WATER MAIN ASSESSMENT STUDY

BOARD OF PUBLIC WORKS
LEWES, DELAWARE

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GMB No. 210129

GMB
GEORGE, MILES & BUHR, LLC

ARCHITECTS/ENGINEERS

400 HIGH STREET
SEAFORD, DELAWARE 19973
302.628.1421

SALISBURY/BALTIMORE/SEAFORD

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Introduction

As the average age of the Lewes Board of Public Works (LBPW) infrastructure increases, it is challenged with maintaining good quality of water while keeping it affordable. In general, condition assessment can help the LBPW identify where money is best spent in order to identify a hierarchy of replacement. Currently, the LBPW has an Asset Management Program (AMP) in which the goal is to assure that resources are appropriately managed to fully maximize the asset's economic life span. Effective management of assets requires accurate and updated inventories of the infrastructure. This water main assessment can be considered an important tool for management of the water mains of the LBPW's water system and supplement the AMP.

To date, the issues of the water main relate to water quality as opposed to structural integrity related to corrosion. Water main breaks as a result of corrosion of old mains are rarely a problem in the City of Lewes. Most often, the issues associated with the older mains are related to the condition of the inside of the pipe. The cast iron pipe most often contains various degrees of tuberculation. Tuberculation is a bacterial-based oxygen-driven form of corrosion that results in iron oxide precipitation. In other words, the deposition of ferrous oxide (tubercles) from the water, as opposed to the material being "taken away," which is typically how corrosion results. Excessive tuberculation can have several adverse effects on the pipe as well as the water quality delivered to end customers. Ferrous oxide accumulation eventually reduces the pipe's effective internal diameter, which lessens its flow capacity. This can lead to several hydraulic issues, such as low flow rates, increased pressure buildup in pipes, and even damaged pumping equipment.

Tuberculation can result in reddish-brown discoloration of water coming out of pipes. Staining of plumbing fixtures, odor and taste irregularities, and damaged appliances, are just some of the adverse effects of tuberculation. The LBPW has an abundance of experience with this phenomenon. Resident complaints are a regular occurrence when there is any type of

event that tends to mobilize the ferrous oxide accumulation (e.g., hydrant flushing, water main breaks, etc.).

This report focuses on the iron pipe in the Lewes water system, with specific emphasis on water quality as opposed to structural integrity. Through evaluation of existing data and examination of water samples obtained throughout the system, GMB has ranked the existing condition of the various mains. Further, GMB has examined some anecdotal data related to the water quality impacts related to various hydraulic impacts to the water system such as water main breaks, hydrant flushing, valve exercising, etc. Finally, the results of the study were used to prioritize the existing projects contained within the five-year capital improvements list.

Background

The City of Lewes is a very old city (founded in 1631, “the first town in the first state”). Because of its age, there is a significant portion of the water and sewer system which has been in service well over 100 years. Historically, very early pipe materials used for water distribution included lead, clay, and wood (hollowed trees). Cast iron pipe began being used in the early 1800s, when Philadelphia installed cast iron pipe to replace wood pipe as early as 1810. Cast iron became popular due to its longevity and ability to withstand higher water pressure. However, cast iron has a high risk of corrosion. Eventually different coatings were developed to help slow down the corrosion process. One of the most popular coatings was cement-lined cast iron. In the 1950s, ductile iron pipe was introduced as an improvement on cast iron. It has higher strength and similar corrosion resistance, making it an attractive material for water and wastewater uses. Ductile iron was introduced in AWWA Standards in 1965 and began replacing cast iron because of higher strength and ductility.

In the last 50 years, there have been significant improvements and changes in water pipe types. The greatest change has been the introduction, use, and acceptance of non-metallic material for water pipe applications, particularly PVC (polyvinyl chloride) and HDPE (high-density polyethylene).

Lewes Water System

The Lewes BPW is served by five wells which are fed by the Columbia Aquifer. All five wells are in a centralized location, far enough away from the bay/ocean to minimize saltwater intrusion. The water is pumped via a common header pipe to a central treatment facility, where it is pH adjusted, fluorinated, and disinfected via caustic, fluoride and chlorination. The water is pumped from the "Wellfield" to the Water Tower and then out to the customers via an approximately 60 miles of distribution network piping, which includes various pipe materials (see **Appendix A – Exhibit 1**). The breakdown of piping in terms of material and length can be seen below in ***Table 1 – Pipe Material Breakdown by Length***. Currently, the Lewes BPW only has a 300,000-gallon elevated storage tower and one wellfield consisting of five production wells, but are planning to add an additional elevated storage tower and production well in the near future. This added overhead capacity will help normalize the pressure throughout the BPW Service Area.

TABLE 1 - Pipe Material Breakdown By Length

Pipe Material	Quantity of Pipes in KYPipe System	Length of Pipe (Feet)	Length of Pipe (Miles)	Percentage of System
Cast Iron	317	88,799	16.82	27.9%
Ductile Iron	209	50,301	9.53	15.8%
HDPE	21	9,443	1.79	3%
PVC	506	169,220	32.05	53.2%
Total	1053	317,763	60.19	-

Additionally, water supply redundancy was put in place several years ago with the installation of an interconnection with Tidewater in case of an emergency. Emergency generators are located at the Wellfield to help ensure delivery of water to the nearly 3,600-meter connections within the BPW service area.

Data Collection

The collection of real-world data through pipe samples was pertinent to achieve the goal of the project, analyzing and ranking the condition of the iron pipe mains in the Lewes water distribution system. The more samples that were taken and recorded, the more accurate the

findings and therefore rankings would be. However, there had to be a limit on the samples taken to ensure proper and reasonable allocation of resources during the project. Prior to the start of the project, GMB worked with the BPW to determine what samples were already available due to replacements, repairs, or other work that has been done on the water system. In addition, they worked to determine additional locations of which new samples would be taken. Once these proposed sample locations were determined, GMB obtained the necessary permitting and coordinated with local contractors as well as the BPW to acquire the samples. Throughout this process, GMB gathered the existing pipe samples from the BPW and their own records to start the process of inspecting and recording information from the samples. **Exhibit 2** in **Appendix A** spatially identifies locations of all samples used within the analysis.

The samples came in a variety of forms, some were whole sections of pipe while others were coupons (a partial section of pipe, typically gathered from tapping into a line). In addition to real world samples, a few photographs from previously completed pipes from work on the water system were utilized to expand the sample collection data. Each sample was then extensively analyzed, and data summarized in **Table 1** shown in **Appendix B**. To start the analysis, as-built records of the water system were reviewed to determine each pipe size, material, and year of installation. Then, each pipe was photographed and measured (photographs can be found in **Appendix C**). Measurements included confirming pipe size and material where possible as well as recording pipe wall thickness and more.

FIGURES 1 & 2 - Best Ranked Sample Pipe

Figure 1: Savannah Road Sample Exterior

Figure 2: Savannah Road Sample Interior

The average thickness of each pipe sample was measured using a caliper and recorded. GMB planned to compare each pipe's existing thickness to its original thickness upon installation. This comparison was to provide the basis for additional analyses such as determining how characteristics such as size, material, and flow effects pipe thickness over time. GMB anticipated that this analysis would provide insight to pipe thickness losses over time. However, as more research was done to find the original pipe wall thickness, it was determined this analysis would be inconclusive. Finding the original thickness was not a direct process as originally thought. This was in part due to lack of detailed information on the pipe class from as-built drawings as well as the immense variety of wall thicknesses across pipe material, class, and size over the 100+ year range of the samples.

FIGURES 3 & 4 – Worst Ranked Sample Pipe

Figure 3: East Market Street Interior

Figure 4: East Market Street Exterior

Additional research was undertaken to determine the soil types prevalent in Lewes and how these soils could have affected the different types of iron pipes. In most of the research articles and resources that were reviewed, external corrosion was a main source of pipe corrosion and was a frequent cause of breaks in water systems across the country. Fortunately, the Lewes water distribution system has not been subjected to many pipe breaks. This analysis process did not provide any significant information as a majority of the pipes did not have external corrosion present, and the water distribution system shares similar soil conditions, none of which were particularly corrosive. The main source of deterioration present on the pipe samples was due to tubercles, the development or formation of small mounds of iron oxide deposits, and can be seen in the sample photos. While tuberculation may not directly affect structural integrity, there are negative effects on the water system, related to decreased water quality and hydraulics.

While the wall thickness and soil analysis did not offer additional clarity, there was one source that provided extensive dynamic analysis and data, the KYPIPE water model. The KYPIPE model was created to simulate the existing LBPW water system and has been continuously updated and utilized for design, evaluation and planning purposes. The model incorporates as-built data, as well as fire hydrant testing and known water demands to create an accurate model of the Lewes water distribution system. One item to note about the model is that it is not built to model the previous layouts of the water distribution system, and therefore, only provides a 'snapshot' of the system's ever-changing design. The model was used to provide flow, velocity, and water age, for each pipe in the water distribution system. A detailed analysis of this data will be discussed later in this report.

GMB worked with the Lewes BPW to collect information relating to pipe breaks, water quality complaints, hydrant testing field reports and other historical data and/or records that could be used with the pipe samples to gather a better understanding of the system. The LBPW was able to provide details of recent events such as water quality complaints in various locations around the City which was used to try and identify problem areas in the data analysis. However, there were no records of past water quality reports or any other pertinent information that could be added to the analysis. While additional data could have been collected from the water main system or extracted from the pipe samples, it was determined that this would require extensive processes, such as metallurgical analysis or ultrasonic testing. Such processes were deemed uneconomical and impractical for the scope of this project and more appropriate for determining the degree and rate of corrosion and estimating remaining life. It was determined that the best indicator of pipe condition was visual observation; specifically, focusing on the internal condition of the pipe and the size, thickness, and density of the tubercules.

