Appendix D: Collection System Desktop Assessment Technical Memorandum

March 4, 2021

To: Scott Gilbertson, ALASD

From: Sean O'Rourke, Hazen and Sawyer
Tracy Ekola, Hazen and Sawyer
Sean FitzGerald, Hazen and Sawyer

cc: Nick Olson, Brad Timm

ALASD Desktop Collection System Assessment FINAL Technical Memorandum

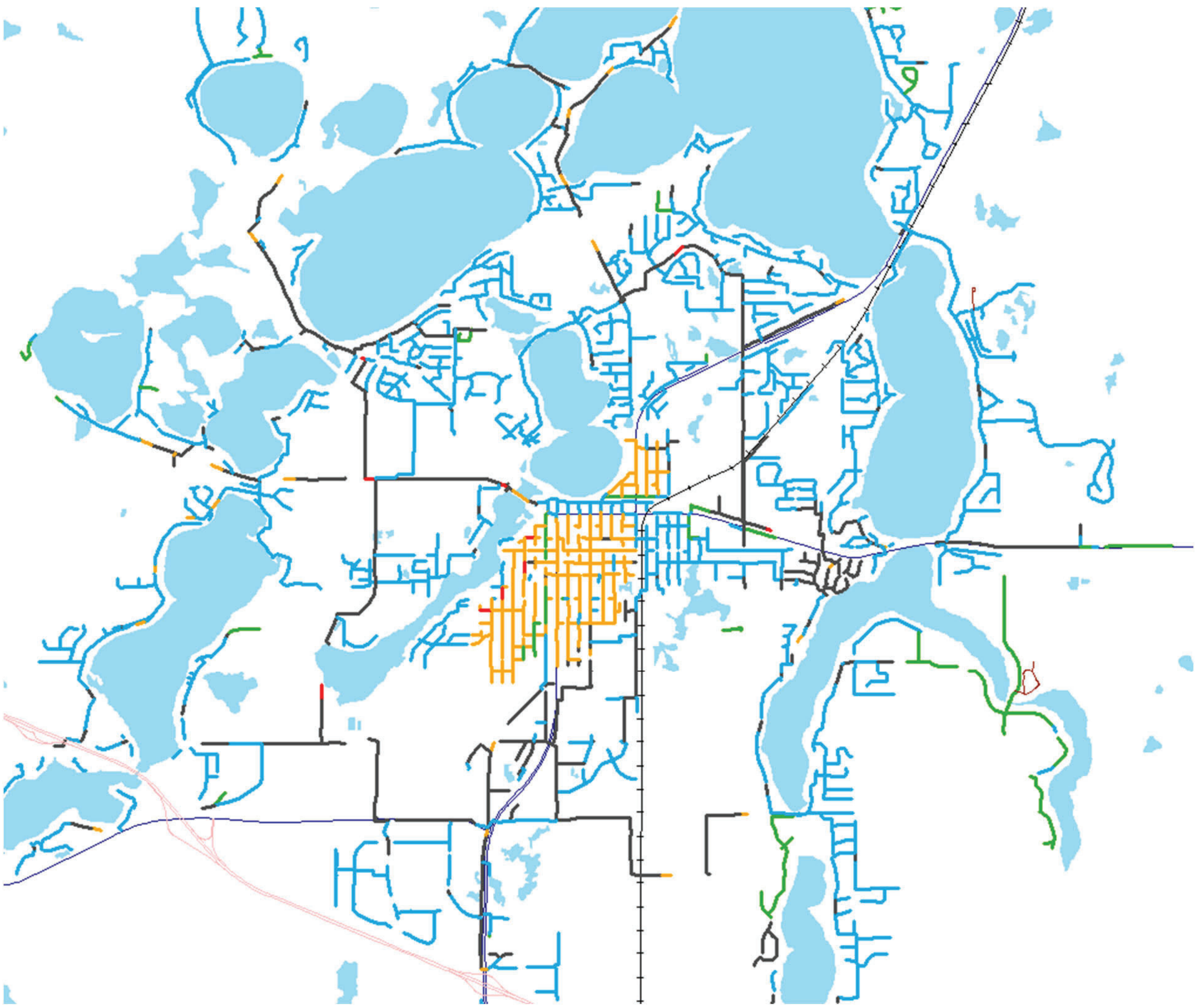


Table of Contents

1. Executive Summary

Based on information provided by ALASD's GIS and other correspondence, a Risk model was constructed and then calibrated. An asset valuation or replacement cost curves were developed for the sewer assets in this evaluation as well. The results of the Risk analysis will be provided via a shapefile to allow for ease of use. The initial findings from this evaluation yield the following results and recommendations for asset replacement over the next 10 years.

1. Gravity Sewers: The quantity of gravity sewers that received an RUL of ≤ 10 years is approximately 134,000 feet (~10% of total). **Using the developed cost curves, the 10-year replacement cost would be approximately $13.4 million**. There are three important things to note about this cost.

   a) This is assuming replacement of all the gravity sewers with an RUL of ≤ 10 years regardless of the CoF. As shown in **Table 1-1**, a quarter of these sewers have a lower CoF and may not need replacement in the next 10 years. The replacement cost is planning level and is based on ALASD's average pipe size under average conditions. Sewers with a CoF of 4 or 5 could have a higher replacement cost due to their larger size, depth, and proximity to water. **Appendix F** illustrates this as well.

   b) The Risk model relied heavily on pipe age as an indicator of RUL since currently only 15% of the system has been CCTV inspected. This included only 12 pipes (3,200 feet) of the 134,000 feet of pipes with an RUL of ≤ 10 years. As more pipes are inspected, it is reasonably anticipated that the quantity with low RULs would be reduced. Currently, most of the inspected pipes have received a 'good' rating.

   c) This replacement cost is based on a construction cost to replace the sewers with open-cut methods. Trenchless rehabilitation (e.g., cured-in-place pipe lining) could be implemented for a lower cost. As the low RUL pipes are evaluated in further detail, it is likely that many could emerge as candidates for trenchless renewal. For a planning level estimate, $55 per foot can be assumed for the predominantly 8- and 10-inch pipes that have an RUL of ≤ 10 years. However, it does appear there could be several projects where complete replacement would be advantageous as a replacement project could potentially eliminate some high-risk force mains or lift stations.

Table 1-1: Gravity Sewers with an RUL of ≤ 10 years

Length of Gravity Sewer (ft)	CoF	Planning Level Cost / ft. for Replacement	Planning Level Cost / ft. for Rehabilitation
		$ 100	$ 55
30,000 (~25%)	5	$ 3,000,000	$ 1,700,000
72,000 (~50%)	4	$ 7,200,000	$ 4,000,000
26,000 (~20%)	3	$ 2,600,000	$ 1,400,000
6,000 (~5%)	2	$ 600,000	$ 300,000
134,000 (100%)	All	$ 13,400,000	$ 7,400,000

2. Force Mains: The quantity of the force mains that received an RUL of ≤ 10 years is approximately 101,000 feet (~30% of the total). Using the developed cost curves, the 10-year replacement cost would be approximately $6.1 million. It is important to note that only half of these force main have a CoF of 4 or 5. The replacement cost is planning level and is based on ALASD's average force main size under average conditions, whereas the force mains with a CoF

of 4 or 5 could likely have a higher replacement cost due to their larger size and proximity to water.

Table 1-2: Force Mains with an RUL of ≤ 10 years

Length of Force Main (ft)	CoF	Planning Level Replacement Cost / ft.
		$ 60
16,000 (~15%)	5	$ 1,000,000
35,000 (~35%)	4	$ 2,100,000
45,000 (~45%)	3	$ 2,700,000
6,000 (~5%)	2 and 1	$ 300,000
101,000 (100%)	All	$ 6,100,000

3. Lift Stations: There are 7 lift station that received an RUL of ≤ 10 years. These lift stations ranged in size from 120 gpm to 3,000 gpm and have low RULs due to a combination of age and reported problematic components (mostly mechanical or electrical). In addition to these 7 stations, there are another 9 stations that have an RUL between 10 and 15 years. Based on the risk scores, replacement or repair of 5 of these is also warranted over the next 10 years. This brings the total to 12 lift station where replacement of repair is recommended. The number of mini lift stations (minis) reaching the end of their RULs is less certain due to the lack of detailed ranking and unknown ages of 20 of the 50 minis. However, there are at least 5 minis that have an RUL of ≤ 10 years - 4 of which also having the highest CoF.

   Using the developed cost curves based on station capacity, the total replacement cost would be approximately $4.5 million over the next 10 years for all of these stations. Separate costs were developed for component-only replacement. Percentages of total replacement were assumed for replacement of mechanical, piping, electrical, and generators. More information is needed to determine if it will be recommended to completely replace the lift stations or to replace only problematic components. However, based on the notes and scores provided by ALASD, recommendations for total replacement or component only replacement are provided in **Appendix C**. **Based on these recommendations, replacement cost could be approximately $3.6 million over the next 10 years**.

   As described later in this report, nearly half the lift stations, most of the minis, and an unknown amount of the residential stations have an RUL between 11 and 20 years. Therefore, beginning in 2030, there will be nearly 50 lift stations and 25 minis that will theoretically reach the final decade of their RUL (see **Appendix D**). Consequently, it is recommended to either increase the budget in the first 10 years to include some of the following decade's projects, or to adapt a robust lift station inspection program to further refine the RUL with the goal of spreading the replacement budget over several decades.

2. Introduction and Background

Alexandria Lake Area Sanitary District (ALASD) was created in 1971 by the Minnesota Legislature as a special purpose subdivision of the State to address problems with water pollution, collection and disposal of sewage in the lake areas around Alexandria, MN. The District's advanced wastewater treatment facility (WWTF) became operational in 1977. In addition to the WWTF, ALASD owns and operates a collection system comprising of approximately 230 miles of gravity sewer, 60 miles of force main, 120 lift stations as well as 170 additional mini lift stations and residential stations (also referred to as 'grinder stations').

The gravity sewers range in size from 6-in to 36-in with the majority being 8-inch. Most of the gravity sewers and force mains are constructed of PVC. The force mains range in size from 1.5-in to 18-in with the majority being 4-inch and 6-inch. The lift stations range in size from 50 gpm to 3,000 gpm, with over 70% being less than 200 gpm.

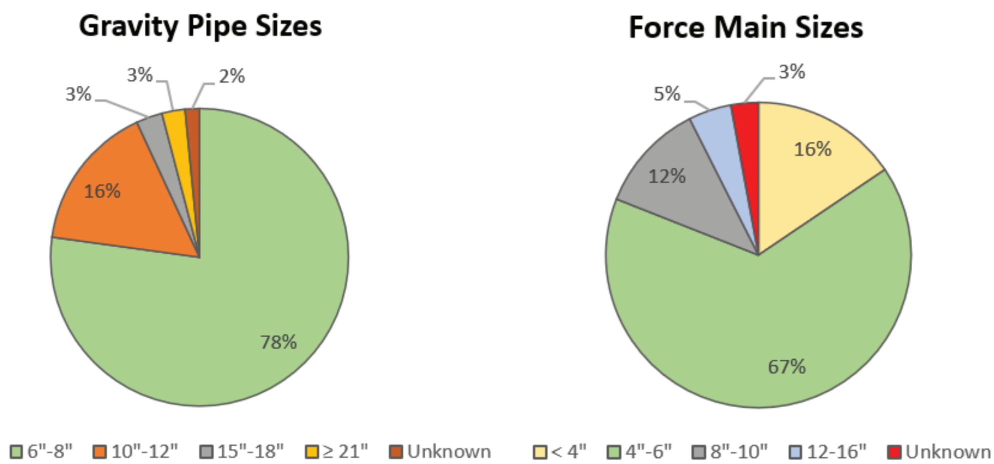


Figure 2-1: Sewer Pipe by Size

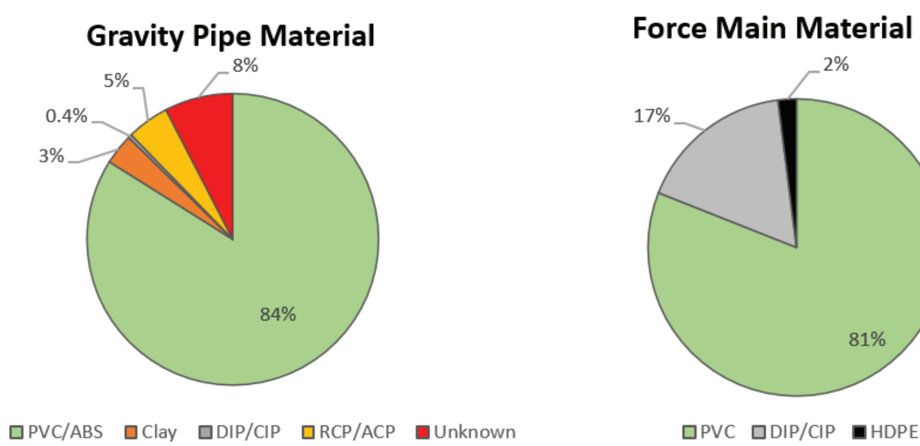


Figure 2-2: Sewer Pipe by Material

The purpose of this Memorandum is to document the risk-based analysis that has been conducted. The analysis provides a theoretical Remaining Useful Life (RUL) of the assets, which will be used to develop a 10-year Rehabilitation and Replacement Plan. Another goal of this analysis is to lay out the preliminary framework for a Data Management and Collection Plan.

3. Sewer Asset Risk Analysis

Sewer Asset Risk (herein termed “risk’) is a combination of the consequence of failure (CoF) and probability of failure (PoF) of a particular gravity sewer, force main, or lift station. The PoF provides a theoretical relative indication of the probability, or likelihood of failure for a sewer asset. For this evaluation, a “failure” is considered a pipe collapse or blockage causing overflowing sewage in an unintended location. It is also considered to be a pump or power failure at a lift station causing overflowing sewage, or any other method resulting in a detrimental impact including public health to the private or public property. The CoF provides a relative indication of the level of impact, both social and financial of a sewer failure at a given pipe or lift station. An asset-by-asset analysis was conducted and a determination of CoF and PoF was performed. The CoF and PoF were each established by assigning weighted scores based on various criteria and then calculating a final weighted score. Both the PoF and CoF are relative numerical values that together produces an overall risk score. These procedures, and the results of each, are described in further detail below.

4. Probability of Failure Analysis

The PoF is based on information known of a given asset. Information may be based on the recorded information (e.g., material, age, etc.) or based on observation (e.g., CCTV scores, lift station rankings, known failures of a given pipe and/or pipe material, etc.). Observed information, where available, was considered to be a higher value for this evaluation. For each asset in ALASD's collection system, PoF was quantified on a 1 to 5 scale, with a 5 representing highest probability of failure and a 1 representing the lowest probability of failure. This was completed by establishing a theoretical Remaining Useful Life (RUL), or number of years to failure for each asset. With all other factors being equal, a gravity pipe built in the 1970s for instance, will have a lower RUL than a pipe built in the 2000's. While RUL is not an exact prediction of when an asset will fail, it is a relative indicator by which ALASD can prioritize inspection, monitoring, and replacement.

Using an asset's age as a predicter of RUL and PoF is an acceptable method. However, devoid of other metrics, it will lead to the predicted ends of asset's useful lives in the same patterns in which they were constructed. It is not uncommon for sewer collection systems, and in the case for ALASD, for construction to have occurred more frequently in specific decades. As seen in the figure below, approximately 35% of ALASD's assets were designed, and presumably built in the 1970s. This means all of these assets are currently between 40 and 50 years old, which is nearing the theoretical end of useful life for certain materials and equipment.

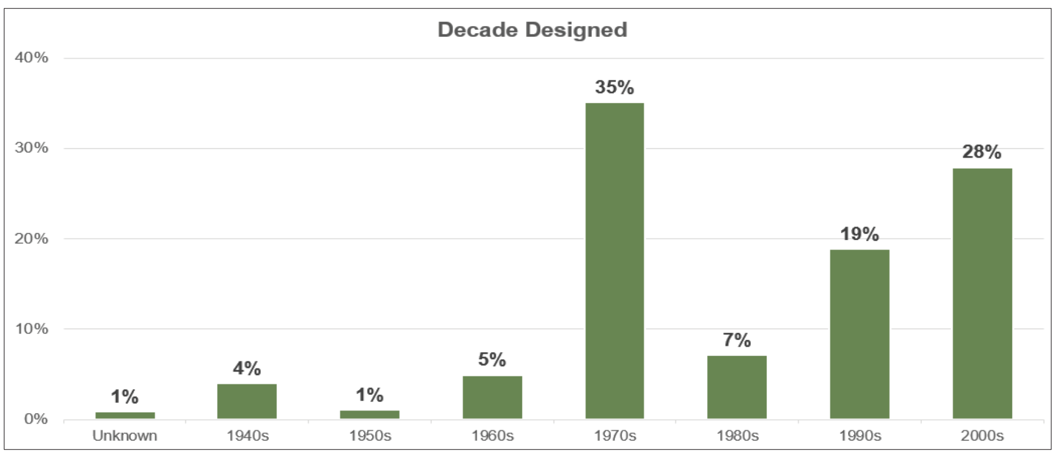


Figure 4-1: Asset Design Decade

4.1 Probability of Failure of Gravity Pipes

A methodology was developed to estimate the PoF and RUL of gravity sewers. As stated above, the observed CCTV information is the best indicator of RUL. The CCTV data provided by ALASD ranked the gravity pipes either 'Good' or 'Fair" or 'Deprecated' for approximately 15% (~600 pipes) of the total gravity sewers. Of those 600 pipes, the percentages received for each ranking and areas the CCTV was conducted can be seen below.

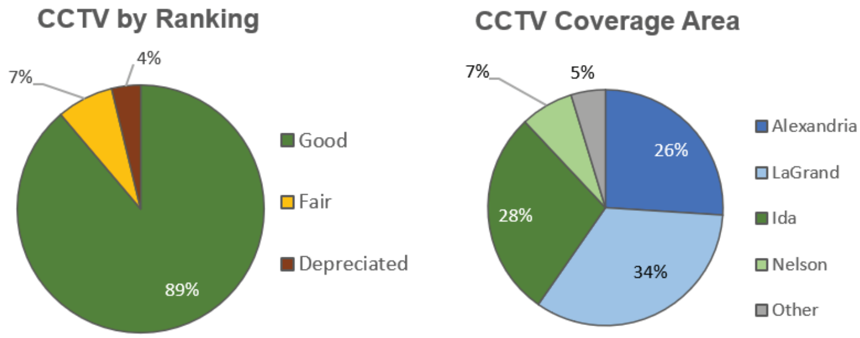


Figure 4-2: CCTV Ranking and Areas

Also used in the PoF estimation was a list of 14 problematic pipes provided by ALASD. Most of the problems were related to sags and/or grease buildup which could lead to a failure by way of a blockage. After the observed information (CCTV and known problems) was used, recorded information was utilized to determine the RUL and PoF. The three pieces of recorded information for each pipe are: age (based on assumed year constructed), material, and whether a force main or grinder station is connected into the gravity line. It is important to note the age was not specifically listed in the GIS shapefile, rather a field called 'Cons-Plan' which is a reference to the construction plan set which the asset can be found on; the construction plans are named with a year as the first characters (e.g., 1997-2-4) which was assumed to be the year the asset was built.

To estimate an RUL, a theoretical Estimated Useful Life (EUL) was first established. The EUL represents the estimated lifespan of an asset by pipe material based on industry knowledge and Hazen's experience. The theoretical EUL assigned to each pipe material is listed below.

Table 4-1: Pipe Material Estimated Useful Life

Pipe Material	Theoretical EUL
PVC	75 years
Clay	75 years
DIP or CIP	40 years
Concrete	50 years
Unknown (assumed to be clay)	75 years

If a force main was connected to the upstream manhole of certain types of pipe (concrete or iron), a reduction in EUL was assumed. It is well known that a force main discharging into a concrete or iron sewer, the pipe's longevity is likely to be reduced near the connection due to the corrosion from the release of hydrogen sulfide (H_2S). Similarly, there are many residential lift stations throughout the collection system that often have force mains tied directly into gravity sewer pipes (not the upstream manhole). It was also assumed these grinder station force main connections would reduce a pipe's EUL due to H_2S corrosion, as well as the strong possibility that the hole to insert the grinder station's force main was field punctured and not a factory tee or wye.

To account for all these factors, a formula was developed to establish a pipe RUL using both the observed (via CCTV) and recorded information. The RUL in turn was used to determine the PoF rating. The formula used two components: a CCTV-Based RUL and a Rule-Based RUL. The CCTV-Based RUL was calculated in the following manner, depending on CCTV Rating of each pipe:

- If Rating = "Good", CCTV-Based RUL = 1.0 x the Material EUL
  For example: a 30-year-old DIP that was rated as "Good" would be given a CCTV-Based RUL of 40 years, despite it already being 30 years into DIP's theoretical 40-year EUL.

- If Rating = "Fair", CCTV-Based RUL = 0.6 x the Material EUL

- If Rating = "Depreciated", CCTV-Based RUL = 0.2 x the Material EUL

- If no CCTV rating exists, CCTV-Based RUL = 1.0 x the Material EUL

The Rule-Based RUL for each gravity pipe was calculated using the steps listed below:

- If a force main equal or greater than 4 inches is tied into the upstream manhole and the pipe was made of concrete or iron, the Ruled-Based RUL = 80% of the Material EUL minus the age of pipe. A 4-inch force main was used because residential stations are less than 4-in, where lift station and mini lift stations used 4 inches and above.
  For example: a 25-year-old RCP sewer with a force main tied into the upstream manhole would be given an RUL of 15 years, (0.8 x 50 years) - 25 years = 15 years

- If additional pipes less than 4 inches were connected to the gravity sewer segment, Rule-Based RUL = 5% reduction for each connection of the Material EUL minus the age of a pipe.
  For example: a 45-year-old RCP sewer with one grinder station mains tied into each pipe would be given an RUL of 2.5 years, [50 years x (1 – 0.05)] – 45 years = 2.5 years

Figure 4-1 shows the example listed above. Each of the 4 grinder stations are tied into 21-inch concrete pipes built in 1975.

Figure 4-3: Example of Grinder Station Force Mains tied into Gravity Sewers

Equally averaging the CCTV-Based RUL and the Rule-Based RUL produced the Final RUL. It is possible that RUL could be a negative value. This simply means a pipe has outlived its material theoretical estimated useful lifespan. The final RUL was then used to determine a PoF score on a 1 to 5 scale, with 5 representing highest probability of failure and least remaining useful life. The score breakdown by years of RUL was as follows:

Table 4-2: Gravity Pipe PoF Scoring and RUL

POF as function of RUL				
≥ 50 yrs.	30 - 49 yrs.	15 - 29 yrs.	5 - 14 yrs.	< 5 yrs.
1	2	3	4	5

4.2 Probability of Failure of Force Mains

The RUL and PoF for force mains were determined in a similar manner to gravity sewers; recorded information combined with observed information were considered. No CCTV data is available for force mains, but ALASD provided notes in the lift station ranking spreadsheet that was utilized instead. The three pieces of physical information for each pipe are: age material, the presence of air release valves on an iron pipe, and whether "manifolding" with other force mains is occurring. The presence of air release valves on a metallic pipe is known to have the potential to cause corrosion to a metallic pressure pipe. If an air release valve malfunctions, H_2S can become trapped in the force main and corrode the walls thereby increasing probability of failure. This is not a concern for corrosion-resistant PVC or HDPE pipes; historically, ALASD has had failures with iron pipes. Force main "manifolding" refers to the joining of multiple lift stations into a single force main. While this practice is not rare, this can lead to cyclic fatigue of the pipe material and reduce the RUL; the more frequently connected pumps turn off and on, the more frequently transient pressure surges are experienced in a pipe.

The same theoretical EUL listed in **Table 4-1** also applies for force mains. Similar to gravity sewer pipes, a formula was developed to establish an RUL by reducing the original theoretical EUL as needed.

- If a DIP force main has an air release valve, the RUL = 0.8 x the Material EUL minus the age of a pipe.
  For example: *a 20-year-old DIP force main would be given an RUL of 12 years, (0.8 x 40 years – 20 years) = 12 years*
  In reality, the entire pipe is not subject to H_2S corrosion, rather just the local high points or areas near the air release valve. However, the GIS only has the entire pipe as one object, so this was able to be modeled with GIS, but the cost of replacement can be assumed to be only a few sticks of DIP (40-60 feet) per each air release valve.

- If the force main was "manifolded" with other force mains, the RUL = 0.9 x the Material EUL minus the age of a pipe.
  For example: *a 15-year-old PVC force main manifolded would be given an RUL of 30 years, (0.9 x 50 years) – 15 years = 30 years*

Like the gravity pipes, the final RUL was then used to determine a PoF score on a 1 to 5 scale, with 5 representing highest probability of failure and least remaining useful life. The score breakdown by years of RUL was as follows:

Table 4-3: Force Main PoF Scoring and RUL

POF as function of RUL				
> 30 yrs.	21 - 30 yrs.	11 - 20 yrs.	6 - 10 yrs.	< 5 yrs.
1	2	3	4	5

Additionally, there were some instances in which manual overrides were used to assign higher PoF scores to certain force mains. In these cases, GIS Model Builder did not assign the force main a high PoF score since the GIS did not always have the pipe materials. However, based on other recorded information, it was known that the following force mains are constructed in DIP and do have an air release valve. The force mains associated with the following lift stations are recorded in other provided spreadsheets as being ductile iron contain at least one air release valve, therefore enhancing the risk pipe corrosion.

- LS-1
- LS-15
- LS-22
- LS-29

The force main associated LS-82 is receiving pigging monthly, indicating significant buildup inside the pipeline. This force main was manually assigned a the highest PoF score as well.

4.3 Probability of Failure of Lift Stations

The RUL and PoF for lift stations were established by also using a combination of its assumed age and the observed information provided by ALASD. The age was assumed to be the same as the gravity pipe connected to it as the lift stations shapefiles did not provide a field for the year constructed. The provided observed information was an internal rating system ranking on a 1 to 5 rating (1 being the highest rating) of each lift station's mechanical, electrical, and structural integrity along with several useful sidebar comments. The rating system was only provided for the 119 lift stations which are contained in the 'LiftStations' shapefile. The 49 mini lift stations and the 120 residential stations were not ranked by ALASD. As such, the mini stations were only scored based on their assumed age and the 120 residential stations were not included in this evaluation as their ages are not know either. Note that if any lift stations are experiencing insufficient capacity, that was not considered as part of this evaluation.

Like the pipes, an estimated theoretical EUL of a typical lift station had to be assumed to estimate the RUL. The EUL was assumed to be 40 years. Although since the same EUL value was used for all lift stations, it is all relevant when ranking lift the RULS of the lift stations. This is important since almost half of the lift stations are over 40 years old. To calculate the RUL, first a strictly Age-Based RUL was calculated by subtracting the lift station's age from 40 years. For instance, a 16-year-old lift station would have an Age-Based RUL of 40 – 16 = 24 years. The breakdown of proportions of ALASD's lift stations age is shown in the figure below and can be seen to be split between stations older and younger than 40 years.

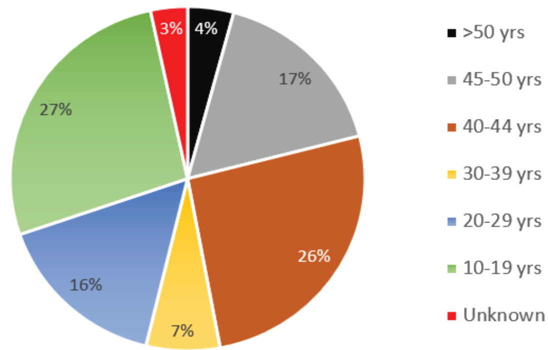


Figure 4-4: Lift Station Ages (excluding mini lift stations)

The Age-Based RUL is strictly the age of the entire station which is not typically representative of the age of the major components as frequently pumps, valves, electrical equipment are replaced throughout the life of a lift station. Therefore, a Rating-Based RUL was calculated based on the 1-5 ratings provided by ALASD by converting them to an equivalent value to the Age-Based RUL. The individual ratings were weighted due to Hazen's experience with which station components that are more likely to lead to a failure. The mechanical rating was weighted the highest at 150%, followed by the electrical score at 125%, followed by the structural score at 100%. Once a weighted Rating-Based RUL was calculated, it was averaged with the Age-Based RUL for a final RUL. See the following example using LS-1:

- The age of the station is 45 years (using 2020 as a baseline). This yields an Age-Based RUL of **-5 years**. What this indicates is by age alone, this station has lived 5 years past the theoretical 40-year useful life.
- The mechanical score was designated as a 2 indicating these components are not optimal, but also not near failure.
- The electrical score was designated as a 5 indicating these components are near failure.
- The structural score was designated as a 1 indicating these components are optimal.
- Using the weighting of 150% mechanical, 125% electrical, and 100% structural score, this yields a total score of 2.73 out of 5.
- Converting the 2.73/5 to an RUL between 1 and 40 years yields a Rating-Based RUL of **23 years.** What this indicates is that based on the internal rating alone and the assigned weighting, this station has another 23 years of useful life (using 2020 as a baseline).
- There is obviously a large discrepancy between -5 years and 23 years. The 23 years is clearly a better indicator of the actual RUL. However, the total age of the lift station is not inconsequential; in Hazen's experience, older stations frequently have outdated, inefficient, or hard to replace components. Therefore, the -5 years and 23 years were averaged to yield an RUL of **9 years.**

It should be noted that since all 119 lift stations were evaluated using the same formula, most adjustments to the equation would produce the same relevant ranking of stations from least to greatest RULs. Modifying the weighted percentages assigned to mechanical, electrical, and structural components would yield a slightly different relevant ranking. It should also be noted that most of the lift station components were given a score of "1", as seen in **Table 4-4** which caused many of the RULs to be age dependent.

Table 4-4: Lift Stations Component Scoring

ALASD Score	Mechanical	Electrical	Structural
Score = 1	104	100	112
Score = 2	2	3	2
Score = 3	4	1	1
Score = 4	6	9	1
Score = 5	1	4	1

Similar to the pipes, the final RUL was then used to determine a PoF score on a 1 to 5 scale, with 5 representing highest probability of failure and least remaining useful life. The score breakdown by years of RUL was as follows:

Table 4-4: Lift Stations PoF Scoring and RUL

PoF as function of RUL				
> 30 yrs.	21 - 30 yrs.	11 - 20 yrs.	5 - 10 yrs.	< 5 yrs.
1	2	3	4	5

Additionally, there were some instances in which manual overrides were used to assign higher PoF scores to certain lift stations. If ALASD gave any component a rating of 5, the PoF score was automatic changed to a value of 4. This was the case for LS-23 and LS-53. They would otherwise receive an RUL of 11 and 12 years and be rated as a PoF of 3.

5. Consequence of Failure Analysis

The CoF was calculated by considering both a sewer asset's failure direct monetary costs and the social impacts to residents, businesses, and other stakeholders. The financial consideration could be very objective in nature regarding features well known to impact a capital cost to repair (e.g., size of pipe or lift station, depth of pipe, bypassing pumping, dewatering, permitting, traffic control, etc.). The social cost was more subjective in nature based on Hazen's experience, local knowledge, and input from ALASD. Hazen relied heavily on the shapefile in the provided GIS files, but also created a few new shapefiles. The GIS Model was used to calculate the distance between sewer assets and features deemed to be of special importance regarding CoF. Refer to **Appendix A** for a list of all the shapefiles used or created for critical customers or features.

A failure of a sewer asset will always generate a consequence, but closer proximity of a failure to any of the areas listed in **Appendix A** was assumed to be of enhanced consequence for ALASD. However, for the purpose of this risk evaluation, a CoF was quantified for each asset on a 1 to 5 scale, with a 5 representing highest probability of failure and 1 the lowest. Both a Social and Cost score were assigned based on proximity to the critical areas. The Total CoF Score was weighed 70% on Social CoF and 30% on Financial CoF. **Table 5-1** lists the proximity and the relevant rankings.

Table 5-1: CoF Proximity and Ranking

Value	CoF Score: Social	CoF Score: Financial
≤ 75' from a water body	5	4
≤ 150' from a public beach		4
≤ 20' from railroad right-of-way		4
≤ 50' from I-94, state, and city streets		4
≤ 100' from a school, park, assisted living, resort, cemetery, major industries, or fairground		3
75.1' - 150' from a water body	4	3
150.1' - 300' from a public beach		3
20.1 – 50' from railroad right-of-way		3
50.1' – 100' from I-94, state and city streets		3
100.1' - 200' from a school, park, assisted living, resort, cemetery, major industries, or fairground		2
150.1' - 300' from a water body	3	2
300.1' – 600' from a public beach		2
≤ 50' from county or township roads		2
200.1' - 300' from a school, park, assisted living, resort, cemetery, major industries, or fairground		1
300.1 - 600' from a water body	2	1
600.1 – 900' from a public beach		1
All Other	1	1

Figure 5-1 shows an example of a force main and gravity sewers within the CoF of 5 range of a beach, water bodies, and a state highway and a CoF of 4 range for a railroad.

Figure 5-1: Force main and gravity sewers near Lake Le Homme Dieu Beach

5.1 Consequence of Failure of Pipes

In addition to proximity to critical features, the pipelines were also assigned a CoF based on their diameter and depth. This is based on an assumption that a failed larger pipe would cause more of an overflow, require more bypass pumping, and a larger trench to repair. The greater the depth for a pipe repair, the more costly and thus requires a longer duration for a repair (assuming open-cut repairs). These criteria were used as part of the automated GIS Model to assign a numerical CoF. The financial and cost were set to equal value for the assigned CoF based on pipe size and depth.

Table 5-2: CoF Pipe Size and Depth

Gravity Pipe Diameter	CoF Financial and Social
30" - 36"	**5**
21" - 24"	**4**
15" - 18"	**3**
10" - 12"	**2**
≤ 8"	**1**

Force Main Diameter	CoF Financial and Social
≥ 12"	**5**
8" - 10"	**4**
6"	**3**
4" - 5"	**2**
≤ 4"	**1**

Pipe Depth	CoF Financial and Social
≥ 20'	**5**
15.01' - 20'	**4**
12.01' - 15'	**3**
8.01' - 12'	**2**
≤ 8'	**1**

In addition to the CoF based on proximity, size and depth, there were some pipes that were manually adjusted based on notes provided by ALASD. The following force main had its CoF scores manually adjusted:

- LS-17 FM: This force main runs directly underneath a river, not just near it. A failure under a constant flowing river can sometimes go undetected for a time and would have be more costly to repair. This increased CoF by 50%.

5.2 Consequence of Failure of Lift Stations

In addition to proximity to critical features, the lift stations were also assigned a CoF based on pumping capacity. This is based on the assumption that a failed larger lift station would cause more of an overflow, require more bypass pumping, be more costly and require a longer duration for a repair. The financial and cost were set to equal values for the assigned CoF based on pumping capacity.

Table 5-3: CoF Pumping Capacity

Lift Station Capacity (gpm)	CoF Financial and Social	Share of Total
1,001 – 3,000	5	4%
401 – 1,000	4	6%
201 – 400	3	18%
101 – 200	2	45%
<= 100	1	27%

Similar to the pipes, there were some lift stations that were manually adjusted based on notes provided by ALASD. The following lift stations had their CoF scores manually adjusted:

- LS-1 does not have back-up power. A failure could result in more overflow. This increased CoF by 50%.
- LS-10 lacks a bypass connection. Repairing a failure could require more challenging bypass pumping and possibly result in more overflow volume. This increased CoF by 50%.
- LS-20 has communication issues. A failure could result in more overflow volume. This increased CoF by 50%.
- LS-29 is difficult to access and snowplow in the winter, potentially making repairs and/or replacement more challenging at certain times of year. This increased CoF by 30%.
- LS-40 has easement issue associated making repairs and/or replacement more challenging. This increased CoF by 30%.
- LS-69, 91, and 99 have difficult access making repairs and/or replacement more challenging. This increased CoF by 30%.

6. Criticality and Risk Results

From the calculated PoF and CoF, the total criticality or risk was established for each sewer asset. For this evaluation, the combination chosen for Total Risk was the weighted as 65% PoF and 35% CoF. A value between 1 and 5 was assigned for Risk based on this formula. At the completion of this evaluation, a shapefile will be provided to ALASD with fields for PoF, CoF, RUL, and Risk for each pipe. Listed below are basic summaries of the calculated results for gravity pipes, force mains, and lift stations. **Appendix F** can also be viewed to see this graphically.

6.1 Gravity Pipe RUL and Risk Score

Page 1 of **Appendix B** shows two important things. First is that that approximately 25 miles of pipe have an RUL less than or equal to 10 years. Secondly, over 80% (181 miles) of the pipes have at least 30 years of RUL. This is not surprising as it matches the large share of sewers made of PVC and clay, and the nearly 90% of sewers CCTV'd receiving a 'good' rating. Over 40% of the sewers received a CoF of 4 of 5. This is not surprising either due to the amount of pipe near water bodies or other critical customers. The figures in **Appendix B** both display in a slightly different way the combination of RUL, PoF and CoF, or the Risk. The heatmap does not calculate the Risk in the weighted formula listed above but does display the results in a more graphical manner. The key takeaway is ~7% of the gravity pipes fall into the high-risk range, and 10% fall into the RUL ≤ 10 years of range, but this is followed by many years where few very pipes reach the end of their RUL. **Appendix F** can also be viewed to see this graphically.

6.2 Force Main Pipe Risk

Page 3 of **Appendix B** shows that approximately 19 miles of the force mains have an RUL of 10 years of less. Beyond this, nearly 25% (13 miles) have at least 20 years of RUL, and another 35% have at least 30 years. This is related to the large share of force mains being constructed of PVC and HDPE. Over 45% of the force mains have CoF in the 4 or 5 range. This is not surprising since many of the lift stations and connected force mains are close to water bodies due to those areas being lower in elevation. **Appendix B** illustrates the heatmap of PoF vs. CoF, and the distribution of RUL and Risk. The key takeaway is there are 19 miles (~30%) of force mains that that fall into the RUL ≤ 10 years of range, and of that 19 miles, 10 miles have a CoF of 4 or 5. This is followed by many years where less pipes will reach the end of their RUL. **Appendix F** can also be viewed to see this graphically.

6.3 Lift Station Risk

Page 5 of **Appendix B** shows there are 7 lift stations with a calculated RUL less than 10 years. There are 27 lift stations with a CoF of 4 or 5. Taken together, there are 12 lift stations that fall into the highest risk ranges and another 7 in the next highest risk range. The figures in **Appendix B** break down RUL, PoF, CoF, and Risk. The lift stations that fall into these ranges are listed below along with a description of what drives the station's higher risk. Several received a risk score of 4 despite having any reported problems. This is due to the formula rating based on their age, high pumping capacity, and proximity to critical areas. **Appendix C** lists the 7 lift stations and 5 minis with a calculated RUL less than 10 years.

