Piney Mountain Subdivision Wastewater System

Asset Management Plan - October 2021

Background

The Piney Mountain Subdivision wastewater system was originally constructed in 1996. The system includes low pressure PVC collector lines from the homes throughout the neighborhood with various valves, a pump station with two pumps and a backup generator and the associated electrical and control appurtenances, and a ductile iron forcemain that discharges to the City of Durham's wastewater collection system. Currently, 56 homes are connected to the Piney Mountain system.

Asset Inventory

Since its construction in 1996, the Piney Mountain Subdivision wastewater system has been maintained by Orange Water and Sewer Authority (OWASA) through a combination of preventative maintenance and corrective maintenance activities. OWASA completed a comprehensive condition assessment of the pump station in 2004 and completed subsequent improvements and rehabilitations in 2006. In 2013 all assets throughout OWASA's facilities were assessed for condition. A 2016 project replaced the station's electrical system, updated the station controls, and added a generator.

Overall condition of the equipment continues to be informally assessed during preventative and corrective maintenance work orders and emergency response calls. Condition of equipment and components is used to obtain a snapshot of the current condition of the assets as well as estimate their remaining life. Condition assessments, when performed regularly, allow OWASA to gauge maintenance requirements and ensure reliability and prolong asset useful lifespans.

Additionally, OWASA periodically collects metal forcemain samples from the ductile iron line in areas with high potential for corrosion to assess the condition of the main that runs from the pump station to the City of Durham manhole. OWASA also inspects the pump station on a weekly basis in addition to responding to any emergency situations, such as leaks or equipment failures.

Attachment 1 provides the current asset inventory within the Piney Mountain Subdivision System. The table includes the date of asset installation (please note some assets are original whereas others have been replaced), condition of the asset, life expectancy of the asset, remaining life of the asset, and the estimated cost to replace. The life expectancy of the asset is based on the original lifespan provided by the equipment or component manufacturer. The remaining life of the asset is based on the installation date, original manufacturer lifespan, and condition noted in the field. Asset life can be quite variable compared to the manufacturer

lifespan depending on installation, environment, and maintenance activities. OWASA tracks whether or not equipment falls within the low (asset lasting less time than the expected manufacturer lifespan), base (asset aligns well with the manufacturer lifespan), or high (asset is lasting longer than the expected manufacturer lifespan) life cycle values within a renewal and replacement model, however all listed lifespan years and remaining life years are estimates. The estimated cost to replace the asset is shown in 2021 dollars and includes labor (both internal OWASA Staff and external contractors as needed), materials and equipment, construction inspection and administration (if necessary for external contractor work), and a 10% contingency. The costs shown are planning level best estimates for a direct replacement of existing assets. Please note that when replacements and rehabilitations are needed, it is also the time to look towards improvements of new equipment or more efficient equipment, potentially impacting the costs shown. Also, note that the costs in the table assume that the asset would be replaced in its entirety, whereas in many instances the equipment or asset may be rehabilitated or only partially replaced depending on the type of wear and tear. The table is not meant to be exhaustive for all assets at the pump station, items such as fences, access areas, and other appurtenances for proper running of the station may not be captured in this inventory.

Planned Improvements

The current plan for planned improvements can generally be inferred from Table 1. Additionally, OWASA's five-year CIP includes funding in 2024 for condition assessment of the force main. This investigation is expected to provide a better understanding of the rate of deterioration of various areas of the force main, and substantially inform the assumptions underlying the replacement plan for this high-dollar asset. Because of the criticality and high replacement cost of this asset, additional information about the force main was provided to the Piney Mountain Homeowners' Association (PMHOA) in August 2021 and is included as Attachment 2.

Attachments

- Piney Mountain Asset Inventory (table)
- Piney Mountain AM Force Main and Collector Lines - August 2021
- Pump station components