Ranking Of Samples

Once all the sample pipes were evaluated and photographed, the photos of each sample were grouped together and combined into a condition ranking survey. The order of the samples was randomized with the name/location of the sample being omitted. The survey was then completed by experienced individuals at GMB. Each individual objectively ranked the condition of the samples, from worst to best, with no prior knowledge of the results of other rankings. The

average ranking was taken for each of the samples used in the evaluation. The sample pipe ranking system was utilized and analyzed for a way to extrapolate out from the 29 samples to all of the iron pipe in the system.

TABLE 2 – Sample Pipe Data Table

Sample ID:	Sample Name:	Nearest Address:	Size: (inches)	Material	Install Year	Pipe Name	AVG Ranking
1	Beebe Hospital	424 Savannah Rd, Lewes, DE 19958	12	DI	1945	917	3.4
2	Big Oyster Hyrdant	1007 Kings Hwy, Lewes, DE 19958	12	DI	1945	274	19.4
3	Burton and 4th	402 Burton Ave, Lewes, DE 19958	6	CI	1957	916	5.1
4	Canal Front	236 Front St, Lewes, DE 19958	10	CI	2006	569	4.6
5	Cape Henlopen	Cape Henlopen Drive	12	CI	1955	116	14.4
6	Cedar Lane	502 Cedar St, Lewes, DE 19958	10	CI	1954	600	13.6
7	Coleman and Savannah	417 Savannah Rd, Lewes, DE 19958	6	DI	1960	281	12.7
8	Delaware Avenue	10 Delaware Ave, Lewes, DE 19958	6	CI	1952	36	24.0
9	East Market Street	410 E Market St, Lewes, DE 19958	6	CI	1904	4	26.6
10	Hornkill Avenue	14 Hoornkill Ave, Lewes, DE 19958	6	CI	1960	121	19.1
11	Kings Highway Lodge Entrance	1008 Kings Hwy, Lewes, DE 19958	12	DI	1945	274	19.0
12	Madison at Railroad	137 Madison Ave, Lewes, DE 19958	6	-	-	-	6.9
13	Madison Avenue and Kings Highway	425 Kings Hwy, Lewes, DE 19958	6	CI	1910	212	26.0
14	Masons Way	1 Charles Mason Way, Lewes, DE 19958	8	DI	1987	369	14.9
15	New Road	107 New Rd, Lewes, DE 19958	6	CI	1951	123	18.9
16	New Road at Pilottown	502 Pilottown Rd, Lewes, DE 19958	6	CI	1951	796	12.4
17	Pilottown and Shipcarpenter	103 Shipcarpenter St, Lewes, DE 19958	6	CI	1904	128	1.9
18	Pilottown Road	358 Pilottown Rd, Lewes, DE 19958	12	CI	1954	656	18.6
19	Queen Anne at Pilottown	340 Pilottown Rd, Lewes, DE 19958	12	CI	1954	657	9.0
20	Railroad Avenue at Monroe	501 Railroad Ave, Lewes, DE 19958	6	CI	1954	940	12.3
21	Rodney Avenue	108 Rodney Ave, Lewes, DE 19958	6	DI	1948	120	22.4
22	Savanah Road - 109	109 Savannah Rd, Lewes, DE 19958	8	-	-	-	11.7
23	Savannah Road - 413	413 Savannah Rd, Lewes, DE 19958	12	CI	1965	176	5.7
24	School Lane and Savannah	817 Savannah Rd, Lewes, DE 19958	6	CI	1950	264	20.7
25	Shipcarpenter	103 Shipcarpenter St, Lewes, DE 19958	6	CI	1904	128	1.9
26	West 4th Street	111 W 4th St, Lewes, DE 19958	8	DI	1965	863	9.3
27	Ferry	41 Cape Henlopen Dr, Lewes, DE 19958	8	CI	1941	867	24.0

Evaluation of Data

The end goal of the project is to assess the existing cast iron and ductile iron water distribution pipes. While it would be impractical to acquire a sample from each iron pipe in the system, utilizing the aforementioned data collection process and analyses an accurate system of ranking can be created.

There were many theories as to what variables and characteristics determine the interior condition of the pipe. GMB examined both hydraulic data and physical attributes. Some of these were the idea that low flow could cause more tubercles to form, lower velocity could also increase tubercles, and that pipe age directly related to condition. Using the sample pipes, each characteristic was analyzed to determine if there were any trends of correlation between age, flow, velocity, etc. and the condition (and eventually ranking) of the pipe. This process was

essential to creating a consistent ranking system as it extrapolates the ranking system from the pipe samples data to all of the iron pipes in the system.

As the various characteristics were reviewed against the sample rankings, trendlines and correlation factors were evaluated to determine how closely the characteristic related to actual condition. Age of the pipe provided the best correlation to visually ranked samples, which is somewhat intuitive, meaning that older pipes are in worse condition. Other characteristics reviewed were average velocity, average flow, and average water age. Average velocity and flow had loose correlation to the sample rankings, whereas the water age did not have correlation at all. As such, the study discounted the water age, and used a weighted formula based on the trendlines of the sample pipes to apply to all the iron pipes in the system. Additional trendline examination was performed, analyzing the trendlines for sample pipes installed in 1950-1960. This group was further analyzed within these installation years as these pipes constituted a third of all samples and it was hypothesized that a smaller sample range would produce more definitive correlations. However, the trendlines produced by this analysis did not provide any notable results. All trendline graphs can be found in **Appendix D**. The weighted formula was created based on 80% of pipe age, 15% average flow and 5% average velocity. It was tested against the sample rankings and returned generally consistent results with the visual rankings.

One important idea to note is that the KYPipe model used to generate the results (flow, velocity, water age) can only predict each characteristic at that specific instance of time. It is nearly impossible to model each pipes average flow, velocity and water ages throughout the pipes' entire lifespan. In summary, the model cannot predict the conditions in the pipe at all points of time and the conditions modeled today may not be indicative of past conditions. (e.g., a pipe in bad visual condition with higher flows today may have had low flows for the majority of its lifespan which created the bad visual condition).

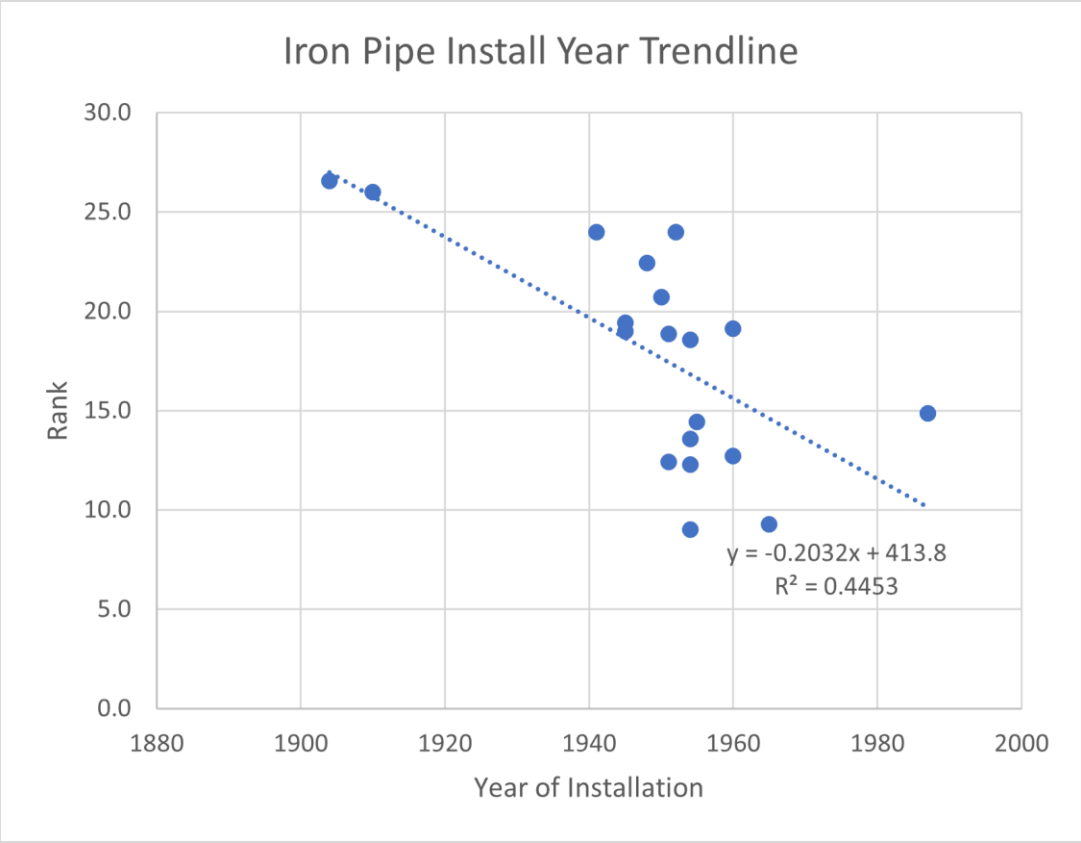


Figure 6: Trendline showing Install Year of all Iron Pipe Samples vs. Age

Out of the modeled system, approximately 506 pipes fell into the iron pipe category. When ranked, those pipes were broken into 5 groupings of approximately 20% of the iron pipe in order to define priority. **Exhibit 3**, in **Appendix A**, provides a visual representation of the pipe ranking whereas **Table 3** below provides the data in tabular form. Note that values are based on the best available data at the time of the study, and quantities and rankings may fluctuate based on new information collected in the field.