Table 6-1: Higher Risk Lift Stations

Lift Station	Age (yr.)	Capacity (gpm)	RUL (yr.)	PoF / CoF	Comments
LS-1	45	3,000	9	4 / 5	Major electrical problems. Minor mechanical problems. Should have stationary Generator. 16-inch DIP force main that runs next to a lake with reported problems.
LS-3	45	1,200	12	3 / 5	Major mechanical problems. Reported to need check and gate valves and a bypass connection. FOG problem. 12-inch force main that runs next to a lake and 3rd Avenue.
LS-10	45	1,200	12	3 / 5	Major mechanical problems. Reported to need a bypass connection. 12-inch force main that runs next to a lake and a county road.
LS-11	45	1,300	18	3 / 5	No major problems other than a 12-inch problematic force main that runs between two lakes.
LS-12	45	450	18	3 / 5	No major problems currently. It has a high risk score due to it being in a golf course and directly across the road from Curt Felt memorial Park
LS-20	44	<100	16	3 / 4	Minor on-going communication problems. Located right by a lake.
LS-23	45	<100	11	4 / 3	Major electrical problems. Reported to need new panel.
LS-24	44	300	12	3 / 4	Major mechanical problems. Reported to be scheduled for new stands and pumps. Located right by a lake and on the shoulder of State Hwy 29. 8-inch DIP force main located near 2 lakes and Lake Le Homme Dieu Beach.
LS-27	45	350	10	4 / 4	Major mechanical problems. Reported to be scheduled for new stands, pumps and wet well plumbing. A DIP force main the High School's property.
LS-28	45	200	18	3 / 5	No major problems currently. It has a high risk score due to it being so close to a boat launch and public fishing pier.
LS-41	44	150	7	4 / 3	Major electrical problems. Reported to be scheduled for a new panel. Moderate mechanical problems. Located near Lake Darling.
LS-53	42	100	12	4 / 5	Major electrical problems. Reported to be scheduled for panel upgrade.
LS-63	32	1,400	19	3 / 4	Moderate mechanical problems. Minor structural problems. Reported to have bypass and ragging issues. 16-inch force main located near an RV park and the Airport.
LS-65	52	400	14	3 / 4	No major problems currently. Reported to have a new panel scheduled. It has a high risk score due to it being so close to a small creek, 3M, and the property owned by the school district.
LS-66	52	150	-1	5 / 3	Major mechanical, electrical and structural problems. Reported to be scheduled for a total replacement. Located right by the Douglas County Hospital and Community College.
LS-68	51	500	7	4 / 4	Major mechanical problems. Minor structural problems. Reported that the valving structure should be replaced.
LS-69	51	170	5	4 / 4	Moderate mechanical, electrical and structural problems. Reported that it should be replaced to new location.
LS-70	41	250	11	3 / 4	Minor mechanical and electrical problems. Reported to have FOG problems and be an ugly station. Cast-iron force main.
LS-73	43	120	2	5 / 3	Major mechanical, electrical and structural problems.

<u>Note</u>: Colored cells indicate the highest risk.

In addition to above listed lift station, there are also 5 Mini lift stations that have ages above or near 35 years; 4 of which fall into the highest CoF range. The conditions or ages of any components are not currently unknown, only the ages of the stations. The estimated useful life of mini stations was assumed to be 35 years for this evaluation.

- AGS13, Age: 39 years, located nowhere near anything critical. CoF = 1
- AGS14, Age: 42 years, located < 250 feet from Lake Geneva (including Geneva Beach) and State Highway 27. CoF = 5
- AGS17, Age: 32 years, located < 50 feet from Lake Latoka. CoF = 5
- AGS19, Age: 53 years, located 300 feet from Lake Henry. CoF = 5
- AGS27, Age: 53 years, located on the shoulder of County road (Geneva Rd.) and < 100 feet from the RxR. CoF = 5
- In addition to these, there are at least another 3 minis that will be in excess of 35 years old by 2030, and another 19 by 2040.

7. Asset Valuation

To estimate values for the common sewer assets, Hazen utilized recent bid tabs provided by Widseth from the Nevada Street Interceptor Sewer, Darling Avenue and Maple Street Improvements, and the Alexandria Street & Utility Improvements. All three of these projects were bid in 2019 or 2020. The bid costs of watermains were used as an approximate equal to sanitary force mains. In addition to bid tabs, Widseth provided recent cost estimates for the replacement of LS-66, LS 69, and LS-73. All of which are less than 150 gpm lift stations, and LS-73 also included a back-up generator. All this taken in account, including local knowledge, other recent bid tabs, and engineering judgement, the following cost curves and table were developed for asset valuation. It should be noted that these estimated monetary values are planning level only for average construction cost and not to be considered a cost opinion for any particular asset replacement project. These construction costs are also not to be considered capital costs and do not contain any estimated costs for engineering, permitting, legal or any other administration.

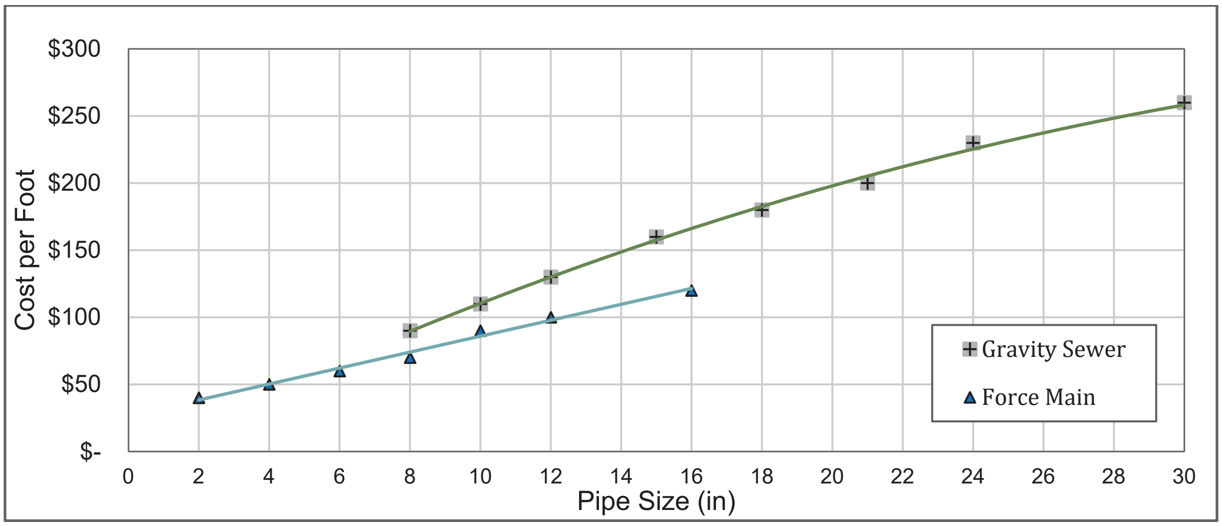


Figure 7-1: Planning Level Cost Curves

Table 7-1: Planning Level Asset Valuation

	Lift Station	Estimated Monetary Value
Complete Replacement	Minis	$100,000
	≤ 100 gpm	$250,000
	100 - 200 gpm	$280,000
	200 - 400 gpm	$300,000
	400 – 1,000 gpm	$350,000
	1,000 – 4,000 gpm	$450,000
	Back-up generator	$70,000
Component Replacement	Electrical and I&C Equipment	20% of full replacement ($50,000 - $70,000)
	Mechanical - Pumps	25% or full replacement ($60,000 - $100,000)
	Mechanical - Pipes and Valve	5% of full replacement ($17,000 - $25,000)

Listed below is the estimate value of the total gravity sewer, force main, lift station, minis, and grinder stations. Based on the listed unit values, the value of the sewer system is approximately **$190 million.**

Table 7-2: Gravity Sewer Asset Valuation

Pipe Size	Asset Value / Foot	Quantity (feet)	Total Value
UNK	$ 90	60,580	$ 5,500,000
8	$ 90	907,970	$ 81,700,000
10	$ 110	72,600	$ 8,000,000
12	$ 130	117,290	$ 15,200,000
15	$ 160	23,930	$ 3,800,000
18	$ 180	10,750	$ 1,900,000
21	$ 200	22,640	$ 4,500,000
24	$ 230	6,540	$ 1,500,000
30	$ 260	7,730	$ 2,000,000
36	$ 280	370	$ 100,000
		Total	**$ 124.2M**

Table 7-3: Force Main Asset Valuation

Pipe Size	Asset Value / Foot	Quantity (feet)	Total Value
UNK	$ 40	19,960	$ 800,000
1 – 2	$ 40	46,400	$ 1,900,000
3 – 4	$ 50	77,370	$ 3,900,000
5 – 6	$ 60	129,920	$ 7,800,000
8	$ 70	33,420	$ 2,300,000
10	$ 90	4,670	$ 400,000
12	$ 100	13,430	$ 1,300,000
16	$ 120	5,560	$ 700,000
		Total	**$ 19.1M**

Table 7-4: Lift Station Asset Valuation

Pipe Size	Asset Value / Each	Quantity	Total Value
Residential Stations	$ 50,000	120	$ 6,000,000
Mini Stations	$ 100,000	50	$ 5,000,000
≤ 100 gpm	$ 250,000	32	$ 8,000,000
100 - 200 gpm	$ 280,000	53	$ 14,800,000
200 - 400 gpm	$ 300,000	22	$ 6,600,000
400 – 1,000 gpm	$ 350,000	7	$ 2,500,000
1,000 – 4,000 gpm	$ 450,000	5	$ 2,300,000
		Total	**$ 45.2M**

7.1 Preliminary 10-year Rehabilitation and Replacement (R&R) Cost Evaluation

Based on the initial findings from this evaluation, the following is recommended as a preliminary 10-year Rehabilitation and Replacement. The key takeaway is there are 44.5 miles of gravity sewers and force mains, and 12 lift stations that are either beyond, or in the last decade of their theoretical RUL. From 2030 to 2040, the quantity of pipes reaching the end of their RUL will decline, whereas the quantity of lift station will increase. **Appendix D** illustrates the RULs and **Appendix E** illustrates the cumulative costs over the next 60 years.

1. Gravity Sewers: Approximately 134,000 feet (10%) of the gravity sewers have an RUL of 10 years or less. It is recommended to replace or repair the sewers with an RUL of ≤ 10 years. Using the developed cost curves, the 10-year replacement cost would be approximately $13.4 million for the 134,000 feet. However, this is independent of the CoF. As shown in the table below, a quarter of these sewers have a lower CoF and may not need replacement in the next 10 years. The replacement cost is conservative but is still planning level. It is based on ALASD's average pipe size under average conditions. Sewers with a CoF of 4 or 5 could have a higher replacement cost due to their larger size, depth, and proximity to water. This replacement cost is based on construction cost to replace the sewers with open-cut methods. Trenchless rehabilitation (e.g., cured-in-in-place pipe lining) could be implemented for a lower cost. As the low RUL pipes are evaluated in further detail, it is likely that many could emerge as candidates for trenchless renewal. For a planning level estimate, $55 per foot can be assumed for the predominantly 8- and 10-inch pipes that have an RUL of ≤ 10 years. However, it does appear there could be several projects where complete replacement would be advantageous as a replacement project could potentially eliminate some high-risk force mains or lift stations.

Table 7-5: Gravity Sewers with an RUL of ≤ 10 years

Length of Gravity Sewer (ft)	CoF	Planning Level Cost / ft. for Replacement	Planning Level Cost / ft. for Rehabilitation
		$ 100	$ 55
30,000 (~25%)	5	$ 3,000,000	$ 1,700,000
72,000 (~50%)	4	$ 7,200,000	$ 4,000,000
26,000 (~20%)	3	$ 2,600,000	$ 1,400,000
6,000 (~5%)	2	$ 600,000	$ 300,000
134,000 (100%)	**All**	**$ 13,400,000**	**$ 7,400,000**

2. Force Mains: Approximately 101,000 feet (~30% of total) of the force mains have an RUL of 10 years of less. Using the developed cost curves, the 10-year replacement cost would be approximately $6.1 million. It is important to note that only half of these force main have a CoF of 4 or 5. The replacement cost is planning level and is based on ALASD's average force main size under average conditions, whereas the force mains with a CoF of 4 or 5 could have a higher replacement cost due to their larger size and proximity to water.

Table 7-6: Force Mains with an RUL of ≤ 10 years

Length of Force Main (ft)	CoF	Planning Level Replacement Cost / ft.
		$ 60
16,000 (~15%)	5	$ 1,000,000
35,000 (~35%)	4	$ 2,100,000
45,000 (~45%)	3	$ 2,700,000
6,000 (~5%)	2 and 1	$ 300,000
101,000 (100%)	All	$ 6,100,000

3. Lift Stations: There are 7 lift station that received an RUL of ≤ 10 years. These lift stations ranged in size from 120 gpm to 3,000 gpm and have low RULs due to a combination of age and reported problematic components (mostly mechanical or electrical). In addition to these 7 stations, there are another 9 stations that have an RUL between 10 and 15 years. The number of mini lift stations

(minis) reaching the end of their RULs is less certain due to the lack of detailed ranking and unknown ages of 20 of the 50 minis. However, there are at least 5 minis that have an RUL of ≤ 10 years. Using the developed cost curves based, the total replacement cost of all of these stations is shown in Tables 7-6 and 7-7. It is recommended to replace or repair all station in **Table 7-6** except AGS13 due to its very low CoF. Based on the risk scores and ALASD's notes, replacement or repair is recommended for 5 of the lift stations in **Table 7-7** over the next 10 years. This brings the total to 12 lift stations and 4 minis where replacement of repair is recommended.

Table 7-7: Lift Stations with an RUL of ≤ 10 years

Lift Station	Capacity	RUL (years)	CoF	Planning Level Replacement Cost
LS-1	3,000	9	5	$ 520,000
AGS14, AGS17 (minis) AGS19, AGS27 (minis)	≤50 gpm	N/A	5	$ 400,000
LS-27	350	10	4	$ 300,000
LS-68	500	7	4	$ 350,000
LS-69	170	5	4	$ 270,000
LS-41	150	7	3	$ 280,000
LS-66	150	-1	3	$ 280,000
LS-73	120	2	3	$ 350,000
ASG13 (mini)	≤50 gpm	N/A	1	$ 100,000
			Total	**$ 2,900,000**

Table 7-8: Lift Stations with an RUL between 10 and 15 years

Lift Station	Capacity	RUL (years)	CoF	Planning Level Replacement Cost
LS-3	1,200	12	5	$ 450,000
LS-10	1,200	12	5	$ 450,000
LS-24	300	12	4	$ 300,000
LS-65	400	14	4	$ 300,000
LS-70	250	11	4	$ 300,000
LS-23	<100	11	3	$ 250,000
LS-50	200	14	3	$ 280,000
LS-75	120	13	3	$ 280,000
			Total	**$ 2,600,000**

Separate costs were developed for component-only replacement. Percentages of total replacement were assumed for replacement of mechanical, piping, electrical, and generators. More information is needed to determine if it will be recommended to completely replace the lift stations or to replace only problematic components. Recommendations are provided in **Appendix C** which are based on the notes and scores provided by ALASD. Based on these recommendations, the planning level replacement cost would be approximately $3.6 million over the next 10 years.

Nearly half the lift stations, most of the minis, and an unknown amount of the residential stations have an RUL between 11 and 20 years. Therefore, beginning in 2030, there will be over 50 lift stations and over 20 minis that will theoretically reach the final decade of their RUL, as seen in **Appendix D.** Consequently, it is recommended to either increase the budget in the first 10 years to include some of the following decade's projects, or to adapt a robust lift station inspection program to further refine the RUL with the goal of spreading the replacement budget over several decades.

8. Next Steps - Data Collection and Management Plan

Based on this evaluation, many miles of buried pipes and lift stations are recommended to be replaced or repaired over the next decade. However, as described above, many of these pipes with a high PoF do not have a high CoF. In addition, many of these pipe's high PoF is theoretical due to lack of inspection data. It is based solely on recorded information such as: age, material, and connections to force mains. Therefore, it recommended to perform inspections to confirm their conditions. Almost half of the lift stations, most of the minis, and an unknown amount of the residential stations have an RUL between 11 and 20 years. Therefore, beginning in 2030, there could be a large quantity of lift stations reaching the final decade of their RUL, as seen in **Appendix D** and **Appendix E**. The recommendations listed below intend to reduce or spread out this large quantity of pipe's and lift station replacement over the following two decades.

8.1 Gravity Pipe CCTV and Cleaning

The first recommendation for CCTV inspection is to confirm the condition of the 134,000 feet described in earlier sections as having an RUL of 10 years or less. The GIS shapefile that will be provided will aid in this effort. The primary goal of inspecting these 134,000 feet is to confirm whether replacement or repair is necessary.

Conversations with ALASD indicate that on average 2,000 feet of pipe can be CCTV inspected in one day if crews and the CCTV van are available. Assuming an inspection rate of 5,000 feet per week (2.5 days per week) could be dedicated to CCTV, the initial 134,000 feet could be inspected in approximately 27 weeks (6 months). Most of these pipes are older and constructed of clay or concrete. As such, a slower CCTV inspection rate may potentially result. After this initial quantity has been inspected, the remaining 1,100,000 feet (208 miles) should be inspected over the following 9 years to complete the entire system within 10 years. At a rate of 5,000 feet per week, this amount could be inspected in approximately 24 weeks per year (5.5 months). Therefore, the entire gravity sewer system may feasibly be inspected within 10 years as long as crews can dedicate 50% of their time toward CCTV inspection for 6 months each year.

Table 8-1: Gravity Sewer 10-Year CCTV Schedule

Year	Footage / Year	Total miles	Comments
1	134,000	25	Identified as having a RUL ≤10 years
2	122,000	48	Requires 2.5 days per week at current CCTV production rate for 6 months per year.
3	122,000	72	
4	122,000	95	
5	122,000	118	
6	122,000	140	
7	122,000	164	
8	122,000	187	
9	122,000	210	
10	122,000	233	Completion of entire collection system in 10 years

Based on information provided by ALASD, there are 14 gravity sewers segments that are flagged as problematic. The problems listed are mainly sags and grease from restaurants. As more pipes are CCTV inspected, it is anticipated that there will be more areas identified as problematic. The sewer cleaning should follow the same the schedule as the CCTV inspection until more problematic areas (roots, sags, grease, debris, etc.) can be identified with CCTV inspection.

Currently, ALASD has been ranking pipes as ‘Good’ or ‘Fair” or ‘Deprecated.’ It is recommended a more detailed system be adopted to better capture the pipe conditions. For example, it would currently not be possible to distinguish between a pipe labeled as ‘fair’ in terms of structural condition, grease, sags, roots, debris, infiltration, etc. The most common CCTV pipe condition system is called the *NASSCO Pipeline Assessment Certification Program (PACP)*. This standard requires inspectors to attend a 2-day certification course. However, it is by far the most widely used system in North America. Likely all CCTV inspection contractors would be certified with this standard which would allow ALASD to utilize outside contractors and have comparable results to their own internal inspections. Using a standard like PACP would allow ALASD to better identify problematic areas, develop a proactive cleaning program, and create a baseline to determine a rate of deterioration with future inspections.

8.2 Force Main / Air Release Valve Inspection

It recommended to develop a force main and air release valve (ARV) inspection program with the goal of completing an inventory and inspection in 2 years. As previously stated, there are 62.5 miles of force main. Of which, nearly 20 miles have an RUL of 10 years or less. The following steps are recommended for all force mains, but segments with higher risk scores should be prioritized first. More information regarding force main inspection and condition assessment can be found in **Appendix G.**

1. Alignment Walk: This would involve walking the alignment to ensure that the force mains are accessible for any potential repair or replacement. All 62 miles of force main could be walked in 2 years if between 2 and 3 miles are walked every week over a 3-month period. It is recommended that this be conducted in the fall, winter, or early spring when trees are bare leading to greater site visibility. Potentially, this seems like it could be a good assignment for seasonal help or an internship.

2. Inventory: ALASD’s force main manhole shapefile shows that there are 80 ARVs. During the alignment walk, it is recommended to confirm this count as well as document the size, make, model, and age (if possible) of the ARVs. It is also recommended to document whether the existing valves are solely air release valves or a combination air release valve/vacuum valve. The shapefile also indicates that there are bypass connections, cleanouts, and vents. An inventory of these is also recommended.

3. Inspection: This would involve inspection of the ARVs to confirm they are operational and functioning properly. It is recommended to reinspect the ARVs at least biannually until a pattern of successful operations can be established. After which point, the ARVs should be inspected annually or every 2 years at a minimum.

4. Desktop Analysis: The results of this evaluation are the foundation of a desktop analysis. A desktop analysis is generally conducted by reviewing all the information, including information about the corresponding lift stations to further refine the PoF and CoF beyond the screening level analysis conducted with this evaluation. Beyond age and material, the following information can

be useful to estimate RUL and PoF. The results of a desktop analysis can be useful in determining if further field investigation is warranted.

- Plan and Profile Review: Most of the force mains reference a set of construction plans. Information could potentially be determined from these such as: burial depth, local highpoints, pipe pressure class, internal coating or external encasement (for metallic pipes), restraint joints, and the quantity of bends.

- Air Release Valves: The RUL of force mains can be reduced by improperly functioning ARVs. Trapped gases can both increase the working pressure and corrode metallic pipe.

- Potential Surge: Rapid changes in velocity are known to reduce the RUL of a pipeline and especially pipes made of PVC. Cyclic fatigue is exacerbated by frequent pump starts and stops, including from manifolded force mains.

- Proximity to Powerlines: The RUL of a metallic force main can be reduced by nearby overhead powerlines from stray electrical currents. Factors such as: voltage, distance, pipe coating, and groundwater can influence this negative effect. More information can be found here: *The Effect of Overhead AC Power Lines Paralleling Ductile Iron Pipelines* as well as other publications from Ductile Iron Pipe Research Association (DIPRA).

- Soil Corrosivity: The RUL of a metallic force main can be reduced by certain soil conditions. Factors such as: soil resistivity, presence of chlorides and/or sulfides, pH, and groundwater can influence this negative effect. Without field investigation, considering soil corrosivity on a desktop level is typically conducted based on known information from recent excavation or soil borings. Information from state and federal departments of natural resources or geological societies can be useful as well. More information about corrosive soil characteristics soil can be found here: Design Decision Model as well as other publications from DIPRA.

- Construction Cost: While construction costs do not determine the PoF, it does determine the CoF and therefore if additional field assessment information is warranted. For this evaluation, the replacement cost was considered, yet it is based only on pipe size and proximity to water and/or other critical customers as determined by the GIS. Further review could determine other factors that can increase construction cost such as: burial depth, road crossing, traffic control, bypass pumping, dewatering, etc.

5. Target Field Condition Program: Force mains with potentially low RULs and/or high risks based on the factors identified in a desktop evaluation could warrant further investigation in the field. Field investigation can come in the form of indirect or direct pipeline condition assessment. Indirect condition assessment is used to determine more information about the pipeline surrounding environment such as: soft-digs, potholing, soil testing, surveying, etc. Direct condition assessment is used to determine more information about the pipeline itself such as: CCTV inspection, physical or ultrasonic thickness testing, acoustic or electromagnetic testing, etc. Refer to **Appendix G** for additional information.

Table 8-2 lists a potential schedule for force main inventory, inspection and condition assessment based on the result of the Risk Analysis. It should be noted that conducting desktop analyses and additional field investigation would be based on initial inventory and inspection findings.

Table 8-2: Force Main Assessment Schedule

Year	Quantity	Activity	Comments
1	28 miles	Field walk force mains with risk scores of 4 or 5	Average 2 mile per week for 3 months
1	40 ARVs	Inventory and Inspect	Initial inventory inspection
1	40 ARVs	Reinspect ARVs	Second biannual inspection
1	TBD	Desktop Analysis of highest risk force mains	
2	34 miles	Field walk force mains with risk scores of 1, 2 and 3	Average 2.6 mile per week for 3 months
2	40 ARVs	Reinspect	Compare to Year 1 inspection
2	TBD	Desktop Analysis of next highest risk force mains	
2+	TBD	Field Condition	Depending on findings desktop analysis
3+	As needed	Reinspect ARVs	Compare to prior years inspection

8.3 Lift Station Inspection

As seen in **Appendix D**, in the late-2030s, there will be nearly 40 lift stations theoretically reaching a zero RUL. There will also be at least 20 minis and an unknown number of grinder stations reaching a zero RUL at that point. The reason for this large number of lift stations with an RUL falling to zero by the late-2030s is over 50 stations were built in the mid-1970s. It is recommended to begin addressing these 50+ stations before the onset of the 2030s when they will reach their final decade of RUL. It is recommended to begin addressing some of these in this decade (2020 to 2030) to spread the cost over several decades.

It is also recommended to continue performing lift station inspections to confirm the RUL and prioritize the repairs. As mentioned in Section 4, most of the components were given a score of “1”, which caused the RUL to be solely age dependent. This in turn caused a substantial amount to have an RUL ending in the late 2030s. It is therefore recommended to increase the depth of the condition inspections to obtain a more accurate anticipated date for needed repair or replacement. Information such as corrosion, vibration, leakage, and component age (if known) should be collected to define the RUL and PoF more accurately. **Appendix H** has examples of lift station inspection forms. These may serve as examples that could be catered to ALASD’s lift stations and minis.

Assuming 3 lift stations could be inventoried and inspected per week, all 119 list stations and 50 minis could be inspected in one year. However, since approximately half the stations have an RUL greater than 20 years, it may not be prudent to inspect all stations in one year. Rather the following 3-year inspection schedule is recommended. Each year, approximately 55 stations would be inspected wherein 3 stations are inspected per week over a 4-month period or 4 stations per week over a 3-month period. This may be a suitable assignment for seasonal help or an intern.

- Year 1: 55 lift stations with the highest risk scores
- Year 2: 32 lift stations and 25 minis with the next highest risk scores
- Year 3: 32 lift stations and 25 minis

8.4 Asset Management / CMMS

The previous sections describe the inspection and inventory recommendations for gravity sewers, force mains, ARVs, and lift stations. This information should be collected and managed to assist ALASD in operation, management, and decision making. A computerized maintenance management system (CMMS) is recommended for this purpose. Task 2 of this Regulatory Compliance and Comprehensive Plan evaluated CMMS for ALASD's asset management needs. The inspection recommendations listed in previous sections should be considered with any CMMS or asset management program.

To aid in incorporating the gathered inventory and inspection data into a CMMS, it is recommended ALASD develop and utilize inventory and inspection forms that could be completed with mobile tablets. Tools such as ESRI Survey123 could be used to create electronic forms with pulldown menus custom to ALASD's system. Mobile tablet forms can be connected to a cellular hotspot or internet Wi-Fi and then could be automatically uploaded to ALASD's network. At a minimum, the following information is suggested to be included in any developed inspection forms.

- Pump manufacturer, model, horsepower, and other nameplate information,
- Sizes and types of valves (gate, plug, check, air release, combination),
- Dimensions of vaults and wells,
- Access hatch types and dimensions,
- Pump operating levels and types of level sensors,
- Geotagged and timestamped photographs and videos

Hazen has successfully utilized ESRI Survey123 to collect information on both vertical assets such as lift stations, meter vaults, treatment plants as well as other types of inspections (e.g., manhole and dye testing). **Figure 8-1** illustrates example forms that were developed for drinking water asset inspections in California and sewer inspections in Massachusetts.

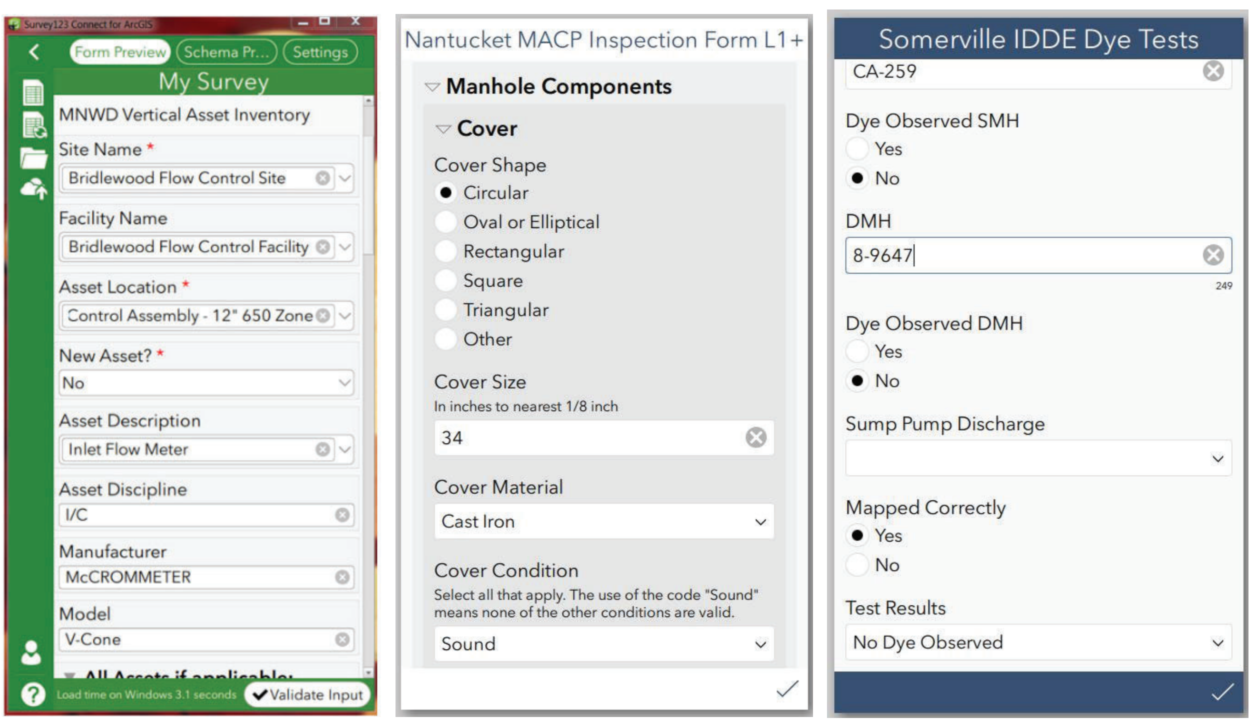


Figure 8-1: Example Survey123 Forms

Regulatory Compliance and Comprehensive Plan Services - Task 3a
Appendix A
Critical Customers

Lakes and Streams – The provided 'water bodies' shapefile was used for this.

Railroads – The provided parcel shapefile was used for this.

Roadways – The provided 'road' shapefile was used for this. The fields within the shapefile allowed the roads to be distinguished between:
- I-94,
- State roads
- County roads
- CSAH (county assisted state highways)
- Township roads
- City streets
- Private roads

Public Beaches – Hazen created a shapefile of the following beaches:
- Alexandria City Park Beach
- Lake Latoka Public Beach
- Lake Darling Resort Beach
- Le Homme Dieu Beach
- Lake Le Homme Dieu Beach
- Lake Burgen Beach

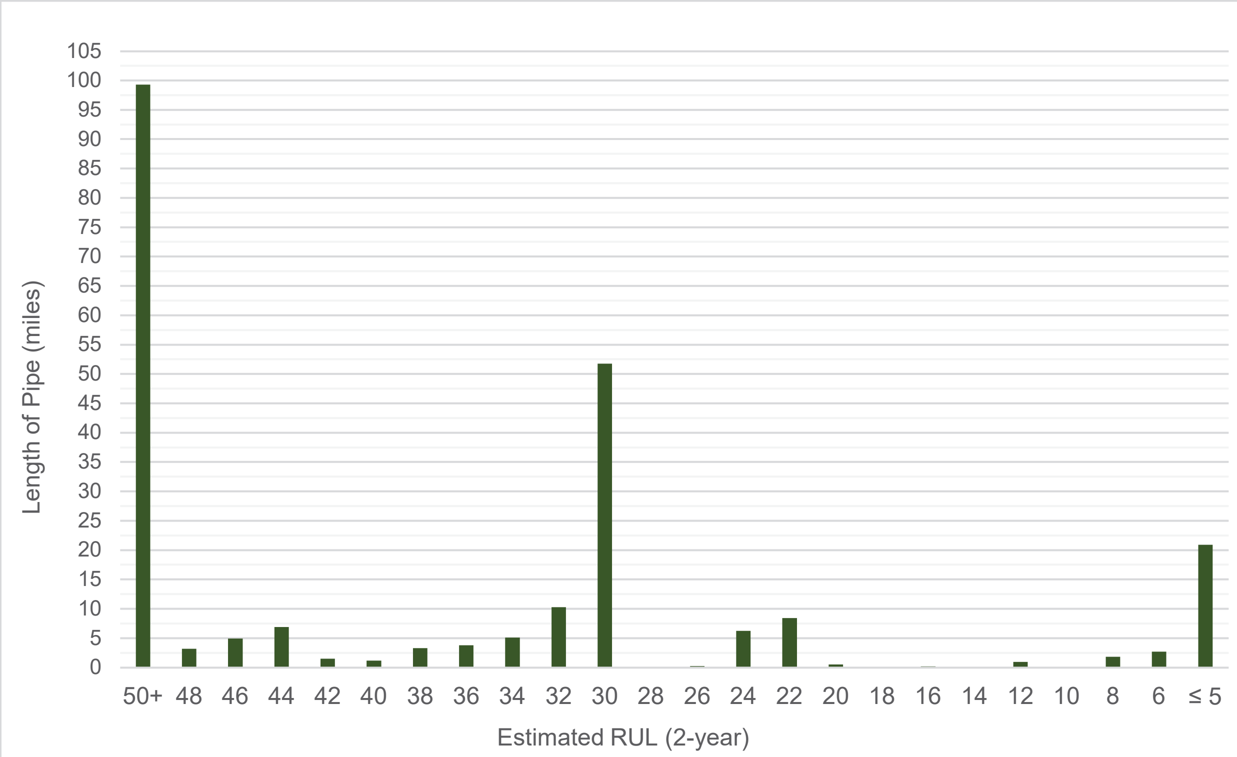
Public Parks – Hazen created a shapefile of the following parks:
- Alexandria City Park
- Noonan Park
- Pooch Playland
- Big Ole Central Park
- Lake Agnes Park
- Skylark Park
- Carter Park
- Fillmore Park
- Lake Brophy County
- Brophy Wayside
- Lake Carlos State
- Tabberts Park
- Curt Felt Memorial
- Veterans Memorial / Legion Park

Schools – Hazen used the parcel shapefile to isolate the following schools:
- Lincoln Elementary School
- Voyager Elementary School
- Woodland Elementary School
- Discovery Middle School
- Alexandria Area High School
- Alexandria Technical College

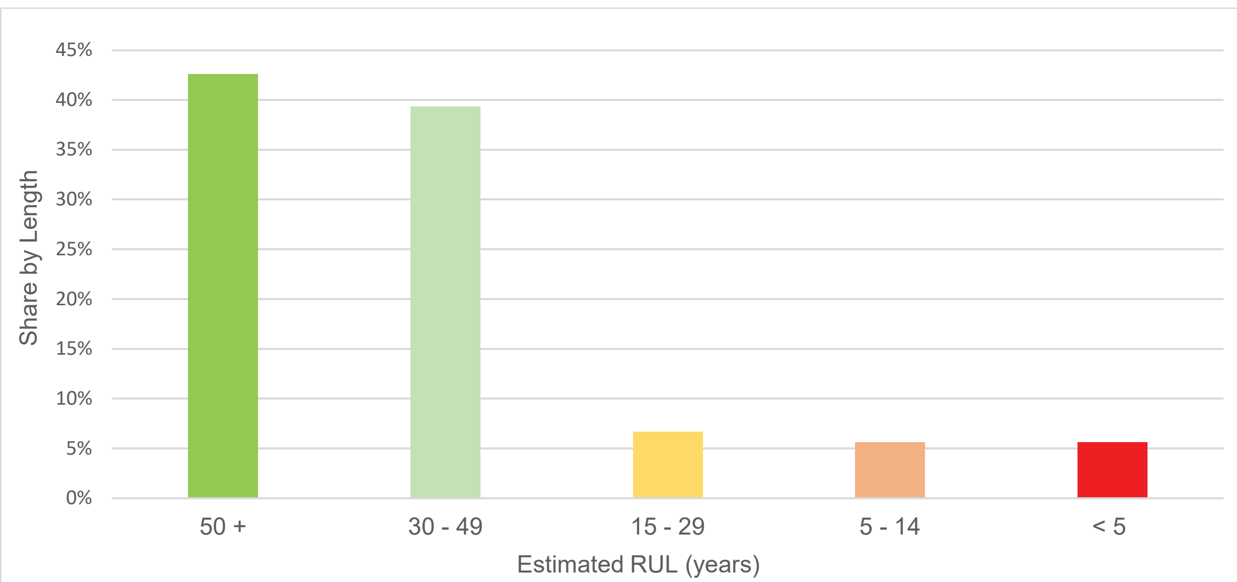
Cemeteries – Hazen used the parcel shapefile to isolate the following cemeteries:
- Kinkaid Cemetery
- Shep Rose Memorial Cemetery
- Evergreen Cemetery

Campsite and Resorts – Hazen created a shapefile of the following:
- Broken Arrow Resort
- Geneva Beach Resort
- Lake Darling Resort
- Vacationer's Inn
- Don's Lakeview RV Park
- Brophy Bay RV Park
- Eden Acres Resort
- Scenic View RV Resort & Campground
- Elmwood Resort
- Eden Acres II
- Big Foot Resort
- Alexandria RV Park
- Lake Victoria Resort
- Brophy Lake Resort

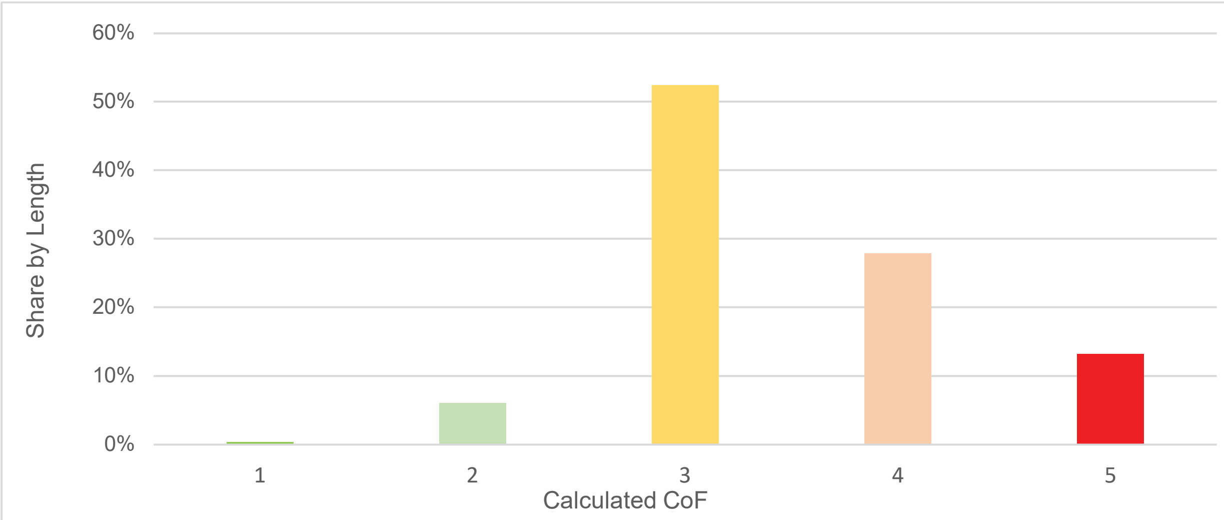
Other Critical Customers – Hazen used the parcel shapefile to isolate the following:
- Douglas County Fairgrounds
- Douglas County Hospitals (Alomere Health and Alexandria Clinic)
- Knute Assisted Living
- 3M
- Magellan Pipeline
- Northern Food and Dairy Inc.
- Airport Industrial Park