Attachment 1
Piney Mountain Wastewater System Asset Inventory - Oct 20, 2021

Asset	Detail	Date Installed	Condition Score*	Initial Life (years)	Approx. Remaining Life (Years)	Replacement Cost in 2021 Dollars**	Next Replacement Year	Next Replacement Future value
Low Pressure PVC Collector Lines - High Risk	Areas near check valves (112 feet)	1995	2	40	15	$ 12,000	2036	$ 16,414
Low Pressure PVC Collector Lines - Remainder	9816 feet	1995	2	50	25	$ 1,021,000	2046	$ 1,720,809
4" DIP Force Main - High Risk Sections	A) Taproot/Mt Sinai intersection (2000 feet) B) near Wilkins Rd loop (700 feet)	1995	2	35	10	$ 486,000	2031	$ 598,851
4" DIP Force Main - Remainder	4700 feet	1995	2	50	25	$ 846,000	2046	$ 1,425,861
Air Relief Valves - Collector Lines	ARV (2)	1995	2	40	15	$ 8,500	2036	$ 23,389
Air Relief Valves - Force Main	ARV (3)	1995	5	25	<1	$ 10,000	2021	$ 10,000
Valves	Valves Gate (5)	1995	3	40	15	$ 3,200	2036	$ 4,377
	Ball Valve (3)	1995	3	40	15	$ 900	2036	$ 1,231
Manholes	4-ft diameter (1)	1995	3	40	15	$ 5,700	2036	$ 7,796
Wet Well	Wet Well	2006	2	40	25	$ 34,000	2046	$ 57,304
Pumps	Pump-1	2006	5	15	<1	$ 8,000	2021	$ 8,000
	Pump 2	2006	5	15	<1	$ 8,000	2021	$ 8,000
	Well Pump	2007	3.5	10	<5	$ 600	2026	$ 666
Controls	Controls -Pump Controller	2006	3.5	10	<5	$ 2,300	2026	$ 2,553
	Well Pump Controls	2019	1	5	5	$ 1,700	2026	$ 1,887
Generator	Generator	2016	2	30	25	$ 42,000	2046	$ 70,787

*Condition Score definitions:

1. Excellent condition - very good or new asset
2. Good condition - minor defects only
3. Fair condition – moderate signs of wear, damage or corrosion and minorly reduced function
4. Poor condition – significant signs of wear, damage or corrosion and reduced function
5. Very poor condition - requires immediate replacement, unserviceable or has a safety concern

Notes/changes from August 2021

Air Release Valves: Revised to $10,000 (formerly $12,800)

Pumps 1 and 2: revised estimate to $8,000 each (formerly $7,900 each)

Notes and assumptions

Future costs assume inflation at 2.11%/year

Replacement estimates assume in-kind replacement only

Replacement costs assume full replacement; in many instances asset rehabilitation or partial replacement may be acceptable.

Orange Water and Sewer Authority
OWASA is Carrboro-Chapel Hill's not-for-profit public service agency
delivering high quality water, wastewater, and reclaimed water services.