TABLE 3 - Iron Pipe Length Breakdown by Rank and Type

Rank Group	Total Length (feet)	Cast Iron Length (feet)	Cast Iron Percentage	Ductile Iron Length (feet)	Ductile Iron Percentage
0-99	28,007	1,509	5.39%	26,498	94.61%
100-199	23,406	8,538	36.48%	14,868	63.52%
200-299	26,523	25,764	97.14%	759	2.86%
300-399	26,665	25,112	94.18%	1,553	5.82%
400-506	31,518	29,075	92.25%	2,443	7.75%

Although each individual pipe was ranked, this did not make sense in regard to developing a maintenance schedule for these pipes to be replaced. Therefore, the pipes were segmented into sections where possible. This segmentation process was conducted such that the pipes that made up a segment would have the same flow, velocity, age, material, to ensure that the ranking system would accurately rank the segment. If any pipe did not match the characteristics of its surrounding pipes, it was given its own segment. This process reduced approximately 500 individual pipes to around 300 pipe segments, each one having a distinct location and rank, and to be considered a replaceable unit.

Function Based Versus Risk Based Analysis

Condition assessment may be defined as the likelihood that an asset will continue to perform its required function. There are two approaches to the assessment. A function-based assessment is a simpler approach that is based on specific prioritizations. The assessment of the water main can be related to age, soil corrosivity, flow rate through the pipe, etc. For example, those pipes that are the oldest, or those that are located in the most corrosive soils, or those that have the lowest flow would rank the highest. A risk-based assessment takes into account the consequences of the failure in addition to the likelihood of failure. Risk = Likelihood of Failure x Consequence of Failure. It should be noted that no single technology or technique provides a comprehensive assessment of a pipeline.

In evaluating the structural integrity of water mains, the risk-based approach addresses not only the pipes in the worst condition, but it also factors the impacts related to the failure (e.g., damage to roadway, buildings or other infrastructure). The total risk must be assessed when making decisions for replacement.

GMB explored the concept of a risk-based analysis. Since this study/report focuses on water quality, GMB equated the “consequences of failure” to those sections of pipe that, if removed, would have the greatest improvement of water quality to the entire water system.

GMB utilized the KYPipe model to try to identify those sections of water main that, if removed, would have the most significant impact to water quality. In other words, are there

sections of water main in the system that, if removed, would have a greater positive impact versus other sections of water main. Positive impact could be defined as a larger improvement over a larger area. Also, are there sections of water main that, if a break occurred or if a hydrant was opened, would have greater impact. For example, would removal of the iron water main in the center of Town have a greater impact than perhaps the removal of the iron water main located on Cape Henlopen Drive.

GMB quickly realized that the risk-based approach was difficult. The water modeling is very complex and is dependent on many variables such as system demands at the time of modeling, operating state of the system (e.g., tank full versus empty; wells pumping versus wells off; etc.). It is for this reason that the report focuses on a function-based analysis.

GMB, in its efforts to apply a risk-based approach, monitored several "water quality impact events." The following section provides some of the anecdotal observations that were noted. GMB believes that these observations provide a greater understanding of the problems associated with the iron water main in the LBPW system.

Anecdotal Observations

During the course of this assessment study, numerous observations were made relating to issues with water quality and being paired with noted real world scenarios. These observations are worth noting to help illustrate a cause-and-effect relationship, but also note the difficulty in pinpointing the starting point of water quality issues.

1. Water Main Break Within Lewes Waterfront Preserve
    a. During the construction effort at Lewes Waterfront Preserve, the gas was bored under the roadway at Red Cedar Drive and Brittingham Drive and hit the water main. The water began leaking out of the main at a high rate, and eventually shut off. The BPW received a couple of calls relating to dirty water being experienced at a few parcels in Pilottown Park along Captains Circle and Lightship Lane. GMB reviewed the water model and simulated a break in the same location to review potential hypotheses about changes in direction of the flow or increased velocity potentially mobilizing dirty water into the system. We reviewed key pipes

which could potentially be a part of the flow path to the water main leak location. The results of that analysis are summarized in the table below. Overall, a couple of pipes had changes in direction of typical flow, while all the key pipes noted an increase in flow and velocity. It is difficult to pinpoint the direct source of the dirty water without real-time data, such as inline turbidity meters, or with additional real-world scenarios to model and find patterns.

TABLE 4 – Lewes Waterfront Preserve Break Analysis

Lewes Waterfront Preserve - Break Analysis							
Pipe Name	Location	Diameter	Control		650 gpm Break		Notes
			Flow (gpm)	Velocity (ft/s	Flow (gpm)	Velocity (ft/s	
P-902	Highland Acres to Pilottown	10	123	0.50	334	1.36	
P-141	Sussex Dr to Johnson Ave	6	12.2	0.14	27	0.31	
P-1008	Mariners Retreat (4th St to Seagull Dr)	10	21	0.09	82	0.33	
P-203	Third St (Park to Burton)	12	102	0.29	276	0.78	
P-128	Shipcarpenter (2nd to Pilottown)	6	44	0.50	118	1.34	
P-796	New Road (Pilottown to 4th)	6	0.8	0.01	42	0.48	Change in direction
P-734	Newport Canal Crossing	12	98	0.28	32	0.09	Change in direction

2. Angler's Marina Water Main Installation
    a. During the testing phase of the water main installation project, flushing occurred in order to get fresh water into the main. It was observed during that flushing effort that dirty water was present for two (2) hours until clean water showed.

3. Hydrant flushing of November 2022
    a. GMB accompanied the LBPW in its routine flushing of hydrants in November 2022. The objective was to observe the flushing to get a sense of severity of the water quality in various areas of the City. A secondary objective was to assess the cause-and-effect relationship associated with opening and closing of the hydrants.

The flushing is performed by the LBPW in predetermined “zones”. Hydrants within a particular zone are flushed before proceeding to the next zone. Typically, two to three hydrants are opened at the same time and the flushing continues until the water flows clear. Those zones closest to the supply were flushed first and proceeded to the outer zones.

Below are GMB’s observations:

- “Dirty water” was encountered at every hydrant. The initial flow is the worst quality and is most likely due to poor water quality in barrel of the hydrant. Generally, this initial flow cleared up within approximately five minutes.
- The average time for the water to clear was approximately 5 to 15 minutes.
- The three worst areas observed as indicated by the dirtiest water and the duration of the flushing were:
    - Park, Johnson
    - Cape Henlopen Drive
    - Bayview Ave
- The hydrant on Bayview Avenue was the longest to be flushed, taking over 25 minutes to run clear.
- Flushing of hydrants in Baybreeze Estates took over one hour even though the mains are all PVC.
- Generally, the water quality of the outer zones was better than those closest to the supply. GMB believes this is most likely due to the fact that the outer zones are PVC mains and the water mains that are being drawn from had previously been flushed.

The general conclusions from the observations are as follows:

- Several zones (Park/Johnson, Cape Henlopen Drive and Bayview Avenue) exhibited much poorer quality water for longer durations than the other zones which were flushed.
- The demand placed on the water system due to opening of the hydrants mobilizes the poor-quality water, and in many cases, can mobilize the water a significant distance from areas with iron pipe.
- All areas of the LBPW's service area are susceptible to poor water quality, even those with PVC water mains on the outskirts of the system.

4. SPI Pharma and Observations of Water Quality Issues
    a. As part of the water tower design and sizing process, GMB and the Lewes BPW made a site visit to SPI Pharma to review and discuss any potential growth or issues in general. In addition to the growth discussed, SPI made the group aware of quality issues and the effect of water quality on their operation. SPI is very sensitive to water quality changes, the intake to the plant has turbidity meters and filters to further monitor and clean the BPW treated water, any quality issues, such as discolored water, impacts the product made and necessitates shut down of the plant, cleaning filters and lost product. Due to the water demanded at the site, any water quality issues which present themselves within the distribution system quickly reach the plant. It was noted in the meeting, that a staff member saw that a fire hydrant was hit near the Cape Henlopen High School on the way to work and by the time the staff member reached the plant, the plant was experiencing water quality issues and shutting down.

Conclusion

Combining all of the research and evaluation together produces a functional list of sections of pipe in which are ranked, in order, based upon, predominantly, the age, and then the anticipated average flow and velocity. Spatially, this ranking is shown in **Exhibit 3**, where the red colored pipes are higher ranked, first to be replaced, than green colored pipes. In most

cases, the water main ranking is based on age, as there was the most correlation between condition of pipe and how old that pipe was. However, it is understood that prioritizing the replacement solely based on condition is difficult as most of the time there are other factors which make up a decision. Factors such as upcoming projects by the City, by DelDOT, by other organizations, volume of complaints from an area, funding availability, etc. all can affect the priority of a project. These are not considered in this report as they are largely project specific and can be subjective to factors outside of the Board of Public Works' control.