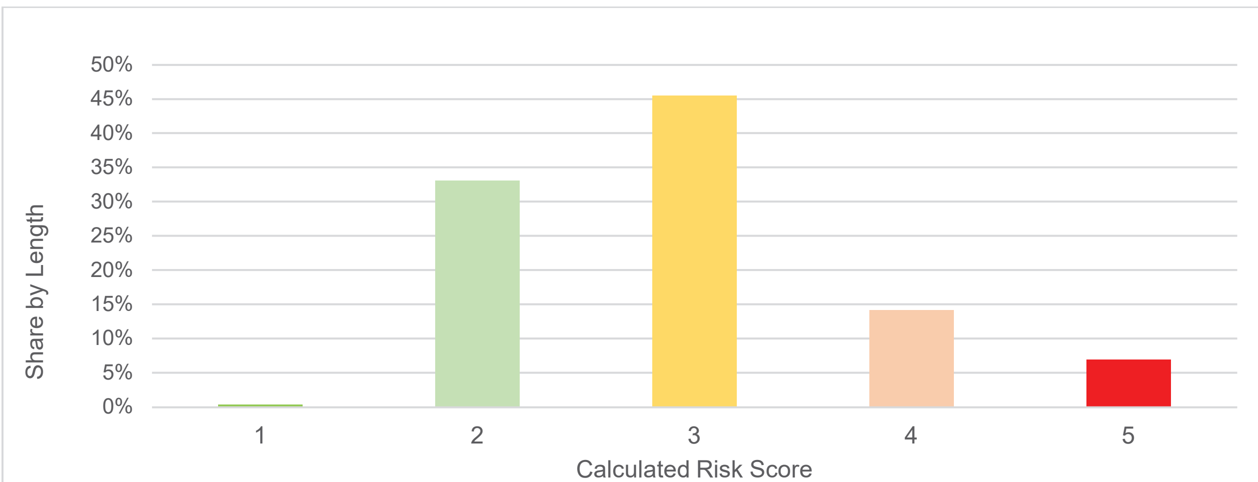
Estimated RUL for Gravity Pipes



Estimated RUL for Gravity Pipes



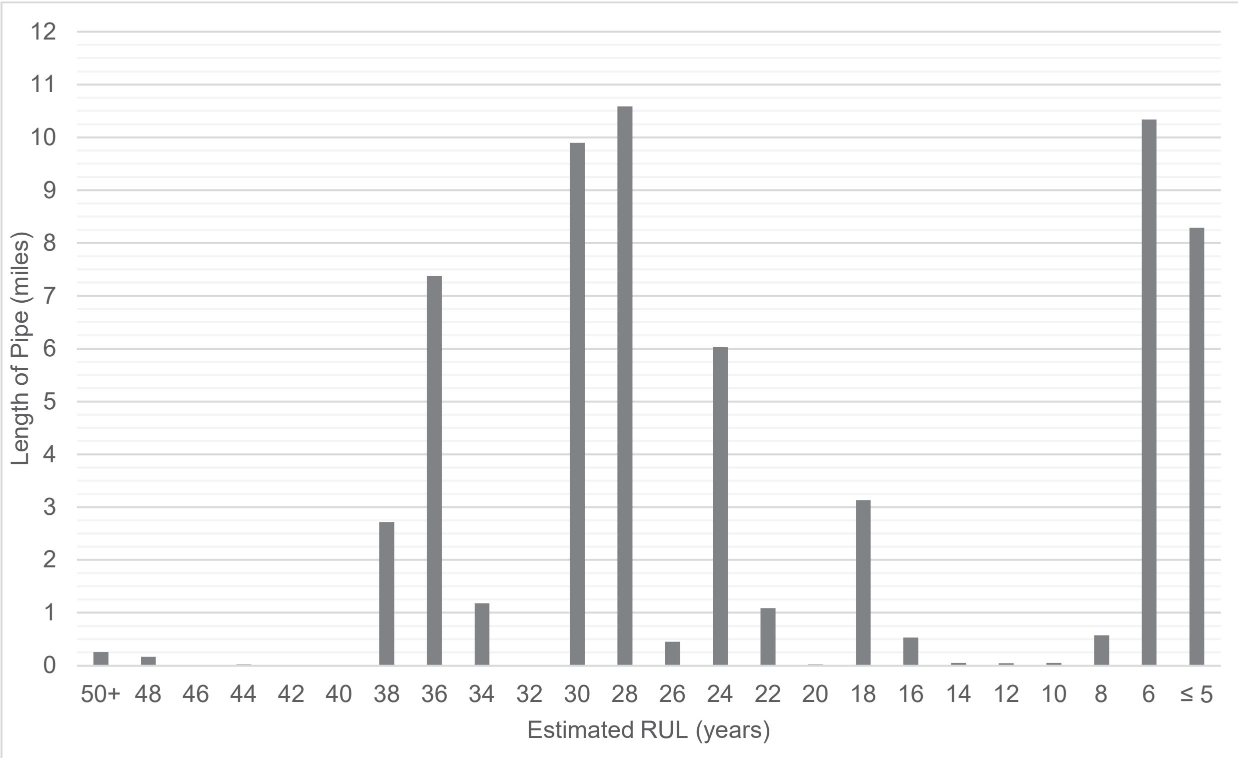
Calculated CoF for Gravity Pipes



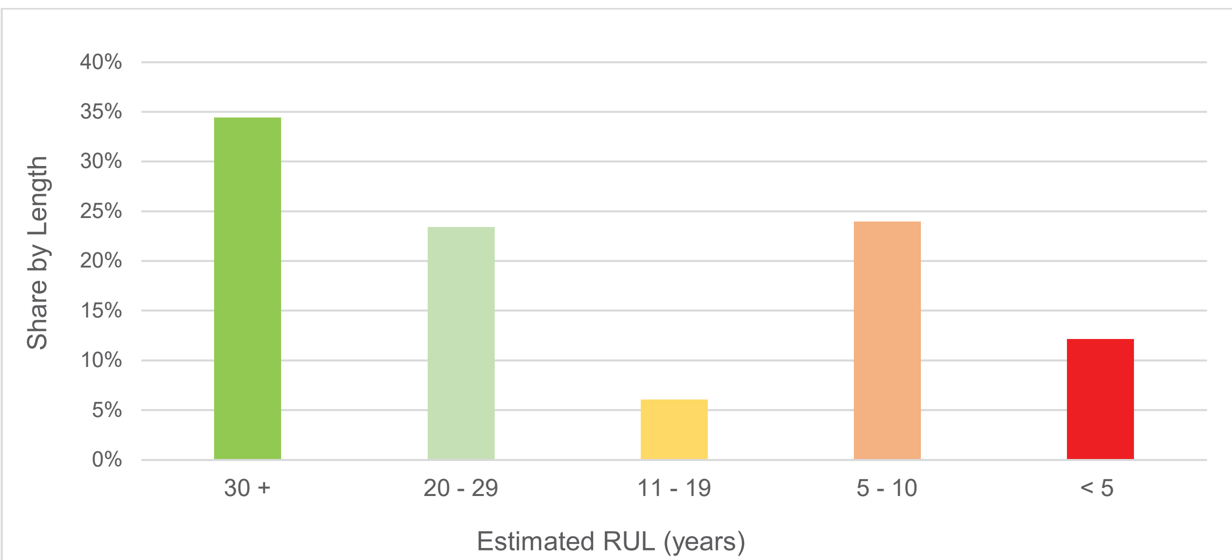
Calculated Risk for Gravity Pipes

		POF				
		1	2	3	4	5
COF	1	0%	0%	0%	0%	0%
	2	3%	2%	1%	0%	0%
	3	28%	21%	1%	2%	0%
	4	8%	11%	3%	2%	4%
	5	3%	5%	2%	1%	1%

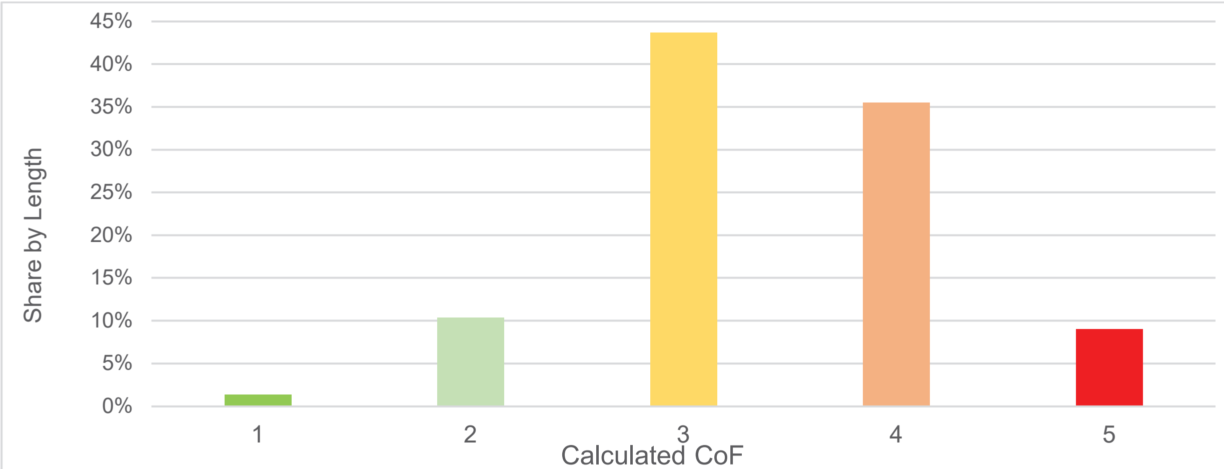
PoF and CoF Heatmap for Gravity Pipes



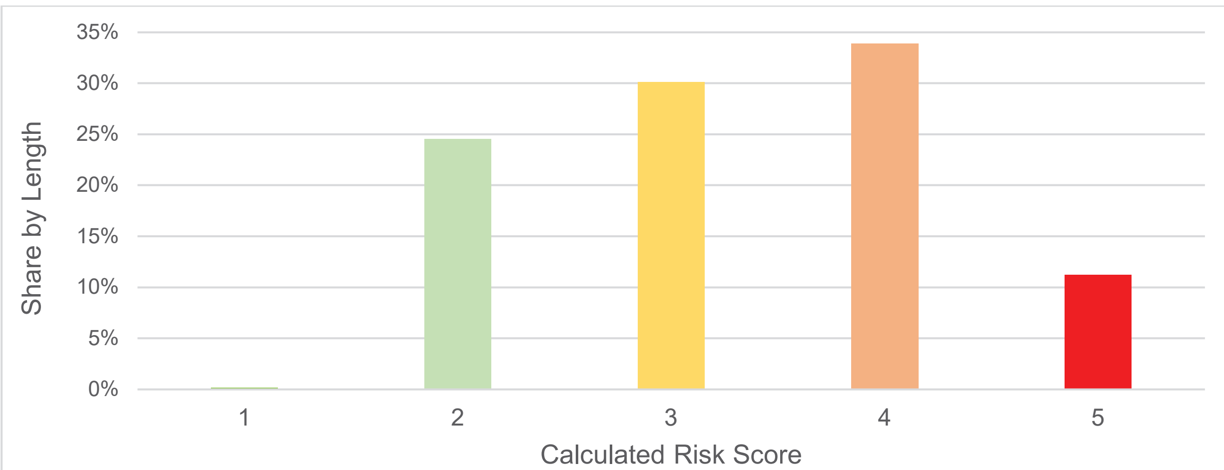
Estimated RUL for Force Mains



Estimated RUL for Force Mains



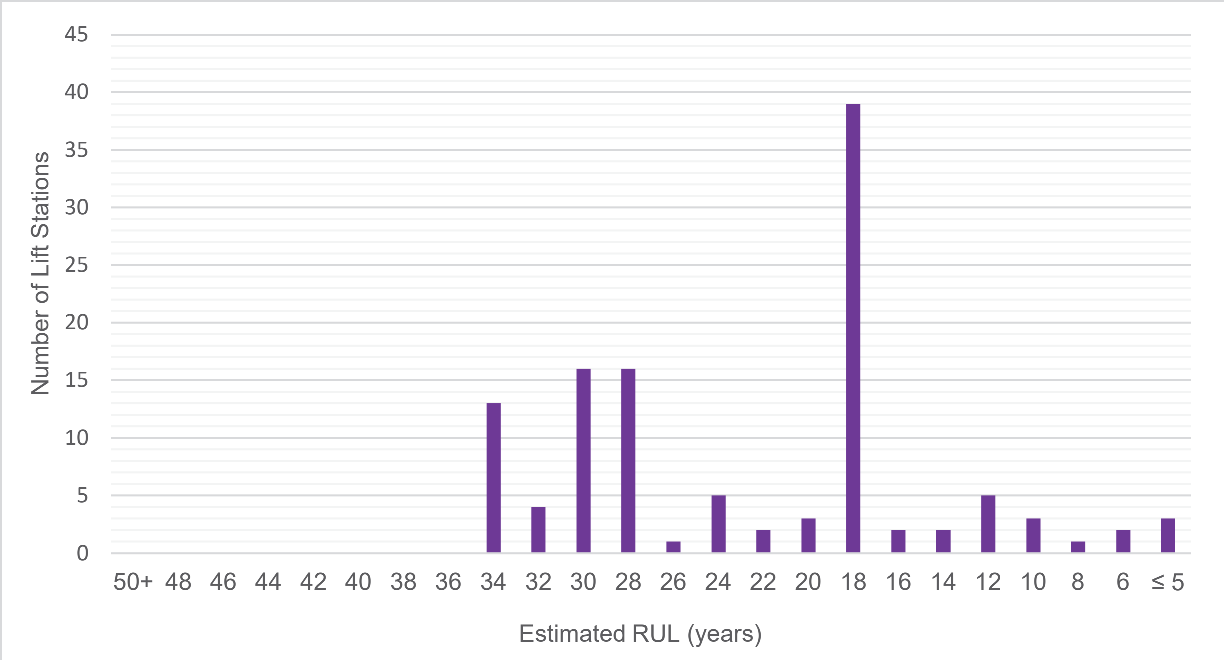
Calculated CoF for Force Mains



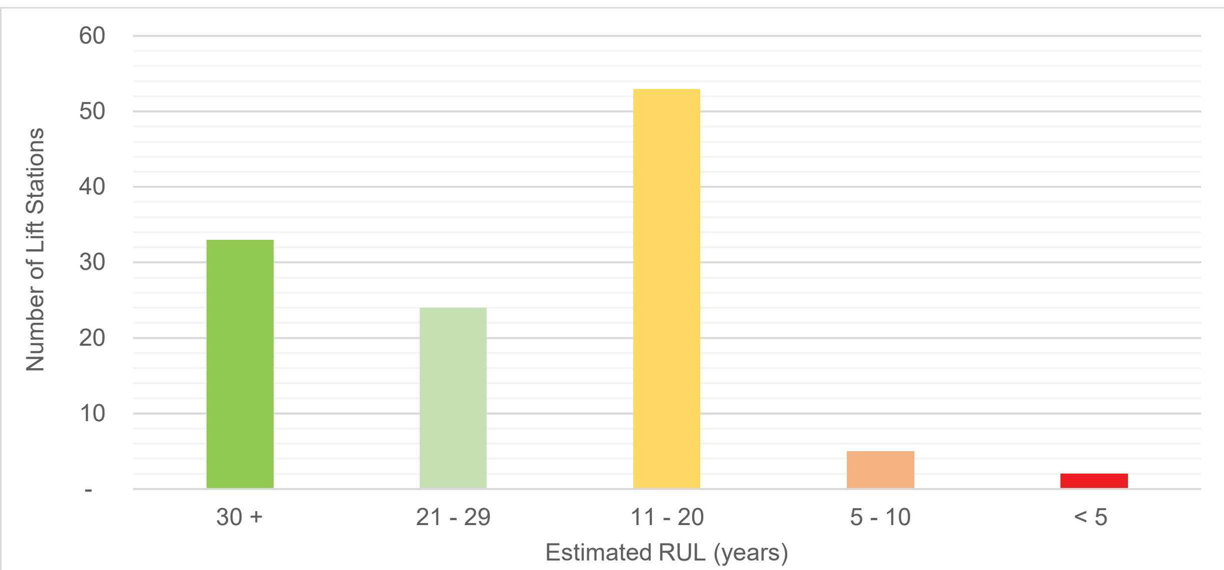
Force Main Risk Scores

		POF				
		1	**2**	**3**	**4**	**5**
COF	**1**	0%	0%	0%	0%	0%
	2	4%	5%	0%	1%	1%
	3	16%	13%	2%	12%	1%
	4	12%	4%	4%	9%	7%
	5	2%	2%	0%	2%	3%

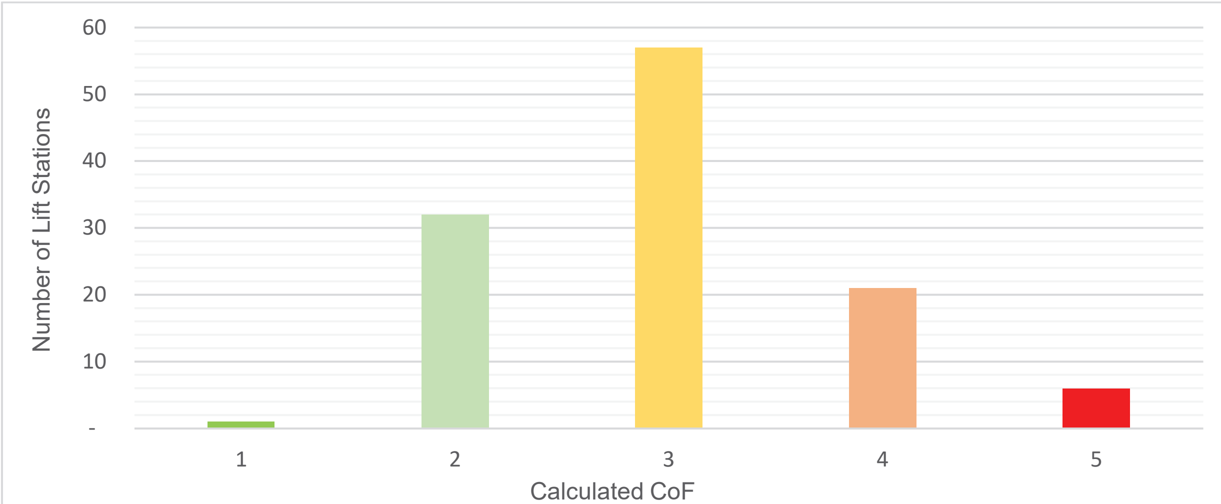
PoF and Cof Heatmap for Force Mains



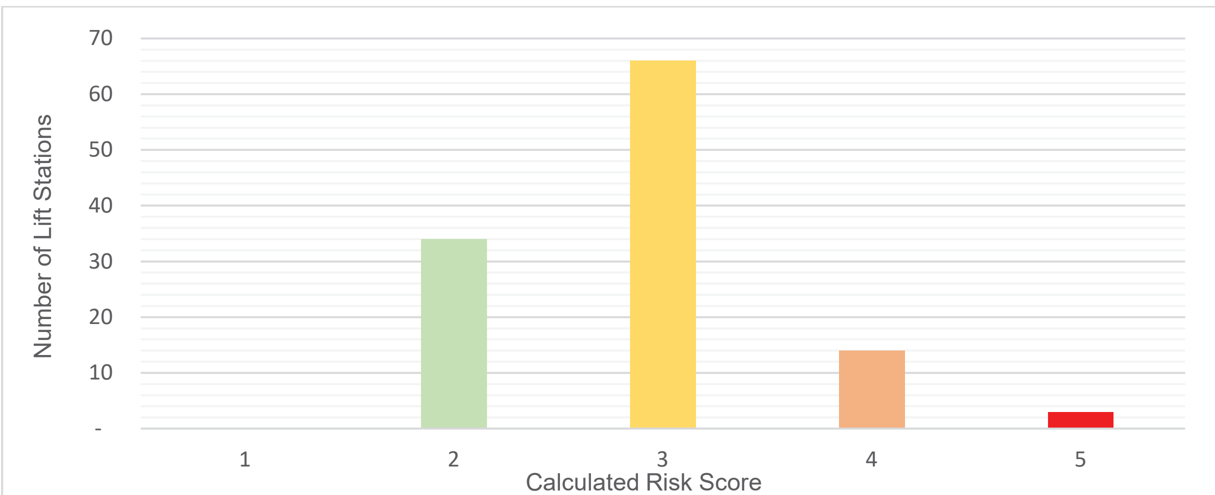
Estimated RUL for Lift Station (excluding Minis and Residentials)



Estimated RUL for Lift Station (excluding Minis and Residentials)



Calculated CoF for Lift Stations (excluding Minis and Residentials)



Lift Station Risk Scores (excluding Minis and Residentials)

		POF				
		1	**2**	**3**	**4**	**5**
COF	**1**	0	0	1	0	0
	2	8	12	12	0	0
	3	14	10	30	1	2
	4	10	2	6	3	0
	5	1	0	4	1	0

PoF and Cof Heatmap for Lift Stations (excluding Minis and Residentials)

Regulatory Compliance and Comprehensive Plan Services - Task 3a
Appendix B
Lift Station Replacement Schedule

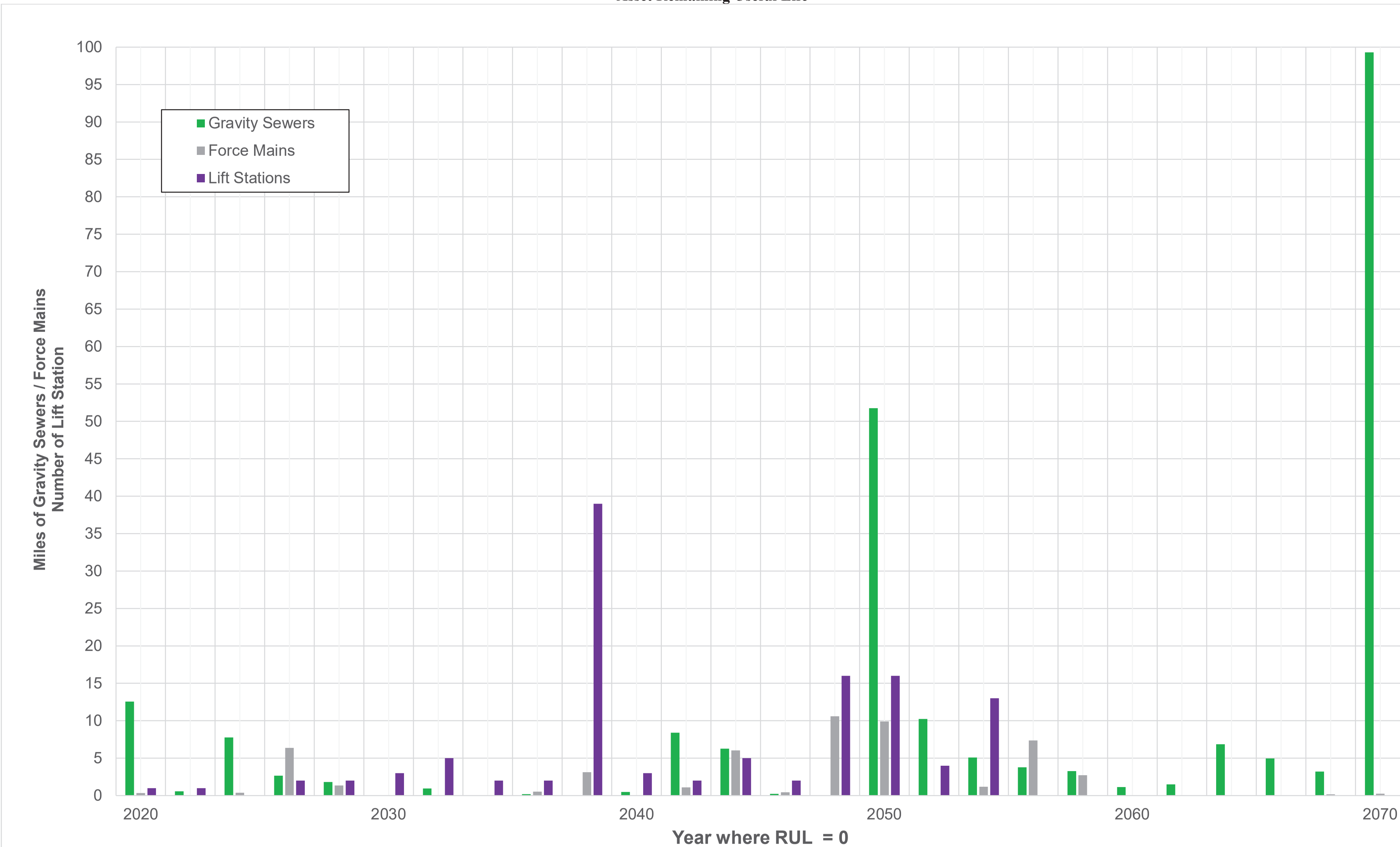
Lift Station	Capacity (gpm)	Age	RuL	CoF	Comments	Recommendation	Total Replacement	Component Replacement
LS-1	3,000	45	9	5	Major electrical problems. Minor mechanical problems. Should have stationary Generator. 16-inch DIP force main that runs next to a lake with reported problems.	Total Replacement	**$ 520,000**	$ 340,000
LS-3	1,200	45	12	5	Major mechanical problems. Reported to need check and gate valves, and bypass connections, FOG problem.	Total Replacement	**$ 450,000**	$ 140,000
LS-10	1,200	45	12	5	Major mechanical problems. Reported to need bypass connection	Total Replacement	**$ 450,000**	$ 140,000
LS-23	< 100	45	11	3	Major electrical problems. Reported to need new panel.	Electrical Replacement	$ 250,000	**$ 50,000**
LS-24	300	45	12	4	Major mechanical problems. Reported to be scheduled for new stands and pumps. Located right by a lake and on the shoulder of State Hwy 29. 8-inch DIP force main located near 2 lakes and Lake Le Homme Dieu Beach.	Mechanical Replacement	$ 300,000	**$ 70,000**
LS-27	350	45	10	4	Major mechanical problems. Reported to be scheduled for new stands, pumps and wet well plumbing. A DIP force main the High School's property.	Mechanical Replacement	$ 300,000	**$ 100,000**
LS-41	150	44	7	3	Major electrical problems. Reported to be scheduled for a new panel. Moderate mechanical problems. Located near Lake Darling.	Electrical Replacement	$ 280,000	**$ 70,000**
LS-53	100	42	12	3	Moderate mechanical, electrical and structural problems. Reported that it should be replaced to new location.	Total Replacement	**$ 270,000**	$ 150,000
LS-66	150	52	-1	3	Major mechanical, electrical and structural problems. Reported to be scheduled for a total replacement. Located right by the Douglas County Hospital and Community College.	Total Replacement	$ 280,000	$ 140,000
LS-68	500	51	7	4	Major mechanical problems. Minor structural problems. Reported that the valving structure should be replaced.	Total Replacement	**$ 350,000**	$ 120,000
LS-69	170	51	5	4	Moderate mechanical, electrical and structural problems. Reported that it should be replaced to new location.	Total Replacement	$ 270,000	$ 150,000
LS-73	120	43	2	3	Major mechanical, electrical and structural problems.	Total Replacement	$ 350,000	$ 220,000
AGS14	-	42	-	5	Mini Lift Stations near or over 35 years old with CoF of 5	Total Replacement	**$ 100,000**	N/A
AGS17	-	32	-				**$ 100,000**	N/A
AGS19	-	53	-				**$ 100,000**	N/A
AGS27	-	53	-				**$ 100,000**	N/A

Notes:
- LS-1 and LS-73 have the cost of back-up generator included.

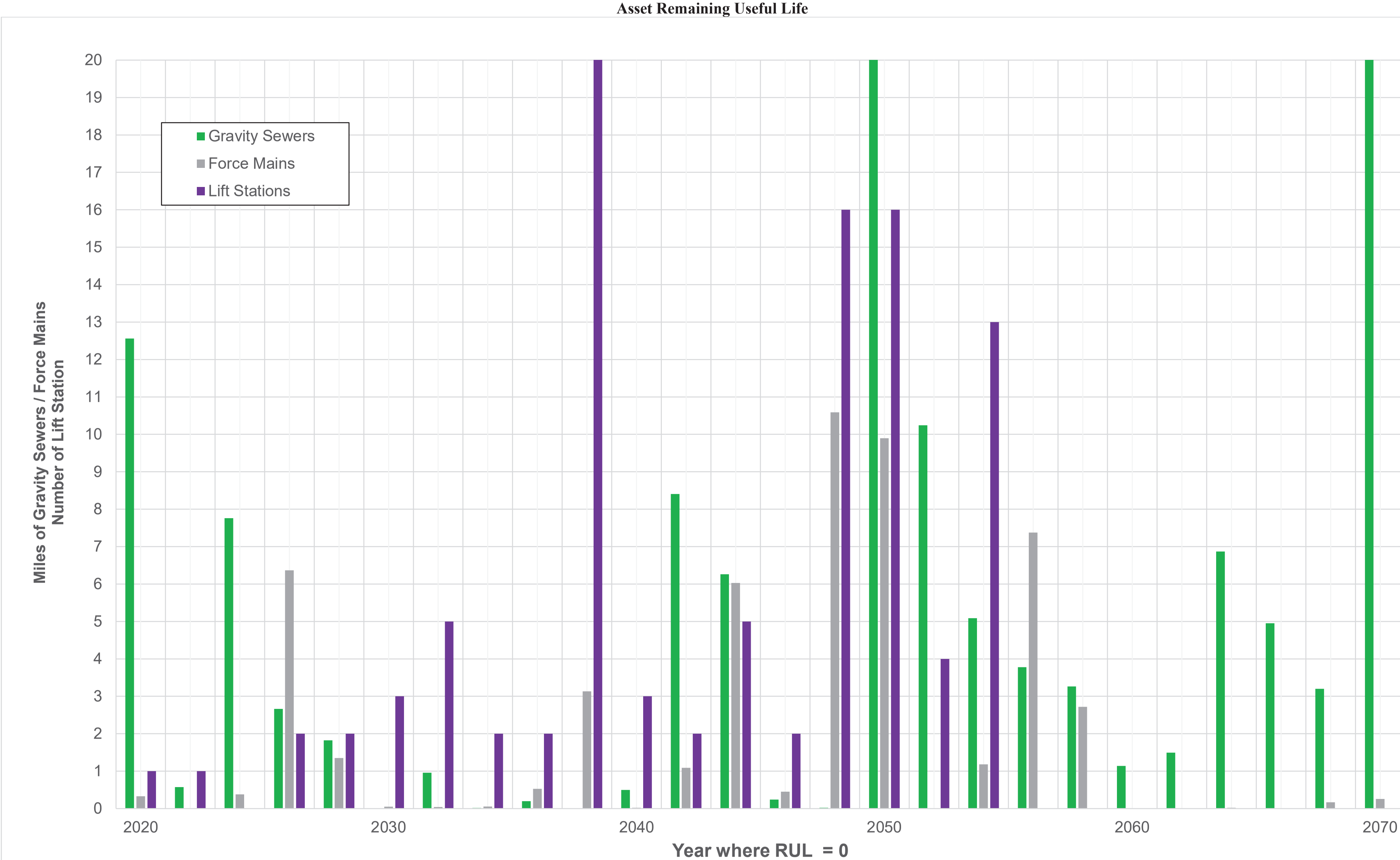
$ 100 Estimated cost was based on estimate provided by Widseth with force main, gravity sewers, design, and CA services removed

$ 100 Initial recommended action

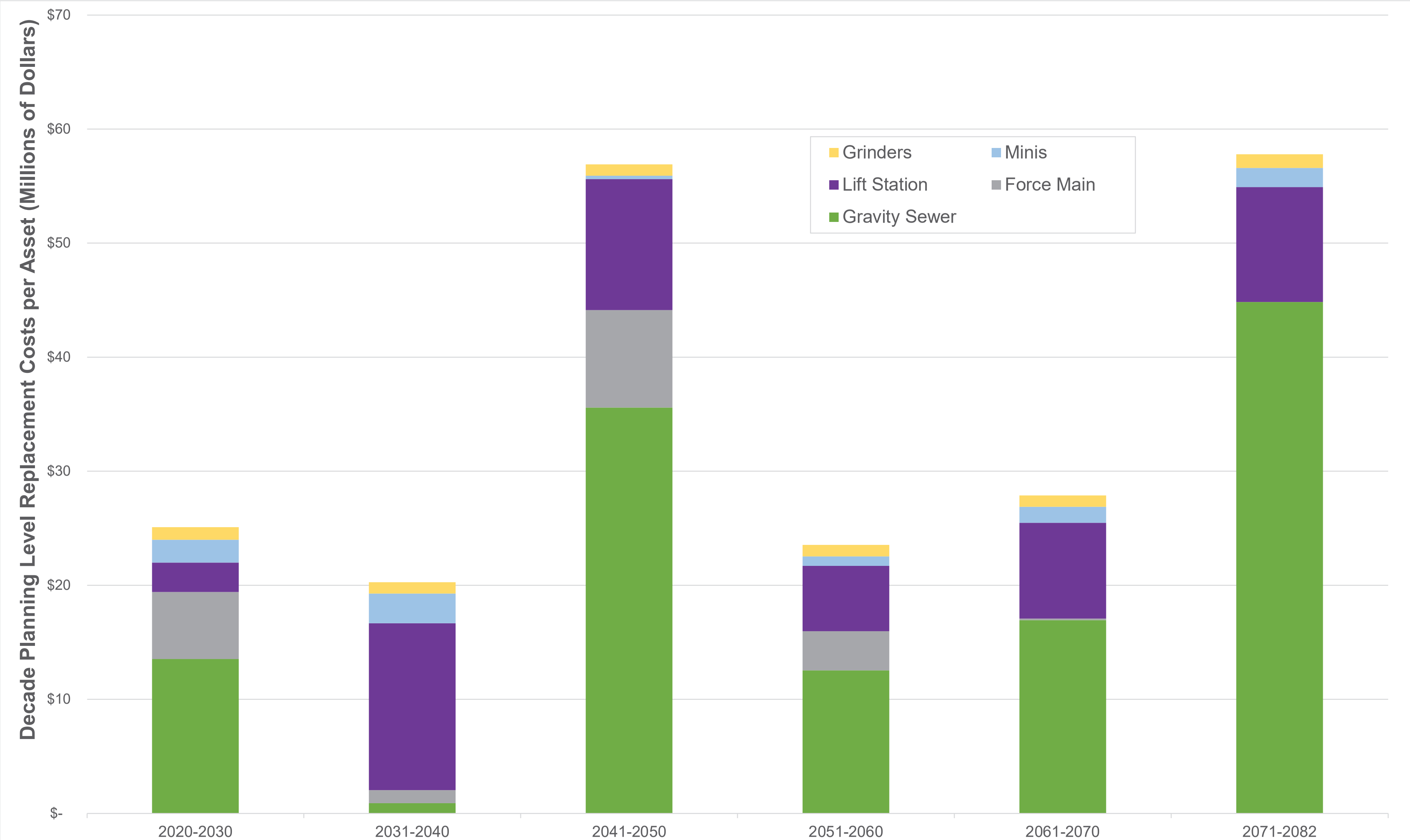
Regulatory Compliance and Comprehensive Plan Services - Task 3a
Appendix D
Asset Remaining Useful Life



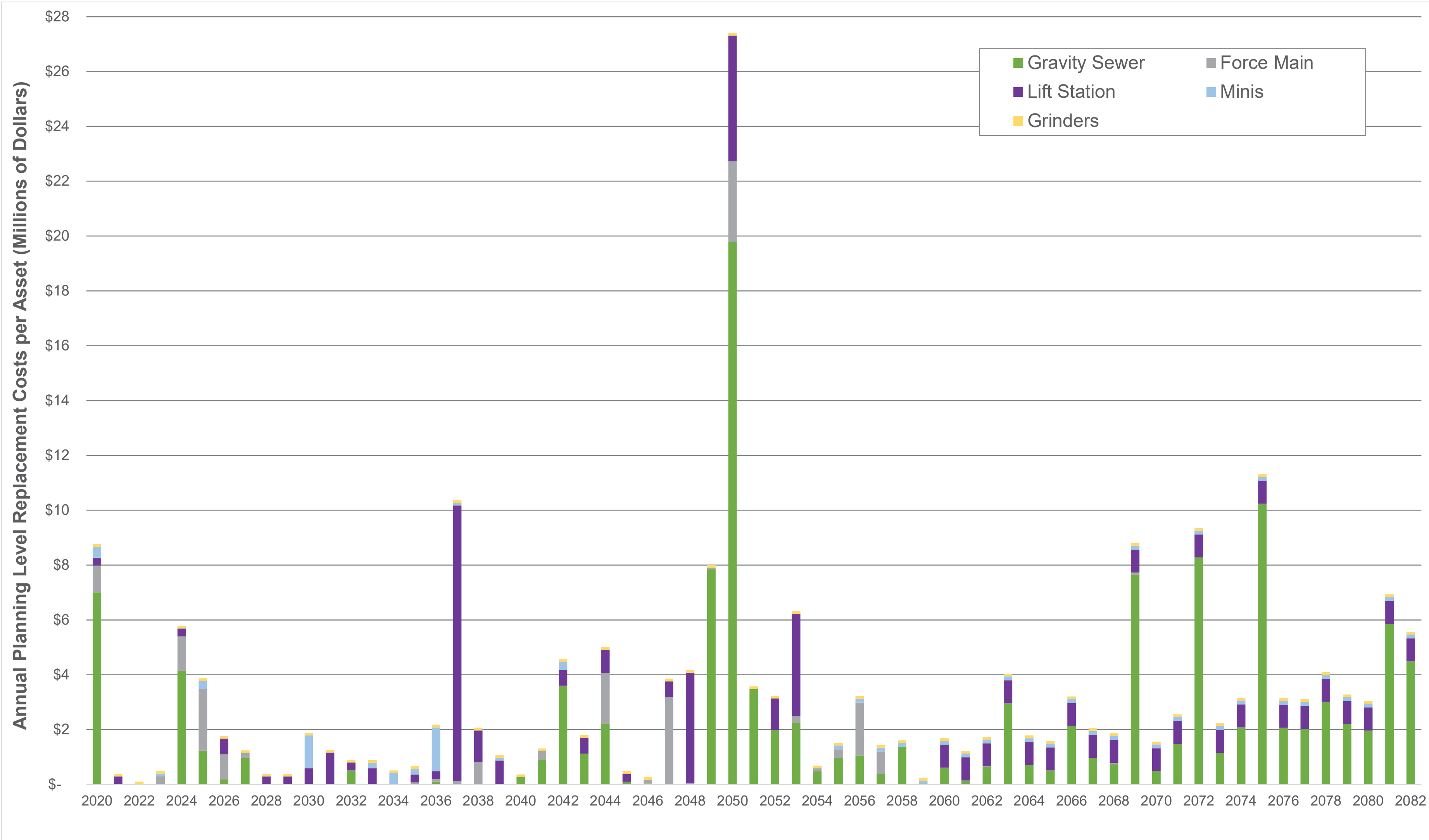
Regulatory Compliance and Comprehensive Plan Services - Task 3a
Appendix D
Asset Remaining Useful Life

