00	EA	$ 500.00	1.25	$ 2,500.00			$ 625.00	$ 2,500.00	WAG
59						$ -			$ -	$ -	
60						$ -			$ -	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	PROCESS - ODOR CONTROL SYSTEM									**$ 12,730.41**	
61	Fiberglass basin - 6' diameter	1.00	LS	$ 4,500.00	1.30	$ 5,850.00	1.15	$ 877.50	$ 6,727.50	$ 6,727.50	
62	Aeration Piping	1.00	LS	$ 200.00	1.25	$ 250.00	1.15	$ 37.50	$ 287.50	$ 287.50	
63	Sump pump	1.00	LS	$ 3,800.00	1.00	$ 3,800.00	1.15	$ 570.00	$ 4,370.00	$ 4,370.00	Grantsburg 1777213 90% OPC
64	Media	2.1	CY	$ 45.00	1.25	$ 117.75	1.15	$ 17.66	$ 64.69	$ 135.41	
65	Excavation	5.33	CY	$ 35.00	1.00	$ 186.67			$ 35.00	$ 186.67	
66	Structural Aggregate	0.67	CY	$ 35.00	1.00	$ 23.33			$ 35.00	$ 23.33	
67	Discharge Piping	1.00	LS	$ 1,000.00	1.00	$ 1,000.00			$ 1,000.00	$ 1,000.00	
68						$ -			$ -	$ -	
69						$ -			$ -	$ -	
70						$ -			$ -	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	ELECTRICAL IMPROVEMENTS									**$ 40,000.00**	
71	Electrical improvements	1.00	LS	$ 40,000.00	1.00	$ 40,000.00			$ 40,000.00	$ 40,000.00	
72						$ -		$ -	$ -	$ -	
73						$ -		$ -	$ -	$ -	
74						$ -		$ -	$ -	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	TOTAL COST	Source
	SCADA, INSTRUMENTATION AND CONTROLS									**$ 60,225.00**	
75	VACUUM PUMP CONTROL PANEL	1.00	LS	$ 23,725.00	1.00	$ 23,725.00			$ 23,725.00	$ 23,725.00	Nash Engineering quote 6/13/2024
76	INSTRUMENTATION (Pressure gauges, water flow meters)	1.00	LS	$ 10,000.00	1.25	$ 12,500.00			$ 12,500.00	$ 12,500.00	
77	PLC and Programming	1.00	LS	$ 24,000.00	1.00	$ 24,000.00			$ 24,000.00	$ 24,000.00	
78						$ -		$ -	$ -	$ -	
79						$ -		$ -	$ -	$ -	
80						$ -		$ -	$ -	$ -	

Lake of the Woods Vaccum Sewer Evaluation **Date:** 09/13/24
PRELIMINARY ENGINEER'S ESTIMATE OF COST OF IMPROVEMI **Time:** 16:27
SEH No. 177782
Return to Cover Sheet

PRELIMINARY ENGINEER'S ESTIMATE OF COST OF IMPROVEMENTS FOR ALTERNATIVES SMALL AND MEDIUM:

Notes:
Please use the weight factor table located to the right of the cost estimate table
(1) Weight factor accounts for Miscellaneous Materials for Installation, Location, and/or Contractor Overhead/Profit
(2) If possible, identify taxes separately.
(3) Estimate Labor with either "Unit Cost" cost or "Labor Factor"

Legend	
###	User Defined Data Not Entered
###	Relevant Output
###	User Defined Data Entered
###	User-Defined Dropdown
###	Out of Range
###	Data Defined in Other Worksheet

SUMMARY	TOTAL	% OF TOTAL
TOTAL COST FOR WORK	**$ 894,400**	**100%**
CIVIL SITE IMPROVEMENTS	VARIES	#VALUE!
BUILDING REPLACEMENT	$ 106,900	12%
PROCESS - VACUUM SYSTEM	$ 503,600	56%
PROCESS - SEWAGE PUMPING SYSTEM	$ 147,800	17%
PROCESS - EMERGENCY STORAGE TANK	$ 30,300	3%
PROCESS - ODOR CONTROL SYSTEM	$ 12,800	1%
ELECTRICAL IMPROVEMENTS	$ 30,000	3%
SCADA, INSTRUMENTATION AND CONTROLS	$ 63,000	7%