The magnitude of the iron pipe within the LBPW's service area is significant. Almost 44% of the mains within the LBPW service area are comprised of iron pipe. The anecdotal observations discussed in this report demonstrate the complexity of the problem and its far-reaching scope. Replacement of all the iron pipe is the ultimate goal to eliminating the water quality issues related to iron pipe. However, it is very long-term and costly endeavor to achieve such a goal. There are approximately 26.35 miles of iron pipe within the LBPW system, with approximately 17 miles as cast iron. Based upon the results of the study, cast iron pipe should be prioritized in replacement. The condition of the interior of the ductile iron pipe is much better than cast iron and not a major contributor to water quality issues in the system.

To give reference to the effort to replace all of the iron pipes, the recently completed Pilottown Road project consisted of replacement of approximately 5,500 feet of water main at a cost of approximately $3.5 million. The duration from design to completion was approximately four years. Replacement of all the iron water main in the LBPW system equates to approximately 25 projects of the size and scope of the Pilottown Road project.

Replacement requires a long-term plan for budgeting and implementation. The results of this report can be utilized as a guideline for a structured approach to the replacement of iron water main in the LBPW service area.

Current Five-Year Capital Budget

The water main assessment study/report started in 2021 when GMB had started design work on the Cedar Avenue project. It was at that time that the LBPW Board members

recommended that GMB assess the condition of all of the iron water main within the LBPW's service area prior to proceeding with project.

The most recent five-year capital budget program proposed by the General Manager includes 9 potential projects that require replacement of water mains. The scope of each is conceptually indicated on **Exhibit 4**, These are listed below as:

- Cedar Avenue – Phase 1
- School Lane
- New Road
- Kings Highway (Third to Dewey)
- Kings Highway (Dewey to Gills Neck)
- Park and Johnson
- Cape Henlopen Drive
- Pilottown Side Streets
- Monroe/Railroad

The list of projects was compiled prior to this report, but most of the projects on the list were selected because of a recognition by the LBPW of known water main issues. More specifically, these 9 projects were identified based on the following factors:

- LBPW knowledge of water quality issues through history of water main breaks, valve exercising, hydrant/valve opening and closing, etc.
- Water Quality Issues reported by residents.
- Age of Water main
- Coordination with other Capital Improvement projects by City or DelDOT, etc.

While the budget identifies the list of projects, it does not include the anticipated schedule of each of the projects. The LBPW has awaited the results of this water main assessment report to assign the prioritization.

GMB ranked the water mains of the 9 projects using the data from each pipe listed in **Table 5**. An average rank for each project was obtained by taking the average rank per pipe and multiplying each pipe by its length. The total was divided by the project total length to

obtain an average rank per foot of pipe for each project. The ranking of the projects from highest (worse condition) to lowest (best condition) is as follows:

TABLE 5 – Capital Improvements Project Ranking

Rank	Project	Approx. Total Pipe Length	Avg. Rank
1	School Lane	428	386.0
2	New Road	768	380.9
3	Kings Highway (Third Street to Dewey)	7,072	357.3
4	Cedar Ave – Phase 1	7,307	347.0
5	Park and Johnson	6,035	339.8
6	Cape Henlopen Drive	17,104	321.9
7	Kings Highway (Dewey to Gills Neck)	12,170	292.3
8	Pilottown Roadside Streets	3,838	217.2
9	Monroe/Railroad	2,761	184.3

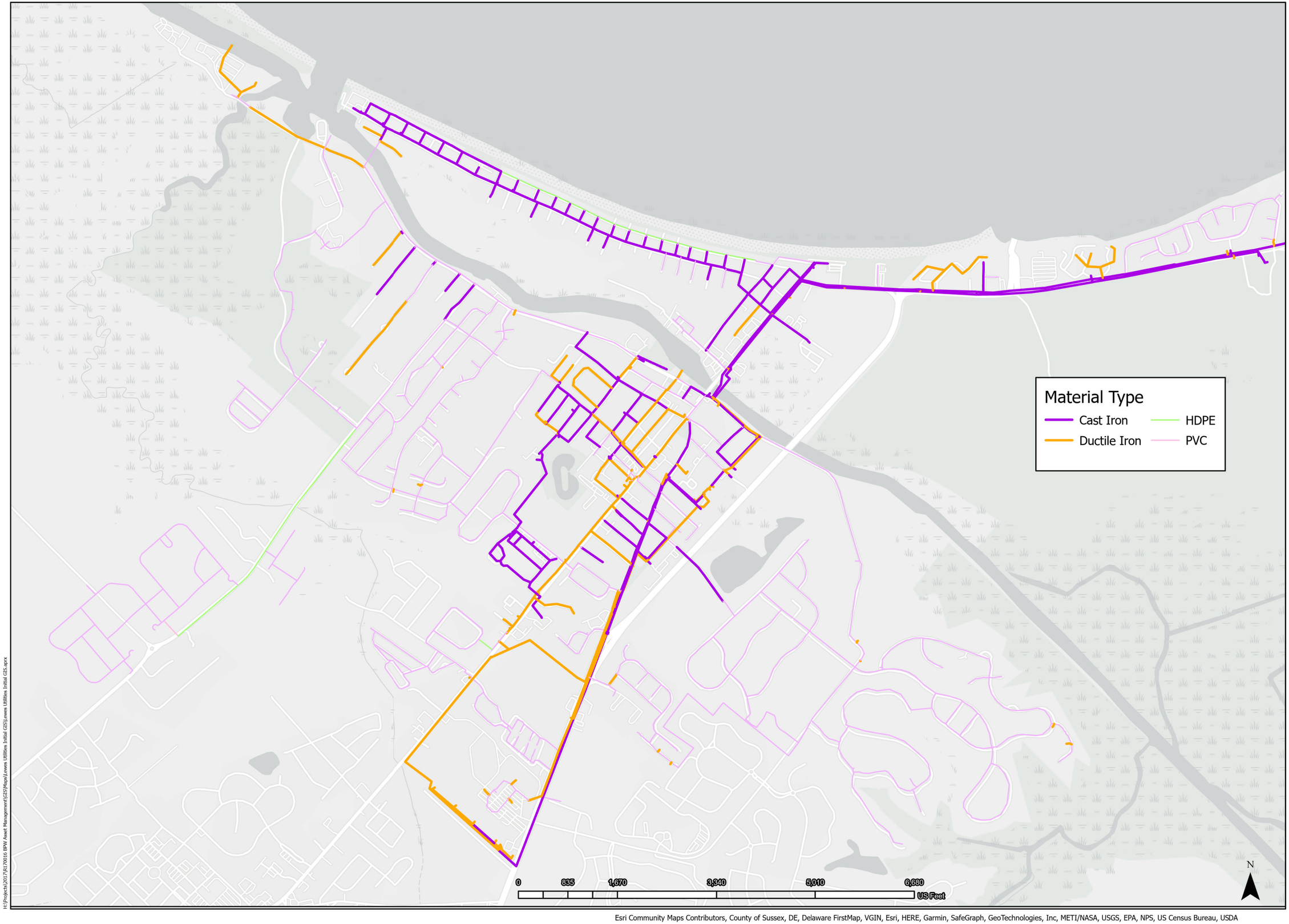
School Lane ranks as the worst of the 9 areas. This is mostly due to the age of pipe and, because it is only a small length, the average is heavily influenced by sections that rank high (i.e., there on the bottom of the list is the Monroe/Railroad project. You will note that the ranking is significantly lower than the School Lane project (184.3 versus 386) but appears on list primarily because of the road reconstruction project planned by the City of Lewes.

Although it is not included in the five-year budget, the Cedar Ave - Phase 3 project ranks higher than any of the existing projects in the Capital Improvements Budget list. It has an average rank of 402.8, with approximately 6,700 lineal feet of pipe to be replaced. This high ranking is mostly due to the poor quality of the mains in the Market, Midland, Massachusetts area. GMB felt it was important to specifically note this project since the Cedar Avenue Phase 3 project does appear in the Capital Improvement list but ranked high.

It is important to reiterate that prioritizing the replacement solely based on condition is difficult, and most times, there are other factors which make up a decision. Factors such as upcoming projects by the City, by DelDOT, by other organizations, volume of complaints from an area, funding availability, etc. all can affect the priority of a project.