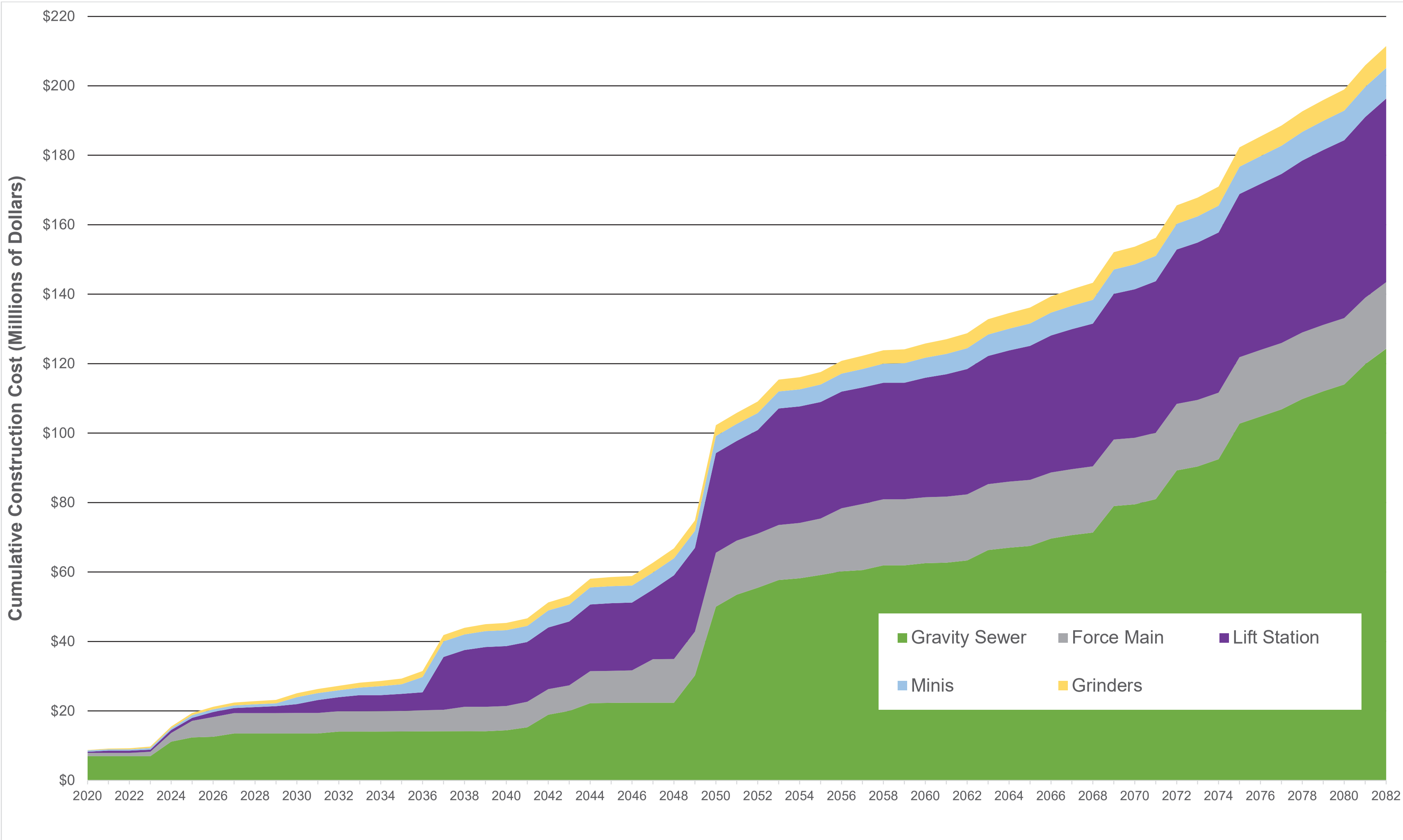


Regulatory Compliance and Comprehensive Plan Services - Task 3a – Desktop Collection System Assessment
Appendix E
Planning Level Replacement Costs

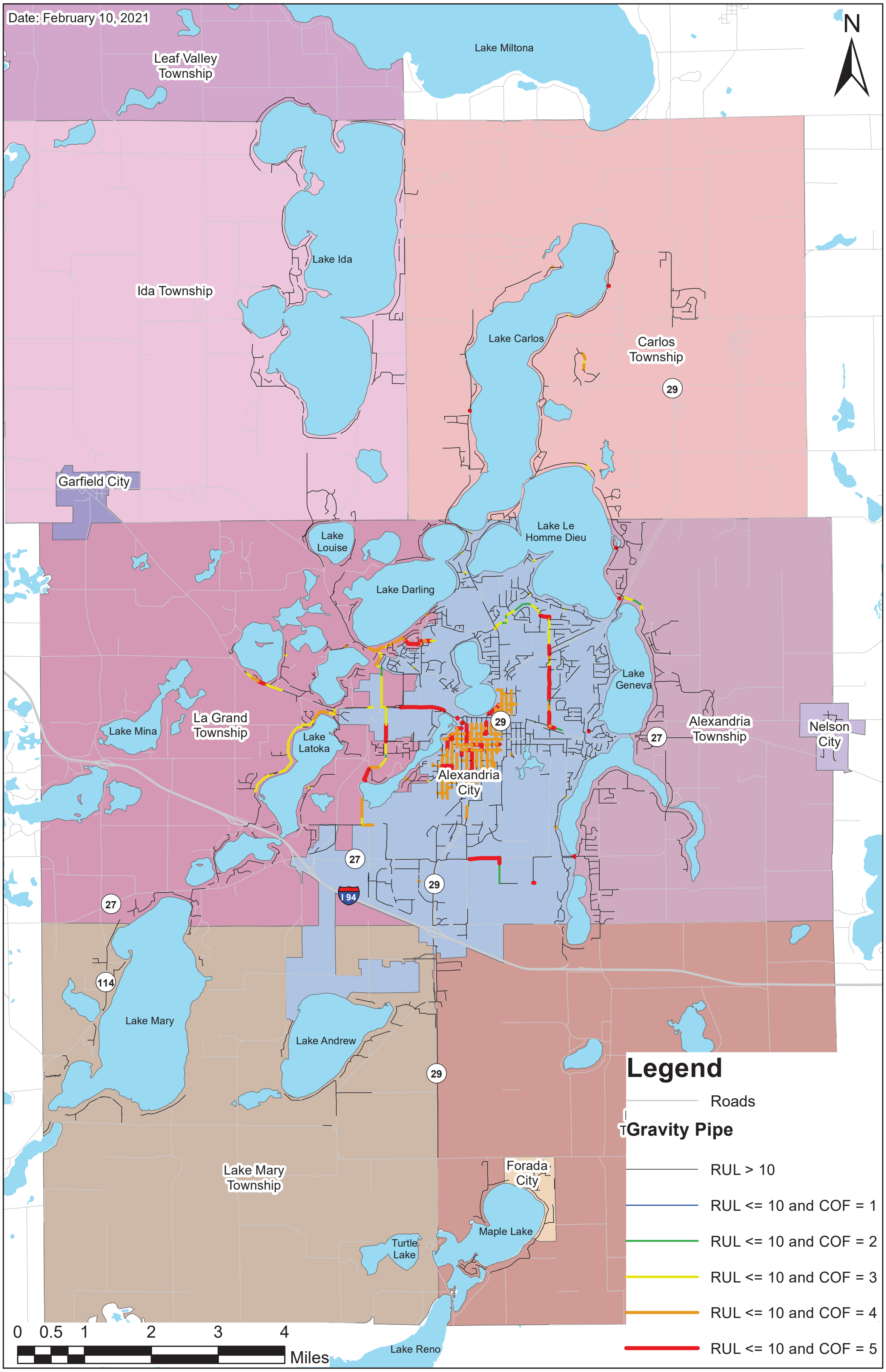


Regulatory Compliance and Comprehensive Plan Services - Task 3a – Desktop Collection System Assessment
Appendix E
Planning Level Replacement Costs

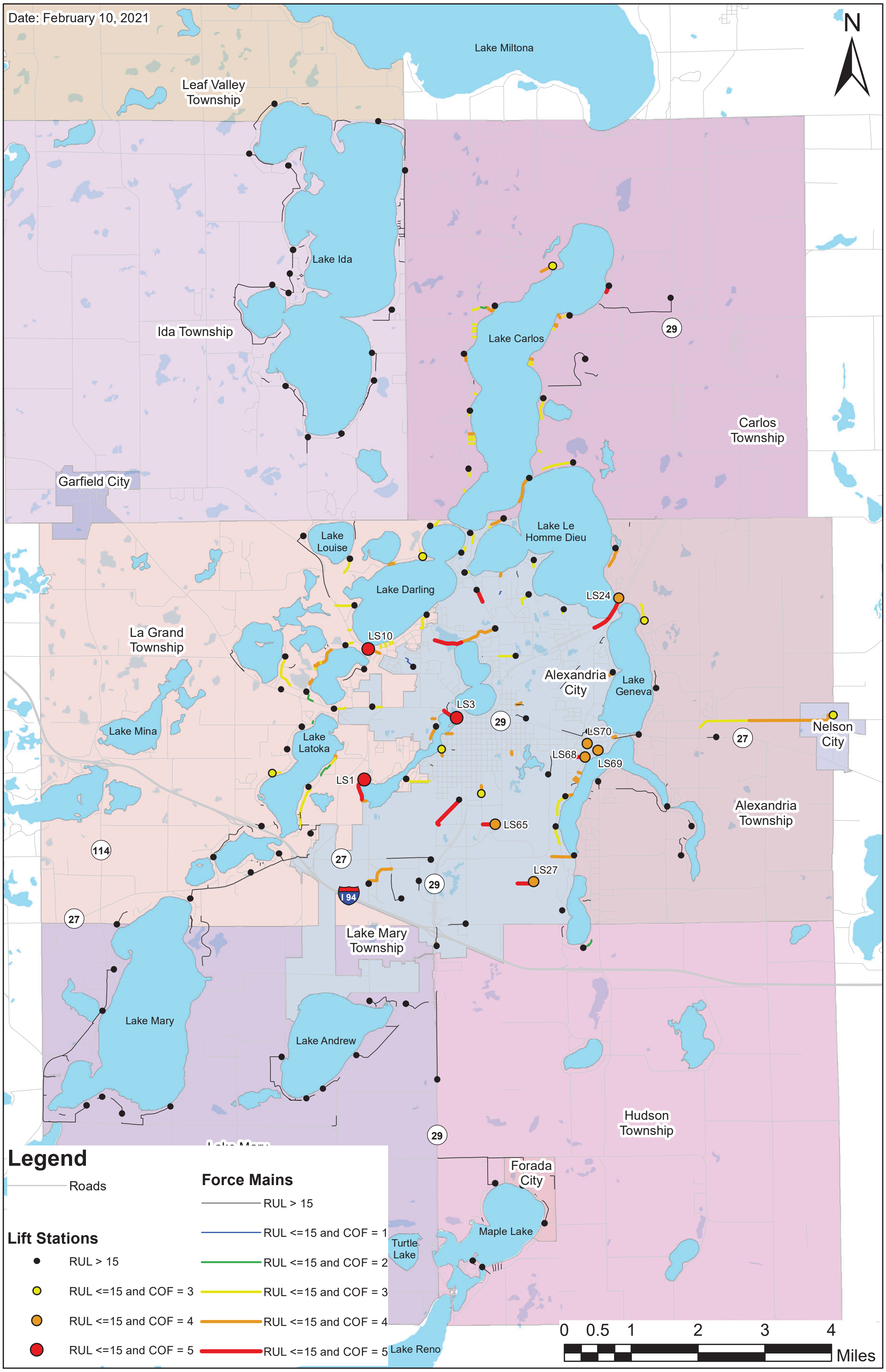



Cumulative Construction Cost (Millions of Dollars)
$0
$20
$40
$60
$80
$100
$120
$140
$160
$180
$200
$220
2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050 2052 2054 2056 2058 2060 2062 2064 2066 2068 2070 2072 2074 2076 2078 2080 2082
Gravity Sewer
Force Main
Lift Station
Minis
Grinders

Regulatory Compliance and Comprehensive Plan Services - Task 3a
Appendix F
Map of Results (Gravity Pipes)



Regulatory Compliance and Comprehensive Plan Services - Task 3a
Appendix F
Map of Results (Force Mains and Lift Stations)



P: (320) 762-1135 • F: (320) 762-1108

ALASD
Alexandria Lake Area Sanitary District
Restoring Our Water for a Healthier Natural Environment

2201 Nevada St. • Alexandria, MN 56308

RESOLUTION 20-11

WHEREAS, the Alexandria Lake Area Sanitary District's **User Charge Ordinance NO.4** establishes the user charges to all customers.

NOW THEREFORE, BE IT RESOLVED by the Board of the Alexandria Lake Area Sanitary District, the user charge rates shall be increased from current rate by 2% for residential, non-residential and commercial, and SIU agreement charges.

Section I. User Rates

Subdivision 1. The user charge for a single-family dwelling (both metered and not metered) shall be increased by 2% from $30.00 per month to **$30.60**, (includes a $.50 per month billing charge). The user charge would also apply to single family dwellings that are rented, partially or in whole, provided it discharges normal domestic strength wastewater and is billed as residential for electricity and water by Alexandria Light and Power (ALP). Structures constructed or modified to serve as multiple family dwellings are not eligible for the single-family rate and will be billed as a non-residential/commercial user.

Subdivision 2. The flow unit charge for the non-residential/commercial user shall be increased by 2% from $6.38 per 1000 gallons to **$6.51 per 1000 gallons,** in addition to a $.50 per month billing charge.

Subdivision 3. The user charge for Biochemical Oxygen Demand (BOD), Total Phosphorous (TP), Total Suspended Solids (TSS), which exceeds the parameters of the general municipal flow (BOD = 290 mg/L, TSS = 270 mg/L, and TP = 6 mg/L) and by rule is agreed upon in Significant Industrial User (SIU) agreements shall be as follows:

BOD -$.36 per pound increased by 2% to **$.37 per pound**
TP - $10.72 per pound increased by 2% to **$10.93 per pound**
TSS - $.34 per pound increased by 2% to **$.35 per pound**

Subdivision 4. The minimum monthly service charge shall increase by 2% for the non-residential/commercial users that are metered. Charges shall be based on the private sewer service pipe connection to structure and shall be as follows:

< 6" - **$30.60 per month plus usage charge**
8" - **$186.64 per month plus usage charge**
10"- **$302.29 per month plus usage charge**
12"--**$486.49 per month plus usage charge**

Subdivision 5.
All non-residential/commercial accounts not having a city metered water supply service shall be charged based on monthly estimated usage. Typical single-family dwellings shall be assigned an M value of 1 (EDU=Equivalent Dwelling Unit) and shall pay the Alexandria Lake Area Sanitary District user rate of 1 EDU= $30.60 (2021 Rate). Minimum Monthly Service charge, based upon service pipe connection to structure and shall be as follows:

4" - **$30.60 per month plus EDU charge**
6" - **$88.56 per month plus EDU charge**
8" - **$186.64 per month plus EDU charge**
10"- **$302.29 per month plus EDU charge**
12"--**$486.49 per month plus EDI charge**

Subdivision 6. All other non-metered examples below:

Facility	EDU or M Value	Parameter
Airport Hanger	.50	$16.00 per mo.
Garage/Storage	.50	$16.00 per mo.
RV Camper	.65	$20.00 per mo.
Guest House	1.0	$30.60 per mo.
Garage with living qtrs.	1.0	$30.60 per. mo.
Townhome	1.0	$30.60 per mo.
House w/Garage (living qtrs.)	1.5	$45.90 per mo.
House w/Guesthouse	2.0	$61.20 per mo.

Subdivision 7. WTEF: The following table is a listing of standards used in assigning the M value for various commercial, public, and institutional facilities in regards to the Wastewater Treatment Expansion Fund (WTEF). The WTEF charge is due prior to customer connecting to ALASD systems.

Facility	EDU or M Value	Parameter
Apartments	0.8	$2,000 (each unit)
Duplexes	0.8	$2,000 (each unit)
Single Family Dwelling	1.0	$2,500 (each unit)
Townhomes	1.0	$2,500 (each unit)
Condominiums	1.0	$2,500 (each unit)
Mobile Homes	1.0	$2,500 (each unit)

Attached: Equivalent Domestic Unit (EDU) Criteria for Non-Residential/Commercial is appended and incorporated into this ordinance by reference.

Section II. Billing and Adjustments

Subdivision I. All billings shall commence the first billing cycle after connection to sanitary sewer. Billing shall continue until the structure generating wastewater is removed from the property or when not occupied and water and electrical service has been removed. The removal of the user charge shall not be retroactive unless the time all of the above conditions were met can be substantiated to the satisfaction of the Executive Director. In no event shall any rebate, credit, or back charge issued to a customer exceed six years.

Subdivision 2. Metered customers that experience a break in the private water service line may receive a credit for unused water if the Executive Director can substantiate the water line break and resultant repair. The credit shall be based upon the highest monthly usage in the 12 months preceding the break.

Section III – Resort and Commercial Off-Season Rates

Subdivision 1. Definitions: "Resort" is defined as a commercial
seasonal enterprise whose income is solely derived from the rental of housing units and associated goods and equipment including boats motors, supplies and recreational equipment. The units and associated equipment must be available for rent to the general public during the minimum period from May 15 to September 1 of each year at reasonable rates as compared to other enterprises of the same character in Douglas County, Minnesota. In any year that the enterprise has no income, it will not be considered a resort. Any units owned by individuals, corporations, cooperatives, associations or other multiple owner groups that units do not meet the definition of resort in this section shall not be considered resorts and will be billed in accordance with Subdivision 1 & 5 Section 1 of this ordinance.

Subdivision 2. Upon annual written notice and the signing of a contractual agreement user rates will be reduced during the resorts off-season to the minimum charge for a six-inch service as shown in Section 1, Subdivision 5. The minimum charge will not apply when the resorts off-season usage exceeds the minimum charge.

Subdivision 3. Failure to comply with the written agreement shall result in the resort's disqualification for a period of one year from the rate allowed in Section II, Subdivision 1 of this ordinance.

Section IV – Deduction Meters

Subdivision 1. If a substantial portion of water utilized by a metered general municipal user is not discharged into the sewer system (e.g.- irrigation), the volume of such water shall be deducted in computing the sewer use charge, provided a separate meter is installed to measure such volume. The user desiring to install such separate meter shall make application to the ALASD, full payment for the meter, and engage, at their own expense, a plumber to affect the necessary piping changes and install the couplings so the meter can be set. The user may also make direct payment to the distributor for the necessary meter provided it is approved by ALASD.

Section V. – Private Water Meter Flow Billing

Subdivision 1. Effective on January 1, 2017, non-residential/commercial sanitary sewer accounts that do not have access to city water or have not connected to city water and have been charged a reduced rate during the winter (e.g – resorts) are required to install a water meter(s) for the purpose of user charge billing based upon metered flow. The private water meter shall be purchased, owned, maintained and if needed, replaced by the commercial account holder. Once a non-residential/commercial account is switched from flat rate billing to metered flow billing the commercial account shall not be qualified to revert to previous flat rate billing.

Subdivision 2. All customers served by District not having a city metered water supply may be required or volunteer to install and maintain a water meter at no charge to ALASD. All water meters shall comply with ALASD guidelines. ALASD reserves the right to inspect and require testing to ensure accuracy. Meters can be purchased through Alexandria Light and Power.

Subdivision 3. Account holder must report meter reading monthly to District Office by no later than the last working day of each month. Application provided by District must be completed, signed by the customer and approved by the District prior to installation of the meter. The installer of the water meter and appurtenances shall be a plumber licensed by the State of Minnesota.

Section VI. - Delinquent Accounts

Subdivision 1. Delinquent sewer charges incurred by the tenant are the responsibility of the property owner.

Subdivision 2. Each user charge levied pursuant to this ordinance shall be a lien against the property, and all such charges due on October 30 and April 30 of each year, delinquent more than six times the monthly billing and having been properly mailed to the owner of the premises shall be certified by the Executive Director to the County Auditor, shall specify the amount thereof, the description of the premises, the name of the owner thereof, and the amount so certified shall be spread upon the tax rolls against such premises in the same manner as other taxes, and collected by the County Treasurer and paid to the Alexandria Lake Area Sanitary District along with other taxes.

Subdivision 3. Delinquent accounts not certifiable to the county auditor shall be forwarded to a collection agency along with ALP's delinquent accounts.

Section VII. - Validity and Effective Date

Subdivision 1. Any person violating any provisions of this ordinance shall become liable to the ALASD for any expense, loss or damage occasioned by the ALASD by reason of such violation.

Subdivision 2. If any portion of this ordinance is ruled invalid by any court of competent jurisdiction, or by reason of any existing or subsequently enacted legislation, the remaining portions or provisions of this ordinance shall continue to have full force and effect.

Subdivision 3. The effective date of this amendment to the ordinance shall be the first ALP billing cycle in year 2021.

==

Approved this 11th of November 2020, by the following vote:

Yes:

No:

Roger Thalman,-Chairman

Rebecca Sternquist, Secretary

Equivalent Domestic Unit (EDU) Criteria for Non-Residential/Commercial Properties

FACILITY	PARAMETER	EDU
Animal Clinic (humane societies, animal research, boarding, etc.)		
Animal holding areas	17 fixture units	1
Animal runs (kennels)	34 fixture units	1
Archery (6 feet/lane)	6 lanes	1
Arenas (bleachers 18 inches/person)	110 seats	1
Auditoriums (7 square feet/person)	110 seats	1
Automobile Service		
Fast service (less than 4 hours/car)	2 service bays	1
Major service (more than 4 hours/car)	14 employees	1
Car dealership (charges for office, retail, etc. are separate at 2 service bays 1 established rates)		
Fast service (number of service bays x 30%)	2 service bays	1
Major service (Number of service bays x 70% x 1 employee/bay)	14 employees	1
Ballroom (exclude dance floor)		
Facility without liquor service	825 square feet	1
Facility with liquor service	590 square feet	1
Bank (exclude bank vault)	2400 square feet	1
Banquet Room (15 square feet/person)		
Food catered	2,060 square feet	1
Food catered with dishwashing	1,180 square feet	1
Food catered with liquor	1,028 square feet	1
Food catered with dishwashing and liquor	750 square feet	1
Food preparation and dishwashing	825 square feet	1
Food preparation with dishwashing and liquor	590 square feet	1
Barber	4 chairs	1
Batting Cages (6 feet/lane)	6 lanes	1
Beauty Salon	4 cutting stations	1
Bingo Hall (used only for bingo)	110 seats	1
Boarding House (dorm rooms)	5 beds	1
Body Shop (major service more than 4 hours/car, no vehicle washing)	14 employees	1
Bowling Alleys (does not include bar or dining area)	3 alleys	1
Camps (number of gallons x occupant or site)		
Children's camps (central toilet and bath; cabins; number of occupants x 50 gallons/occupant)	200 gallons	1
Day camps (no meals served; number of occupants x 10 gallons/occupant)	200 gallons	1
Labor/construction camps (number of occupants x 50	200 gallons	1

FACILITY	PARAMETER	EDU
Resorts and Cabins (with housekeeping)	Each unit	1
Travel trailer parks with water and sewer hookup	Each Site	.5
Sanitary RV Dump Site	200 gallons	1
Car Wash	Each	3
Car Wash (self-service)	1 stall	3
Catering - Contact ALASD for Determination		
Churches	50 seats	1
Cocktail lounge (no food service)	23 seats	1
Coffee Shop (no food service)	23 seats	1
Correction Facility (prison)	2.5 inmates	1
Court Rooms	1,650 square feet	1
Dorm Rooms		
(on and off campus; charge for classrooms is additional)	5 students	1
Daycare		
Number of children for which facility is licensed	14 children	1
Child/adult play area (not licensed)	490 sq.ft.	1
Dental clinic vacuum device (9 hours x gallons per minute x 200 gallons) 60 minutes)		1
Dry Cleaners (retail)	3,000 sq ft	1
Elder Housing		
No washer/dryer in each unit	3 residents	1
Washer/dryer in each unit	2.5 residents	1
Three- bedroom unit with washer/dryer (separate from formula below)		
Calculate the number of residents as follows:		
Number of efficiency units x 1.0 residents/unit		
+ Number of one-bedroom units x 1.5 residents/unit)		
+ Number of two-bedroom units x 2.0 residents/unit)		
+ Number of three-bedroom units x 3.0 residents/unit)		
Total number of residents for SAC calculation		
Exercise Area/Gym (juice bars at no charge; sauna and whirlpool included)	700 sq ft	1
No showers	2,060 sq ft	1
Fire Station (charges for office, meeting rooms, etc., are separate, at established rates)		
Washing (hose tower, truck)	200 gallons	1
Full time, overnight people (75 gallons/person)	200 gallons	1
Volunteer (occasional overnight stays)	14 volunteers	1
Funeral Home (charge for viewing areas only: i.e., chapel)	770 sq ft	1
Apartment	1 apartment	.8
Game Room (billiards, video and pinball games)		
With bar	590 sq ft	1
Without bar	2,060 sq ft	1

FACILITY	PARAMETER	EDU
Golf Course (if facility has showers, use Locker Room criteria for those areas)		
18 hole		3
9 hole (par 3)		2
Miniature		3
Country club (private)		
Dining room (used only on evenings and weekends)	15 seats	1
Bar and grill (with bar and grill separate)		
Bar only	23 seats	1
Grill	15 seats	1
Golf Dome or Driving Range	6 driving stations	1
Greenhouse		
Area not open to the public	15,000 sq ft	1
Area open to the public	5,000 sq ft	1
General retail area	3,000 sq ft	1
Group Home		
Secondary treatment (residents leave during the day)	5 beds	1
Primary treatment (residents stay all day)	3 beds	1
Guest Rooms (in an apartment or condominium complex; charge as apartment)		
Washer/dryer		1
No washer/dryer 80% of current rate		.8
No kitchen 50% of current rate		.5
Handball and Racquetball Courts	1 court	2
Hospitals(licensed beds or baby cribs)	1 bed	1
Outpatient clinic	17 fixture units	1
Sterilizers (4 hours x gallons per minute x 60 minutes)	200 gallons	1
X-ray film processors (9 hours continuous operation; 4 hours intermittent operation; operation time (hours) x gallons per minute x 60 minutes)	200 gallons	1
Ice Arena		
Showers (see Locker Rooms)		
Team Rooms (plumbing fixture units)	17 fixture units	1
Bleachers 110 seats 1		
Laundromat	2 machines	3
Library (subtract book storage areas, file areas; charge for common plumbing fixture units in public areas)	17 fixture units	1
Meeting rooms, board rooms, reception, book checkout offices	2,400 sq ft	1
Loading Dock	7,000 sq ft	1
Locker Rooms(if showers 20 gallons/locker)	14 lockers	1
Medical Clinic (see Hospitals, Outpatient Clinic)		
Meeting Rooms (conference rooms)	1,650 sq ft	1

FACILITY	PARAMETER	EDU
Mini-storage (storage area no charge)		
Living area		1
Public restroom	17 fixture units	1
Mobile Home		1
Motels and Hotels	2 rooms	1
saunas, whirlpools, game rooms, or exercise rooms used exclusively by guests)		
Breakfast only (complimentary)	45 seats	1
Cocktail hour (complimentary)	55 seats	1
Kitchenettes (number of kitchenettes x 10 gallons/day)	200 gallons	1
Museum	2,400 sq ft	1
Nursing Home	3 beds	1
Office		
General office (deduct mechanical rooms, elevator shafts, stairwells, restroom and storage areas)	2,400 sq ft	1
Dental and Doctors' offices, see Hospital, Outpatient Clinic		
Police Station (charge as Office)		
Cells (overnight jail)	3 people	1
Cells (holding area with no overnight stays)	14 people	1
Recording/Film Studios	7,000 sq ft	1
Restaurant		
Drive-in	9 parking	1
Fast food (with disposable plates, drink cups, and table utensils)	22 seats	1
Take-out (no seating)	3,000 sq ft	1
Full service (with washable plates, drink cups, and table utensils)	8 seats	1
Restaurant with cocktail lounge	9 seats	1
Restaurant (24-hour service)	12 seats	1
Retail Stores (deduct mechanical rooms, elevator shafts, stairwells, escalators, restrooms and unfinished storage areas)	3,000 sq ft	1
Roller Rink (skating area only)	825 sg. ft.	1
Rooming Houses (no food service)	7 beds	1
Recreational Vehicle		.65
RV Dumping Station (not in association with camp grounds)		1
Schools		
Elementary schools (15 gallons/student; 30 square feet/student)	18 students	1
Colleges/technical/vocational (30 square feet/student)	18 students	1
Lecture halls (15 square feet/student)	18 students	1
Labs (50 square feet/student)	18 students	1
Dorm rooms (on and off campus students)	5 students	1
Nursery schools (number of children for which facility is licensed)	14 students	1
House of worship nurseries (used during worship service only; 30 square feet/child)	55 children	1
Nursery (health clubs, bowling alleys, etc.)	2,400 sq ft	1
Secondary schools (30 square feet/student, at 20 gallons/student)	14 students	1
Labs (50 square feet/student)	14 students	1
Weekly worship schools (i.e., not daily parochial schools; 30 square feet/student)	55 students	1

FACILITY	PARAMETER	EDU
Service Station		
Gas pumping	1 each	1
Convenience center	3000 sq ft	1
Service bays	2 bays	1
Car wash (see Car Wash)		
Shooting Ranges (rifle and handgun ranges, @ 6 feet per lane)	6 lanes	1
Swimming Pools (public, swimming pool area only; no charge for private residential, townhouse, apartments, condominiums, hotels, or motels)	900 sq ft	1
Tanning Rooms	3000 sq ft	1
Tennis Courts (public; shower facilities available)	1 court	2
Theatre	64 seats	1
Drive-in (parking spaces)	55 spaces	1
Vehicle Garage		
Employees stationed in garage	14 employees	1
Vehicle drivers (per day)	28 drivers	1
Vehicle washing (number of vehicles per day x gallons per minute x minutes/vehicle)	200 gallons	1
Warehouses		
Assembly areas	7,000 sq ft	1
Office/warehouse		
Minimum 30% office	2,400 sq ft	1
Maximum 70% warehouse	7,000 sq ft	1
Whirlpools, therapy (at doctor's office or clinic; number of gallons to fill tank x 8 fills/day)	200 gallons	1
Yard Storage Buildings (i.e., lumber storage; customer pickup; no permanent employees)	15,000 sq ft	1
Plumbing Waste Fixture Units		
Type of Fixture, Fixture Unit Value (f.u.)		
Note: 17 Fixture Units (f.u.) = 1		
Drinking Fountain		1
Floor Drain		
2" waste (only if hose bib included)		2
3" waste (only if hose bib included)		3
4" waste (only if hose bib included)		4
Trench drain: per 6-foot section		2
Sinks		1
Lab in exam room, bathroom		1
Kitchen and others		2
Surgeon		3
Janitor		4
Water closet		

Hazen

Pressure Pipe Condition Assessment

September 20, 2018

1

Outline

- Understanding Modes of Pressure Pipe Failure
- Risk-Based Assessment Approach
- Condition Assessment Technologies
- Examples

Hazen 2

2

Pressure Pipe Failure Modes

- PVC
- DIP/CIP
- Steel

Hazen

3

PVC Pipe Failure

- Bell failure
  - ✓ Over-homing
  - ✓ Excessive deflection
- Point load failure
  - ✓ Poor bedding
- Cyclic fatigue
- Excessive deflection

Hazen 4

4

DIP/CIP Pipe Failure

- Corrosion
  - ✓ Internal
  - ✓ External
- Joint failure
- Split
- Graphitization
- Erosion

Hazen 5

5

Steel Pipe Failure

- Corrosion
  - ✓ Internal
  - ✓ External
- Loss of mortar lining
- Joint failure

Hazen 6

6

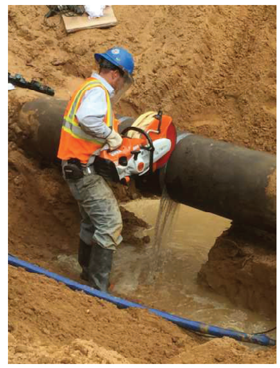
Condition Assessment Options

Indirect condition assessment

Use of known pipe and surrounding environment characteristics to infer risk of failure

Direct condition assessment (Level 1 and Level 2)

Use of destructive and non-destructive tools to directly measure in-situ conditions



Hazen

7

7

Overall Phased Risk-Based Approach

- Phase 1 → Conduct Desktop Risk Assessment Indirect PoF and CoF
- Phase 2 → Develop and Implement Level 1 Inspection Plan
- Phase 3 → Develop and Implement Level 2 Inspection Plan

Hazen

8

8

Desktop Risk Analysis

Risk =
Likelihood of Failure x Consequence of Failure

- Physical Attributes
- Condition Attributes
- Environmental Attributes
- Operational Attributes

- Critical Customers
- Pipe Size
- Pipe Location
- Redundancy

ESRI Model Builder is Excellent Tool For This

Hazen 9

9

Desktop Risk Analysis

Risk analysis: consequence and likelihood of failure

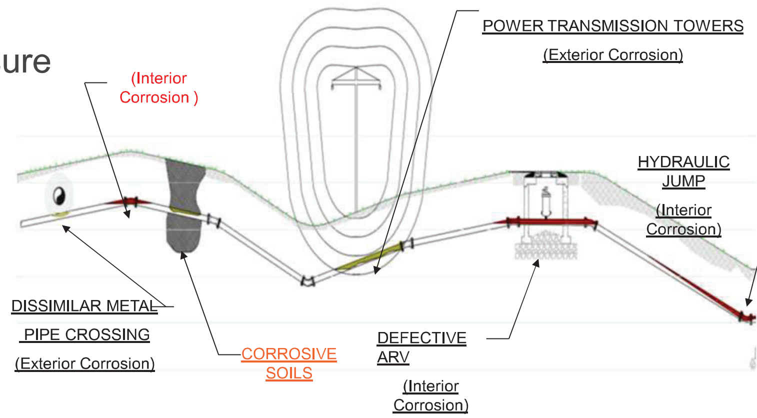
Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Severe
Almost certain	M	H	H	E	E
Likely	M	M	H	H	E
Possible	L	M	M	H	E
Unlikely	L	M	M	M	H
Rare	L	L	M	M	H

Hazen

10

Phase 1 Risk Analysis - Desktop Condition Assessment

- Material
- Age
- Profile
- Soil
- Pressure



Hazen

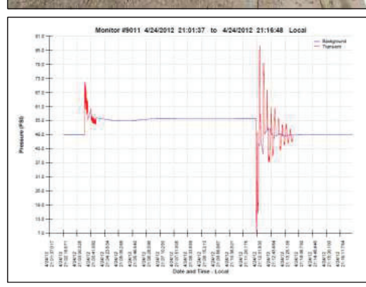
11

Indirect Condition Assessment

Environment factors

- Soil (AWWA C105)
  - ✓ Resistivity
  - ✓ pH
  - ✓ Sulfides
  - ✓ Redox potential
- Groundwater
- External loads

Pressure Monitoring



Hazen

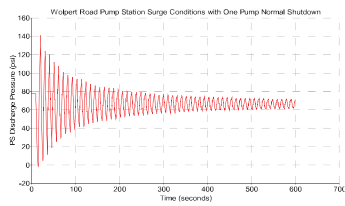
12

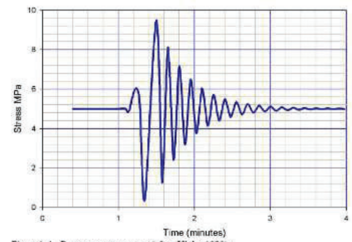
Phase 1 Risk Analysis– Cyclic Fatigue for PVC

Analysis of Cyclic Cumulative Damage:

- Cumulative affect of variable-amplitude surge events can be estimated using Miner’s rule by “adding up the percentage of life consumed by each stress cycle.”
- **Using this method, life expectancy of 8” DR18 PVC pipe is estimated to be about 19 years.**

$$\frac{n_1}{N_1} + \frac{n_2}{N_2} + \cdots + \frac{n_k}{N_k} = 1 \quad or \quad \sum_{j=1}^{j=k} \frac{n_j}{N_j} = 1$$





FigureA-1. Pump pressure wave (after Kirby 1980).

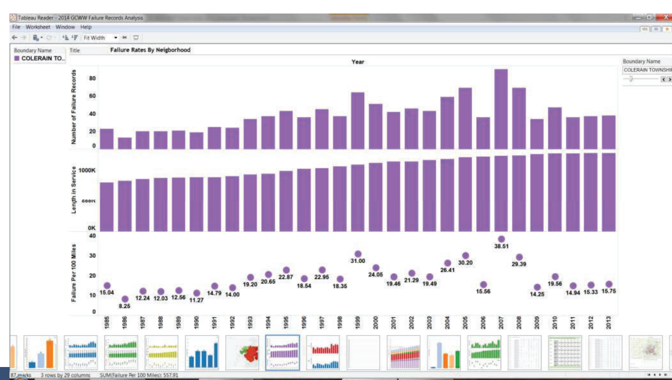
From Appendix A of *Long-Term Cyclic Testing of PVC Pipe* by Jeffrey, Moser & Folkman, Utah State University, for Uni-Bell PVC Pipe Association, February 26, 2004.

Hazen

13

Indirect Condition Assessment – Failure Data Analytics

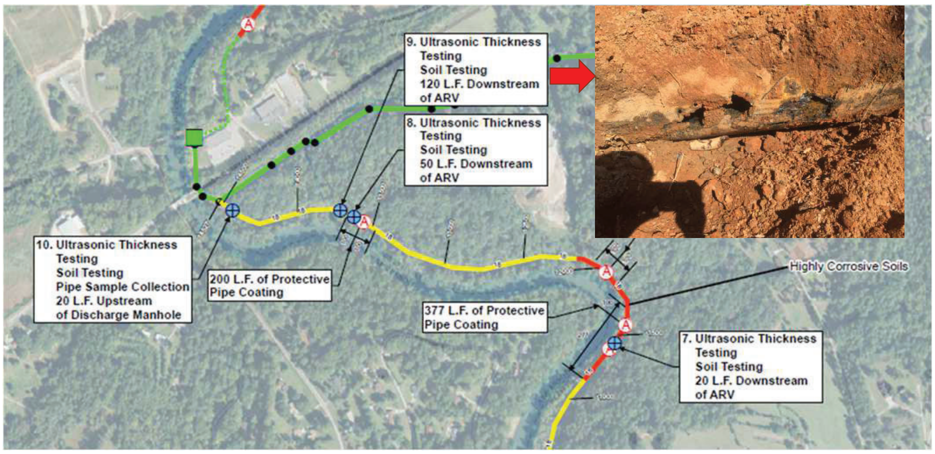
- Utilize available pipe leak and failure data to identify trends and most “at-risk” pipes
- Visual analytics can be very powerful
- Tableau software is an example
- Dashboard views allow slicing and dicing of data



Hazen

14

Example Phase 2 Field Plan



Hazen

15

Direct Condition Assessment

Level 1 – Direct condition assessment that results in a screening level condition analysis. Generally less expensive but is generally qualitative. Can be used to target a Level 2 assessment.

Level 2 – Direct condition assessment that provides more quantitative measurements of defects. Typically, but not always more expensive than a Level 1 assessment.