Piney Mountain Subdivision Wastewater System

Asset Management Approach for Force Main and Collector Lines

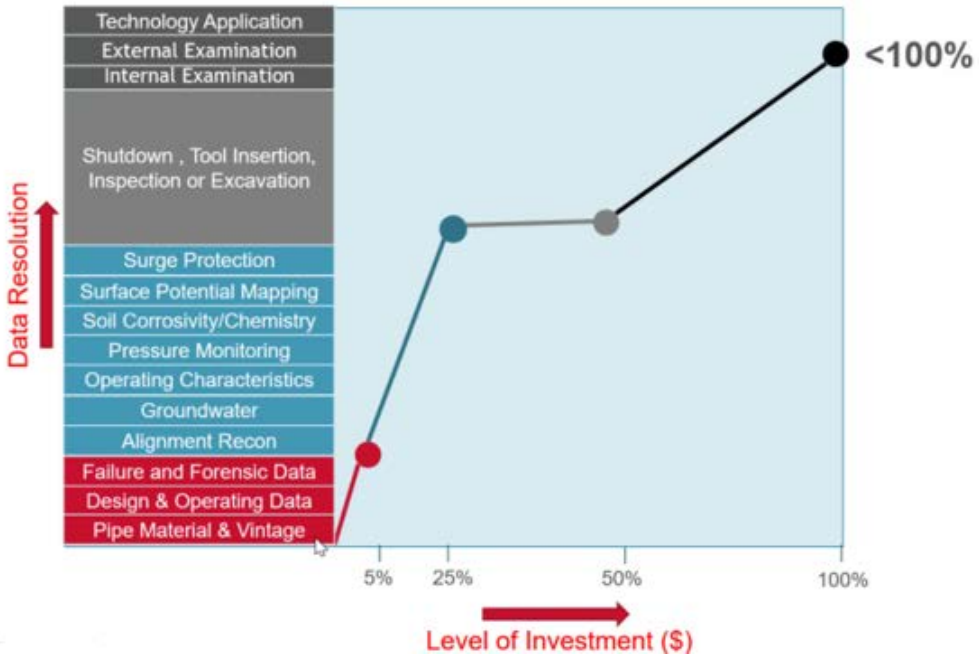
August 2021

Due to the high expected replacement value of the force main and collector line assets, the estimates of reserve amounts for the overall system are governed in large part by the assumptions for replacement of these two asset categories. It will be useful to align the replacement plan for these items as closely as possible with our current understanding of asset failure risk, with knowledge that 1) our understanding of risk will continuously be refined as future inspections bear out the deterioration pattern of different sections of the force main, and 2) unit costs for replacement of the force main are dependent on the future construction bidding environment and complicating construction factors such as rock, conflicting utilities, etc.

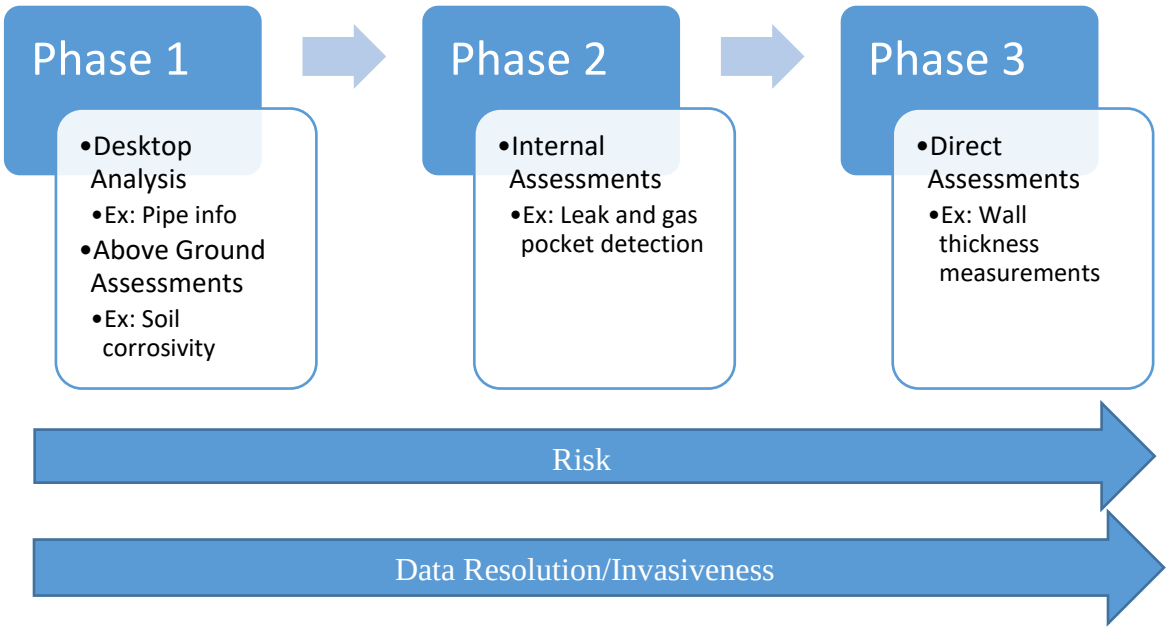
The sections below provide background on general asset management concepts and apply a tiered approach to the understanding of failure risk of each of these two assets.

Asset Management – General Concepts

Understanding and predicting when force mains and collector lines will fail or need rehabilitation occurs with a deficit of information. With buried infrastructure there will never been 100% data resolution on the asset, even with the highest level of investment. The graphic below illustrates this general concept (*Source: HDR)*.



As such, OWASA utilizes a progressive approach to condition assessment. To date, OWASA has historically relied on low risk, low data resolution and minimally invasive techniques to ascertain the condition of our buried assets. An overall profile of the progressive approach to condition assessment is shown below:



Historically, for buried pipe assets OWASA has mainly relied on Phase 1 investigations where we utilize previous break data or information from opportunistically collected pipe samples to ascertain the health and remaining life expectancy. Utilizing historical pipe information, installation information, and soil information OWASA has maintained assets throughout the service area to meet or exceed their anticipated life expectancies.