Appendix A:

- **Exhibit 1: Lewes Water Distribution System Material**
- **Exhibit 2: Water Main Assessment Sample Pipe Locations**
- **Exhibit 3: Water Main Assessment Pipe Ranking**
- **Exhibit 4: Water Main Assessment**



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Electric, Water, and Sewer Utility

GMB
GEORGE, MILES & BUHR, LLC
ARCHITECTS & ENGINEERS
SALISBURY BALTIMORE ISSAQUAH
206 WEST MAIN STREET
SALISBURY, MARYLAND 21801
410 - 742 - 3115 FAX 410 - 548 - 5790
www.gmbnet.com

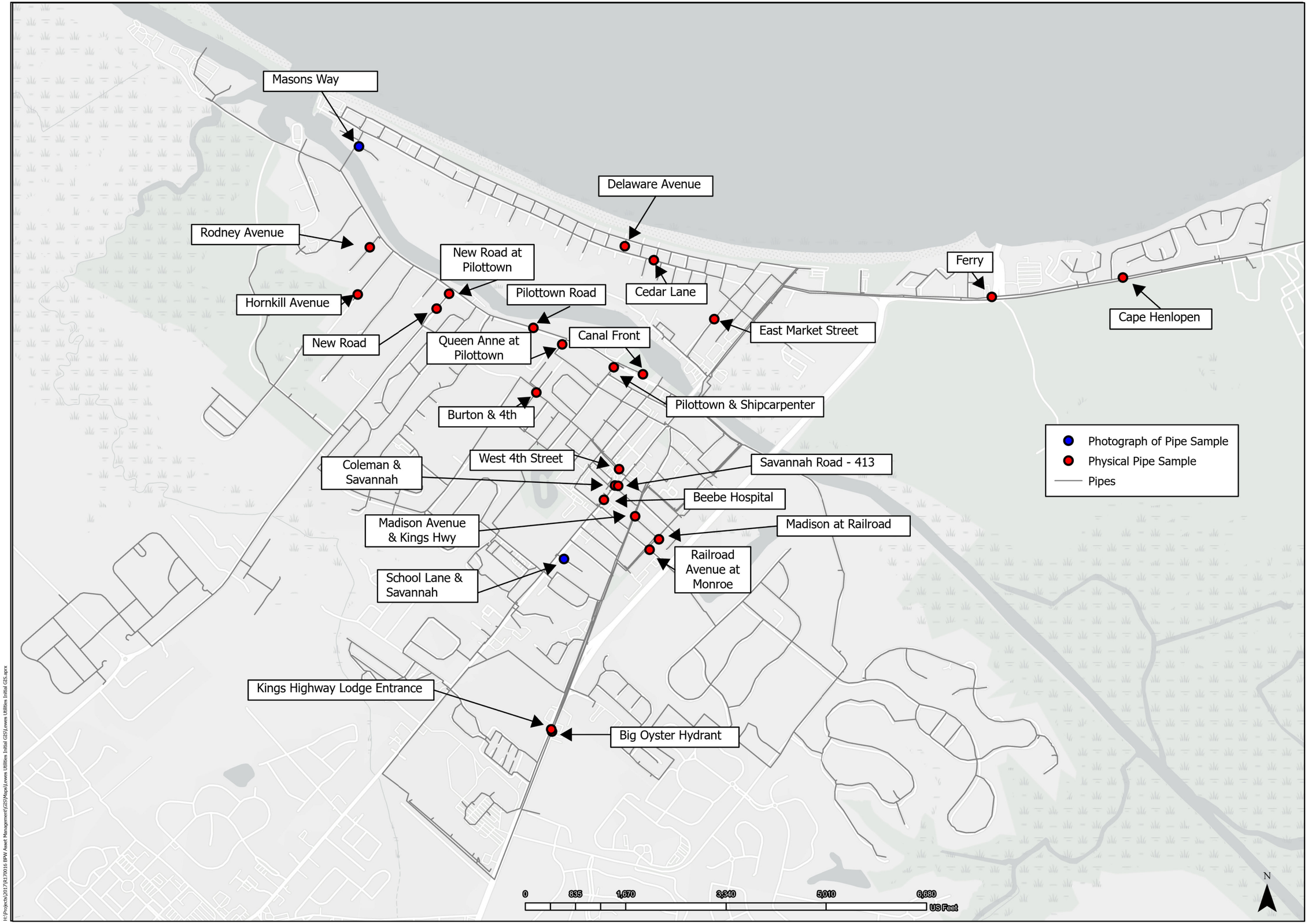
LEWES WATER DISTRIBUTION SYSTEM MATERIAL

Lewes, DE

MATERIAL

SCALE	1"=1,458'
DESIGN BY	
DRAWN BY	
CHECKED BY	
GMB FILE	
DATE	5/11/2023

SHEET NO.
EX. 1



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SALISBURY, MARYLAND 21801
410 - 742 - 3115 FAX 410 - 548 - 5790
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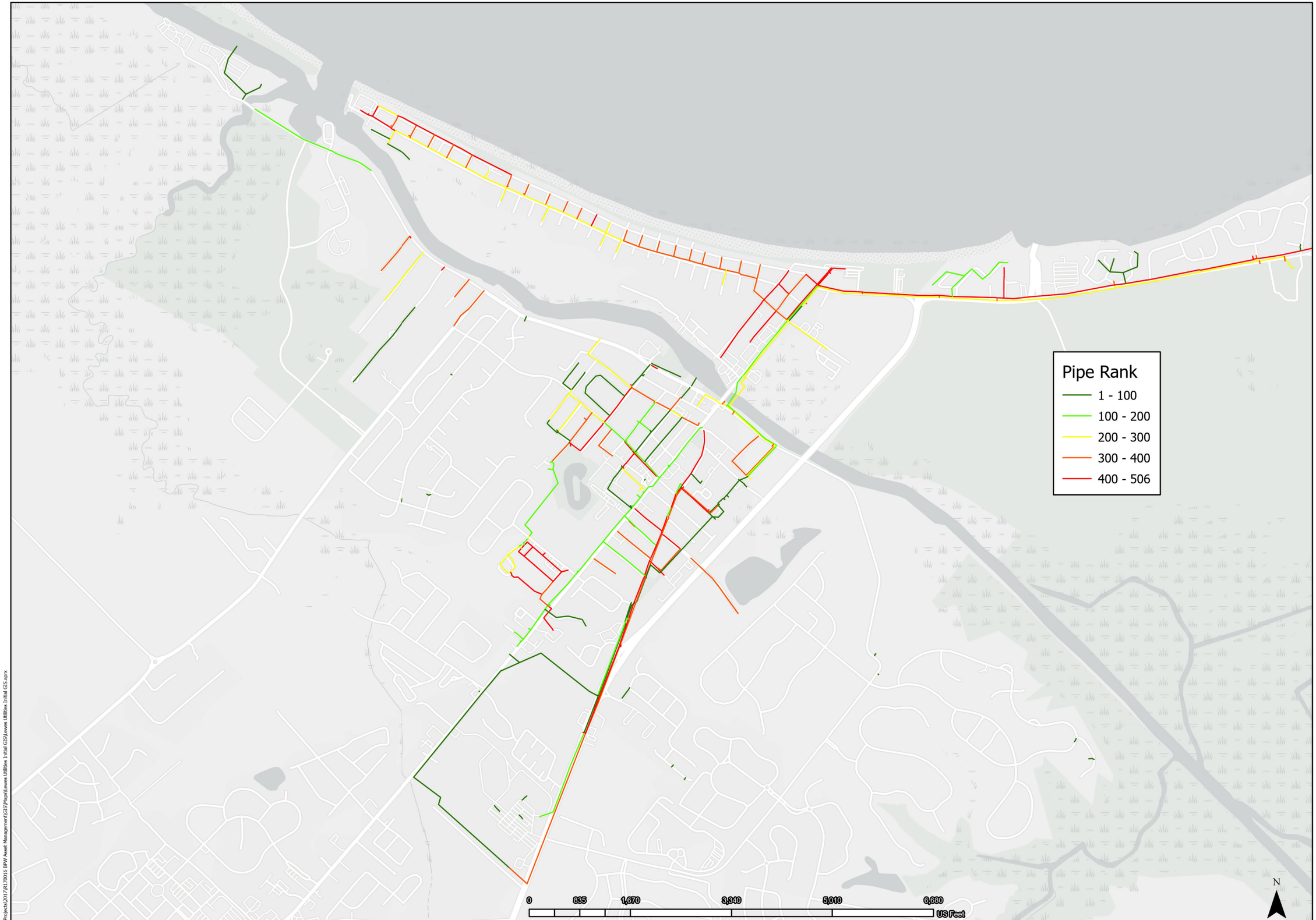
WATER MAIN ASSESSMENT SAMPLE PIPE LOCATIONS

Lewes, DE

WATER MAIN ASSESSMENT SAMPLE PIPE LOCATIONS

SCALE	1"=1,458'
DESIGN BY	
DRAWN BY	
CHECKED BY	
GMB FILE	
DATE	5/15/2023

SHEET NO.
EX. 2



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SALISBURY, MARYLAND 21801
410 - 742 - 3115 FAX 410 - 548 - 5790
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WATER MAIN ASSESSMENT
PIPE RANKING
Lewes, DE

PIPE RANKING

SCALE	1"=1,458'
DESIGN BY	
DRAWN BY	
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GMB FILE	
DATE	5/25/2023

SHEET NO.
EX. 3

Cedar - Phase 1

Cedar - Phase 3

Cape Henlopen Drive

Pilottown Road Side Streets

New Road

Kings Highway - Dewey to 3rd Ave

Park and Johnson

Railroad and Monroe

School Lane

Kings Highway - Whites Pond

Kings Highway - Dewey to Gills Neck

Pipe Rank

- 1 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 506

0 835 1,670 3,340 5,010 6,680 US Feet

N

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ARCHITECTS & ENGINEERS
SALISBURY BALTIMORE ESSEX
206 WEST MAIN STREET
SALISBURY, MARYLAND 21801
410 - 742 - 3115 FAX 410 - 548 - 5790
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WATER MAIN ASSESSMENT CAPITAL PROJECT RANKING

Lewes, DE

CAPITAL PROJECTS RANKING

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GMB FILE	
DATE	5/25/2023

SHEET NO.
EX. 4

Appendix B:

- **Pipe Sample Data**
- **Pipe Segment Ranking**
- **Pipe Segment Ranking Data**