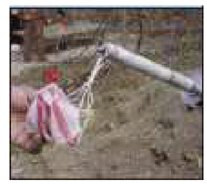
Hazen

16

Direct Condition Assessment

Non-destructive

- Ultrasonic/Acoustic – Level 1 &2
  - Handheld – Level 1
  - Free swimming – Level 2
  - Guided wave – Level 1
- Electromagnetic – Level 2
  - Magnetic flux leakage
  - Remote field technology
  - BEM – Pulse Eddy Current
- Laser profile – Level 2
- CCTV – Level 2



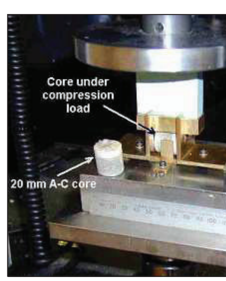
Hazen

17

Direct Condition Assessment – Level 2

Destructive

- Coupons
- Failure specimens
- Core sample
- Phenolphthalein dye test



Hazen

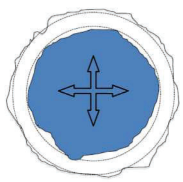
18

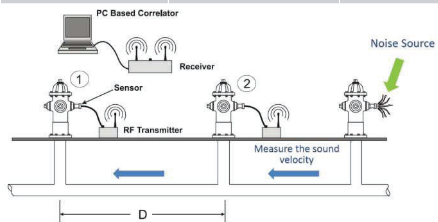
Direct Condition Assessment Level 1 – Acoustic

Echologics E-Pulse Guided Wave

- Uses acoustic "pressure wave"
- Measures average minimum remaining wall thickness over 100'-500'
- Requires 15 psi
- Air pockets cause error

Materials	Diameter	Mobilization	Assessment Cost
Metallic, ACP, PCCP	Any	$15,000	$5 per foot





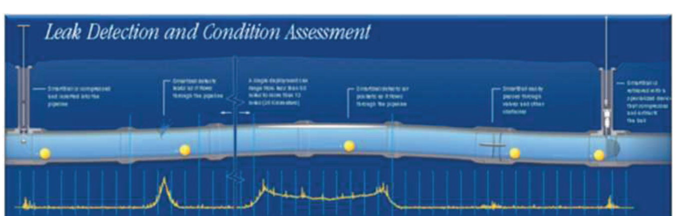
Hazen

19

Direct Condition Assessment Level 1 - Acoustic

- Pure Smartball
  - Measures leaks and detects gas pockets using sound detection
  - Can indicate where there are risks of corrosion
  - Smart ball free swimming needs about 1.7 fps and 15 psi for leaks
  - Requires 4" minimum inlet

Materials	Diameter	Mobilization	Assessment Cost
Any	>=8"	$25,000	$4-$5 per ft.



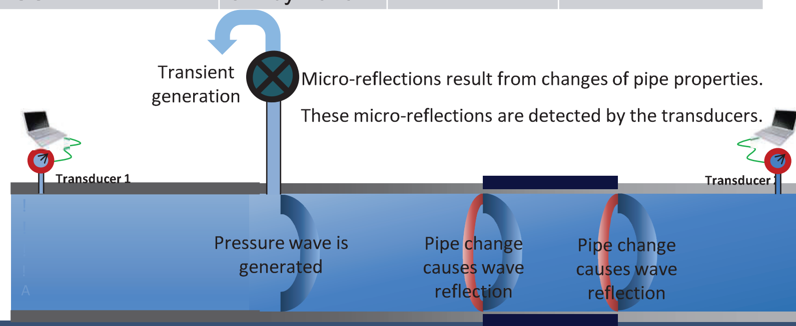
Hazen

20

Direct Condition Assessment Level 1 – p-CAT

- Uses “transient pressure wave”
- Measures average wall thickness over 30’ lengths
- Requires 30 psi
- Air pockets cause error

Materials	Diameter	Mobilization	Assessment Cost
Metallic, ACP, PCCP	<= 36” (up to 54” by 2019	$15,000	$5-7 per foot



Hazen

21

Direct Condition Assessment Level 1 – Acoustic

- Pure Sahara
  - Measures leaks and detects gas pockets using sound detection
  - Can add video
  - Tethered with range of about 2,500 LF each access
  - Approximately 2” access needed
  - Very accurate location capabilities
  - Requires 1 fps and about 3-5 psi

Materials	Diameter	Mobilization	Assessment Cost
PCCP/Metallic	>6”	$25,000	$6 per foot

22

Direct Condition Assessment Level 1 – Acoustic

Impact Echo

- Uses small sphere to generate transient sound waves
- Reflects off of defects and measures strength
- Can be internal or external
- External is point measurement

Materials	Diameter	Mobilization	Assessment Cost
PCCP, RCP	Any	$10,000	$5,000 per day
PCCP,RCP	>48" (internal)	$10,000	$11 per foot

Hazen

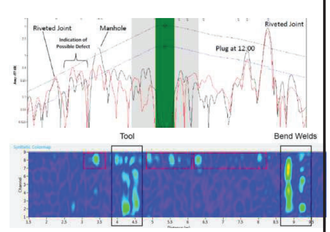
23

Direct Condition Assessment Level 1 – Acoustic

Guided Wave Testing (GWT)

Direct Condition Assessment – Ultrasonic

- Benefits:
  - Screening of long length of pipe (100')
  - 100% of pipe wall is inspected
  - Detects corrosion in insulated and buried pipes
- Limitations:
  - Variable range: 1"-60" and 60-1,000 LF
  - Exposure of pipe exterior is required
  - Applies to metallic pipes only and primarily steel
  - Interference from bends, welds, joints and may miss major point defects
  - Cement lining significant issue



Materials	Diameter	Mobilization	Assessment Cost
Metallic	Up to 42"	$2,500	$5,000 per day

Hazen

24

Direct Condition Assessment Level 2 – Ultrasonic

Ultrasonic thickness testing

- Usually handheld
- Measures thickness directly
- Point measurement around multiple locations
- Coatings must be removed

Materials	Diameter	Mobilization	Assessment Cost
Metallic	Any	< $1,000	$1,200 per day

Hazen

25

Direct Condition Assessment Level 2 – Electromagnetic

Broadband Electromagnetic (BEM)

- Relatively accurate, average thickness over small area (2 in)
- Typically external inspection for sewer force mains (over 3' sections)
- Can work through coatings

Materials	Diameter	Mobilization	Assessment Cost
Metallic	any	$10,000	$10,000 ea

Hazen

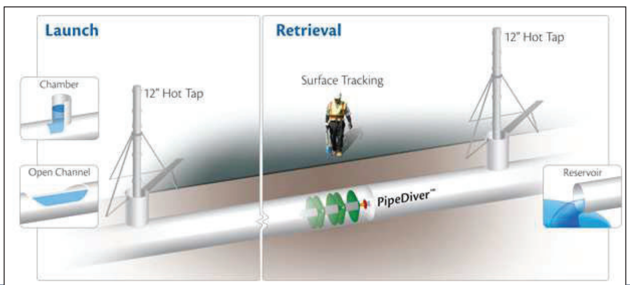
26

Direct Condition Assessment Level 2 – Electromagnetic

Pure PipeDiver

- Uses remote field technology
- Measures wire breaks with pipe active
- Measures pipe wall defects in metallic pipe

	Materials	Diameter	Mobilization	Assessment Cost
Diver	PCCP/ Metallic	> 24”	$70,000	$13 per foot



Hazen

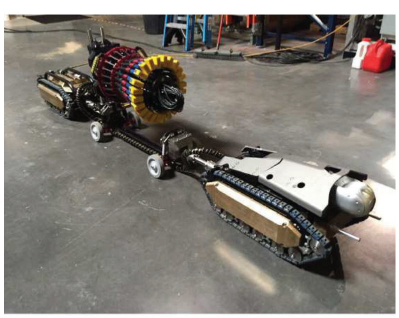
27

Direct Condition Assessment Level 2 – Electromagnetic

Pure Robotics

- Uses remote field technology
- Can also take video, sonar, and laser
- Measures pipe wall defects in metallic pipe
- Internal

	Materials	Diameter	Mobilization	Assessment Cost
Robotics	Steel/DI	> 24”	$70,000	$15 per foot



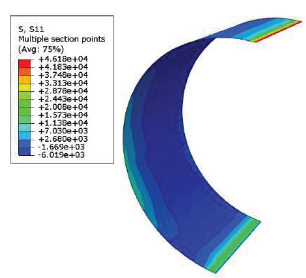


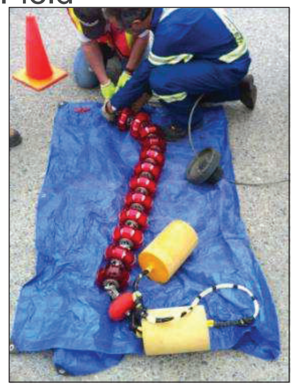
Figure 4 – Structural Analysis Model

Hazen

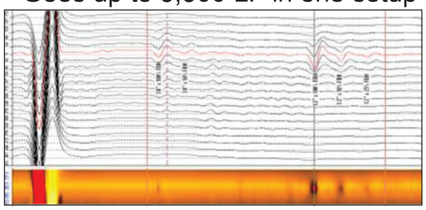
28

Direct Condition Assessment Level 2 – Electromagnetic

PICA See Snake and RAFT Remote Field Technology



- Uses remote field technology
- Internal inspection
- Requires some cleaning
- Must be depressurized
- Goes up to 3,300 LF in one setup



Materials	Diameter	Mobilization	Assessment Cost
Metallic	Up to 48"	$15,000	$8-$10 per foot

Hazen

29

Direct Condition Assessment Level 2 – Electromagnetic

Magnetic Flux Leakage

- Accurate to detect wall loss and defects but very new to sewage force mains
- Internal or external inspection (external 3' sections)
- Typically requires intimate contact but Pure claims up to 1" concrete coating

	Materials	Diameter	Mobilization	Assessment Cost
Internal (Pure)	Metallic	Up to 78"	Variable	Variable
External	Metallic	any	$15,000	$2,500-$7,400 ea

Figure 1: Smart Cat on Pipe

Hazen

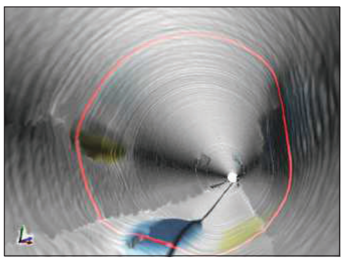
30

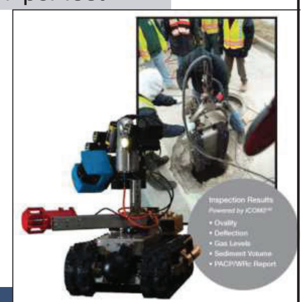
Direct Condition Assessment Level 2 – CCTV and Laser Profile

Redzone Robotics and Pure Robotics

- Accurate 3D Lidar scan of profile and CCTV in one unit
- Tethered with maximum range of about 8,000 LF each access
- Requires pipe to be out of service

Materials	Diameter	Mobilization	Assessment Cost
Any	>=36”	$30,000	$7 per foot





Hazen

31

Direct Condition Assessment – Summary

Inspection Technology	Type	Pipe active	Mobilization Cost	Inspection Cost	Length Per Setup	Free Swimming	Dia	Direct Contact Required	Material	Comment
Pure Sahara	Acoustic	Yes	Approx $25,000	Approx $6 ft	Approx 2,500 LF max	No	Any	No	Any	Requires 2" tap Leak and gas only
Pure Smartball	Acoustic	Yes	Approx $25,000	Approx $4 ft	Any	Yes	Any	No	Any	Requires 4” tap
Pure Pipediver	Electromagnetic (RFT)	Yes	$70,000	$13 ft	Any	No	>24"	No	PCCP/Metallic	Requires 12“ access
Pure Robotics	Electromagnetic (RFT)	No	$70,000	$15/ft	Varies	Tethered	24”-48”	No	Steel/DIP	Requires 18” access
Pure MFL Internal	Electromagnetic (MFL)	Yes				No	8"-78"	No	Metallic	Very new
Echologics Acoustic	Acoustic	Yes	$15,000	$5 ft	300'-500'	No	Any	No	no PVC	Averages loss over distance. Min 30 psi
Smart-CAT MFL External	Electromagnetic (MFL)	Yes	$15,000	Approx $5,000 site	3' each	No	Any	Yes	Metallic	Usually used as refinement to Acoustic findings
PICA See Snake	Electromagnetic (RFT)	No	$15,000	$8 ft	3,300 LF max	Yes/No	Up to 28"	No	Metallic	Must be depressurized and section of pipe removed
Handheld Ultrasonic	Ultrasonic	Yes		$1,200 day	Point measurement	No	Any	Yes	Metallic	localized
Redzone Lidar/CCTV	CCTV/Laser	No	$30,000	$7 ft	8,000 LF max	No	Any	No	Any	Highly accurate measurements
BEM	Electromagnetic (RFT)	Yes	$10,000	$10,000 site	3' each	No	Any	No	Metallic	3' length only
NDT Impact Echo Internal	Ultrasonic/Acoustic	No	$10,000	$11 ft		No	>48"	Yes	PCCP/RCP	Entire pipe tested. Measures thickness, wire breaks and strength
NDT Impact Echo External	Ultrasonic/Acoustic	Yes	$10,000	$5,000 day	Point measurement	No	Any	Yes	PCCP/RCP	Point test. Measures thickness wire breaks and strength'

Note: Costs do not include excavation of sites and installation of insertion point s which can be $5,000-$30,000 each

Hazen

32

Case Study: Greater Cincinnati Water Works (GCWW)

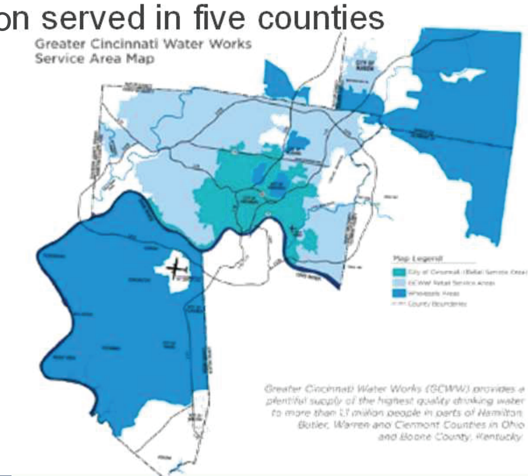
~247,000 accounts

~1.1 million population served in five counties

2 WTPs

133 MGD average

~3,100 miles of pipe



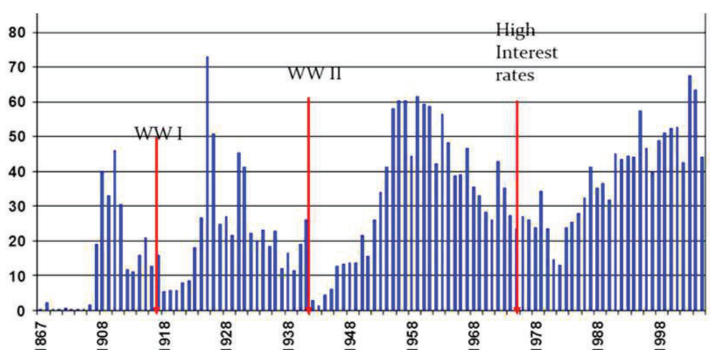
Hazen

33

Greater Cincinnati Water Works (GCWW) Main Replacement Program Background

Pipes' ages up to 150 years old

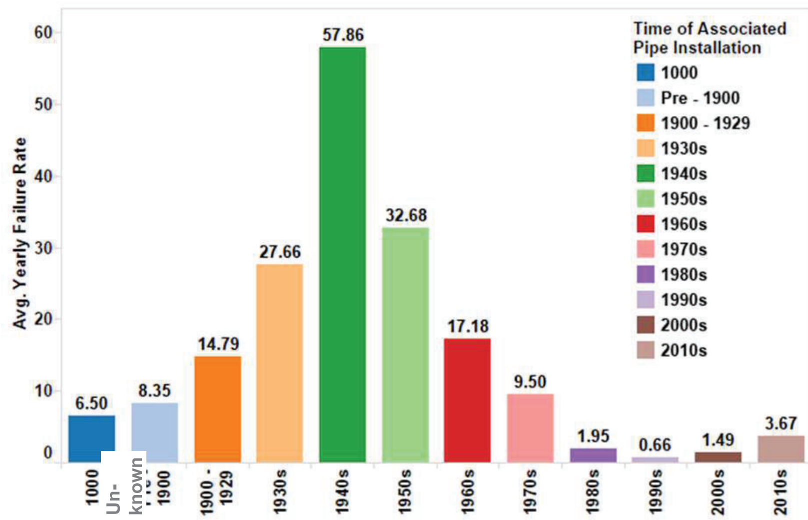
Average pipe age (by length) = 46 yrs.



Hazen

34

GCWW Water Main Replacement Program Effectiveness Evaluation – Key Findings

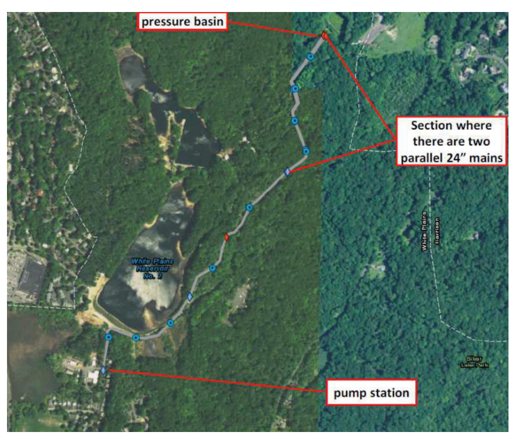


Hazen

35

Echologics – White Plains Transmission Main

- 6,600 lf of 24" CI pipe built 1925
- Leak detection and e-pulse condition assessment
- Echolife® used to predict remaining useful life
- Transient pressure monitoring



Hazen

36

Echologics – White Plains Transmission Main

- Numerous segments > 20% loss

Segment	Distance	Internal Diameter	Pipe Material	Design Thickness	Remaining Thickness	% Change from Design Thickness
	(ft)	(in)		(in)	(in)	
1	269	24.0	CI	1.13	0.76	-32.8%
2	375	24.0	CI	1.13	0.78	-30.5%
3	337	24.0	CI	1.13	0.92	-18.8%
4	319	24.0	CI	1.13	0.94	-17.0%
5	312	24.0	CI	1.13	0.87	-23.3%
6	528	24.0	CI	1.13	0.94	-17.0%
7*	396	24.0	CI	1.13	0.79	-30.0%
8	361	24.0	CI	1.13	0.81	-28.6%
9	395	24.0	CI	1.13	0.92	-18.9%
10	340	24.0	CI	1.13	0.85	-25.1%
11	398	24.0	CI	1.13	1.01	-10.6%
12	405	24.0	CI	1.13	0.91	-19.6%
13	359	24.0	CI	1.13	0.85	-24.4%
15	267	24.0	CI	1.13	0.85	-24.4%
16	370	24.0	CI	1.13	0.91	-19.1%
17	342	24.0	CI	1.13	0.89	-21.3%
18	320	24.0	CI	1.13	0.93	-17.6%
19	310	24.0	CI	1.13	0.74	-34.6%

Hazen

37

P-CAT – Rosemont Rd. WM Condition Assessment

- 20” CI transmission main Virginia Beach, VA
- 5,100 LF installed 1967
- Used p-CAT to conduct screening assessment
- 32% considered highly deteriorated (<70% remaining thickness on average)

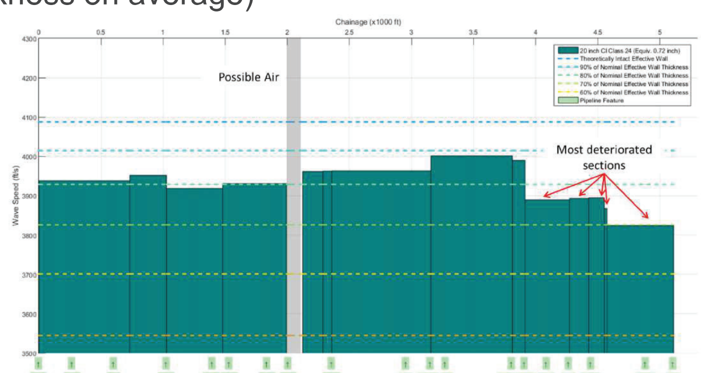


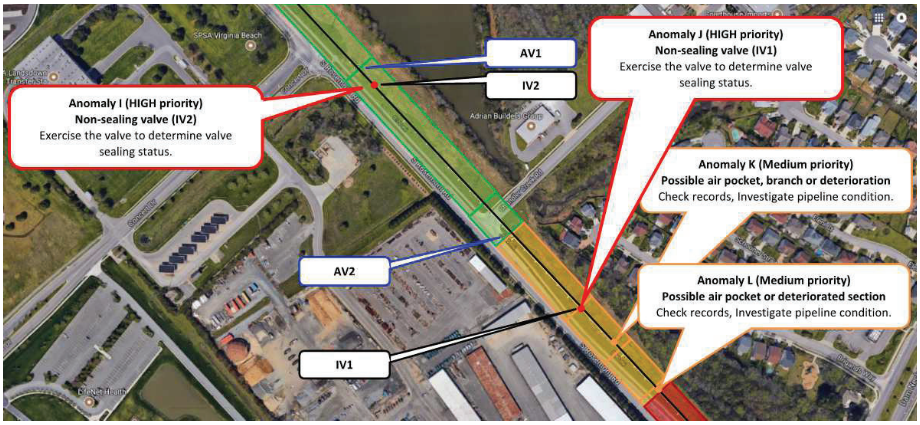
Figure 4.3: Internal wall deterioration for the Rosemont Road (Scenario 2 - 0.72 inch).

Hazen

38

P-CAT – Rosemont Rd. WM Condition Assessment

- Next Steps conduct more detailed assessment in targeted locations.

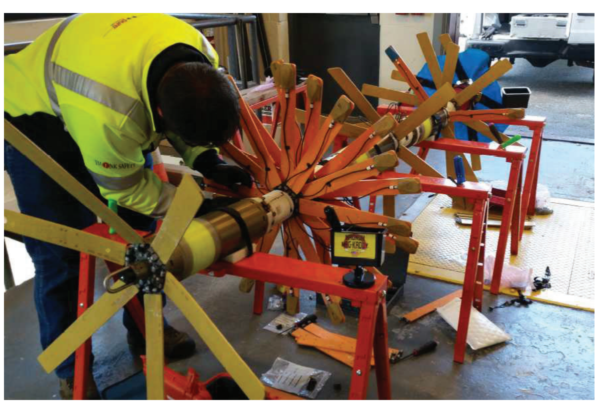


Hazen

39

TOSA Outfall Pipediver Inspection

- 36” PCCP and Steel Ocean Outfall had failed
- Utilized PipedDver to assess condition of remaining pipe under pressure conditions

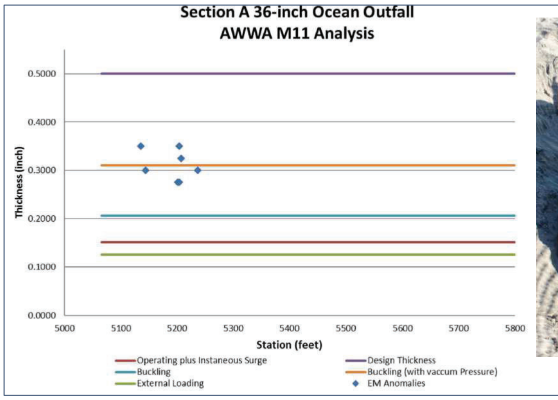


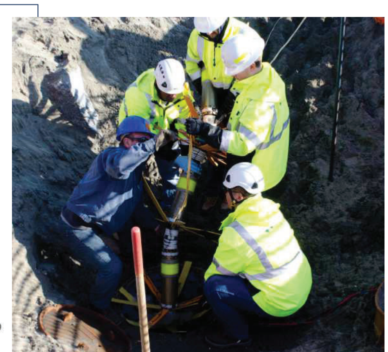
Hazen

40

TOSA Outfall Pipediver Inspection

- Found sections were actually 33” rather than 36”
- Only one PCCP pipe had prestressing wire breaks
- Several steel sections did not meet design requirements for pipe thickness.



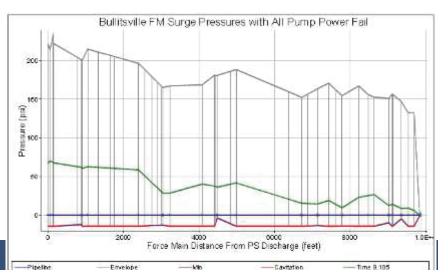


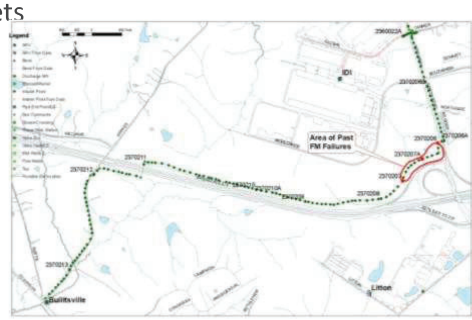
Hazen

41

Assessment Case Study - Bullitsville Force Main Condition Assessment

- 13,360 LF of Ductile Iron FM
- FM has experienced numerous failures due to internal corrosion
- **Desktop analysis** showed history of failures, local high spots, failing ARV’s and gravity section
- Sahara leak detection selected to locate FM and identify potential leaks and gas pockets
- Surge analysis



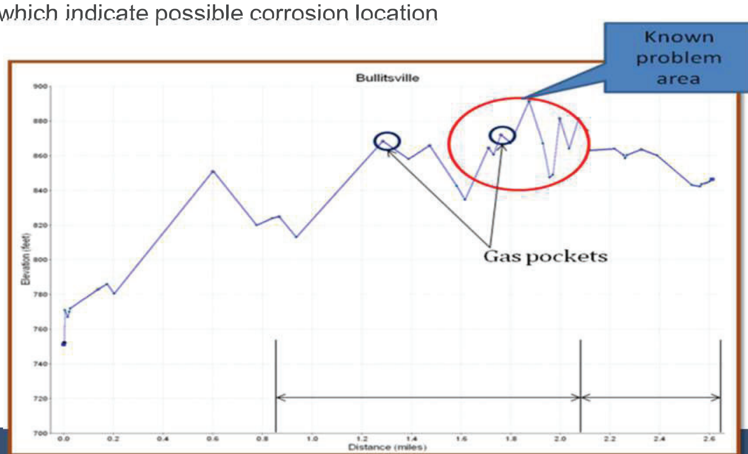


42

Bullitsville PS and Force Main Condition Assessment

Results of gas and leak detection

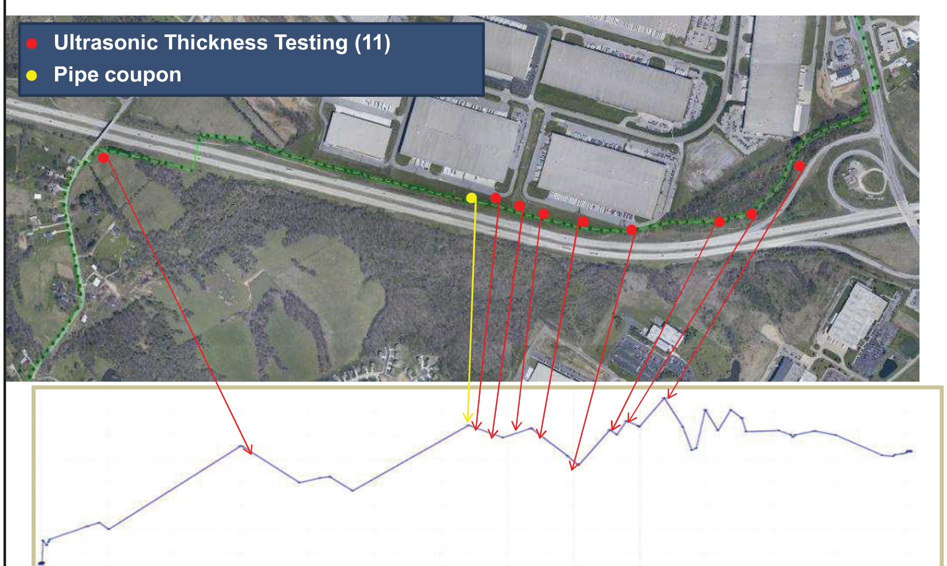
- No evidence of leaks,
- Several gas pockets at high points and near ARVs were located which indicate possible corrosion location



Hazen

43

Bullitsville PS and Force Main Condition Assessment – Level 2 Inspection Plan

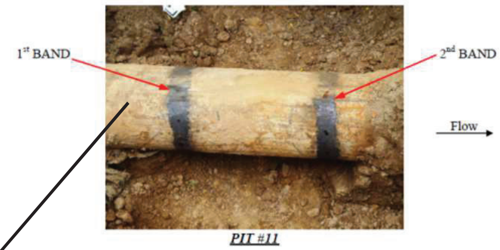


Hazen

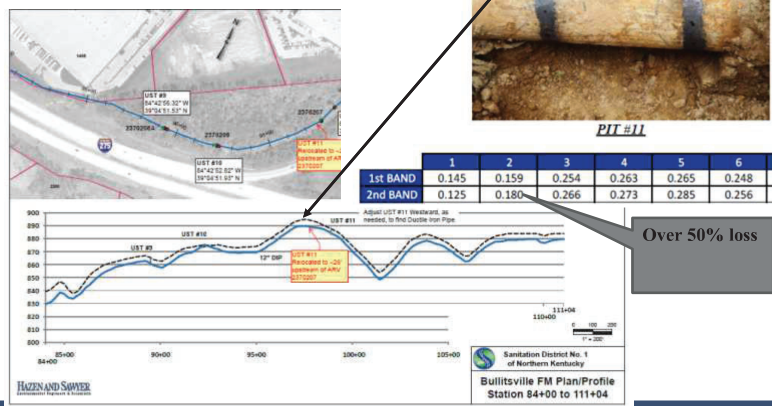
44

Bullitsville PS and Force Main Condition Assessment Results

Pipe: Pressure Class 350 DIP (0.280" nominal with +/-0.06" casting



	1	2	3	4	5	6	7	8
1st BAND	0.145	0.159	0.254	0.263	0.265	0.248	0.250	0.197
2nd BAND	0.125	0.180	0.266	0.273	0.285	0.256	0.251	0.205



Hazen

45

Bullitsville PS and Force Main Condition Assessment Results

- Only vicinity of absolute high point had significant corrosion
- Surge not an issue
- Results correlate well with desktop assessment
- Gas pocket locations did not show metal loss likely due to fact that gas is anaerobic
- Most of the force main does not need to be replaced.
  - **From >6,500 LF to less than 1,200 LF**
- Phase approach saved over
- **$400,000 in construction**
- Ultrasonic thickness cost $3,400
- for 11 locations

Hazen

46

Summary

- There are numerous methods for assessing pressure pipe but costs are a major factor.
- Taking a phased/risk-based approach enables cost-effective decisions.
- For metallic pipe, our experience has shown desktop analysis is very good at predicting areas for corrosion for force mains.
- Ultrasonic thickness measurement is often the most-cost effective if corrosion is main concern.
- Electromagnetic inspection is shown to be accurate but can be expensive. However, amount of risk may make this type of inspection cost-effective.
- Technology is improving rapidly

Hazen 47

47

Rehabilitation Technologies

Cured-in-Place

Tight-Fit

Pipe Bursting

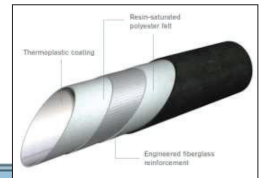
Spray lining

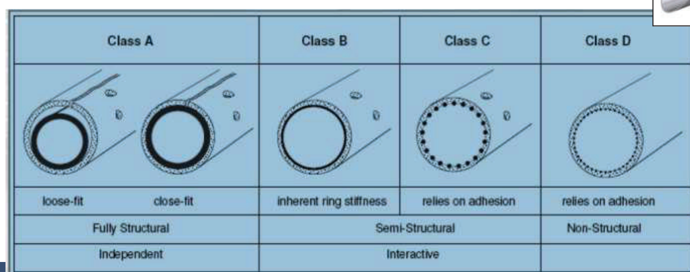
Hazen

48

Rehabilitation Technologies - Cured-in-Place (CIPP) for Pressure pipe

- Use of CIPP in pressure pipes gaining in popularity
  - Fiberglass reinforcement for pressure applications
  - Couplings available at transition
  - Up to 150 PSI
  - Can design for class A or class B conditions



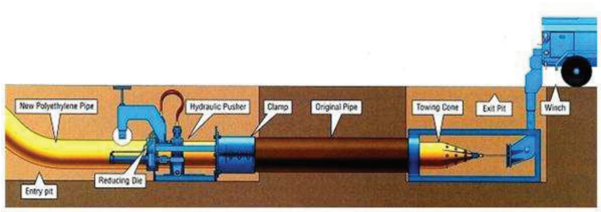


Hazen

49

Rehabilitation Technologies – Close Fit Pressure

- Diameter Reduction (swaglining)
  - Pipe HDPE pipe, butt-fused, pulled through reducing dies or rollers
  - Up to 60”
  - Full structural solution

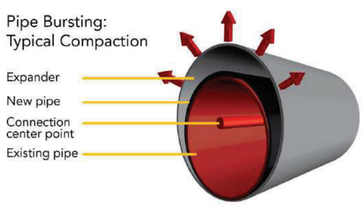


Hazen

50

Pipe Bursting/Splitting

- Insert new pipe through old pipe
  - ✓ Static
  - ✓ Pneumatic
- Up to 48”
- Can upsize up to 3 sizes depending on conditions
- CIP and DIP



Hazen

51

Rehabilitation Technologies – Polymer Coatings

- Gravity Sewer
  - Thick application of epoxy or polyurethane to wall of pipe
  - Can be designed with structural properties
  - Little or no loss of hydraulic capacity
- Pressure pipe
  - Centrifugally applied coating to existing pipe
  - Can be class C or D

Warren Environmental Epoxy from trenchlessonline.com

Hazen

52

Rehabilitation Technologies – Polymer Coatings

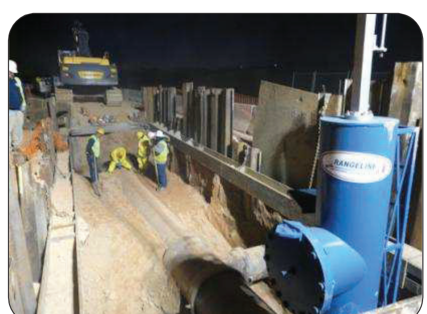
- Advantages
  - –Corrosion resistant
  - –No size or geometry limitation
  - –Little or no loss of hydraulic capacity
- Disadvantages
  - –Typically little structural support
  - –Bypass pumping usually required
  - –Surface preparation and quality control is critical
  - –Expensive

Hazen

53

Rehabilitation – Line stopping

- Line stopping
  - Can keep pipeline live during construction
  - Option to keep stopple in service or use to create temporary force main



Hazen

54

54

Mechanical	1	2	3	4	5
Corrosion	No corrosion present.	Less than 10% corrosion present	10 - 50% corrosion present	50 - 75% corrosion present	Over 75% corrosion present.
Paint/Coatings	No coating damage/deterioration present.	Less than 10% coating/deterioration present	10 - 50% coating/deterioration present	50 - 75% coating/deterioration present	Over 75% coating/deterioration present
Nameplates	Nameplates are legible and in "like new" condition.	Nameplates are legible but showing signs of wear.	Nameplate data is fading/difficult to read. Nameplate beginning to detach from asset.	Majority of nameplate data is missing and/or nameplate is barely secure to asset. Consider replacing nameplate.	Nameplates are missing or are illegible. Nameplate should be replaced.
Heat/Odor	No abnormal heat or odor is evident.	Mild odor and/or mild heat is evident. No damage is evident that has been caused by excessive heat.	Odor and heat are evident and should be addressed in the near term. Asset is still functional but showing signs of wear due to the excessive heat.	Significant wear from heat is evident and the asset should be replaced or is in need of a major overhaul.	Such excessive heat or odor that asset should not be in operation.
Vibration / Noise	No abnormal noise/vibration is evident.	Abnormal noise is present, no vibration is present.	Both abnormal noise and vibration is apparent.	Non-structural damage due to abnormal vibration is present.	Structural damage due to abnormal vibration is present.
Leakage	No leakage present.	Past leakage is evident but no rehabilitation is required. Leak is not reoccurring.	Active leak present, continuous drip.	Active leak present, continuous stream in one location.	Active leak present, continuous stream in more than one location.
Piping/Valves/Appurtenances	No damage to adjacent piping, valves, and/or appurtenances.	Piping, valves, and/or appurtenances show signs of wear. Minor corrosion and coating peeling.	Valves/piping/appurtenances show 10 - 50% corrosion. Valves show signs of leakage and need of maintenance.	Valves/piping/appurtenances show 50 - 75% corrosion. Leakage is evident from valves and/or piping. Consider replacing/overhauling in near future.	Valves are inoperable, piping and appurtenances have corroded > 75% and piping/valves have continuous leakage.
Supports / Anchors / Base	No damage to supports/anchors.	Minor damage to one location. Minor cracking, grout loosening and/or surface corrosion.	Major damage to one location. Major cracking, grout loosening and/or surface corrosion.	Major damage to 2 locations. 25 - 50% cracking, grout loosening and/or surface corrosion.	Major damage to more than 2 locations. > 50% cracking, grout loosening and/or surface corrosion.
Electrical Controls	Electrical Controls are fully functioning.	Electrical controls are fully functioning, however showing signs of wear.	Electrical controls are in need of maintenance.	Controls are barely functioning. Needs to be replaced or overhauled.	Push buttons are not functioning. Equipment should not be operational.
Physical Damage (ex. Dent)	No physical damage to equipment.	Less than 10% physical damage present	10 - 25% physical damage present	25 - 50% physical damage present	Over 50% physical damage present.