Current Date	June 2024
Current CCI ENR Index	12,556
CCI Index Correction	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	MATERIAL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	CIVIL SITE IMPROVEMENTS										**#VALUE!**	
1	General Civil Site Work (10% of construction estimate)	1	LS	VARIES	1.00	#VALUE!			#VALUE!	1.00	#VALUE!	
2						$ -		$ -	$ -	1.00	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	BUILDING REPLACEMENT										**$ 106,820.27**	
3	Demolition of old Building	1	LS	$ 10,000.00	1.00	$ 10,000.00			$ 10,000.00	1.00	$ 10,000.00	
4	Footing Excavations and Grading	1	LS	$ 4,300.00	1.00	$ 4,300.00			$ 4,300.00	1.00	$ 4,300.00	1.5 days x 10 hours x 3 man crew x $45/hr + $150/hr for equipment
5	Concrete for Footings	8.6	CY	$ 1,800.00	1.00	$ 15,450.67			$ 1,800.00	1.00	$ 15,450.67	MEDFO 174290 CDBG EST.
6	Concrete for Slab on Grade	5.1	CY	$ 1,800.00	1.00	$ 9,224.60			$ 1,800.00	1.00	$ 9,224.60	MEDFO 174290 CDBG EST.
7	Exterior walls (Precast CMU wall panels)	470	SF	$ 65.00	1.00	$ 30,550.00			$ 65.00	1.00	$ 30,550.00	Quote for Red Hill (Feb 14, 2024
8	Roofing stystem (Metal Truss w/ Shingles)	210	SF	$ 60.00	1.30	$ 16,380.00			$ 78.00	1.00	$ 16,380.00	Quote for Red Hill (Feb 14, 2025
9	Interior Paint	470	SF	$ 5.00	1.10	$ 2,585.00			$ 5.50	1.00	$ 2,585.00	MEDFO 174290 CDBG EST.
10	Lighting Fixtures	2	EA	$ 150.00	1.10	$ 330.00			$ 165.00	1.00	$ 330.00	MEDFO 174290 CDBG EST.
11	Double Leaf Doors	1	EA	$ 6,250.00	1.00	$ 6,250.00			$ 6,250.00	1.00	$ 6,250.00	GRANT 172213 90% Est
12	Vent Fan	1	EA	$ 750.00	1.00	$ 750.00			$ 750.00	1.00	$ 750.00	GRANT 172213 90% Est
13	Unit Heater	1	EA	$ 1,000.00	1.00	$ 1,000.00			$ 1,000.00	1.00	$ 1,000.00	GRANT 172213 90% Est
14	Misc. Electrical	1	LS	$ 10,000.00	1.00	$ 10,000.00			$ 10,000.00	1.00	$ 10,000.00	
15						$ -		$ -	$ -	1.00	$ -	
16						$ -		$ -	$ -	1.00	$ -	
17						$ -		$ -	$ -	1.00	$ -	
18						$ -		$ -	$ -	1.00	$ -	
19						$ -		$ -	$ -	1.00	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	PROCESS - VACUUM SYSTEM										**$ 503,579.51**	
20	Duplex Vacuum Pump (SC7) w/ Control Panel	1	LS	$ 63,542.00	1.25	$ 79,427.50	1.15	$ 11,914.13	$ 91,341.63	1.00	$ 91,341.63	Quote from Gardner Denver Nash, June 13, 2024
21	4" SCH80 PVC - at/above grade	150	LF	$ 11.00	1.30	$ 2,145.00	1.30	$ 643.50	$ 18.59	1.00	$ 2,788.50	Grainger.com
22	4" SCH80 PVC 45 Bend	4	EA	$ 76.09	1.30	$ 395.67	1.30	$ 118.70	$ 128.59	1.00	$ 514.37	Grainger.com
23	Misc Fittings	1	LS	$ 500.00	1.00	$ 500.00			$ 500.00	2.00	$ 500.00	
24	Receiving Tank	1	EA	$ 81,000.00	1.25	$ 101,250.00	1.25	$ 25,312.50	$ 126,562.50	1.00	$ 126,562.50	Quote from Reco USA
25	Overflow Tank	1	EA	$ 100,000.00	1.25	$ 125,000.00	1.25	$ 31,250.00	$ 156,250.00	1.00	$ 156,250.00	Quote from Reco USA
26	Equalization Tank	1	EA	$ 58,800.00	1.25	$ 73,500.00	1.25	$ 18,375.00	$ 91,875.00	1.00	$ 91,875.00	Quote from Reco USA
27	Swing Check Valve	1	EA	$ 1,062.81	1.20	$ 1,275.38	1.15	$ 191.31	$ 1,466.68	1.00	$ 1,466.68	
28	Hinge Check Valve	1	EA	$ 1,062.81	1.20	$ 1,275.38	1.15	$ 191.31	$ 1,466.68	1.00	$ 1,466.68	
29	Precast Concrete Valve Vault	2	EA	$ 270.00	1.20	$ 648.00	1.15	$ 97.20	$ 372.60	1.00	$ 745.20	