Pipe Sample Data

Sample ID:	Sample Name:	Nearest Address:	Size: (inches)	Material	Install Year	Pipe Name	Max Flow (gpm)	Avg. Flow (gpm)	Max Velocity (ft/sec)	Avg. Velocity (ft/sec)	Avg. Wall Thickness	AVG Ranking
1	Beebe Hospital	424 Savannah Rd, Lewes, DE 19958	12	DI	1945	917	115.9	74.07	0.3	0.21	0.505	3.4
2	Big Oyster Hyrdant	1007 Kings Hwy, Lewes, DE 19958	12	DI	1945	274	78.8	51.02	0.2	0.16	0.51	19.4
3	Burton and 4th	402 Burton Ave, Lewes, DE 19958	6	CI	1957	916	11.2	6.4	0.1	0.07	0.415	5.1
4	Canal Front	236 Front St, Lewes, DE 19958	10	CI	2006	569	0	0	0	0	0.335	4.6
5	Cape Henlopen	Cape Henlopen Drive	12	CI	1955	116	322	305.91	0.9	0.87	0.535	14.4
6	Cedar Lane	502 Cedar St, Lewes, DE 19958	10	CI	1954	600	32.6	15.37	0.1	0.04	0.445	13.6
7	Coleman and Savannah	417 Savannah Rd, Lewes, DE 19958	6	DI	1960	281	5.7	3.41	0.1	0.04	0.385	12.7
8	Delaware Avenue	10 Delaware Ave, Lewes, DE 19958	6	CI	1952	36	0.7	0.33	0	0	0.36	24.0
9	East Market Street	410 E Market St, Lewes, DE 19958	6	CI	1904	4	37.1	29.18	0.4	0.34	0.475	26.6
10	Hornkill Avenue	14 Hoornkill Ave, Lewes, DE 19958	6	CI	1960	121	5.6	3.2	0.1	0.02	0.45	19.1
11	Kings Highway Lodge Entrance	1008 Kings Hwy, Lewes, DE 19958	12	DI	1945	274	78.8	51.02	0.2	0.16	0.475	19.0
12	Madison at Railroad	137 Madison Ave, Lewes, DE 19958	6	-	-	-	-	-	-	-	0.455	6.9
13	Madison Avenue and Kings Highway	425 Kings Hwy, Lewes, DE 19958	6	CI	1910	212	17	10.75	0.2	0.13	0.43	26.0
14	Masons Way	1 Charles Mason Way, Lewes, DE 19958	8	DI	1987	369	2.8	1.59	0	0	-	14.9
15	New Road	107 New Rd, Lewes, DE 19958	6	CI	1951	123	3.2	1.86	0	0	-	18.9
16	New Road at Pilottown	502 Pilottown Rd, Lewes, DE 19958	6	CI	1951	796	3.9	2.01	0	0	0.385	12.4
17	Pilottown and Shipcarpenter	103 Shipcarpenter St, Lewes, DE 19958	6	CI	1904	128	72	44.25	0.8	0.5	0.335	1.9
18	Pilottown Road	358 Pilottown Rd, Lewes, DE 19958	12	CI	1954	656	220.1	136.67	0.6	0.39	0.505	18.6
19	Queen Anne at Pilottown	340 Pilottown Rd, Lewes, DE 19958	12	CI	1954	657	159.4	98.82	0.5	0.28	0.48	9.0
20	Railroad Avenue at Monroe	501 Railroad Ave, Lewes, DE 19958	6	CI	1954	940	23.1	15.33	0.3	0.18	0.325	12.3
21	Rodney Avenue	108 Rodney Ave, Lewes, DE 19958	6	DI	1948	120	2.8	1.59	0	0	0.365	22.4
22	Savanah Road - 109	109 Savannah Rd, Lewes, DE 19958	8	-	-	-	-	-	-	-	0.39	11.7
23	Savannah Road - 413	413 Savannah Rd, Lewes, DE 19958	12	CI	1965	176	102.2	54.64	0.3	0.15	0.505	5.7
24	School Lane and Savannah	817 Savannah Rd, Lewes, DE 19958	6	CI	1950	264	2.8	1.59	0	0	-	20.7
25	Shipcarpenter	103 Shipcarpenter St, Lewes, DE 19958	6	CI	1904	128	72	44.25	0.8	0.5	0.325	1.9
26	West 4th Street	111 W 4th St, Lewes, DE 19958	8	DI	1965	863	62.3	46.32	0.4	0.28	0.425	9.3
27	Ferry	41 Cape Henlopen Dr, Lewes, DE 19958	8	CI	1941	867	131	119.6	0.8	0.8	0.385	24.0

Road Name	Rank of Section
W 4th Street (South) Connector towards Mulberry	343
Kings Hwy (main) from E 4th Street to Jefferson	342
Kings Hwy (main) from Washington to E 4th Street	341
Kings Hwy (main) from Jefferson to Coleman	340
W 4th Street (South) from Market towards Savannah (ends at W 4th Street Street north)	339
East Market Street from Anglers to Mass.	338
Kings Hwy (main) from Lewes Presbyterian to Franklin	337
W 4th Street (South) Connector Towards Market	336
Washington from Franklin to Kings (Hwy Main)	335
Franklin to Washington	334
Kings Hwy (main) from Franklin to E 3rd Street	333
Bayview Ave - End	332
East Savannah From Lewes House to Bayview Dr	331
Park Ave from W. 4th Street to W. 3rd Street	330
Kings Hwy (main) from Monroe to Dewey	329
Kings Hwy (main) at Mcfee Intersection	328
Kings Hwy (main) from Dewey to Manila	327
Kings Hwy (main) from Adamns to Mcfee	326
East Market Street from Cedar to Bay Ave	325
Kings Hwy (main) from Manila to Adam	324
East Savannah from Mass. To Cedar Connection	323
Monroe from Kings Hwy to Railroad	322
Kings Hwy (main) from Beebe to Monroe	321
East Savannan from Cedar Connection to Lewes House	320
East Market Street from Mass. To Cedar	319
Intersection of Park Ave and W 4th Street	318
Kings Hwy (6") Devries Cir to First Baptist Church	317
Kings Hwy (main) Devries Cir to Dead End	316
Intersection of Shipcarpenter and Pilottown	315
Park Ave from Johnon Ave to W. 4th Street	314
Beebe Ave	313
Kings Hwy (main) from Mcfee to Devries Cir.	312
Market Street from Hospital Entrance Line to W 4th Street South	311
Johnson Ave from Dupont Ave to Park Ave	310
Cedar from Maine to End	309
Maine Ave	308
Cedar from Nebraska to Maine Ave	307
Bay Ave from Missouri to California	306
Kings Hwy (main) from Coleman to Beebe	305
Bay Ave from Nebraska to Iowa	304
Bay Ave from California to N Washington	303
Bay Ave from Iowa to Mussouri	302
Bay Ave from N Washington to Michigan Ave	301

South Cape Shores Drive 8	299
East Savannah Road Hydrant	299
Texas Ave	298
Market street from Hospital Sign line to Hospital Entrance Line	297
Cape Henlopen North from E Cape Shores Dr to End of road	296
Canal Crossing West 8" From Cape to Bayview	295
Canal Crossing West 8" from Cape to Cape	294
Cape Henlopen North from W Cape Shores Dr To E Cape Shores Dr	293
Cape Henlopen North from Pilot Point to Texas Ave	292
Cape Henlopen from Pilot Point to Connector	291
Cape Henlopen North from E Savannah to Pilot Point	290
Cape Henlopen North from Texas Ave to Port Lewes Court	289
Cape Henlopen North from Port Lewes Court to W Cape Shores Dr	288
Oregon Ave	287
Adams Ave form Railroad to Dead End	285
Midland Ave South of Mass.	285
Top of Maury to Shields Ave	284
Maury Circle	283
Top of Harborview Road	282
Adams Ave from Kings to Railroad	281
Cedar St from Midland to E Market	280
Bowman to Maury Circle	279
End of Maury to Shields Av	278
Shields Ave From Sussex to Top of Maury	277
End of Bowman to Shields Ave	276
Shields Ave from Top of Maury to Bottom of Maury	275
Bay Ave from E Savannah to Midland Ave	274
Midland Ave from Bay to Cedar	273
Bottom of Shields to Savannah (ends at US Army Reserve)	272
Shields Ave from Bottom of Maury to End of Bowman	271
Franklin Junction to Kings Hwy (Kings #12-1)	270
Rodney Ave	269
Cedar from Newport to Nebraska Ave	268
Kings Hwy #12-1 From Coleman to Madison	267
Kings Hwy #12-1 From Madison to Kings Hwy Junction	266
School Lane	265
Dewey Ave Branch	264
Rodaline from Gills to E 3rd Street	263
Carney Lane	262
New road from 4th W to Pilottown	261
W Canal	260
E Canal	259
Connecticut Ave	258
New York Ave	257