Electrical/I&C	1	2	3	4	5
Corrosion	No corrosion present.	Less than 10% corrosion present	10 - 50% corrosion present	50 - 75% corrosion present	Over 75% corrosion present.
Heat/Odor	No abnormal heat or odor evident.	Mild odor and/or mild heat is evident. No damage is evident that has been caused by excessive heat.	Odor and heat are evident and should be addressed in the near term. Asset is still functional but showing signs of wear due to the excessive heat.	Significant wear from heat is evident and the asset should be replaced or is in need of a major overhaul.	Such excessive heat or odor that asset should not be in operation.
Fluid/Water Damage	No fluid and/or water damage is evident.	Past moisture accumulation is evident but no rehabilitation is required. Moisture problem is not reoccurring.	Moisture accumulation is evident and continuous. Increased maintenance is required to maintain typical operation.	Immediate replacement is needed due to water damage.	Wiring is submerged and should be locked out until wiring is replaced and leak source repaired.
Paint/Coatings	No coating damage/ deterioration present.	Less than 10% coating/deterioration present	10 - 50% coating/deterioration present	50 - 75% coating/deterioration present	Over 75% coating/deterioration present
Doors/Seals	No damage to doors/seals.	Seals are showing signs of wear. No damage to doors.	Seals are missing pieces/deteriorating. No damage to doors.	Doors no longer shut entirely and seals are missing pieces/deteriorating.	Seals are deteriorated and/or doors have extensive damage so that equipment is no longer protected.
Nameplates	Nameplates are legible and in "like new" condition.	Nameplates are legible but showing signs of wear.	Nameplate data is fading/difficult to read. Nameplate beginning to detach from asset.	Majority of nameplate data is missing and/or nameplate is barely secure to asset. Consider replacing nameplate.	Nameplates are missing or are illegible. Nameplate should be replaced.
Sunshield	No damage to sunshield.	Shield shows minor wear due to age and/or exposure to the elements.	Visible cracking in shield.	Shield supports/anchors are loose; visible cracking in shield.	Sunshield is missing or does not provide protection to instrumentation.
Display Screen	Display screen is fully operational and no damage is evident.	Less than 10% damage is evident to screen.	10 - 50% of damage is evident to screen.	50 - 75% of damage evident to screen. Consider replacing.	Screen is no longer functional and needs to be replaced. Over 75% damage evident to screen.
Indicator Lights	Indicator lights are fully functioning, bright, and visible.	Indicator lights are fully functioning, however showing signs of wear/dimming.	Indicator lights are functioning, however, full attention must be given to distinguish what they are indicating.	Indicator lights are barely functioning. Cannot tell if on or off, or flickering frequently.	Indicator lights are not functioning.
Push Buttons	Push Buttons are fully functioning, bright, and visible.	Push Buttons are fully functioning, however showing signs of wear/labels wearing off.	Push Buttons are sticking and in need of maintenance.	Push buttons are barely functioning. Needs to be replaced or overhauled.	Push buttons are not functioning. Equipment should not be operational.
Conduits and Support Brackets	Conduits and support brackets meet all standards and are well maintained. No wear is evident.	Typical wear is evident but does not allow fluid to penetrate.	Maintenance is required to repair damage to conduit and/or supports which could allow fluid to penetrate and contact wiring.	Conduit and/or brackets show significant wear/deterioration, should be replaced or overhauled.	Conduit needs immediate replacement and asset should be locked out until replacement has occurred.
Wiring	Wiring and/or wire labeling meets all standards and shows no wear.	Wiring and/or wire labeling is starting to show signs of wear, however no performance deterioration is present.	Wiring and/or labeling is showing signs of wear which indicate reduced performance may be possible.	Wiring and/or labeling is showing significant deterioration which should be replaced or overhauled.	Such excessive deterioration that the asset should not be in operation.
Supports / Anchors	No damage to supports/anchors.	Minor damage to one location. Minor cracking, grout loosening and/or surface corrosion.	Major damage to one location. Major cracking, grout loosening and/or surface corrosion.	Major damage to 2 locations. 25 - 50% cracking, grout loosening and/or surface corrosion.	Major damage to more than 2 locations. > 50% cracking, grout loosening and/or surface corrosion.
Physical Damage	No physical damage to equipment.	Less than 10% physical damage present	10 - 50% physical damage present	50 - 75% physical damage present	Over 75% physical damage present.
Pests/Critters	No signs of pests or damage.	Signs of pests, but no damage.	Signs of pests, minor damage.	Pests are present with extensive damage. May need pest control.	Pest infestation; requires immediate pest control and replacement of asset.

Structural		1	2	3	4	5
Foundation		No settling/cracking apparent	Minor (no structural impact)	Moderate (structural impacts)	Moderate (structural impacts)/multiple locations	Major (close to failure)
Walkways/Platforms		No deterioration apparent.	Surface Corrosion <10%	Surface Corrosion 10%-25%	Surface Corrosion >25%-50%	Surface Corrosion >50%
			Structural Corrosion - Loss of Section - None	Structural Corrosion - Loss of Section - <10%	Structural Corrosion - Loss of Section - 10%-30%	Structural Corrosion - Loss of Section - >30%
			Cracking - None	Cracking - 1 location (minor)	Cracking - 1 location (major) or 2 locations (minor)	Cracking - 1 location (major) or 2 locations (minor)
			Fatigue/Connection Failure - None	Fatigue/Connection Failure - None	Fatigue/Connection Failure - 1 location	Fatigue/Connection Failure - 1 location
			Deformation - minor (no structural impacts)	Deformation - moderate (no structural impacts)	Deformation - moderate (structural impacts)	Deformation - major (close to failure)
Ladders		No deterioration apparent.	Surface Corrosion <10%	Surface Corrosion 10%-25%	Surface Corrosion >25%-50%	Surface Corrosion >50%
			Structural Corrosion - Loss of Section - None	Structural Corrosion - Loss of Section - <10%	Structural Corrosion - Loss of Section - 10%-30%	Structural Corrosion - Loss of Section - 10%-30%
			Cracking - None	Cracking - 1 location (minor)	Cracking - 1 location (major) or 2 locations (minor)	Cracking - 1 location (major) or 2 locations (minor)
			Fatigue/Connection Failure - None	Fatigue/Connection Failure - None	Fatigue/Connection Failure - 1 location	Fatigue/Connection Failure - 1 location
			Deformation - minor (no structural impacts)	Deformation - moderate (no structural impacts)	Deformation - moderate (structural impacts)	Deformation - major (close to failure)
Railings		No deterioration apparent.	Surface Corrosion <10%	Surface Corrosion 10%-25%	Surface Corrosion >25%-50%	Surface Corrosion >50%
			Structural Corrosion - Loss of Section - None	Structural Corrosion - Loss of Section - <10%	Structural Corrosion - Loss of Section - 10%-30%	Structural Corrosion - Loss of Section - >30%
			Cracking - None	Cracking - 1 location (minor)	Cracking - 1 location (major) or 2 locations (minor)	Cracking - 2 locations (major) or 4 locations (minor)
			Fatigue/Connection Failure - None	Fatigue/Connection Failure - None	Fatigue/Connection Failure - 1 location	Fatigue/Connection Failure - 2 locations
			Deformation - minor (no structural impacts)	Deformation - moderate (no structural impacts)	Deformation - moderate (structural impacts)	Deformation - major (close to failure)
Structural Damage	Concrete	Cracking (width of crack) - None	Cracking (width of crack) - Minor (<1mm)	Cracking (width of crack) - Moderate (1-2mm)	Cracking (width of crack) - Major (>2mm)	Cracking - Excessive (close to failure)
		Exposed Reinforcement - None	Exposed Reinforcement- None	Exposed Reinforcement- None	Exposed Reinforcement- 1 location	Exposed Reinforcement- >1 location
		Spalling, Exposed Aggregate, Pitting, Freeze/Thaw - None	Spalling, Exposed Aggregate, Pitting, Freeze/Thaw - None	Spalling, Exposed Aggregate, Pitting, Freeze/Thaw - <10%	Spalling, Exposed Aggregate, Pitting, Freeze/Thaw - 10%-30%	Spalling, Exposed Aggregate, Pitting, Freeze/Thaw - >30%
	Steel	Joint Damage - None	Joint Damage - <10%	Joint Damage - 10%-25%	Joint Damage - 25%-50%	Joint Damage - >50%
		Structural Corrosion - None	Structural Corrosion - Loss of Section - None	Structural Corrosion - Loss of Section - <10%	Structural Corrosion - Loss of Section - 10-30%	Structural Corrosion - Loss of Section - >30%
		Cracking-None	Cracking (width of crack) - Minor (<1mm)	Cracking (width of crack) - Moderate (1-2mm)	Cracking (width of crack) - Major (>2mm)	Cracking - Excessive (close to failure)
		Fatigue/Connection Failure - None	Fatigue/Connection Failure - None	Fatigue/Connection Failure - None	Fatigue/Connection Failure - 1 location	Fatigue/Connection Failure - >1 location
		Deformation - None	Deformation - minor (no structural impacts)	Deformation - moderate (no structural impacts)	Deformation - moderate (structural impacts)	Deformation - major (close to failure)
Exterior Coatings		No wear, cracking, or peeling present.	Wear, cracking, or peeling covers < 10%.	Wear, cracking, or peeling covers 10%-25%	Wear, cracking, or peeling covers 25%-50%	Wear, cracking, or peeling covers >50%
Interior Coatings		No wear, cracking, or peeling present.	Wear, cracking, or peeling covers < 10%.	Wear, cracking, or peeling covers 10%-25%	Wear, cracking, or peeling covers 25%-50%	Wear, cracking, or peeling covers >50%
Metal Hatches		No visible corrosion.	Minor corrosion visible.	Moderate corrosion.	Significant corrosion or minor yielding.	Significant yielding or rupture.

Appendix E: Lake Management Plan

Technical Memo

To: Scott Gilbertson, Alexandria Lake Area Sanitary District

From: Joe Bischoff, Wenck Associates, Inc.

Date: April 22, 2020

Subject: 2020 Lake Management Activities

The purpose of this memorandum is to provide a brief summary of our current understanding of carp populations in Lake Winona and to provide an outline for activities to pursue in 2020 through Spring of 2021. This memo also addresses activities for the alum treatment on Lake Agnes.

Carp Population Assessment and Impact Summary

Summary of Carp Population Dynamics

The Lake Winona, Lake Agnes, and Lake Henry chain of lakes has a history of poor water quality and a need for restoration. Lake Winona sits at the top of the chain of lakes and receives discharge from the ALASD WWTF. ALASD has worked diligently to reduce phosphorus loading to Lake Winona, reducing their phosphorus loading to the lake by more than half with minimal changes in lake water quality. The muted response of Lake Winona and the downstream lakes is likely the result of biological factors including carp infestation and a highly degraded or nonexistent submerged aquatic plant community.

Carp density in the chain of lakes, especially Lake Winona, was determined to be extremely high, well above established thresholds for impacting water quality and the SAV community. Carp appear to have established in the chain of lakes sometime between 2001 and 2008 (primarily 2002 based on the carp aging analysis), quickly reproducing to extremely high densities. This founding population spawned an enormous year class of carp that together with founders make up the majority of the hyperabundant population present currently. Following this initial infestation and reproduction event, carp recruitment appears to be sporadic with three recruitment classes (2002, 2005, and 2011) comprising the bulk of the carp surveyed in the chain of lakes. Carp recruitment appears to be minimal in recent years, likely limited by the already high population density utilizing the chain of lakes. There is some evidence that reproduction in might be occurring in Lake Winona itself which may be a result of limited egg predation by panfish whose abundance is low. Therefore, controlling the carp population in Lake Winona will require both isolation and periodic, targeted removals of carp.

Carp appear to move freely throughout the chain of lakes with carp biomass densities varying through the seasons as the fish move unimpeded between suitable habitats. Measured carp movements for a 25-day period in out of Lake Winona using PIT tags demonstrated approximately 7,000 fish moved in and out of the lake. Further, radio telemetry data suggest that carp move seasonally in and out of lake Winona. Carp that do spend extended time in Lake Winona tend to congregate around the WWTF's outfall. The freedom of movement facilitates carp reproduction and survival by allowing carp spawning migrations to minimize the impacts of egg consumption by panfish populations. These movements throughout the system suggest that fish barriers are necessary to manage carp in the chain of lakes, especially in Lake Winona. Anecdotal evidence (carp scales and carcasses on the shores) suggest that carp also move between Lake L'homme Dieu and Lake Henry, the likely source of the carp infestation following the failure of a carp barrier around 2001. Lakes within the greater watershed may be affected by the carp populations that grow and reproduce in Lakes Winona/Agnes/Henry and control in these headwater lakes will presumably reduce carp in the overall watershed.

Aquatic plant communities in the chain of lakes are also highly degraded, a likely result of poor water quality and high carp densities. All three lakes demonstrated a limited areal extent of Submerged Aquatic Vegetation (SAV) communities, minimal species diversity, and were dominated by tolerant aquatic plant species.

Recommendations

Monitoring activities completed in 2019 verified that carp densities are very high in the chain of lakes and are likely degrading water quality and aquatic plant communities. While a better understanding of where carp reproduction occurs is needed, it is clear that the carp population must be reduced, and their movement restricted to effectively improve water quality in the lakes.

Over the next year, Wenck will collect and analyze movement data from the radio tags to inform the execution of carp management activities including removal of adult individuals and suppression of reproduction. Specific methods to sustainably manage the carp population will continue to be developed based on analysis of data collected and integrated into the ongoing work plan. However, carp should be removed from Lake Winona and movement into Lake Winona should be restricted. Wenck recommends pursuing the following activities in 2020:

1. Develop a carp removal plan that outlines the techniques to be employed, when these techniques are appropriate, and benchmarks or goals for the control of the carp population.

2. Design and installation of a carp barrier the discharge from North Pond to Lake Agnes to limit carp migration into Lake Winona. This task will require a number of meetings with the Minnesota DNR to develop an appropriate design and permits. Wenck Recommends considering a permeable rock berm that has been used successfully in Iowa (Figure 1).

3. Carp removal in Lake Winona, South Pond, and North Pond to lower carp densities below water quality thresholds. This will likely be accomplished through a mix of removal activities that may include seining, baited trapping, migration trapping, and electrofishing.

4. Continued tracking of radio tagged carp to further develop an understanding of carp spawning areas to minimize overall population size in the chain of lakes.

Figure 1. Example permeable rock berm fish barrier used in Iowa.

The next steps are to prepare for the installation of carp barrier at the outlet of lake Winona to prevent carp movement into the lake and to develop and execute a carp removal action plan to improve water quality in Lake Winona (Table 1). The District received approximately $50,000 from LCCMR (not included in Wenck's current scope of work) to conduct carp removals. No funding was provided for carp barriers, but the design and installation are required in the District's NPDES permit. Wenck's scope of work does include funding to facilitate carp removal in Lake Winona including permitting support, managing local fisherman, facilitating the identification of disposal sites, and other activities as necessary. Wenck recommends ALASD start pursuing fish removals for this fall and winter. Wenck will work with the District in the summer of 2020 to develop a detailed carp removal plan for Lake Winona.

Table 1. Carp Management Activity Timeline.

Carp Management Activity	**Date**
Develop carp removal action plan for Lake Winona	May 2020
Approve proposal to permit and design carp barrier	June 2020
Approve plans and specifications for carp barrier	August 2020
Bid carp barrier project	August 2020
Select contractor	September 2020
Install barrier	October/November 2020
Seining events for carp removal (3 possible events)	October 2020 through February 2021

Lake Agnes Aluminum Sulfate Treatment

The purpose of the Lake Agnes alum application is to reduce sediment phosphorus release and improve water quality in the lake. Alum permanently bind phosphorus in the sediments preventing release into overlying water and subsequent algal production.

Lake Agnes receives discharge from ALASD's WWTF via Lake Winona in addition to stormwater discharge from the City of Alexandria. Previous analyses suggested that Lake Agnes is also impacted by a large internal phosphorus load with hypolimnetic phosphorus concentrations exceeding 1.2 mg/L total phosphorus (Wenck 2018). In fact, changes in hypolimnetic phosphorus suggest that peak sediment phosphorus release rates may exceed 32.8 mg/m^2/day. It is important to note that a hypolimnetic mass balance can often overestimate the release rate due to sensitivity in defining the hypolimnetic volume. However, internal phosphorus loading is clearly a significant source of phosphorus to Lake Agnes.

Initial project dosing suggests adding **144,354 gallons of aluminum sulfate (alum)** to areas of the lake greater than 15 feet in depth. The application should be split in two with the first application occurring in Fall of 2019 followed by a Fall of 2021 application. The overall estimated cost for the project is **$318,708** including materials, application, and mobilization (Table 2). Each application should take 2 to 4 days to complete.

Table 2. Alum quantities and costs for a treatment on Lake Agnes.

Item	Unit	Quantity	Unit Cost	Total Cost
Total alum application (76 acres; top 4 cm; g/m^2; 15-feet and deeper)				
Aluminum sulfate	Gal $Al_2(SO_4)_3$	144,354	$2.00	$288,708
Mobilization	Lump sum	2	$15,000	$30,000
			Total application cost estimate	**$318,708**

Following is the proposed schedule for implementing the Lake Agnes alum treatment (Table 3).

Table 3. Proposed timeline for implementing the Lake Agnes alum treatment

Date	**Task and Requested Board Action (if required)**
July 1, 2020	Approve Plans and Specifications; Request project go out to bid
July 10, 2020	Bid request published
July 24, 2020	Bid opening
August 12, 2020	Board award project
August 21, 2020	Contracts and bonds due to ALASD
September 8, 2020 to October 15, 2020	Completion of the initial alum treatment (half dose)
Summer/Fall, 2021	Sediment monitoring
June 1, 2022	Contract addendums due if necessary
September 9, 2022 to October 15, 2022	Final alum application
September 2023	Final sediment monitoring

Appendix F: Phosphorus and Chloride Reduction Facility Plan (Executive Summary)

Brown AND Caldwell

Alexandria Lake Area Sanitary District

Phosphorus and Chloride Reduction Facility Plan

August 2017




Phosphorus and Chloride Reduction Facility Plan

Prepared for
Alexandria Lake Area Sanitary District
Alexandria MN

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

DONAVAN G. ESPING

Date: August 25, 2017 Reg. No. 22972

Brown AND Caldwell

30 East 7th Street Suite 2500
St. Paul, MN 55101

Executive Summary

This Facility Plan addresses the Alexandria Lake Area Sanitary District (ALASD) existing National Pollutant Discharge Elimination System (NPDES) permit requirements to submit a Facility Plan which identifies alternative treatment technologies and/or other discharge locations/methods to further reduce effluent total phosphorus (TP) and total chloride resulting in attaining the future final effluent limits which are effective March 30, 2021. The Facility Plan presents the design flows and loadings, effluent discharge criteria, existing operations, low phosphorus technology screening, phosphorus reduction alternatives, total chloride and phosphorus reduction alternatives and recommendations.

Projected Design Flows

Table ES-1 presents the plant design flow projections through Year 2040. Plant influent flow and loading projections assume the annual average flow increases at the historical growth rate of 1.5%/year with the same blend/contribution of residential, commercial, and industrial sources. Overall, the design flows increase by roughly 45 percent over the 20-year planning period.

Table ES-1. ALASD WWTF Projected Design Flows

Item	Units	Current Conditions	2020	2025	2030	2035	2040
Flows							
Annual average	mgd	2.8	3.1	3.3	3.6	3.8	4.1
Average dry weather	mgd	2.4	2.6	2.8	3.0	3.2	3.5
Average wet weather	mgd	3.9	4.2	4.5	4.9	5.3	5.7
Maximum day	mgd	8.1	8.7	9.4	10.1	10.9	11.8
Peak hour wet weather	mgd	9.6	10.1	10.6	11.1	11.6	12.1
Peak instantaneous wet weather	mgd	11.4	11.9	12.4	12.9	13.4	13.9

Effluent Discharge Criteria

The ALASD Wastewater Treatment Facility (WWTF) existing NPDES permit was issued on July 16, 2013 and contains two future TP permit scenarios of which one will go into effect on March 30, 2021. Scenario 1 effluent TP discharge requirements are based upon the Minnesota Pollution Control Agency (MPCA) Water Quality Based Effluent Limits (WQBEL) calculations using the existing state standards for shallow lakes under Minn. R. 7050.0222, subp.3. Scenario 2 effluent TP discharge requirements are based upon the MPCA May 2011 proposed Site Specific Standard for Lake Winona of 0.075 mg/L TP and 20 ug/L chlorophyll-a.

On June 12, 2015, the U.S. Environmental Protection Agency (EPA) Region V approved the MPCA Scenario 2 – MPCA Proposed Site Specific Standards (0.157 mg/L monthly average and 665 kg/yr as a 12-month rolling total). The Lake Winona Phosphorus Total Daily Maximum Loading (TMDL) study has not been approved by EPA Region V nor has ALASD received responses to its questions related to the Draft TMDL. As such, the effluent TP design criteria considers both effluent TP scenarios to compare the facility requirements with a focus on the Scenario 2-Site Specific Standard.

Table ES-2 summarizes the average effluent TP discharge concentration required to meet the effluent TP Scenario 1 and 2 mass loading requirements. As flows increase, the average effluent TP discharge concentration to achieve the mass loading requirements becomes lower than the monthly concentration requirements. To consistently achieve the effluent TP discharge requirements, facility sizing is based upon reducing TP discharges to 80 percent of the monthly concentration requirements and 90 percent of the yearly mass loading requirement presented in Table ES-2.

Table ES-2. Average Total Phosphorus Discharge to Comply with the Future Total Phosphorus Mass Loading[1] Requirements

Item	Design Year				
	2020	2025	2030	2035	2040
Projected Annual Average Flow, mgd	3.1	3.3	3.6	3.8	4.1
Scenario 1 - MPCA WQBEL Standard, mg/L TP	0.121	0.115	0.107	0.099	0.092
Scenario 2 – MPCA Proposed Site Specific Standard, mg/L TP	0.157	0.145	0.135	0.125	0.116

1. Future permit requirements effective March 30, 2021. Scenario 1 based upon a 12-month rolling total discharge of 526 kg/yr and Scenario 2 based upon a 12-month rolling total discharge of 665 kg/yr.

The current NPDES permit contains a future total chloride daily maximum discharge requirement of 252 mg/L which goes into effect on March 30, 2021. For this analysis, total chloride reduction alternatives discharging to a surface receiving water are based upon a target effluent total chloride concentration of 202 mg/L or 80% of the future maximum day limit currently identified in the ALASD NPDES permit.

Existing Operations

This facility plan reviews the plant historical TP and total chloride discharges relative to the future permit requirements. The ALASD WWTF currently adds ferric sulfate to reduce effluent TP discharges. From January 2014 through June 2017 the plant influent and effluent TP concentrations averaged 5.0 mg/L and 0.147 mg/L, respectively, with monthly TP discharges ranging from 0.09 mg/L to 0.23 mg/L. ALASD current discharges are typical of facilities with effluent filtration.

During this same period, the 12-month rolling total effluent TP discharge was 595 kilograms per year (kg/yr) with a range of 540 kg/yr to 650 kg/yr. To date, the plant has consistently met the future Scenario 2 12-month rolling total mass limitation of 665 kg/yr but has not consistently achieved the future monthly effluent TP concentration of 0.157 mg/L. Attempts to optimize TP reduction to consistently achieve the monthly TP requirement of 0.157 mg/L are ongoing but have not been successful to date. Based upon historical plant operations, a low phosphorus removal technology will need to be added to the plant flow scheme to achieve the target effluent TP discharge concentrations.

Total chloride is a soluble species which is not removed through conventional wastewater treatment plant processes. For ALASD, the effluent total chloride discharge concentrations are equal to the plant influent concentration since metals salts such as ferric chloride or equal are not added to the treatment flow scheme. Total chloride discharge concentrations measured between March 2010 through September 2016 typically ranged between 650 mg/L to 750 mg/L.

Phosphorus Reduction Alternatives

Phosphorus reduction alternatives focused on alternatives with a proven track record of reducing monthly effluent TP discharges below 0.1 mg/L or alternatives which eliminate the discharge of treated effluent to a surface receiving water. A screening of low TP discharge technologies selected single stage deep bed continuous backwash upflow filters, dual stage deep bed continuous backwash upflow filters, and tertiary clarifiers with the existing cloth media filters as treatment technologies which could be added to the ALASD flow scheme to achieve the target effluent TP concentrations. In addition, three alternatives which eliminate discharges to Lake Winona were considered including spray irrigation, deep well injection, and discharge to the Long Prairie River. Table ES-3 summarizes the opinion of probable costs for each alternative. Facility improvements required to treat Year 2040 projected flows but not related to TP reduction (i.e. primary clarifier capacity) are not included in the facility costs.

Table ES-3. Opinion of Probable Phosphorus Reduction Alternative Costs

Alternative	Capital Cost	Year 2020 Additional O& M	Present Worth
1A – Single Stage Deep Bed Continuous Backwash Filters[1]	$10,300,000	$175,000	$13,300,000
1B – Dual Stage Deep Bed Continuous Backwash Filters[1]	$14,100,000	$180,000	$18,600,000
2 – Spray Irrigation	$138,000,000	$2,100,000	$150,000,000
3 – Deep Well Injection	$95,000,000	$1,300,000	$105,000,000
4 - Long Prairie River Discharge[1]	$45,000,000	$150,000	$47,000,000
5 – Tertiary Clarifiers[1]	$10,700,000	$360,000	$16,700,000
6 – Water Quality Standard Variance	NA	NA	NA

Year 2016 costs (ENR CCI = 12118)

Capital Costs include 20% to 30% undefined design details, 20% engineering and administration, 3% bonds and start-up and 12% contractor overhead and profit.

Present worth: 5% Discount rate, 2% labor escalation, 2.5% material escalation, 20-year period

O&M costs based upon: Power=$0.065/kWh; 50%Ferric Sulfate=$1.67/gallon; Solids Processing=$75/DT; Land Application=$35/WT; Labor=$85,000/FTE;

1. Does not include costs for chloride reduction to meet future total chloride discharge requirements contained in NPDES permit.

The most economical solution to meet the Scenario 2 future effluent TP permit requirements is Alternative 1A -Single Stage Deep Bed Continuous Backwash Filters, which is a new 7 mgd tertiary filtration system to replace the existing cloth media filters. If the NPDES permit is modified to reduce effluent TP discharge requirements below Scenario 2 requirements, Alternative 1B – Dual Stage Deep Bed Continuous Backwash Filters may be required. Given the uncertainty in finalizing the Lake Winona TMDL and timeline for the total chloride reduction approach presented below, ALASD should also consider a variance for meeting the future reduced effluent TP discharges until the chloride reduction approach below is approved by MPCA and such time when the MPCA can confirm the TMDL/NPDES permit requirements do not contain more stringent requirements than the current permit, which could impact the facility recommendation.

Chloride and Phosphorus Reduction Alternatives

The chloride concentration in wastewater is a function of the potable water chloride background concentration, water uses by the public, particularly in-home water softening, and inflow/infiltration of salts used for deicing of roadways. Chloride is not removed through traditional wastewater treatment methods and presents significant challenges for wastewater agencies. Chloride reduction requires a desalting process, of which there are several technologies including reverse osmosis, forward osmosis, electrodialysis/electrodialysis reversal (EDR), membrane distillation, multiple effect distillation, and capacitive deionization. Of these technologies, only reverse osmosis and EDR have been applied to tertiary treatment of wastewater at a municipal scale and only reverse osmosis was considered for this analysis.

The alternatives to reduce both chloride and TP discharges to the target effluent concentrations either adds reverse osmosis to the TP reduction alternatives (Alternatives 1C and 4C), uses the combination of membrane filtration and reverse osmosis (MF/RO) with and without centralized water softening, or ceases discharges to Lake Winona.

Table ES-4 summarizes the total chloride and phosphorus reduction alternative costs. All alternatives have significant capital costs and additional annual operating costs. There are several concerns with the lowest cost alternatives including the following:

- Alternative 2C - Spray irrigation of effluent with chloride concentrations ranging from 650 to 750 mg/L is limited. Chloride discharges greater than 355 mg/L will severely impact crop growth, although some grasses will tolerate high chloride concentrations; and chloride will transfer through the soils to groundwater. This analysis assumes the 5000 acres of spray irrigation fields suitable for high chloride levels for application of wastewater can be found and there are no land or easement costs to ALASD.
- Alternative 3C - MPCA has not permitted deep well Injection for treated municipal effluent. It should also be noted that insufficient hydrogeology data of the bedrock systems beneath Alexandria exists so general information from other studies in similar crystalline rock settings was used to estimate well injection requirements. A more detailed analysis, including updating costs, is required if this alternative is considered for further evaluation.
- Alternative 6C - Centralized softening of the Alexandria Light and Power (ALP) water supply assumes ALP installs lime softening or reverse osmosis at its treatment facility. ALP and ALASD are two independent municipal government agencies and ALASD cannot direct ALP to install these technologies

Installing MF/RO or adding reverse osmosis to a dual stage filtration system have similar costs; however, industry standard is for membrane filtration to be used upstream of reverse osmosis system as a pretreatment step to reduce solids to lowest levels to protect the reverse osmosis system and minimize reject water flows. The cost for both of these systems are significant.

Table ES-4. Opinion of Order of Magnitude Chloride and Phosphorus Reduction Alternative Costs

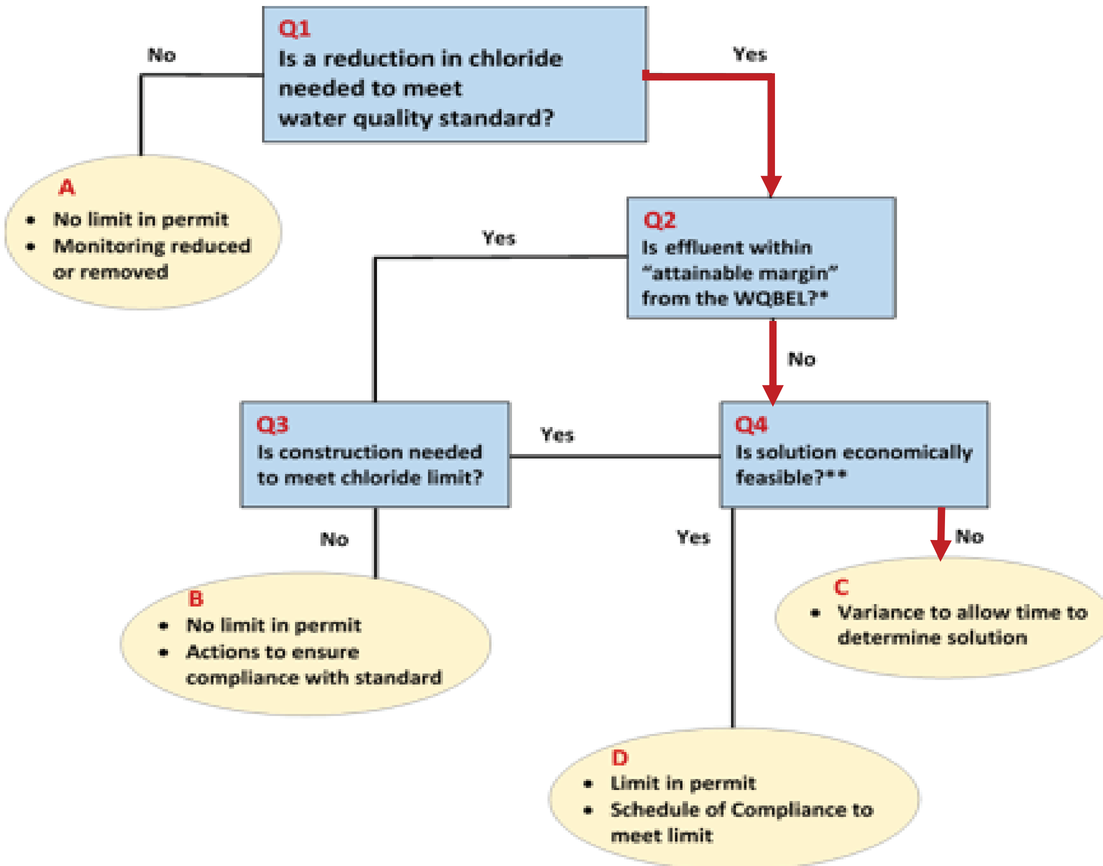
Alternative	Capital Cost	Year 2020 Additional O& M	Present Worth
1C – Dual Stage Filters with Reverse Osmosis	$105,000,000	$4,800,000	$190,000,000
2C – Spray Irrigation	$138,000,000	$2,100,000	$150,000,000
3C – Deep Well Injection	$95,000,000	$1,300,000	$105,000,000
4C- MF/RO with Long Prairie River Discharge	$137,000,000	$5,700,000	$247,000,000
5C – Membrane Filtration/Reverse Osmosis	$107,000,000	$6,000,000	$210,000,000
6C - Centralized Water Softening with MF/RO	$70,000,000	$4,500,000	$148,000,000
7C – Chloride Water Quality Standard Variance	NA	NA	NA

Year 2016 costs (ENR CCI = 12168)
Capital Costs include 20% to 30% undefined design details, 20% engineering and administration, 3% bonds and start-up and 12% contractor overhead and profit.
Present worth: 5% Discount rate, 2% labor escalation, 2.5% material escalation, 20-year period
O&M costs based upon: Power=$0.065/kWh; 50%Ferric Sulfate=$1.67/gallon; Solids Processing=$75/DT; Land Application=$35/WT; Labor=$85,000/FTE;

Based upon concerns of high chloride treatment costs throughout the State on Minnesota, the MPCA developed a Chloride Work Group in December 2016 consisting of municipal permit holder, environmental consulting, and MPCA staff to develop recommendations on chloride permitting strategies. The MPCA Chloride Work Group recommended approach to chloride reduction, which the MPCA Commissioner directed MPCA staff to implement into practice on June 15, 2017, is shown in Figure ES-1 and consists for four key questions resulting in one of four solutions. The ALASD chloride reduction flow path leads to a chloride variance and is highlighted in red based upon the following:

1. Chloride reduction is required to meet the current chloride WQS.
2. The ALASD effluent chloride discharges of roughly 700 mg/L are not within the defined attainable margin (100 mg/L) of the WQBEL standard of 252 mg/L.
3. Treatment for chloride at the end of the wastewater treatment plant is not economically feasible, according to MPCA's "Alternatives for addressing chloride in wastewater effluent-Appendix B." ALASD reports chloride treatment will increase current ALASD sewer rates by a factor of at least 3.
4. MPCA economical solutions also suggest installing water softening technology at the drinking water source to eliminate end of plant treatment systems. ALP softening will not attain the target effluent chloride discharge concentrations without an end of plant treatment system. As noted above, ALASD and ALP are separate and autonomous local government units in which ALASD cannot dictate ALP add treatment processes, increase its plant capacity, nor

expanded its current service area to meet the chloride standard.



* "Attainable margin" may be defined by a numeric threshold or by the anticipated chloride reduction due to implementation of specific actions. See the Chloride Work Group Policy Proposal for details.
** Municipalities may use the MPCA variance screening calculator tool to evaluate the economic feasibility of a solution. See the policy proposal for details.

Figure ES-1. MPCA Chloride Reduction Permitting Flow Chart.

Recommendations

The first criteria which impacts the recommended plan is whether a chloride variance will be granted through the MPCA Water Quality Standards Variance process. Chloride reduction to meet ALASD chloride permit limits which take effect in March 2021 present an economic hardship as the 20-year present worth is over $100 million dollars. ALASD reports the costs to reduce total chloride discharges would increase its sewer rates by a factor of 3 or more.

The MPCA variance process is required with each permit cycle to continue to demonstrate the need for the variance. If a chloride variance is granted, ALASD should continue with efforts to reduce chloride inputs into the sewerage system (high efficiency softeners). If the chloride variance is not granted, ALASD will need to move forward with detailed evaluations comparing deep well injection and MF/RO. As noted previously, the MPCA direction to date is a chloride WQS variance will be granted. ALASD should submit the total chloride variance request as soon as possible as MPCA Guidance for Water Quality Standard Variances indicates it may take a year or more before a final action can be made on a variance request.

The total chloride variance timing presents a unique situation for ALASD as its NPDES permit requires submission of plans and specifications for the chosen phosphorus and chloride reduction alternative by September 1, 2018. If a chloride variance request is granted, a new 7 mgd single stage deep bed filtration system is recommended to meet the future Scenario 2 effluent TP discharge requirements (monthly TP discharges less than 0.157 mg/L and 12-month rolling total discharge less than 665 kg/yr).

ALASD should continue open discussions with MPCA on when these improvements are required as the final effluent chloride/TP reduction alternative will not be known until the following occur:

- The chloride WQS variance is granted as this will direct ALASD on whether a MF/RO (or Deep Well injection) system or Alternative 1A – Single Stage Deep Bed Continuous Upflow Filtration is required.
- The Lake Winona Phosphorus TMDL is finalized and the TP loading contributions from the ALASD WWTF are confirmed as more stringent effluent TP requirements may require the more costly Alternative 1B – Dual Stage Deep Bed Continuous Upflow Filtration.
- The next NPDES permit is drafted and issued to confirm the effluent TP requirements do not change from current levels.

In addition, ALASD should consider submitting a conditional water quality variance to defer any new TP reduction facilities until the roughfish, primarily carp, are controlled and submersed aquatic vegetation are established in Lake Winona. This approach of roughfish removal to re-establish submerged aquatic vegetation and associated biota has proven successful at significantly improving water clarity (secchi disc), chlorophyll-a, total suspended solids, and TP concentrations in Lake Staring (Sorenson). Following carp removal and establishment of submerged aquatic vegetation, the Lake Winona Phosphorus TMDL would need to be updated to reflect the new lake condition and the plant effluent TP loading requirements re-examined to determine whether a new filtration system is needed to meet water quality goals.

Appendix G: ALASD Chloride Identification and Minimization Plan (w/o appendices)

Alexandria Lake Area Sanitary District
Chloride Investigation and Minimization Plan

Job no

Hazen

Hazen and Sawyer • 445 Minnesota Street, Suite 1510 • St. Paul, MN 55101 • 513.469.5105

Table of Contents

Appendix A:

Summary of Statewide Chloride Management Plan and

Streamlined Chloride Variance Action Tree

Appendix B:

Sample Results

Appendix C:

January 19, 2021 Chloride Citizen's Advisory Committee Agenda/Presentation,

April 6, 2021 Chloride Citizen's Advisory Committee Agenda/Presentation

Introduction

Chloride is one of the components of salt, which is used in forms such as sodium chloride (table salt), calcium chloride and magnesium chloride (road salts). Sodium chloride is commonly used in home water softeners and by water treatment plants to treat "hard" water. Minnesota generally has groundwater with high levels of calcium and magnesium that must be removed through softening in order to prevent lime scale buildup in appliances, pipes and water fixtures. The majority of home water softeners use sodium chloride (NaCl) in a softening process than replaces calcium and magnesium ions with sodium, while the chloride ions are discharged in the wastewater and eventually end up in the environment. High chloride levels can cause impairments to surface water quality.

Chloride released into local lakes and streams does not break down, and instead accumulates in the environment, potentially reaching levels that are toxic to aquatic wildlife and plants. Because salt water is more dense than fresh water, it settles at the bottom of lakes potentially preventing the natural mixing of oxygen and nutrients and in effect creating a "dead zone." The Minnesota Pollution Control Agency (MPCA) has authority to require discharges to comply with water quality standards using the Clean Water Act and National Pollutant Discharge Elimination System (NPDES) permits for the protection of aquatic plants, invertebrates, and fish. Variances can be used by the MPCA to implement a logical and reasonable pathway to meeting permit requirements. The variance process considers economic factors that allow more flexible timelines and offers the potential for renewal of a variance if the permit goal remains unachievable. The variance process requires approval by the Environmental Protection Agency (EPA).

Lake Winona was placed on the 2010 MPCA Clean Water Act (CWA Section 303(d)) list of impaired waters due to excess chloride which impedes the attainment of designated uses for Aquatic Life and Industrial Consumption. Lake Winona is exceeding the 230 milligram per Liter (mg/L) chronic standard intended to protect Class 2B waters for the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life, and their habitats. Lake Winona is also exceeding the 250 mg/L standard intended to protect Class 3C waters for industrial cooling and material transport without a high degree of treatment being necessary to avoid severe fouling, corrosion, scaling, or other unsatisfactory conditions. A TMDL study has not yet been initiated to address Lake Winona's chloride impairments. Lake Agnes and Lake Henry have also recently been added to the list of impaired waters due to excess chloride. The MPCA is in the process of evaluating revisions to the aquatic life and recreation and industrial consumption chloride standards.