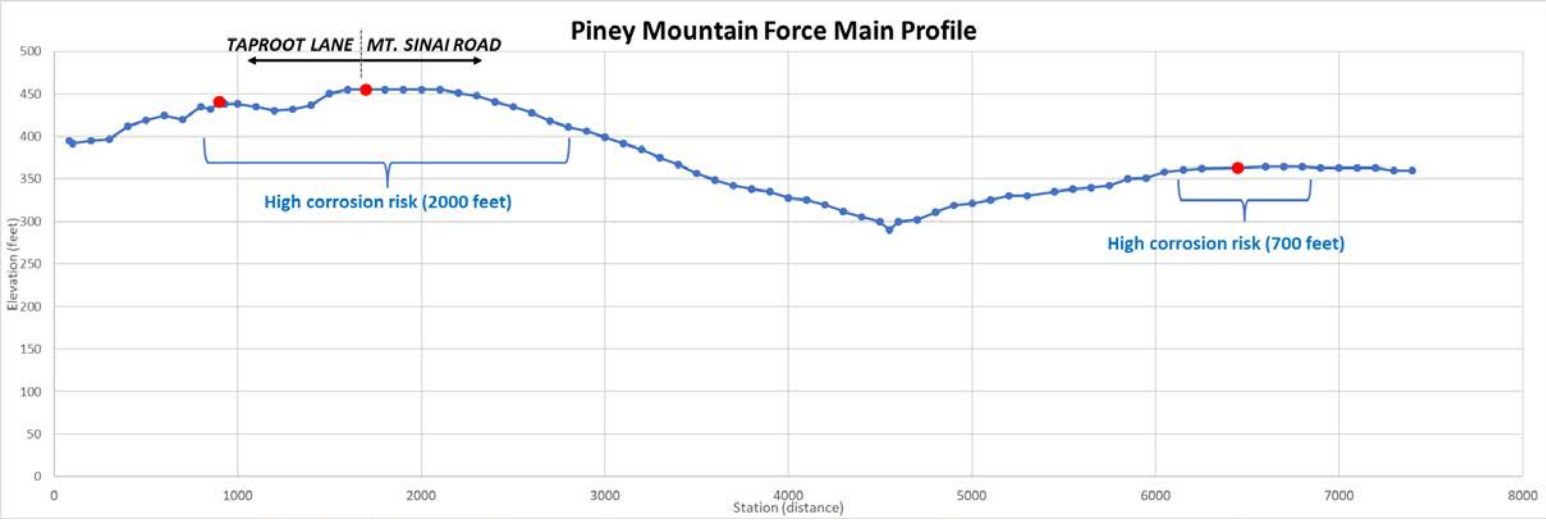
Phase 2 type investigations come with much more cost and risk since an actual piece of equipment is placed within the buried pipe. In pressurized pipe such as force mains, this risk often outmatches the potential reward of the internal assessment data. Additionally, smaller diameter mains (such as the Piney Mountain 4” diameter force main) preclude the use of many if not most of the currently available internal assessment technologies.

Phase 3 type investigations have not yet occurred in OWASA’s service area on in-service force mains or in-service low-pressure collector lines.

Additional information about any given asset is also captured during any work history. Work history is captured by our maintenance management system that contains work orders assigned to assets, including information about when and what was completed and any comments that can be used to further understand the asset and its health. Repair work orders often contain very useful information that can assist with understanding trends in buried asset health. There have been, however, few repair work orders directly relating to the Piney Mountain system collector lines and none relating to repair of the force main pipe itself.

Force Main

The approximately 7400-foot Piney Mountain force main runs from the pump station off of Taproot Drive, then along Mt. Sinai Road to the City of Durham manhole where the force main enters the City's gravity sewer system. The (elevation) profile of the force main is shown below and is based on the construction record drawings from the original 1995 installation. Three red dots in the profile show the locations of air release valves (ARVs), which are designed to be located at high spots in the line where air and sewer gases (particularly hydrogen sulfide) can accumulate. The presence of corrosive gases may lead to pipe wall deterioration and is one of the primary modes of failure for a ductile iron pipe, which is otherwise a relatively strong and long-lasting pipe material.