Delaware Ave	256
N Washington Ave	255
St Paul Street	254
California Ave	253
Dupont Ave from W. 4th street and Johnson Ave	252
From Well Field to Gills Neck Rd along Kings Hwy	251
6 CI Schley	250
Nebraska Ave from Hydrant to Cedar	247
Michigan Ave Hydrant	247
Iowa Ave Hydrant	247
Cape Henlopen Connector near Pilot Point	246
Cape Henlopen Connector near Virginia Ave	245
Vermont	244
Missouri Ave	243
Ohio Ave	242
Kentucky Ave	241
Rodaline from E 3rd to Schley	240
Iowa Ave	238
Iowa Ave from Hydrant to Cedar	238
Cedar from Lewes to W Canal Street	237
Cedar from W Canal to Milton Ave	236
Cedar from Milton to Vermont Ave	235
Cedar from E Canal to Lewes Ave	234
Nebraska Ave	233
Michigan Ave	232
Cedar from Rehoboth Ave to E Canal Street	231
Cedar from Mass. To Rehoboth Ave	230
Mass. From Cedar to Bay Ave	229
Mass. From Midland to E Market	228
Mass from E Market to Cedar	227
Midland Ave from Cedar to Mass.	226
Mass from E Savannah to Midland	225
Intersection of Shipcarpenter and W 3rd St Hydrant	222
3rd Street from Savannah to Chestnut	222
Illinois Ave Hydrant to Cedar	222
Rhode Island Ave	221
Indiana Ave	220
3rd St from Mulberry St to Park Ave Hydrant	219
Manilla Avenue	218
Illinois Ave	217
Rodaline from 6 CI to 12 CI	216
Intersection of Shipcarpenter and W 3rd St to Hydrant	215
Railroad from Adams to Monroe	214
Cedar from Vermont to Delmar Ave	213

Cedar from Delmar to New Hampshire Ave	212
Cedar from New Hampshire to Houston Ave	211
Cedar from Houston to Rhode Island Ave	210
Cedar from Rhode Island to Delaware Ave	209
Cedar from Delaware to Connecticut Ave	208
Cedar from Connecticut to New York Ave	207
End of Monroe	206
Market St from 3rd St to 2nd St	205
Gills Neck Between Canal Crossing and Rodaline Hydrant	199
Gills Neck from Rodaline to Schley Hydrant	199
Sotuh Cape Shores Drive 12	199
East Savannah Road Hydrant near Cedar	199
Cape Henlopen Hydrant near Cape Shores	199
Cape Henlopen to SPI Branch	199
New Hampshire Ave	198
3rd St from Market St to Mulberry St	197
Cape Henlopen Connector near Tennessee Ave	196
3rd St from Mulberry St to Park Ave	195
Intersection of Shipcarpenter and W 3rd St	194
Cape Henlopen Hydrant at Port Lewes	193
Kings Hwy 12 to 4 Connector South	192
West 3rd Street from Queen Annes to Shipcarpenter	191
Intersection of 3rd St and Mulberry St	190
Kings Highway Connector at Mass. East	189
Kings Hwy 12 to 4 Connector North	188
3rd St from Chestnut St to Market St	187
Queen Anne Ave at Pilottown	186
Neils Street	185
Cape Henlopen Connector near Habor Point Ct.	184
Kings Highway Connector at Mass. West	183
Cape Henlopen Connector near Port Lewes	182
Felton Ave	181
New Jersey Ave	180
Cedar from Oregon to Kentucky	179
Lewes Ave	176
Odessa Ave	176
Pennsylvania Ave	176
Clayton Ave	174
Newark Ave	174
Front Street Between Canal Crossings	173
Cedar from New York to Clayton Ave	172
Cedar Clayton to Newark Ave	171
Gills Neck from Rodaline to Schley	170
Cedar Newark to Oregon Ave.	169

Rodaline from 12 CI to 12 DI	168
Gills Neck Between Canal Crossing and Rodaline	167
Cedar from Ohio to Felton Ave	165
Cedar from Felton to Indiana Ave	165
Cedar from Kentucky to Ohio	164
Cedar from Indiana to Illinois Ave	163
Cedar from Illinois to Odessa Ave	162
12 CI Schley	161
Cedar from Odessa to Pennsylvania Ave	160
Paynter Ave	159
Cedar from PA to N Washington Ave	158
Cape Henlopen Connector near South Cape Shores Drive	157
Rodaline from 12 DI to Water Tower	156
Burton Ave from W. 4th st to Johnson Ave	155
W. 4th Street from Paynter Ave to Dupont Ave	154
W. 4th Street from Burton Ave to Paynter Ave	153
W. 4th Street from Dupont Ave to Park Ave	152
Front Street from Savannah to Canal Crossing	151
Savannah from Mass. East to Mass West	150
Canal Crossing East from Connection to Mass.	149
Canal Crossing East from Gills Neck to Gills Neck North	147
Canal Crossing East from Gills Neck North to Anglers Road	147
Canal Crossing East from Cedar Connection to Lewes House	146
Canal Crossing East from Lewes House to Cape Henlopen	145
Front Street from Savannah to Canal Crossing	144
Cedar from N Washington to California Ave	143
Cedar from Missouri to Iowa Ave	142
Cedar from California Ave to Missouri Ave	141
Cedar From Iowa to Newport Ave	140
Newport Ave from Cedar to Breakwater St	139
Newport Ave from Breakwater to Ch Mason Way	138
Hornkill Ave	137
Bay Ave from Maine to Nebraska	136
Beebe Healthcare Sign to Market Street	135
Beebe Healthcare Sign towards Market Street	134
Market Street from Fire Hydrant to Hospital Sign Line	133
Cape Henlopen South from Georgia to SPI	132
Cape Henlopen South from E Savannah to Georgia	131
Mass. From Savannah to Dead End (WWTP)	130
Cape Henlopen From Cape Shores Connector to Hydrant	129
Canal Crossing Connection after Anglers Road	128
Kings Highway 12 to 12 Connector	127
Bowman Drive (circle)	126
Intersection of Gills Neck and Schley	125

Bowman Dr and Suxxex Drive	124
Canal Crossing West from Cape Henlopen to Cape Henlopen	123
Canal Crossing West from Gills Neck to Gills Neck North	122
Gills Neck North from Canal Crossing to Schley	121
12 DI Schley	120
Canal Crossing West from Cedar Connection to Cape Henlopen	119
Beebe Healthcare Hydrant (across from Lewes Election Distribution Office)	117
Savannah Road Hydrant near Shields	117
Mcfee Street	116
Mulberry Hydrant at Church St Intersection	115
Dewey Ave from Savannah to 119 Dewey Ave	114
Fire Department Line	113
Dewey Ave from 119 Dewey Ave to Kings Hwy	112
Mulberry St from W 4th Street to Church St	111
W 4th Street from Connector to Market	110
Canal Crossing West from Mass. To Cedar Connection	109
Mulberry from Church to 3rd Street	108
Dupont Ave from Johnson Ave to Sussex Drive	107
W 4th Street From St Paul to Mulberry	106
W 4th Street From Park to St Paul Street	105
W 4th Street from Market to Chestnut	104
W 4th Street From Intersection of 4th and Mulberry to Connector	103
W 4th Street Connector	102
Intersection of W 4th Street and Mulberry	101
Savannah Rd from 424 Savannah Rd Boiler Room to Beebe Healthcare Bus Stop	100
Canal Crossing West from Anglers road to Connection	99
Canal Crossing West from Connection to Mass.	98
Intersection of W 4th Street and Market Hydrant Line	97
Savannah Rd from Beebe Healthcare Sign to Emergency Entrance	96
Savannah Rd from Emergency Entrance to Coleman Line	95
E 4th Street to Kings Hwy	94
Savannah Rd from Beebe Healthcare Bus Stop to Beebe Healthcare Sign	93
Savannah from Beebe Healthcare to Beebe Healthcare Hydrant	91
Savannah Rd from Beebe Healthcare Hydrant to 424 Savannah Rd Boiler Room Line	91
Savannah to US Army Reserve Line	90
Savannah from Devries to School Lane	89
Canal Crossing West from Gills Neck North to Anglers Road	88
Intersection of Savannah Rd and Beebe Ave	87
W 4th Street from Chestnut to end of W 4th Street South	86
Savannah Rd from Fire Department to 3rd Street	85
Savannah Rd from W 4th Street to Fire Department	84
Savannah from Manila Ave to Dewey Ave	83
Savannah Rd from Dewey Ave to Beebe Ave	82
Savannah from Mcfee St to Manila Ave	81

(Both) W 4th Street to Savannah	80
Savannah Rd at intersection of E 4th Street	79
Savannah from School to Mcfee St	78
Savannah Rd from Coleman to just before E 4th Street	77
424 Savannah Rd Boiler Room Line	76
Intersection of Savannah Dr and Devries Circle	75
Hulling Cove	74
Savannah Rd from E 4th Street to W 4th Street	73
Savannah from Drake Knoll to Savanah Circle	72
Savannah From Sussex to Bottom of Shields	71
Pilottown Road from Canary Creek to St Peters Cemetary	70
Savannah From Shields to Drake Knoll Road	69
Kings Hwy Connector South of Devries	68
Kings Hwy Junction towards Bike Path (Kings #16)	67
Pilot Point	66
Savannah from Bike Path to Donovans Road	65
Kings Hwy from First Baptist Church past Henlopen Gardens	64
Kings Hwy (main) Devries Cir to First Baptist Church	63
Franlkin Junction to Kings Hwy Junction (Kings #16)	61
Schley to Kings Hwy	61
Shipcarpenter from W 3rd St to 2nd St	60
2nd St from Shipcarpenter St to Mulberry St	59
Shipcarpenter Square from Second to Pilottown Rd	58
Breakwater St	57
Savannah from Bike Path to Kings Hwy (towards water tower)	56
Harborview Road	55
Intersection of Donovans Road and Savannah	54
Savanah from N. Atlantic Drive to Wells	53
Church St	52
Hospital Parking Lot Hydrant	51
Lab Express Lewes Fire Hydrant (Market St)	50
Bradley Lane	49
Shipcarpenter Square	48
Port Lewes Court	47
Beebe Healthcare Line (Corner of Savannah and Beebe)	46
Frog Hill Rd to Savannah Rd	45
Frog Hill/Market Street to Hospital Back Entrance	44
Drake Knoll Rd	43
Ch Mason Way	42
Surf Ave	41
Baybreeze Drive	40
Market St from Church to 3rd	39
Market St from W 4th Street to Church St	38
E Cape Shores Drive	37