Background

Alexandria Lake Area Sanitary District (ALASD) operates the sanitary sewer collection system and wastewater treatment facility (WWTF) to provide wastewater services to the City of Alexandria, and the surrounding townships of Alexandria, Carols, Hudson, Ida, LaGrand, Lake Mary and provides contract sanitary services to the City of Nelson, City of Forada, Leaf Valley Township, Carlos State Park and two rest areas. The ALASD service area covers approximately 102 square miles and a population of more than 26,000 people.

Major sources of influent flow to ALASD's system include residential, industrial and commercial/institutional facilities from area cities and townships located within the ALASD service area. ALP Utilities (ALP) operates the public water supply and has the same service area as the City of Alexandria. The residential and commercial areas outside the City of Alexandria and ALP service area use private well water. Treated wastewater collected from within the ALASD service area is discharged from the WWTF to Lake Winona.

The ALASD NPDES permit MN 0040738 regulates discharges from the facility. ALASD applied for a variance from the chloride water quality standard in Minnesota Rule 7050, designed to protect the Class 2 beneficial use of the receiving water. A variance is a temporary change in the applicable water quality standards. During the term of the variance the WWTF is required to comply with the highest attainable condition for the pollutant which the variance is granted. To ensure this is met, an alternate effluent limit is developed and becomes effective at permit issuance. In addition, ALASD is required to complete chloride source investigation and minimization plan (CIMP), as well as an evaluation of the feasibility of water treatment or other applicable treatment technologies in an effort to control sources of chloride. The variance is approved for an 8-year term with the effective date of November 15, 2020, and the expiration date of November 15, 2028. Upon expiration of the variance, the Permittee is required to comply with the final effluent limits or if eligible, apply for subsequent variance. The basis of the variance is *'controls more stringent than those required by sections 301(b) and 306 of the Clean Water Act (CWA) would result in substantial and widespread economic and social impact*'. *The MPCA has determined that the ALASD has satisfied the conditions necessary to grant a variance and as a result supports the inclusion of the variance in ALASD's NPDES permit.* The final/future limit is based on the existing state standard of 230 mg/L (monthly average) and 252 mg/L (daily maximum). The alternate effluent limit for total chloride discharge from the ALASD WWTF is 839 mg/L (daily maximum.)

The most recent NPDES permit was issued November15, 2020, and expires October 31, 2025. Under the terms of the NPDES permit (Special Requirements Section 5.14.79 – 5.14.97), ALASD is required to take action to reduce chloride discharge to Lake Winona in accordance with the variance requirements.

Chloride levels monitored in area lakes are shown in Figure 1.

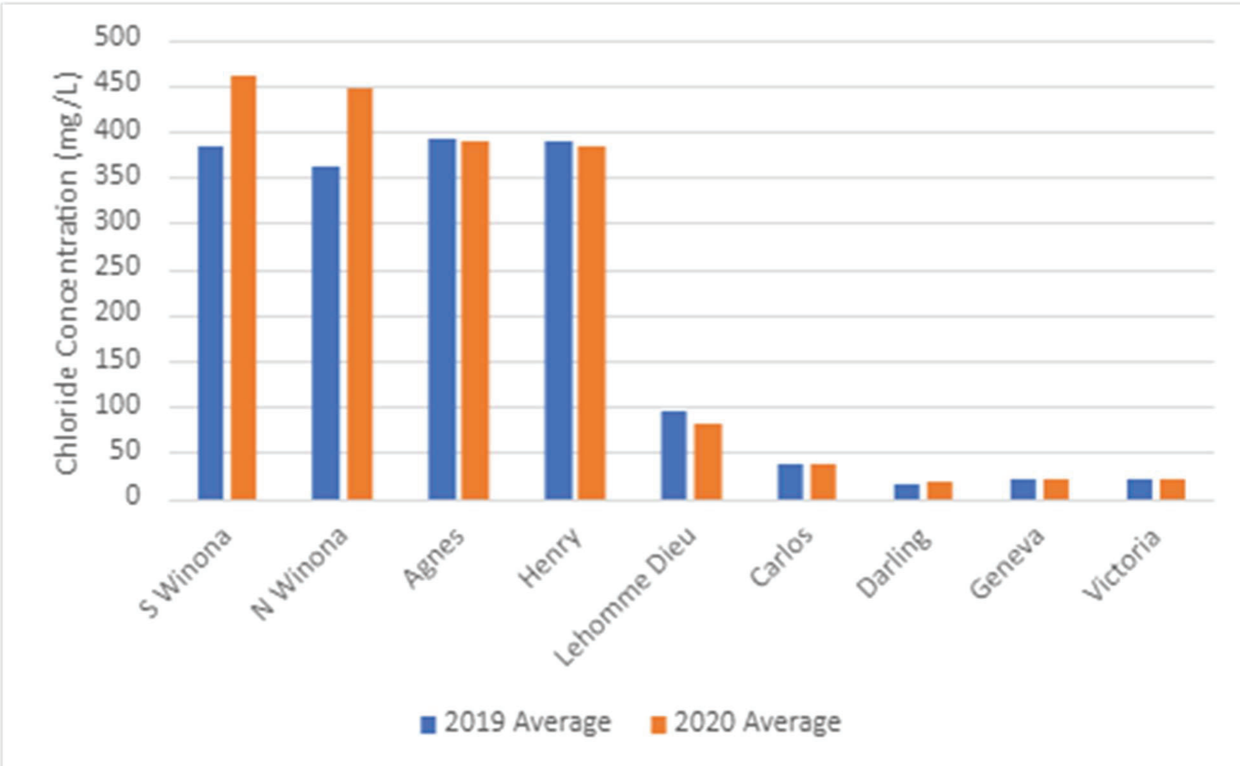


Figure 1. Area Lake Chloride Concentration (mg/L), 2019-2020

The Chloride Investigation and Minimization Plan (CIMP) is required to address the following items:

- Document historic WWTF influent and effluent concentrations – most recent five years of data.
- Identify and quantify the existing and potential sources of chloride loading to the WWTF.
- Provide a summary of chloride source reduction activities implemented and a proposed schedule of reduction activities to be implemented.

This plan addresses the permit requirements for CIMP submittal due 180 days after permit issuance.

Historic Data

Hazen reviewed five (5) years of historic data from the ALASD WWTF to evaluate the influent and effluent chloride concentrations, flows from major commercial and industrial facilities, and other key data. As mentioned previously, ALASD treats flows received from residences (both within and outside of ALP's service area), major commercial sources including the Douglas County Hospital, several car wash facilities, and a number of significant industrial users (SIU's). The locations were selected based on an evaluation of users likely to have higher water usage and/or chloride discharge. The SIU's include two (2) grain processing facilities (Sunopta), a 3M facility, a dairy facility (Nelson Creamery), a metal extrusion facility, and a metal finishing facility. Influent and effluent flows to the WWTF are summarized in Figure and Table 1. Over the past five years, the average influent flows to the WWTF have been approximately 3.0 million gallons per day (mgd), with a maximum daily flow of 6.1 mgd. The facility has seen modest, but inconsistent increases in average daily flows over the past five years. The ALASD WWTF is designed for a wet weather flow of 4.7 mgd.

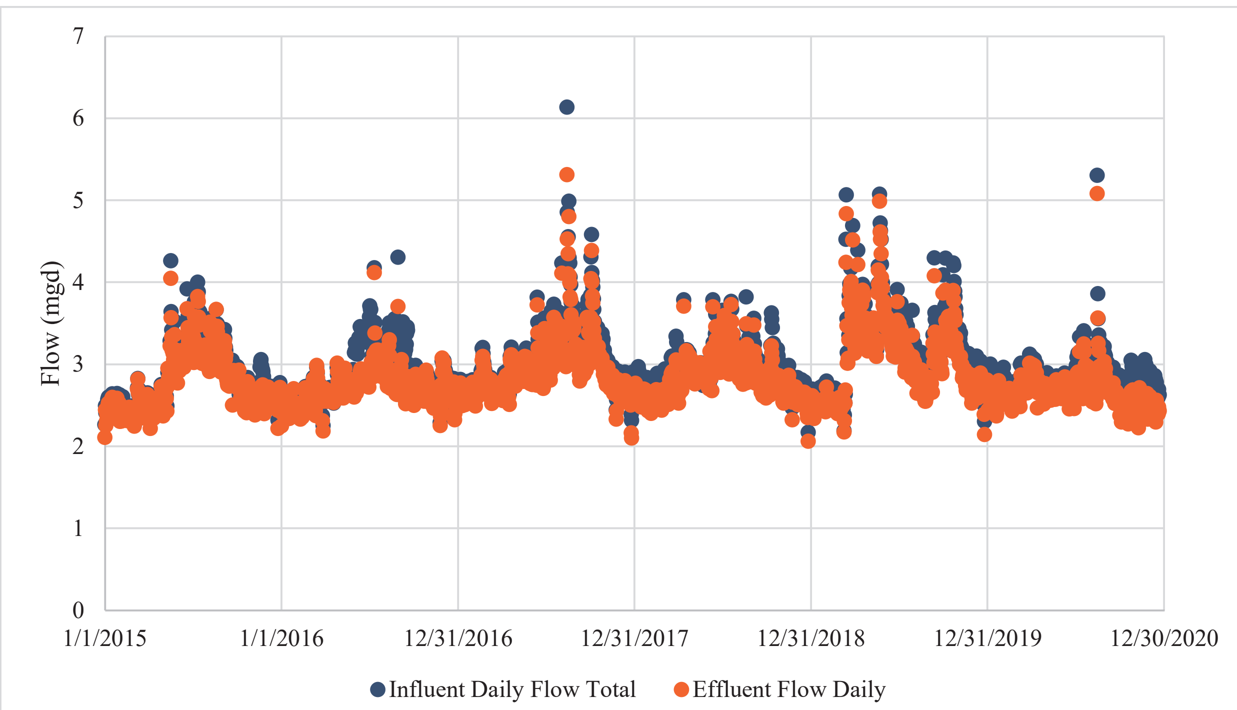


Figure 2. ALASD WWTF Daily Flows, 2015-2020

Table 1. ALASD WWTF Average and Maximum by Year, 2015-2020

Year	Average Daily Flow	Maximum Daily Flow
2015	2.8	4.3
2016	2.9	4.3
2017	3.1	6.1
2018	3.0	3.8
2019	3.2	5.1
2020	2.9	5.3

Flow contributions from major SIUs and commercial facilities are summarized in Figure ,

Table 2, and Table 3. As shown, the overall contribution of flows from SIU's to the WWTF influent typically ranges from approximately 10% - 15% of the total WWTF influent. The most significant dischargers by volume to the WWTF are the two Sunopta facilities, which cumulatively account for nearly 10% of the overall influent flow. Other SIU's and commercial facilities such as the Douglas County Hospital are a significantly lower fraction of the total influent flow, and account for the remaining 5% - 10% that are attributable to SIU's and major commercial facilities.

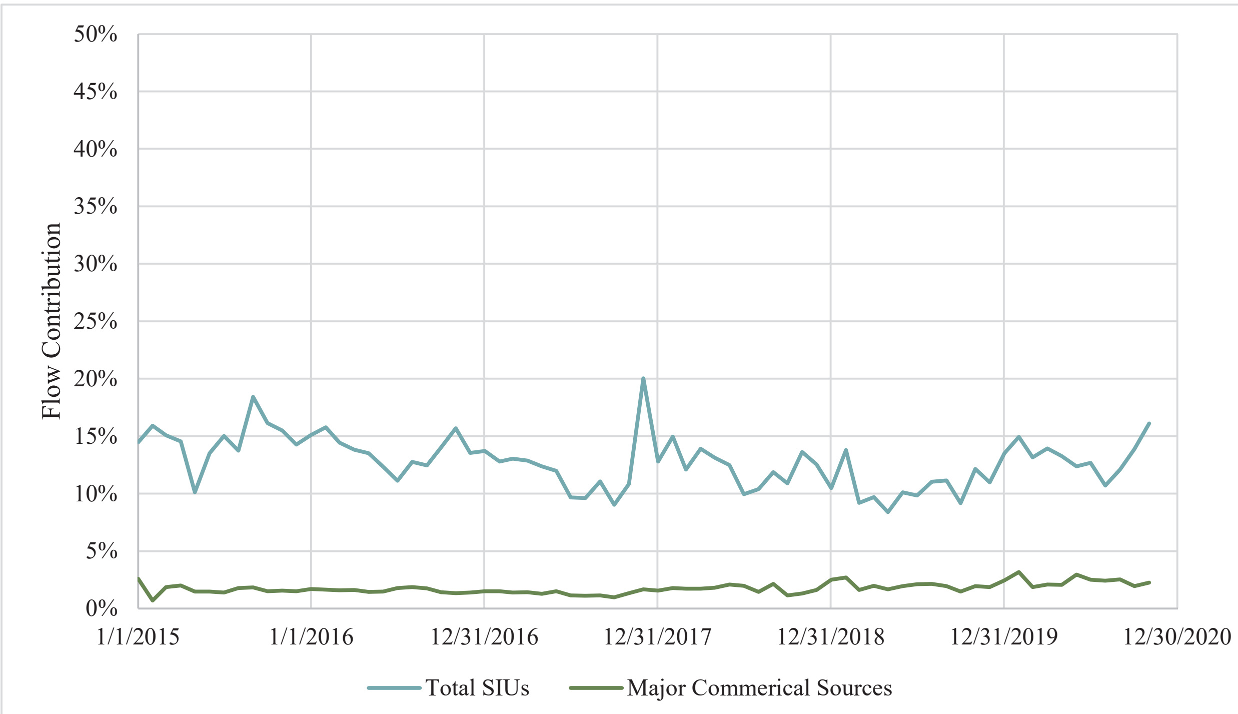


Figure 3. ALASD WWTF - Historic SIU and Commercial Flow Contributions, 2015-2020

Table 2. ALASD WWTF - Daily Average SIU Flow Contributions, 2015-2020

Year	WWTF Flows (mgd)	Sunopta Ingredients - SOI (gpd)	3M (gpd)	Nelson Creamery (gpd)	DMF (gpd)	Sunopta Aseptic - SOA (gpd)	EXT (gpd)	TWF (gpd)
2015	2.8	154,900	16,000	3,300	34,000	127,100	72,100	8,800
2016	2.9	171,800	20,100	2,800	30,500	126,100	32,500	8,100
2017	3.1	132,500	34,700	2,800	63,300	121,000	8,800	8,400
2018	3.0	128,900	16,600	2,900	63,300	134,800	7,500	11,500
2019	3.2	163,400	11,400	2,200	1,300	138,300	6,900	12,500
2020	2.6	145,000	15,200	1,800	53,700	122,200	1,200	10,200

Table 3. ALASD WWTF - Daily Average Commercial Flow Contributions, 2015-2020

Year	WWTF Flows (mgd)	Douglas County Hospital (gpd)	Douglas/Pope Solid Waste Facility (gpd)	Car Washes (gpd)
2015	2.8	31,600	15,100	No Data
2016	2.9	32,200	13,800	No Data
2017	3.1	25,200	15,300	No Data
2018	3.0	31,300	19,100	No Data
2019	3.2	26,900	14,300	22,400
2020	2.6	29,700	12,400	20,700

As required by the NPDES permit ALASD has regularly monitored the WWTF influent and effluent chloride concentrations, along with periodic monitoring of chloride concentrations in Lake Winona and the Alexandria area chain of lakes. Historic influent and effluent chloride concentrations from the WWTF are shown in Figure and Table 4. Over the past five (5) years the average influent and effluent chloride concentrations from the WWTF are approximately 715 mg/L and 685 mg/L, respectively. Minimum daily concentrations observed over the past five (5) years have typically been in the range of 500 – 600 mg/L, from both the influent and effluent. As shown, there have been no constituent trends indicating increases or decreases in chloride concentrations to the WWTF over this time period.

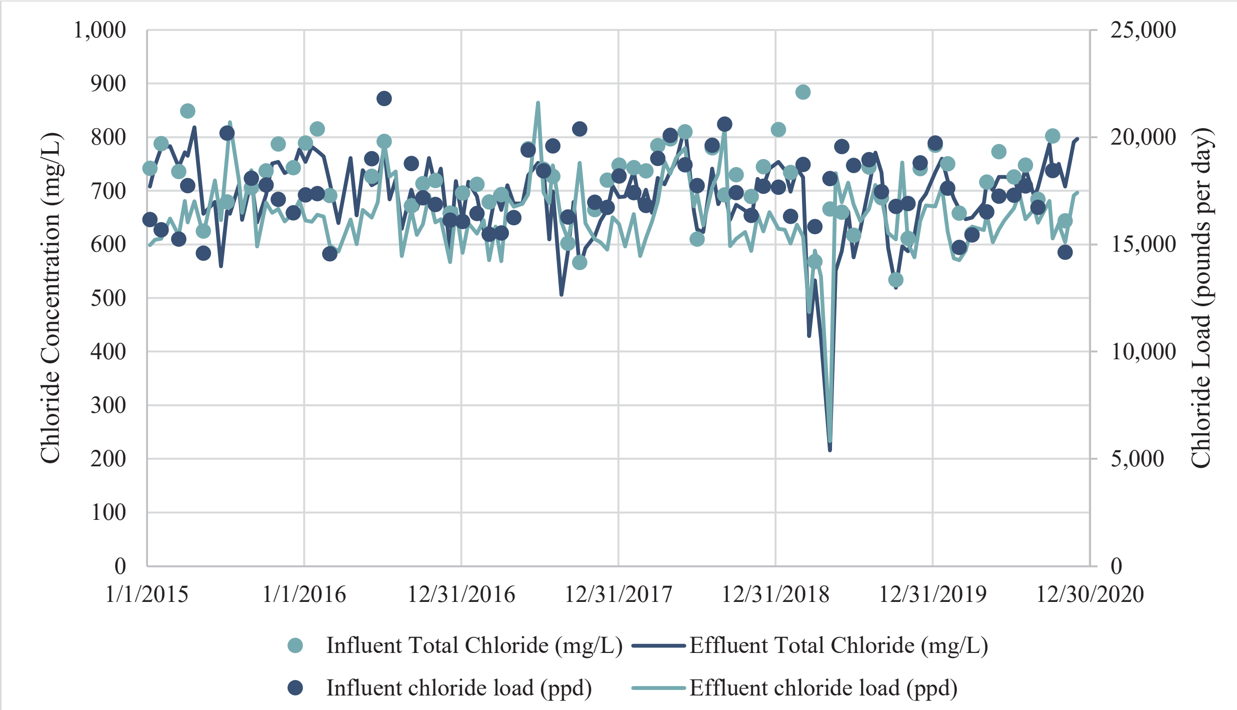


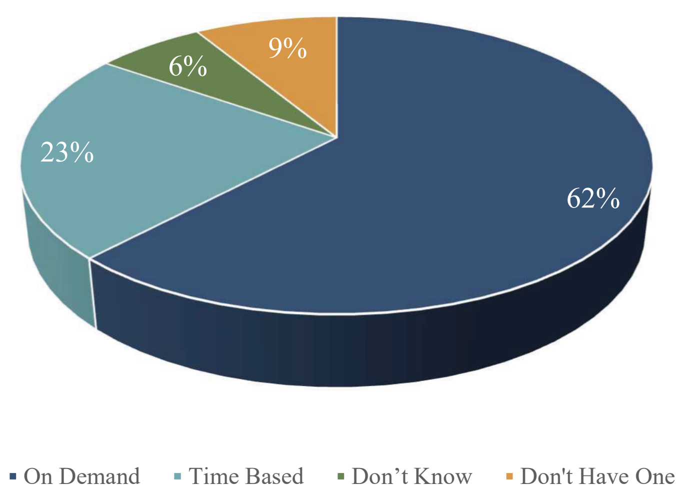
Figure 4. ALASD Historic Chloride Influent and Effluent Concentrations and Loads, 2015-2020

Table 4. ALASD Historic Chloride Influent and Effluent Concentrations and Loads, 2015-2020

Year	Average Influent Concentration (mg/L)	Minimum Influent Concentration (mg/L)	Maximum Influent Concentration (mg/L)	Average Influent Load (ppd)	Average Effluent Concentration (mg/L)	Maximum Effluent Concentration (mg/L)	Minimum Effluent Concentration (mg/L)
2015	740	625	849	16,900	720	818	559
2016	730	658	815	17,660	710	782	591
2017	690	566	778	17,290	660	752	506
2018	740	610	810	18,305	700	821	623
2019	690	534	884	17,810	615	771	216
2020	720	620	802	16,930	720	797	647

ALASD Customer Home Softener Survey

ALASD surveyed customers in spring 2021 to better understand customer softener systems. Approximately 16% of customers provided responses. Results of the survey are provided below and were used in the mass balance calculations to determine number of time-based versus on-demand softeners. Approximately 10% of customers responded to the survey and of those submitted the average age was 8 years old for demand softeners was 12 years old for time-based softeners. According to softener installation professionals, older time-based systems may not likely no-longer efficient resulting in significantly higher salt usage.



The percentages were also compared with data from local water softener companies which confirmed that roughly two-thirds of salt delivery customers had demand softeners compared to one-third time-based softeners in their service area around Alexandria.

Supplemental Sampling

In order to better inform the chloride mass balance developed for this plan and to understand the contributions of various chloride sources within the ALASD service area, ALASD collected supplemental sample from identified points within the collection system. These points were identified to collect specific data on chloride concentrations and contributions from residential, industrial, and commercial sources. Samples were collected by ALASD staff at the following locations:

- Several manholes and a lift station composed primarily of residential houses with ALP service
- One (1) manhole composed primarily of residential houses with private well water
- All SIU's
- Douglas County Hospital
- Car wash facilities

All samples were collected via a 24-hour composite sample. The sample results exhibited significant variability, as expected based on potential fluctuations in the softener regeneration patterns within a service area or facility. The sampling results are summarized in Table 5. There are several notable observations from this supplemental sampling data:

- The initial sampling from a residential neighborhood with ALP source water indicated unexpectedly low chloride concentrations (Ridgewood Dr neighborhood). Follow-up sampling was conducted at several additional locations to confirm the initial sample results. The sampling had a high degree of variability due to difficulties with sample collection at localized residential manholes and potential variation in softener recharge schedules in a small residential area. Omitting outlier values, the average concentration of all the samples collected is approximately 600 mg/L. Since the ALP treatment plant removes iron and manganese the expected chloride loading from softening systems is lower and this concentration makes sense in comparison to the samples collected from private well households.

- Sampling from a residential neighborhood with private well water (Lake Mary) indicated chloride concentrations in line with typical average values to the WWTF (700 – 950 mg/L).

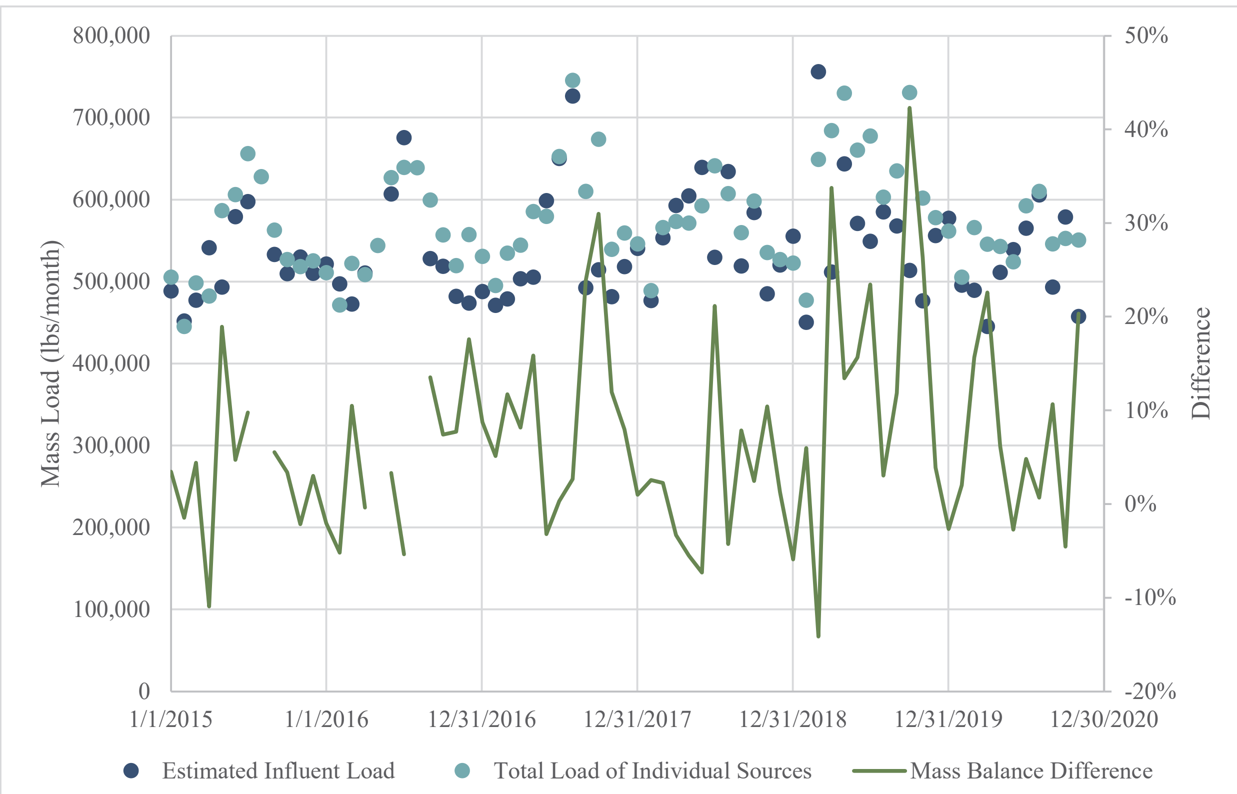
- A number of the industrial and commercial facilities within the ALASD service area had chloride concentrations in line with typical average values to the WWTF (500 – 1,000 mg/L). This includes the majority of the SIU facilities and Douglas County Hospital.

- Both Sunopta facilities had high chloride concentrations in the samples. Most notable, Sunopta Aseptic concentrations exceeded 1,300 mg/L in nearly all samples collected. Sunopta Ingredients also had concentrations exceeding 1,000 mg/L in most samples collected. 3M had significant variability in samples with one sample in line with typical WWTF influent concentrations (500 – 1,000 mg/L) and one sample exceeding 1,000 mg/L.

- Similarly, samples collected from the car wash facilities had significant variability in concentrations, with three samples indicating lower than typical influent concentrations at the WWTF and one sample with a concentration of 1,900 mg/L.

- The combination of sampling data and flow contributions indicate that residential sources are the largest contributor of chlorides to the ALASD WWTF. Overall, this accounts for an estimated 75% - 80% of the influent chlorides to the facility. Industrial contributions are approximately 22%. A comparison of the overall contribution from each source is shown in Figure 2.

- A comparison of the historic flows and WWTF influent chloride loading with the sampling data collected in 2021 is shown in
-
-



- **Figure 3**. In general, the sampling data concentrations appear to overestimate WWTF influent chloride loading by approximately 5% to 10% on average, with significant month to month variability. However, accuracy within 10% of overall WWTF influent loading is expected to be useful for a planning level evaluation. Therefore, the sampling concentrations are expected to be representative of the general magnitude and contribution from each set of sources.

Table 5. ALASD Supplemental Chloride Source Sampling Summary (February 2021)

Location	Average Chloride Concentration (mg/L	Maximum Chloride Concentration (mg/L)	Minimum Chloride Concentration (mg/L)	Typical Flows[1] (mgd)	Estimated Chlorides Load[2] (ppd)
Sunopta Ingredients	1,170	1,370	707	0.163	1,590
Sunopta Aseptic	1,400	1,580	1,110	0.133	1,557
Alex Extrusion	510	850	172	0.001	5
Alex Hospital	530	623	428	0.024	108
Douglas Machine - North	310	578	47.6	0.058	150
Douglas Machine - South	300	361	234		
3M	1,010	1,200	826	0.017	150
Nelson	610	946	266	0.002	10
TWF	820	835	801	0.012	80
Carwash North (Holiday)	370	510	220	0.010	30
Carwash South	1,350	1,900	796	0.010	120
Lake Mary - Private Well Water	830	953	697	1.16	8,030
Ridgewood Drive - ALP Water	250	264	243	N/A	N/A
Lakeside Drive Lift Station - ALP Water	1,130	1,130	1,130	N/A	N/A
Lakeside Drive Manhole - ALP Water	350	408	286	N/A	N/A
S Le Homme Dieu Dr - ALP Water	3,510	9,150	161	N/A	N/A
All ALP Water Sources[3]	600	1,210	1,130	1.16	5,800
WWTF Influent	820	866	777	2.84	19,420
WWTF Effluent	780	784	784	N/A	N/A

Notes:

1. Based on December 2020 average daily flows.
2. Loads estimated based on averages of all samples collected.
3. Omitting high outlier values.

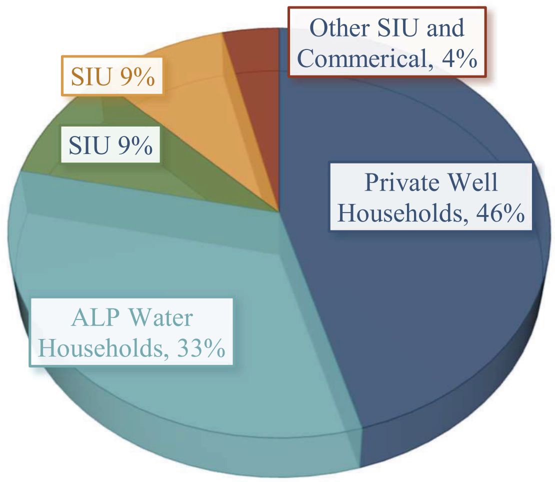


Figure 2. Estimated Influent Chloride Source Distribution, Based on 2021 Sampling

(Note: **Institutional category** is combined with the Commercial category and is not broken down. Based on review of individual significant water users and sampling data, Institutional flows are not a significant contributor.)

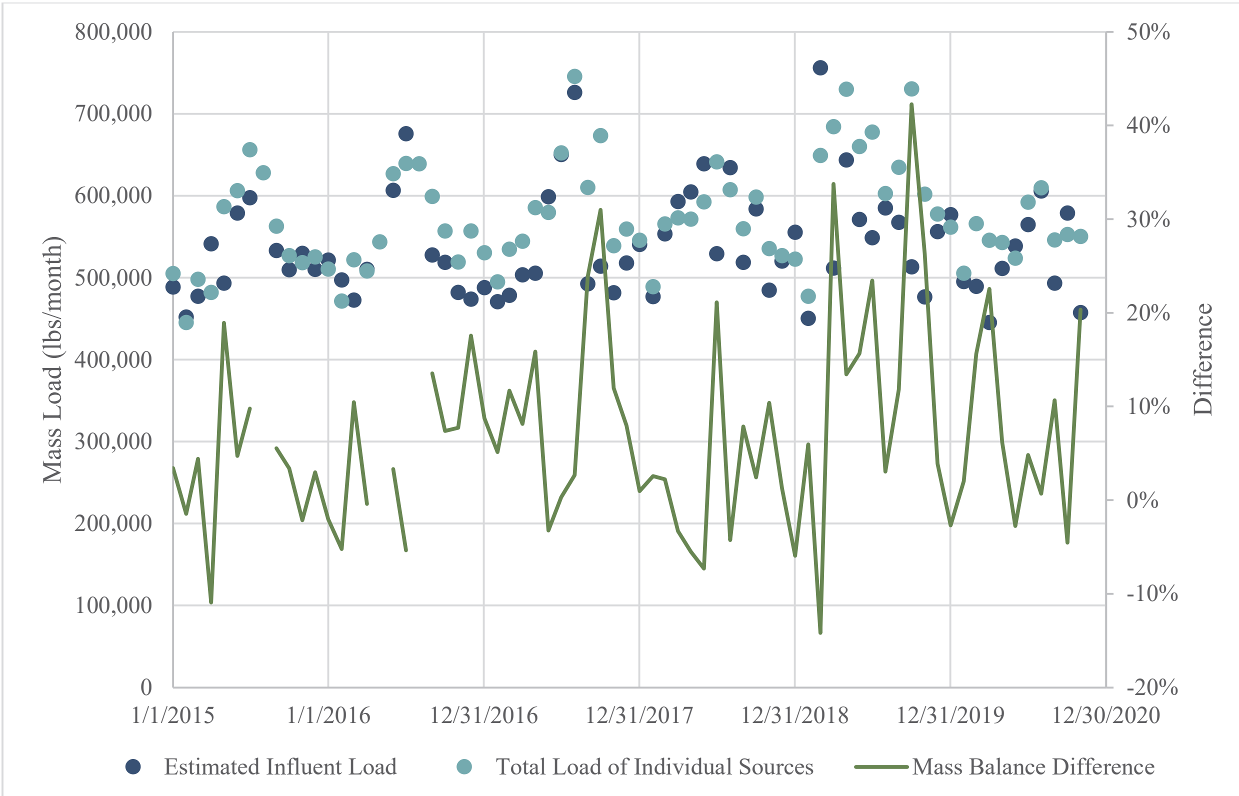


Figure 3. Comparison of Historic WWTF Influent Loading with Calculated Loads from 2021 Sampling Data

Chloride Mass Balance Model

A previous chloride mass balance model was developed as part of the ALASD Chloride Management Plan submitted to the MPCA in 2014. However, the mass balance estimates were largely based on theoretical values with limited field sampling data collected from residential, commercial, or industrial discharges. Hazen developed an update to this model based on the latest five (5) years of ALASD data and the sampling data collected from residential, commercial (including institutional), and industrial customers.

Several key assumptions related to residential water softener usage were incorporated in development of the mass balance model. These assumptions were adjusted to calibrate the model to match the historic WWTF influent data. These key assumptions include the following:

- There are a total of 10,500 households discharging to ALASD. Of this, approximately 5,245 are ALP customers. The remaining approximately 5,255 utilize private well water.
- Based on input from local water softening suppliers and servicers, it is estimated that approximately 2/3 are demand based systems and 1/3 are timer-based systems. This assumption was also confirmed in a survey conducted by ALASD in February to March 2021.
- Background hardness for both ALP and private well water is approximately 25 grains per gallon, based on the latest sampling data. Similarly, background chloride concentrations for ALP and private well waters are approximately 63 mg/L and 15 mg/L, respectively, based on the latest sampling data. However, there is significant variability in the data from private wells.
- Individual customer water softening is a common practice in the ALASD service area due to water supply hardness. The most common types of water softeners use an ion exchange process to remove magnesium and calcium that cause water hardness and to remove iron and manganese from the water supply. The softeners work by pumping water through a resin matrix. This matrix traps the magnesium and calcium ions that cause hard water and other naturally occurring ions by exchanging them with sodium or potassium ions. Over time, however, the efficiency of the matrix decreases as the sodium or potassium is exhausted. To regenerate the treatment capability of the softener, the device is backwashed with a concentrated sodium or potassium chloride solution. The frequency of regeneration cycles and volume of backwash created depends on the hardness of the water, the amount of water used in the building, and the size of the water softener. Used properly, softeners regenerate one to three times per week and produce between 40 and 150 gallons of brine per week. If the water softener is set up incorrectly the amount of brine can be much higher. Water softeners are set to regenerate based on either flow measurements or by a timed interval. Flow regulated softeners generally produce less backwash brine than timer regulated systems.
- The typical household softener systems include the following:
    - 1 cubic foot (cf) capacity with 24,000 grain capacity.
    - Approximate salt usage during regeneration of 7 lbs/cf.

- Timer based systems initiate regeneration cycle every 2 to 3 days. Resulting chloride discharge is approximately 50 – 60 lbs/month.
- Demand based systems on average initiate regeneration cycle when approximately 90% of resin bed capacity is consumed. The resulting regeneration frequency is approximately 2 – 3 days, with approximate chloride discharges of 30 – 40 lbs/month.

A comparison of the model predicted ALASD influent chloride mass to the 2015 – 2020 historic influent loading is shown in Figure 4. The model matches the ALASD historic influent data well to within approximately 10% and is a valuable planning tool for evaluation of scenarios for reduction of chlorides at ALASD.

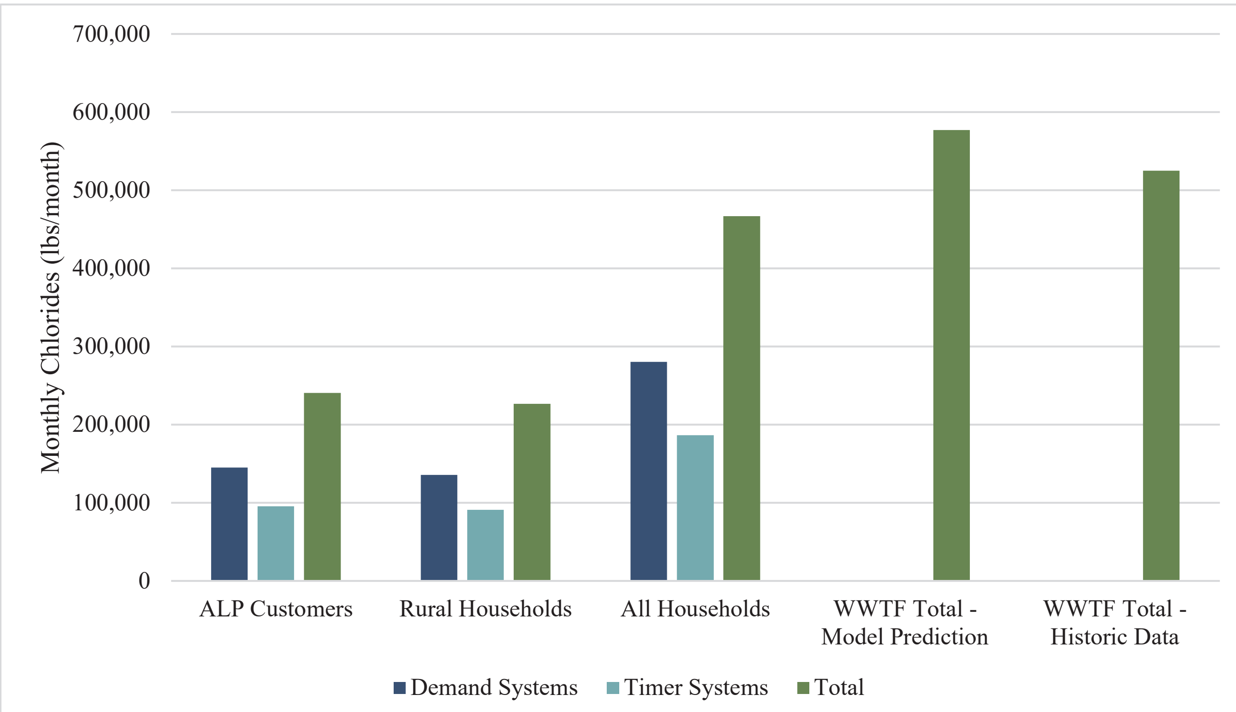


Figure 4. ALASD Predicted Influent Chloride Mass Compared to 2015 – 2020 Historic Data

Long Prairie River Watershed Restoration and Protection Strategies (WRAPS)

As required in the ALASD NPDES permit, the following section summarizes findings from the Long Prairie River WRAPS related to chloride levels in the ALASD receiving waters which are part of the Long Prairie River Watershed:

- Lake Winona, Lake Agnes and Lake Henry chloride levels are above the state standard and are considered impaired due to high chloride levels.
- Strategies for chloride reduction should include education campaign on smart salting techniques and education on road salt usage to LGUs.
- Wastewater actions should follow the statewide chloride management plan.
- Alternatives to water softeners should be explored within the ALASD area. Research should include feasible alternatives to traditional water softeners including the provision of soft water by the municipal supplier or prohibiting the use of individual water softeners in the ALASD.