30	2" Actuated True Ball Valves	2	EA	$ 1,091.95	1.20	$ 2,620.68	1.40	$ 1,048.27	$ 1,834.48	1.00	$ 3,668.95	USABlueBook, Asahi Actuated Ball Valve
31	Vacuum line insulation and heat trace	50	LF	$ 20.00	1.00	$ 1,000.00	1.40	$ 400.00	$ 28.00	1.00	$ 1,400.00	
32	Bypass Pumping	1	LS	$ 25,000.00	1.00	$ 25,000.00			$ 25,000.00	1.00	$ 25,000.00	
33						$ -		$ -	$ -	1.00	$ -	
34						$ -		$ -	$ -	1.00	$ -	
35						$ -		$ -	$ -	1.00	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	PROCESS - SEWAGE PUMPING SYSTEM										$ 147,750.00	
36	Wet Well Coating	310	SF	$ 25.00	1.00	$ 7,750.00			$ 25.00	1.00	$ 7,750.00	Assumes 16 VF of 6' dia. Wetwell
37	Package Pumping Station	1	LS	$ 140,000.00	1.00	$ 140,000.00			$ 140,000.00	1.00	$ 140,000.00	Email from Lynn Clements
55						$ -		$ -	$ -	1.00	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	PROCESS - EMERGENCY STORAGE TANK										$ 30,288.97	
56	Precast concrete storage tank - 8,000 gal	1	EA	$ 14,000.00	1.25	$ 17,500.00	1.25	$ 4,375.00	$ 21,875.00	1.00	$ 21,875.00	https://sheaconcrete.com/wp-
57	Excavation	111	CY	$ 35.00	1.00	$ 3,888.89			$ 35.00	1.00	$ 3,888.89	
58	Structural aggregate	5	CY	$ 40.00	1.00	$ 200.00			$ 40.00	1.00	$ 200.00	
59	4" PVC Pipe - buried	40	LF	$ 61.50	1.25	$ 3,075.08			$ 76.88	1.00	$ 3,075.08	
60	Frame and Cover	2	EA	$ 500.00	1.25	$ 1,250.00			$ 625.00	1.00	$ 1,250.00	WAG
61						$ -		$ -	$ -	1.00	$ -	
62						$ -		$ -	$ -	1.00	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	PROCESS - ODOR CONTROL SYSTEM										$ 12,712.75	
63	Fiberglass basin - 6' diameter	1	LS	$ 4,500.00	1.30	$ 5,850.00	1.15	$ 877.50	$ 6,727.50	1.00	$ 6,727.50	
64	Aeration Piping	1	LS	$ 200.00	1.25	$ 250.00	1.15	$ 37.50	$ 287.50	1.00	$ 287.50	
65	Sump pump	1	LS	$ 3,800.00	1.00	$ 3,800.00	1.15	$ 570.00	$ 4,370.00	1.00	$ 4,370.00	Grantsburg 1777213 90% OPC
66	Media	2.1	CY	$ 45.00	1.25	$ 117.75			$ 56.25	1.00	$ 117.75	
67	Excavation	5.3	CY	$ 35.00	1.00	$ 186.67			$ 35.00	1.00	$ 186.67	
68	Structural Aggregate	0.7	CY	$ 35.00	1.00	$ 23.33			$ 35.00	1.00	$ 23.33	
69	Discharge Piping	1	LS	$ 1,000.00	1.00	$ 1,000.00			$ 1,000.00	1.00	$ 1,000.00	
70						$ -			$ -	1.00	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	ELECTRICAL IMPROVEMENTS										$ 30,000.00	
71	Electrical improvements	1.00	LS	$ 30,000.00	1.00	$ 30,000.00			$ 30,000.00	1.00	$ 30,000.00	
72						$ -		$ -	$ -	1.00	$ -	
73						$ -		$ -	$ -	1.00	$ -	

ITEM NO.	SYSTEM DESCRIPTION / DESCRIPTION	MATERIALS QTY	UNIT	UNIT COST	INSTALL FACTOR	SUBTOTAL COST	LABOR FACTOR	LABOR SUBTOTAL COST	TOTAL UNIT COST	INDEX CORR.	TOTAL COST	Source
	SCADA, INSTRUMENTATION AND CONTROLS										$ 62,925.00	
74	VACUUM PUMP CONTROL PANEL	1.00	LS	$ 18,875.00	1.00	$ 18,875.00	1.40	$ 7,550.00	$ 26,425.00	1.00	$ 26,425.00	Nash Engineering quote 6/13/2024
75	INSTRUMENTATION (Pressure gauges, water flow meters)	1.00	LS	$ 10,000.00	1.25	$ 12,500.00			$ 12,500.00	1.00	$ 12,500.00	
76	PLC and Programming	1.00	LS	$ 24,000.00	1.00	$ 24,000.00			$ 24,000.00	1.00	$ 24,000.00	
77						$ -		$ -	$ -	1.00	$ -	

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