The ARVs are on a regular preventative maintenance schedule and currently are reaching the end of their useful life and need to be replaced. The ARVs are located near areas for potential air and sewer gas pockets around the high point locations along the force main. A photo of the ARV closest to the pump station (taken on 6/14/21) is shown below.

Air and sewer gas pockets are the primary drivers for potential corrosion of the ductile iron pipe. Even though the ductile iron pipe was manufactured with a cementitious liner, the high points are expected to be the first locations that could experience failure. Pipe samples near the ARVs were previously taken in 2005 and 2017 and showed that the pipe in those locations was in good condition and the cementitious liner was still in place. Samples were visually assessed by OWASA staff and not sent out for an external corrosion expert's review. These coupon results provide some of the basis for giving this asset a Condition Score of 2 (out of 5, with 5 being the worst condition).

The force main profile figure shown above identifies the two sections near the ARVs where we currently expect pipe failure risk to be highest. Absent any inspection data to the contrary, we would expect a need to replace these sections on a more frequent recurrence than the remainder of the force main. Please note that this estimate of potential replacement need is based on the elevations shown by the construction record drawing; actual installation, if it differed in elevation or construction quality, could lead to other sections having greater failure risk.

Since the ARVs are working properly, it is less likely that gas pockets would linger in lower sections of the main, so there is less concern for corrosion along other low points and slopes throughout the force main.

As previously noted in the Piney Mountain Subdivision Asset Management Plan, the upcoming 5-year CIP includes additional force main investigations. These investigations will target the areas adjacent to the 2005 and 2017 previous coupons and will add to our understanding of the pace of pipe degradation as well as the extents of the sections deemed higher risk. Future coupons will be taken at regular recurrences.

Low-Pressure Collector Lines

The low-pressure collector lines throughout the Piney Mountain neighborhood have been installed since 1995. These PVC lines were installed primarily in the shoulder of the road and therefore do not experience the weight of traffic in most locations.

Little information is available of the current health of the PVC collector lines beyond that of the general industry knowledge about PVC pipe installation. Based on past work orders, the most likely places for future collector line failure is at the check valves at the demarcating line of responsibility between OWASA and the homeowner. Most repairs require the replacement of the check-valve (homeowners' cost) and a few feet of the PVC collector line. For the purpose of this memo, a length of two feet will be assumed for each PVC collector line failure.

As is the case with all wastewater collection system, the reduction of fats, oils and greases (FOG) in the Piney Mountain low pressure collection system will help maintain the longevity of the system. If FOG is making its way into the collector lines and depositing along the walls of the PVC pipe it could be limit flow capacity which could lead to a costly backup in the future. Additional information about FOG and the sewer system is available in OWASA's annual wastewater report card and on the website www.owasa.org.

Tiered Approach for Force Main and Collector Line assets

Neither the force main nor the low-pressure collector lines are expected to fail uniformly along their entire length. As such, replacement assumptions have been refined into two categories for each asset, based on additional risk factors. The table below illustrates the recommended estimate replacement assumptions that are included in the current asset management table for the Piney Mountain wastewater collection system:

Asset	Detail	Date Installed	Condition Score*	Initial Life (years)	Approx. Remaining Life (Years)	Total Cost in 2021 Dollars**
Low Pressure PVC Collector Lines - High Risk	Areas near check valves (112 feet)	1995	2	40	15	$ 12,000
Low Pressure PVC Collector Lines - Remainder	9816 feet	1995	2	50	25	$ 1,021,000
4" DIP Force Main - High Risk Sections	A) Taproot/Mt Sinai intersxn (2000 feet) B) near Wilkins Rd loop (700 feet)	1995	2	35	10	$ 486,000
4" DIP Force Main - Remainder	4700 feet	1995	2	50	25	$ 846,000

In addition to creating risk tiers for these assets, it was suggested that developing a probability estimate (or confidence factor) for the remaining life estimates would allow the distribution of these high dollar future replacement needs over a period of years. Given our current understanding of risk and the relative uncertainty of replacement timing for each of these assets, the following factors may be appropriate for purposes of distributing the replacement costs:

- Collector Lines: High Risk (25%)
- Collector Lines: Remainder (50%)
- Force Main: High Risk (75%)
- Force Main: Remainder (50%)


Junction Box
Generator
Controls and Electrical
Wetwell/Pumps


Controls and Electrical Panel
Junction Box
Generator
Wetwell/Pumps