ALASD Chloride Reduction and Management Strategies

In addition to the 2014 Chloride Management Plan, ALASD completed a 2017 study of combined improvements that could be implemented at ALASD to address both phosphorus and chloride reduction to meet long-term NPDES permit limits. These evaluations have indicated that improvements needed at ALASD to meet the long-term chloride requirements will be extremely expensive and difficult to implement for both technical and non-technical (social and affordability) reasons.

ALASD has also undertaken an extensive public outreach and education campaign since 2010. These efforts have included the following:

- Newspaper interviews, radio shows, and public education efforts throughout 2018 through 2020.
- Inclusion of educational materials on the ALASD website.
- Billing inserts with educational materials on chloride issues distributed to customers to promote awareness.
- A customer survey on water softener usage and practices in 2020.
- Civic organization outreach in 2020 and 2021 (i.e., Sertoma and Rotary clubs).

ALASD revived the Chloride Citizen's Advisory Committee in 2021 to continue to address chloride minimization strategies with the guidance of the recent Draft Statewide Chloride Management Plan and the streamlined chloride variance action tree. The Committee meets quarterly and includes representatives from stakeholder groups to discuss chloride issues and work towards developing an attainment Plan for chloride reduction.

This minimization plan used the mass balance model developed in 2021 to provide a conceptual level evaluation of alternatives to reduce chloride discharges from ALASD. This includes strategies to be implemented at residential households, at ALP, at ALASD, and at industrial and commercial dischargers. Highlights of possible scenarios considered include the following:

1. Replacement of older, timer based softening systems with new, demand based softening systems at homes throughout all of ALASD's service area.
2. Development and implementation of ordinances throughout ALASD's service area that reduce the level of hardness reduction that can be provided by home softening systems. This would likely be done in conjunction with a program to replace older, timer based softening systems at homes throughout all of ALASD's service area. However, it is anticipated that this program would be extremely difficult to implement, monitor, and ensure compliance over a long-term timeframe. This alternative was included to evaluated whether any alternative to optimize in-home water softening systems could be utilized to meet the future effluent limit.
3. Installation of centralized softening at ALP's water treatment plant. This scenario would also require implementation of an ordinance program to ban and mandate removal of home-based water softener systems within the ALP service area in order to achieve anticipated reductions

in chloride. In addition, it is anticipated home compliance checks would be required to maintain the efficacy of this scenario.

4. In conjunction with alternative 3 for centralized softening at ALP's water treatment plant, a program for replacement of older, timer based softening systems at private well homes throughout all of ALASD's service area.
5. In conjunction with alternative 3 for centralized softening at ALP's water treatment plant, a program for replacement of all salt based softening systems at private well homes throughout all of ALASD's service area with saltless RO units.
6. Expansion of ALP's water treatment plant and service area to cover all of ALASD dischargers. This would be implemented alongside new centralized softening at the ALP treatment plant and ordinances to ban and mandate removal of home-based water softener systems as noted in the above scenario.
7. Source specific reduction strategies at major industrial and commercial dischargers. The specific reduction strategies are 'to be determined' through continued evaluation and meetings with individual industrial and commercial facilities/customers. This would be combined with a for replacement of older, timer based softening systems at homes throughout all of ALASD's service area.

A summary of the estimated chloride impacts at ALASD resulting from these alternatives are shown in Figure 5 and Figure 6. As shown, the most significant impacts on chloride loading to ALASD are from programs that significantly eliminate water softener usage across the service area. Only the alternatives that include complete or near complete removal of all water softeners are predicted to meet the ALASD long-term NPDES discharge permit limit.

The alternatives that involve water softener optimization programs, through either demand system replacement incentivization or ordinance-based programs are predicted to have a more modest impact. The extent of chloride reduction associated with these alternatives range from approximately 15% - 45% overall chloride reduction, but none are sufficient to approach to meet the long-term NPDES discharge permit limit. The range of predicted ALASD influent chloride concentrations associated with these water softener optimization programs are approximately 400 mg/L to 600 mg/L.

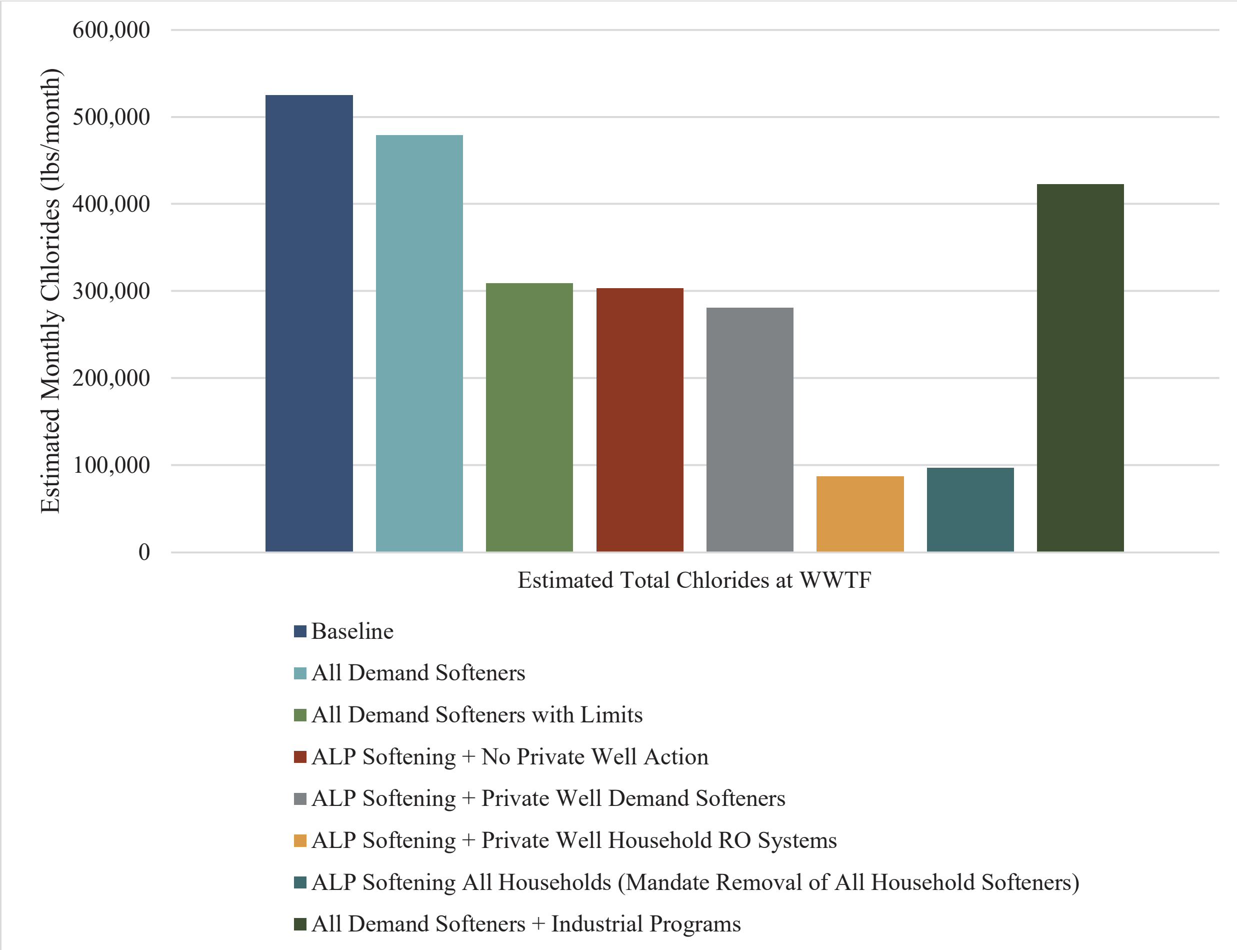


Figure 5. ALASD Estimated Influent Chlorides from Reduction Strategies

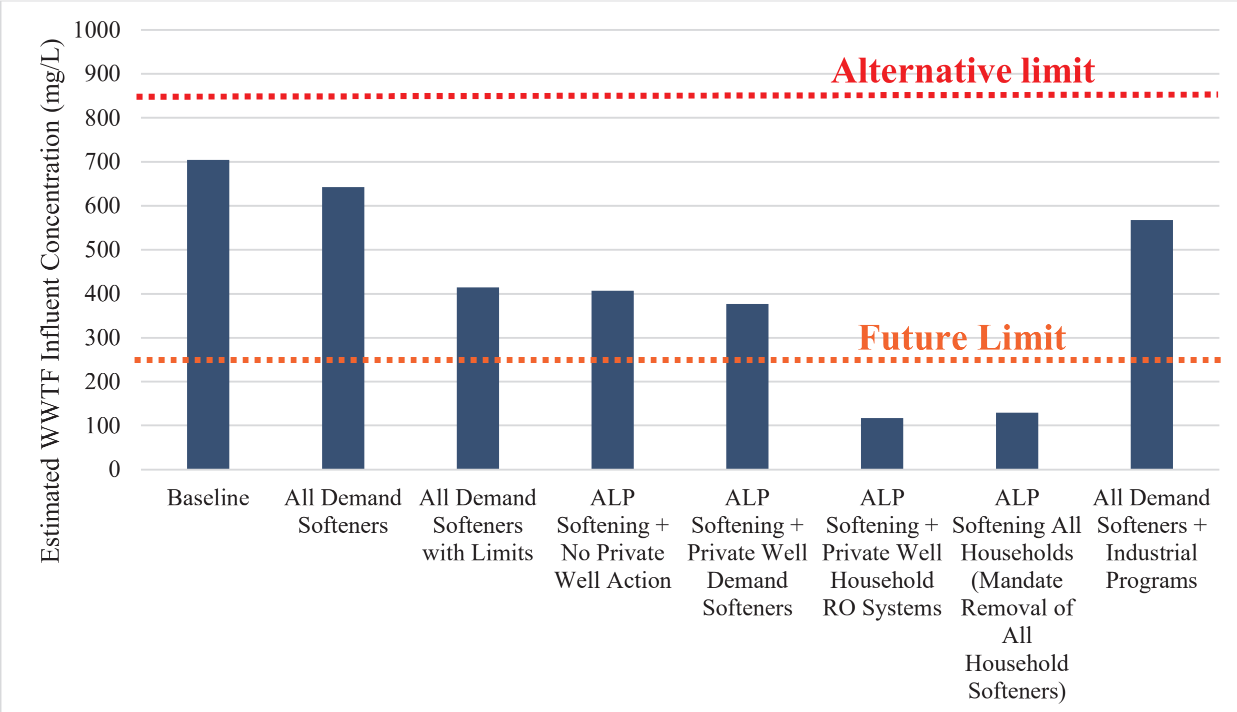


Figure 6. ALASD Estimated Influent Chloride Concentrations from Reduction Strategies

For each alternative, Hazen also developed high level, conceptual installation and operation and maintenance (O&M) cost impacts to ALASD and the surrounding community. These costs provide an overall indication of installation feasibility and economic efficiency of each alternative. The costs are summarized in Table 6. In addition to the alternatives described previously, prior reports developed for ALASD have evaluated “end of pipe” treatment systems at the WWTF to remove chlorides from facility effluent prior to discharge. This treatment approach would require installation of an RO membrane systems and an evaporator to handle concentrate from the membranes. These costs for this alternative have been inflated to 2021 dollars and are also included with the alternatives presented here.

Key assumptions that were used in the development of the cost estimates include the following and are stated in 2021 dollars:

- For the 30-year life cycle cost estimates inflation and discount/interest rates were 3% and 5%, respectively.
- Timer based water softeners were estimated to have an annual operating cost of $120.
- Demand based water softeners were estimated to have an annual operating cost of $95. New equipment installation costs were estimated at $1,350 per household, and estimated equipment service life is 15 years.
- Household RO systems were estimated to have an annual operating cost of $250. New equipment installation costs were estimated at $10,000 per household, and estimated equipment service life is 15 years.

- Centralized ALP softening was estimated to have an installation cost of approximately $11.3 million in 2017. This cost was escalated to 2021 dollars for inflation. O&M costs for ALP softening were assumed to be $750/mg.
- Expansion of ALP service to all of ALASD's customers has a significant installation cost. This includes approximately $10 million to expand the capacity of the ALP water treatment plant, $15 million for installation of softening, and approximately $125 million for installation of 180 miles of new water piping at approximately $140/lf installed. O&M costs for ALP softening were assumed to be $750/mg.
- Installation of an "end of pipe" treatment system at the WWTF combined with centralized ALP softening was estimated to have an installation cost of approximately $70 million and annual O&M cost of approximately $4.5 million in 2017. These costs were escalated for inflation to 2021 dollars.

As shown, the most cost-efficient strategies for chlorides reduction are those that utilize installation of saltless water conditioner systems in place of household water softeners. The next most cost efficient are those that include centralized softening at ALP in combination with softener replacement in private well households. The remaining alternatives either have relatively low impact (a timer softener system replacement program) or extremely high installation costs (ALP softening and service area expansion).

Table 6. Chloride Reduction Alternatives based on 2021 dollars
Opinion of "Order of Magnitude" Cost Summary

Alternative	Installation Costs	30-Year NPV	Annualized Costs
Baseline	0	$38,420,000	$2,500,000
All Demand Softeners	$14,175,000	$45,600,000	$2,970,000
All Demand Softeners with Limits	$14,175,000	$45,600,000	$2,970,000
ALP Softening & No Private Well Action	$12,800,000	$44,000,000	$2,870,000
ALP Softening & Private Well Demand Softener	$19,900,000	$46,600,000	$3,030,000
ALP Softening for All Households w/in ALASD	$150,000,000	$170,000,000	$11,030,000
ALP Softening & private well RO systems	$170,000,000	$250,000,000	$16,030,000
ALP Softening & MF/RO at ALASD WWTF	$78,000,000	$195,700,000	$12,730,000

Saltless water conditioning systems were also researched and evaluated, but not included as an alternative to private home water softeners in any scenario. Due to the high hardness from both ALP and private wells, these technologies are not likely to meet the needs of the households in the area. It is expected that uptake may be low, with a high degree of replacement and reinstallation of conventional water softeners likely. In addition, concentrations of other ions from the groundwater may impact overall efficacy of the technology and result in significant corrosion issues within the households. However, ALASD could consider a pilot program to evaluate the technology in a limited number of households to assess suitability for wider roll-out.

Conclusions and Next Steps

Based on the historic data from ALASD and the additional sampling conducted in 2021, the majority of influent chlorides to the ALASD WWTF is from residential sources. The current loading contributions are approximately 75% to 80% from residential sources, 15% to 20% from two industrial facilities, and the remaining commercial and industrial sources accounting for less than 5%. Of the portion from residences, private well households appear to contribute a higher percentage of the overall chloride loading to the WWTF (46% of total) compared to the ALP households (33% total).

In order to meet proposed final limits, residents in the ALASD service area must reduce the amount of salt added to their water supply. Removing salt chloride from wastewater after it has been added is not feasible according to the MPCA studies and guidance documents. Solutions must therefore reduce the amount of salt added to the water used for residential purposes in order to meet final limits.

ALASD is in a unique situation where one-half of the customers are served by a public water supplier (ALP) and the other half use private wells. In addition, ALASD is a separate government entity from the City of Alexandria and does not have authority to regulate activity within the City or for the municipal water supply entity. ALP Utilities is the municipal water supplier for residents of the City and would need to make process changes to their water treatment plant (i.e., upgrade current WTP to add lime softening or reverse osmosis facility) to eliminate the need for home water softener usage. In addition, private well water usage at residences not served by ALP are subject to the local ordinances of the communities, and ALASD does not have authority to regulate these activities. The CIMP efforts require collaboration and long-range planning with the City, ALP Utilities, and private well stakeholders to meet requirements.

Given the high hardness of available groundwater supply in the region, alternatives to meet the proposed final chloride limits at the ALASD WWTF require significant modifications to the water treatment processes across the entire ALASD service area. Alternatives identified that meet future permit limit require elimination of nearly all in-home water softening. These alternatives have high capital, operation, and maintenance costs, and do not meet the affordability standards for utility fees (i.e., resulting wastewater costs are > 2% of median household income).

A number of other scenarios were evaluated to optimize in-home water softener performance, upgrade the ALP water treatment plant without a service area expansion, and target industrial sources. Several of these alternatives would meet the affordability standards. However, none of these alternatives would meet the final chloride effluent limits.

There currently is not an affordable, effective, and feasible solution identified that would meet the future effluent chloride limit. However, implementation of incremental improvements to take advantage of cost-effective opportunities for chloride reductions exist. This may include promotion programs to accelerate the elimination of older, timer-based softener systems throughout the entire ALASD service area and collaboration with ALP Utilities during future water treatment plant upgrades to enable implementation of centralized limit softening.

In addition, emerging technologies should be further researched to determine if future innovation and market demand will provide new alternatives to address more cost-effective treatment of home-based systems for the township areas outside of ALP service area.

WTP upgrades are currently scheduled in 10 to 15 years according to ALP which could include lime softening upgrades, however this solution alone will not meet the final effluent limit for chloride. If a more affordable home-based "point of entry" water treatment system is available in the future, a combined solution of ALP lime softening and private well treatment would be desirable.

Funding opportunities exist to create more affordable solutions for chloride reductions. The most significant opportunity is the Point Source Implementation Grant (PSIG) from the State of Minnesota Clean Water Funds which could result in up to $7M grant funding for water treatment plant upgrades. We have initiated discussions with the MPCA to discuss the ability for PSIG eligibility while still maintaining the variance status (i.e., our current understanding is eligibility for the PSIG would require eliminating ALASD's variance status). The PSIG funding would be for upgrading ALP's municipal WTP to a lime softening plant. However, this is only "part" of the solution. Out of the 10,000 customers of ALASD, about ½ are in the city. The other half use private wells and the ALASD will still need a variance until a more feasible solution is found to deal with these remaining chloride sources.

Phase 1 Steps (to be completed in 2021) for the CIMP include the following:

Annual report to be completed in December and submitted to the MPCA.

Continue Chloride CAC meetings on quarterly basis.

Stakeholder meetings to held in 2021 with select industrial and commercial customers to investigate potential chloride reduction available to users with high chloride discharges. Follow up discussions may be required. Recommendations to be included in 2021 Annual Report.

Continued chloride education events for residential customers will be planned and implemented in 2021.

Meeting with ALP to be scheduled in 2021 after ALP feasibility study results for future water treatment plant alternatives/costs are available.

Funding opportunities to be reviewed including:

- Chloride Reduction Grant for chloride reduction from business or industrial water softening systems.
- Small Business Environmental Assistance for zero-interest loans to businesses to upgrade equipment to reduce salt use.
- Clean Water Partnership loans for zero-interest loans for LGU to implement practices that reduce non-point source chloride reduction.
- Point source implementation grant (PSIG) for water plant treatment upgrades related.

- Investigate other funding opportunities.

ALASD to engage ALP and the City of Alexandria to discuss Integrated Planning to determine how to streamline regulatory issues related to chlorides.

Future steps (beyond 2021) for the CIMP include the following:

Annual reports to be completed in December of each year and submitted to the MPCA.

Continue Chloride CAC meetings on quarterly basis.

Evaluate alternatives to industrial water treatment systems to reduce chloride discharges from industrial and/or commercial sources with high chloride levels.

Per the ALASD NPDES permit, within three years this CIMP, research nonpoint source discharges of chloride such as road salt application and the use of de-icing products on ALASD property. Review MPCA's Smart Salting Assessment tool (www.wintermaintenancetool.com) with LGUs. This web-based tool will help winter maintenance organizations assess operations, identify opportunities to reduce salt using proven best management practices (BMPs), and track progress. Along with this tool are Smart Salting training opportunities.

Per ALASD NPDES permit, work with and provide funding for one City of Alexandria staff member to attend at least one smart salting trainings and submit documentation of completion to the MPCA. The preferred City staff to attend should be a staff member who is considered a decision-maker in road maintenance. This will satisfy the requirement that Permittees with a variance will implement cost-effective and reasonable BMPs for nonpoint source control (Minn. R. 7050.0190 subp 1(B)).

Identify the appropriate quantifiable sampling and reporting methods necessary to determine if the chloride source reduction activities are resulting in a reduction, or if changes are needed.

Continue to update schedule of CIMP actions per the Streamlined Chloride Action Tree.

Appendix A: Summary of Statewide Chloride Management Plan and Streamlined Chloride Variance Action Tree

Appendix B: Sample Results

Appendix C:

January 19, 2021 Chloride Citizen's Advisory Committee Agenda/Presentation

April 6, 2021 Chloride Citizen's Advisory Committee Agenda/Presentation

Appendix H: Existing ALASD User Rates

P: (320) 762-1135 • F: (320) 762-1108

ALASD
Alexandria Lake Area Sanitary District
Restoring Our Water for a Healthier Natural Environment

2201 Nevada St. • Alexandria, MN 56308

RESOLUTION 20-11

WHEREAS, the Alexandria Lake Area Sanitary District's **User Charge Ordinance NO.4** establishes the user charges to all customers.

NOW THEREFORE, BE IT RESOLVED by the Board of the Alexandria Lake Area Sanitary District, the user charge rates shall be increased from current rate by 2% for residential, non-residential and commercial, and SIU agreement charges.

Section I. User Rates

Subdivision 1. The user charge for a single-family dwelling (both metered and not metered) shall be increased by 2% from $30.00 per month to **$30.60**, (includes a $.50 per month billing charge). The user charge would also apply to single family dwellings that are rented, partially or in whole, provided it discharges normal domestic strength wastewater and is billed as residential for electricity and water by Alexandria Light and Power (ALP). Structures constructed or modified to serve as multiple family dwellings are not eligible for the single-family rate and will be billed as a non-residential/commercial user.

Subdivision 2. The flow unit charge for the non-residential/commercial user shall be increased by 2% from $6.38 per 1000 gallons to **$6.51 per 1000 gallons,** in addition to a $.50 per month billing charge.

Subdivision 3. The user charge for Biochemical Oxygen Demand (BOD), Total Phosphorous (TP), Total Suspended Solids (TSS), which exceeds the parameters of the general municipal flow (BOD = 290 mg/L, TSS = 270 mg/L, and TP = 6 mg/L) and by rule is agreed upon in Significant Industrial User (SIU) agreements shall be as follows:

BOD -$.36 per pound increased by 2% to **$.37 per pound**
TP - $10.72 per pound increased by 2% to **$10.93 per pound**
TSS - $.34 per pound increased by 2% to **$.35 per pound**

Subdivision 4. The minimum monthly service charge shall increase by 2% for the non-residential/commercial users that are metered. Charges shall be based on the private sewer service pipe connection to structure and shall be as follows:

< 6" - **$30.60 per month plus usage charge**
8" - **$186.64 per month plus usage charge**
10"- **$302.29 per month plus usage charge**
12"--**$486.49 per month plus usage charge**

Subdivision 5.
All non-residential/commercial accounts not having a city metered water supply service shall be charged based on monthly estimated usage. Typical single-family dwellings shall be assigned an M value of 1 (EDU=Equivalent Dwelling Unit) and shall pay the Alexandria Lake Area Sanitary District user rate of 1 EDU= $30.60 (2021 Rate). Minimum Monthly Service charge, based upon service pipe connection to structure and shall be as follows:

4" - **$30.60 per month plus EDU charge**
6" - **$88.56 per month plus EDU charge**
8" - **$186.64 per month plus EDU charge**
10"- **$302.29 per month plus EDU charge**
12"--**$486.49 per month plus EDI charge**

Subdivision 6. All other non-metered examples below:

Facility	EDU or M Value	Parameter
Airport Hanger	.50	$16.00 per mo.
Garage/Storage	.50	$16.00 per mo.
RV Camper	.65	$20.00 per mo.
Guest House	1.0	$30.60 per mo.
Garage with living qtrs.	1.0	$30.60 per. mo.
Townhome	1.0	$30.60 per mo.
House w/Garage (living qtrs.)	1.5	$45.90 per mo.
House w/Guesthouse	2.0	$61.20 per mo.

Subdivision 7. WTEF: The following table is a listing of standards used in assigning the M value for various commercial, public, and institutional facilities in regards to the Wastewater Treatment Expansion Fund (WTEF). The WTEF charge is due prior to customer connecting to ALASD systems.

Facility	EDU or M Value	Parameter
Apartments	0.8	$2,000 (each unit)
Duplexes	0.8	$2,000 (each unit)
Single Family Dwelling	1.0	$2,500 (each unit)
Townhomes	1.0	$2,500 (each unit)
Condominiums	1.0	$2,500 (each unit)
Mobile Homes	1.0	$2,500 (each unit)

Attached: Equivalent Domestic Unit (EDU) Criteria for Non-Residential/Commercial is appended and incorporated into this ordinance by reference.

Section II. Billing and Adjustments

Subdivision I. All billings shall commence the first billing cycle after connection to sanitary sewer. Billing shall continue until the structure generating wastewater is removed from the property or when not occupied and water and electrical service has been removed. The removal of the user charge shall not be retroactive unless the time all of the above conditions were met can be substantiated to the satisfaction of the Executive Director. In no event shall any rebate, credit, or back charge issued to a customer exceed six years.

Subdivision 2. Metered customers that experience a break in the private water service line may receive a credit for unused water if the Executive Director can substantiate the water line break and resultant repair. The credit shall be based upon the highest monthly usage in the 12 months preceding the break.

Section III – Resort and Commercial Off-Season Rates

Subdivision 1. Definitions: "Resort" is defined as a commercial
seasonal enterprise whose income is solely derived from the rental of housing units and associated goods and equipment including boats motors, supplies and recreational equipment. The units and associated equipment must be available for rent to the general public during the minimum period from May 15 to September 1 of each year at reasonable rates as compared to other enterprises of the same character in Douglas County, Minnesota. In any year that the enterprise has no income, it will not be considered a resort. Any units owned by individuals, corporations, cooperatives, associations or other multiple owner groups that units do not meet the definition of resort in this section shall not be considered resorts and will be billed in accordance with Subdivision 1 & 5 Section 1 of this ordinance.

Subdivision 2. Upon annual written notice and the signing of a contractual agreement user rates will be reduced during the resorts off-season to the minimum charge for a six-inch service as shown in Section 1, Subdivision 5. The minimum charge will not apply when the resorts off-season usage exceeds the minimum charge.

Subdivision 3. Failure to comply with the written agreement shall result in the resort's disqualification for a period of one year from the rate allowed in Section II, Subdivision 1 of this ordinance.

Section IV – Deduction Meters

Subdivision 1. If a substantial portion of water utilized by a metered general municipal user is not discharged into the sewer system (e.g.- irrigation), the volume of such water shall be deducted in computing the sewer use charge, provided a separate meter is installed to measure such volume. The user desiring to install such separate meter shall make application to the ALASD, full payment for the meter, and engage, at their own expense, a plumber to affect the necessary piping changes and install the couplings so the meter can be set. The user may also make direct payment to the distributor for the necessary meter provided it is approved by ALASD.

Section V. – Private Water Meter Flow Billing

Subdivision 1. Effective on January 1, 2017, non-residential/commercial sanitary sewer accounts that do not have access to city water or have not connected to city water and have been charged a reduced rate during the winter (e.g – resorts) are required to install a water meter(s) for the purpose of user charge billing based upon metered flow. The private water meter shall be purchased, owned, maintained and if needed, replaced by the commercial account holder. Once a non-residential/commercial account is switched from flat rate billing to metered flow billing the commercial account shall not be qualified to revert to previous flat rate billing.

Subdivision 2. All customers served by District not having a city metered water supply may be required or volunteer to install and maintain a water meter at no charge to ALASD. All water meters shall comply with ALASD guidelines. ALASD reserves the right to inspect and require testing to ensure accuracy. Meters can be purchased through Alexandria Light and Power.

Subdivision 3. Account holder must report meter reading monthly to District Office by no later than the last working day of each month. Application provided by District must be completed, signed by the customer and approved by the District prior to installation of the meter. The installer of the water meter and appurtenances shall be a plumber licensed by the State of Minnesota.

Section VI. - Delinquent Accounts

Subdivision 1. Delinquent sewer charges incurred by the tenant are the responsibility of the property owner.

Subdivision 2. Each user charge levied pursuant to this ordinance shall be a lien against the property, and all such charges due on October 30 and April 30 of each year, delinquent more than six times the monthly billing and having been properly mailed to the owner of the premises shall be certified by the Executive Director to the County Auditor, shall specify the amount thereof, the description of the premises, the name of the owner thereof, and the amount so certified shall be spread upon the tax rolls against such premises in the same manner as other taxes, and collected by the County Treasurer and paid to the Alexandria Lake Area Sanitary District along with other taxes.

Subdivision 3. Delinquent accounts not certifiable to the county auditor shall be forwarded to a collection agency along with ALP's delinquent accounts.

Section VII. - Validity and Effective Date

Subdivision 1. Any person violating any provisions of this ordinance shall become liable to the ALASD for any expense, loss or damage occasioned by the ALASD by reason of such violation.

Subdivision 2. If any portion of this ordinance is ruled invalid by any court of competent jurisdiction, or by reason of any existing or subsequently enacted legislation, the remaining portions or provisions of this ordinance shall continue to have full force and effect.

Subdivision 3. The effective date of this amendment to the ordinance shall be the first ALP billing cycle in year 2021.

==

Approved this 11th of November 2020, by the following vote:

Yes:

No:

Roger Thalman,-Chairman

Rebecca Sternquist, Secretary

Equivalent Domestic Unit (EDU) Criteria for Non-Residential/Commercial Properties

FACILITY	PARAMETER	EDU
Animal Clinic (humane societies, animal research, boarding, etc.)		
Animal holding areas	17 fixture units	1
Animal runs (kennels)	34 fixture units	1
Archery (6 feet/lane)	6 lanes	1
Arenas (bleachers 18 inches/person)	110 seats	1
Auditoriums (7 square feet/person)	110 seats	1
Automobile Service		
Fast service (less than 4 hours/car)	2 service bays	1
Major service (more than 4 hours/car)	14 employees	1
Car dealership (charges for office, retail, etc. are separate at 2 service bays 1 established rates)		
Fast service (number of service bays x 30%)	2 service bays	1
Major service (Number of service bays x 70% x 1 employee/bay)	14 employees	1
Ballroom (exclude dance floor)		
Facility without liquor service	825 square feet	1
Facility with liquor service	590 square feet	1
Bank (exclude bank vault)	2400 square feet	1
Banquet Room (15 square feet/person)		
Food catered	2,060 square feet	1
Food catered with dishwashing	1,180 square feet	1
Food catered with liquor	1,028 square feet	1
Food catered with dishwashing and liquor	750 square feet	1
Food preparation and dishwashing	825 square feet	1
Food preparation with dishwashing and liquor	590 square feet	1
Barber	4 chairs	1
Batting Cages (6 feet/lane)	6 lanes	1
Beauty Salon	4 cutting stations	1
Bingo Hall (used only for bingo)	110 seats	1
Boarding House (dorm rooms)	5 beds	1
Body Shop (major service more than 4 hours/car, no vehicle washing)	14 employees	1
Bowling Alleys (does not include bar or dining area)	3 alleys	1
Camps (number of gallons x occupant or site)		
Children's camps (central toilet and bath; cabins; number of occupants x 50 gallons/occupant)	200 gallons	1
Day camps (no meals served; number of occupants x 10 gallons/occupant)	200 gallons	1
Labor/construction camps (number of occupants x 50	200 gallons	1

FACILITY	PARAMETER	EDU
Resorts and Cabins (with housekeeping)	Each unit	1
Travel trailer parks with water and sewer hookup	Each Site	.5
Sanitary RV Dump Site	200 gallons	1
Car Wash	Each	3
Car Wash (self-service)	1 stall	3
Catering - Contact ALASD for Determination		
Churches	50 seats	1
Cocktail lounge (no food service)	23 seats	1
Coffee Shop (no food service)	23 seats	1
Correction Facility (prison)	2.5 inmates	1
Court Rooms	1,650 square feet	1
Dorm Rooms		
(on and off campus; charge for classrooms is additional)	5 students	1
Daycare		
Number of children for which facility is licensed	14 children	1
Child/adult play area (not licensed)	490 sq.ft.	1
Dental clinic vacuum device (9 hours x gallons per minute x 60 minutes)	200 gallons)	1
Dry Cleaners (retail)	3,000 sq ft	1
Elder Housing		
No washer/dryer in each unit	3 residents	1
Washer/dryer in each unit	2.5 residents	1
Three- bedroom unit with washer/dryer (separate from formula below)		
Calculate the number of residents as follows:		
Number of efficiency units x 1.0 residents/unit		
+ Number of one-bedroom units x 1.5 residents/unit)		
+ Number of two-bedroom units x 2.0 residents/unit)		
+ Number of three-bedroom units x 3.0 residents/unit)		
Total number of residents for SAC calculation		
Exercise Area/Gym (juice bars at no charge; sauna and whirlpool included)	700 sq ft	1
No showers	2,060 sq ft	1
Fire Station (charges for office, meeting rooms, etc., are separate, at established rates)		
Washing (hose tower, truck)	200 gallons	1
Full time, overnight people (75 gallons/person)	200 gallons	1
Volunteer (occasional overnight stays)	14 volunteers	1
Funeral Home (charge for viewing areas only: i.e., chapel)	770 sq ft	1
Apartment	1 apartment	.8
Game Room (billiards, video and pinball games)		
With bar	590 sq ft	1
Without bar	2,060 sq ft	1

FACILITY	PARAMETER	EDU
Golf Course (if facility has showers, use Locker Room criteria for those areas)		
18 hole		3
9 hole (par 3)		2
Miniature		3
Country club (private)		
Dining room (used only on evenings and weekends)	15 seats	1
Bar and grill (with bar and grill separate)		
Bar only	23 seats	1
Grill	15 seats	1
Golf Dome or Driving Range	6 driving stations	1
Greenhouse		
Area not open to the public	15,000 sq ft	1
Area open to the public	5,000 sq ft	1
General retail area	3,000 sq ft	1
Group Home		
Secondary treatment (residents leave during the day)	5 beds	1
Primary treatment (residents stay all day)	3 beds	1
Guest Rooms (in an apartment or condominium complex; charge as apartment)		
Washer/dryer		1
No washer/dryer 80% of current rate		.8
No kitchen 50% of current rate		.5
Handball and Racquetball Courts	1 court	2
Hospitals(licensed beds or baby cribs)	1 bed	1
Outpatient clinic	17 fixture units	1
Sterilizers (4 hours x gallons per minute x 60 minutes)	200 gallons	1
X-ray film processors (9 hours continuous operation; 4 hours intermittent operation; operation time (hours) x gallons per minute x 60 minutes)	200 gallons	1
Ice Arena		
Showers (see Locker Rooms)		
Team Rooms (plumbing fixture units)	17 fixture units	1
Bleachers 110 seats 1		
Laundromat	2 machines	3
Library (subtract book storage areas, file areas; charge for common plumbing fixture units in public areas)	17 fixture units	1
Meeting rooms, board rooms, reception, book checkout offices	2,400 sq ft	1
Loading Dock	7,000 sq ft	1
Locker Rooms(if showers 20 gallons/locker)	14 lockers	1
Medical Clinic (see Hospitals, Outpatient Clinic)		
Meeting Rooms (conference rooms)	1,650 sq ft	1

FACILITY	PARAMETER	EDU
Mini-storage (storage area no charge)		
Living area		1
Public restroom	17 fixture units	1
Mobile Home		1
Motels and Hotels 2 rooms 1		
saunas, whirlpools, game rooms, or exercise rooms used exclusively by guests)		
Breakfast only (complimentary)	45 seats	1
Cocktail hour (complimentary)	55 seats	1
Kitchenettes (number of kitchenettes x 10 gallons/day)	200 gallons	1
Museum	2,400 sq ft	1
Nursing Home	3 beds	1
Office		
General office (deduct mechanical rooms, elevator shafts, stairwells, restroom and storage areas)	2,400 sq ft	1
Dental and Doctors' offices, see Hospital, Outpatient Clinic		
Police Station (charge as Office)		
Cells (overnight jail)	3 people	1
Cells (holding area with no overnight stays)	14 people	1
Recording/Film Studios	7,000 sq ft	1
Restaurant		
Drive-in	9 parking	1
Fast food (with disposable plates, drink cups, and table utensils)	22 seats	1
Take-out (no seating)	3,000 sq ft	1
Full service (with washable plates, drink cups, and table utensils)	8 seats	1
Restaurant with cocktail lounge	9 seats	1
Restaurant (24-hour service)	12 seats	1
Retail Stores (deduct mechanical rooms, elevator shafts, stairwells, escalators, restrooms and unfinished storage areas)	3,000 sq ft	1
Roller Rink (skating area only)	825 sg. ft.	1
Rooming Houses (no food service)	7 beds	1
Recreational Vehicle		.65
RV Dumping Station (not in association with camp grounds)		1
Schools		
Elementary schools (15 gallons/student; 30 square feet/student)	18 students	1
Colleges/technical/vocational (30 square feet/student)	18 students	1
Lecture halls (15 square feet/student)	18 students	1
Labs (50 square feet/student)	18 students	1
Dorm rooms (on and off campus students)	5 students	1
Nursery schools (number of children for which facility is licensed)	14 students	1
House of worship nurseries (used during worship service only; 30 square feet/child)	55 children	1
Nursery (health clubs, bowling alleys, etc.)	2,400 sq ft	1
Secondary schools (30 square feet/student, at 20 gallons/student)	14 students	1
Labs (50 square feet/student)	14 students	1
Weekly worship schools (i.e., not daily parochial schools; 30 square feet/student)	55 students	1

FACILITY	PARAMETER	EDU
Service Station		
Gas pumping	1 each	1
Convenience center	3000 sq ft	1
Service bays	2 bays	1
Car wash (see Car Wash)		
Shooting Ranges (rifle and handgun ranges, @ 6 feet per lane)	6 lanes	1
Swimming Pools (public, swimming pool area only; no charge for private residential, townhouse, apartments, condominiums, hotels, or motels)	900 sq ft	1
Tanning Rooms	3000 sq ft	1
Tennis Courts (public; shower facilities available)	1 court	2
Theatre	64 seats	1
Drive-in (parking spaces)	55 spaces	1
Vehicle Garage		
Employees stationed in garage	14 employees	1
Vehicle drivers (per day)	28 drivers	1
Vehicle washing (number of vehicles per day x gallons per minute x minutes/vehicle)	200 gallons	1
Warehouses		
Assembly areas	7,000 sq ft	1
Office/warehouse		
Minimum 30% office	2,400 sq ft	1
Maximum 70% warehouse	7,000 sq ft	1
Whirlpools, therapy (at doctor's office or clinic; number of gallons to fill tank x 8 fills/day)	200 gallons	1
Yard Storage Buildings (i.e., lumber storage; customer pickup; no permanent employees)	15,000 sq ft	1
Plumbing Waste Fixture Units		
Type of Fixture, Fixture Unit Value (f.u.)		
Note: 17 Fixture Units (f.u.) = 1		
Drinking Fountain		1
Floor Drain		
2" waste (only if hose bib included)		2
3" waste (only if hose bib included)		3
4" waste (only if hose bib included)		4
Trench drain: per 6-foot section		2
Sinks		1
Lab in exam room, bathroom		1
Kitchen and others		2
Surgeon		3
Janitor		4
Water closet		