Intersection of Johnson Ave and Paynter Ave Hydrant	36
Burton Ave from W. 4th st to W. 3rd st	35
Intersection of Johnson Ave and Paynter Ave	34
Johnson Ave from Paynter Ave to Dupont Ave	33
Ocean View Blvd Near Flamingo Ct	31
Seagull Drive Hydrant between Ocean View and Canary Dr	31
Canal Crossing East from Mass. To Cedar Connection	30
Johnson Ave from Burton Ave to Paynter Ave	29
Washington from Franklin to Lewes Public Library	28
219 Marina Drive Hydrant	25
Emergency Entrance Hydrant Line	25
Blue Marlin Hydrants	25
Lewes Presbyterian	24
Canal Square Line	23
Gills Neck at Show Jumper Lane	22
Franklin from Schley to Dead End 2	21
W Market Street	20
Intersection of Johnson and Dupont	19
Kings Highway (main) from Washington to W 4th Street Connection	18
Franklin Hydrant North	17
Franklin Hydrant South	16
End of Pilottown Road to Canary Creek	15
Franklin from Schley to Dead End	14
Franklin Junction towards Washington	13
Chestnut from W 4th Street to 3rd Street	12
2nd St from Shipcarpenter St to Mulberry St Hydrant	10
Cape Henlopen High Scool	10
Front Street from Shipcarpenter to dead end	9
near franklin junction Kings Hwy (Main)	8
Intersection of Franklin and Schley	7
Schley from Rodaline to Franklin	6
Franklin towards Washington	5
Franklin Junction	4
Savanah - Bike Path Crossing	3
Pilottown Road Hydrant at Ocean Blvd.	2
Line from wells towards Savannah	1

Road Name	Material	Size (inches)	Install Year	Pipe Name(s)	Avg. Velocity (fps)	Avg.Flow (gpm)	Pipe Rank	Weighted Total	Rank of Section
End of Pilottown Road to Canary Creek									
	DI	6	2005	868	0.000	0.2	26	8.516937	
	DI	6	2005	869	0.000	0.1	28	8.5171185	
	DI	6	2005	821	0.000	0.3	24	8.5167555	15
Pilottown Road from Canary Creek to St Peters Cemetary									
	DI	8	1970	632	0.000	0.3	121	14.2063555	
	DI	8	1970	592	0.000	0.8729	120	14.20531569	
	DI	8	1970	118	0.000	0.8792	119	14.20530425	70
Rodney Ave									
	CI	6	1948	120	0.000	1.4973	393	17.7805024	
	CI	6	1945	323	0.000	1.4973	415	18.2681824	269
Hornkill Ave									
	CI	6	1960	121	0.013	3.024	227	15.82380367	137
	CI	6	1960	122	0.000	1.4973	229	15.8297824	
Top of Harborview Road									
	CI	6	1945	390	0.064	6.0394	413	18.24382372	282
Harborview Road									
	DI	8	1979	235	0.000	3.024	83	12.73837144	
	DI	8	1979	430	0.000	1.4793	84	12.74117507	55
Carney Lane									
	CI	6	1951	478	0.000	1.4793	387	17.29285507	262
New road from 4th W to Pilottown									
	CI	6	1951	796	0.014	2.5575	386	17.28736202	
	CI	6	1951	123	0.054	4.0511	384	17.27447216	261
219 Marina Drive Hydrant									
	DI	8	2001	795	0.000	0	40	9.16754	25
Pilottown Road Hydrant at Ocean Blvd.									
	DI	6	2020	704	0.000	0	3	6.0789	2
Queen Anne Ave at Pilottown									
	CI	12	1954	656	0.281	101.8643	290	16.55188825	
	CI	12	1954	657	0.208	75.0199	299	16.61912565	186
West 3rd Street from Queen Annes to Shipcarpenter									
	CI	12	1954	337	0.212	76.5285	298	16.6153633	
	CI	12	1954	203	0.213	78.0416	297	16.61249073	
	CI	12	1954	612	0.216	79.5543	295	16.60883589	191
Bradley Lane									
	DI	6	1985	610	0.000	1.4973	76	11.7657824	
	DI	6	1985	563	0.013	3.024	71	11.75980367	
	DI	6	1985	609	0.013	3.024	71	11.75980367	49
Burton Ave from W. 4th st to W. 3rd st									
	DI	6	1995	608	0.000	1.4973	52	10.1401824	35
Burton Ave from W. 4th st to Johnson Ave									
	CI	6	1957	204	0.203	18.2697	248	16.23569624	
	CI	6	1957	928	0.071	7.5747	256	16.28859977	

	CI	6	1957	916	0.064	6.0394	257	16.29310389	155
Johnson Ave from Burton Ave to Paynter Ave									
	DI	6	1995	336	1.100	400	35	9.139062	
	DI	6	1995	151	0.071	7.5747	50	10.11131977	29
Johnson Ave from Paynter Ave to Dupont Ave									
	DI	6	1995	611	0.167	15.0955	49	10.07332081	33
Johnson Ave from Dupont Ave to Park Ave									
	CI	4	1931	184	0.050	1.9982	454	20.53043375	
	CI	4	1931	712	0.000	0	456	20.54674	
	CI	4	1931	711	0.050	1.9982	454	20.53043375	310
Park Ave from Johnon Ave to W. 4th Street									
	CI	4	1922	148	0.087	3.1937	462	21.98203423	314
Intersection of Park Ave and W 4th Street									
	CI	6	1910	145	0.221	19.98914027	471	23.86844639	318
Paynter Ave									
	CI	6	1957	155	0.005	3.0072	261	16.31345903	
	CI	6	1957	460	0.058	4.5104	258	16.29724295	159
W. 4th Street from Burton Ave to Paynter Ave									
	CI	6	1957	154	0.147	12.2145	252	16.26085616	153
W. 4th Street from Paynter Ave to Dupont Ave									
	CI	6	1957	156	0.137	11.5825	253	16.26463008	154
W. 4th Street from Dupont Ave to Park Ave									
	CI	6	1957	149	0.176	15.581	251	16.24744641	152
Park Ave from W. 4th Street to W. 3rd Street									
	CI	6	1910	146	0.073	7.3729	485	23.92860407	
	CI	6	1910	812	0.057	3.7299	488	23.9394342	
	CI	6	1910	814	0.021	2.5023	489	23.95057837	
	CI	6	1910	188	0.055	5.0647	486	23.93746619	330
Shipcarpenter Square									
	DI	6	1985	813	0.047	3.6516	70	11.74997583	
	DI	6	1985	815	0.000	2.5742	75	11.76382783	48
Shipcarpenter Square from Second to Pilottown Rd									
	DI	6	1977	128	0.380	33.0176	87	12.91317369	58
Shipcarpenter from W 3rd St to 2nd St									
	DI	6	1977	723	0.148	13.4928	89	13.0070077	60
Intersection of Shipcarpenter and W 3rd St Hydrant									
	CI	6	1954	724	0.000	0	337	16.80786	222
Intersection of Shipcarpenter and W 3rd St to Hydrant									
	CI	8	1954	130	0.072	13.49276018	327	16.76508431	215
Intersection of Shipcarpenter and W 3rd St									
	CI	12	1954	127	0.191	68.46561086	303	16.63525042	194
Dupont Ave from W. 4th street and Johnson Ave									
	CI	6	1952	157	0.041	3.5054	374	17.1162114	
	CI	6	1952	716	0.000	0	382	17.13298	
	CI	6	1952	715	0.041	3.5054	374	17.1162114	
	CI	6	1952	183	0.202	17.0516	370	17.0510607	252

Dupont Ave from Johnson Ave to Sussex Drive									
	CI	6	1965	140	0.000	0	183	15.0197	
	CI	6	1965	82	0.202	17.0516	166	14.9377807	
	CI	6	1965	171	0.100	2	171	14.990812	
	CI	6	1965	141	0.234	19.0516	162	14.92604288	
	CI	6	1965	317	0.234	20.562	161	14.92317522	107
Bowman Dr and Suxxex Drive									
	CI	6	1962	966	0.389	34.42714932	201	15.34671996	
	CI	6	1962	318	0.393	35.932	200	15.34284636	124
Bowman Drive (circle)									
	CI	6	1962	311	0.134	12.345	202	15.45114448	
	CI	6	1962	309	0.087	6.479	205	15.47356321	
	CI	6	1962	310	0.093	7.367	204	15.47057876	
	CI	6	1965	818	0.000	0.000	183	15.0197	
	CI	6	1962	817	0.134	12.345	202	15.45114448	126
Bowman to Maury Circle									
	CI	8	1945	115	0.093	15.188	407	18.21990399	
	CI	8	1945	312	0.135	22.254	403	18.19633586	
	CI	8	1945	305	0.064	9.910	408	18.23679778	279
Maury Circle									
	CI	8	1945	306	0.041	7.703	414	18.24651922	283
End of Bowman to Shields Ave									
	CI	6	1945	313	0.157	15.369	404	18.20323207	276
End of Maury to Shields Av									
	CI	8	1945	307	0.124	17.612	406	18.20773359	278
Top of Maury to Shields Ave									
	CI	8	1945	304	0.064	9.001	410	18.23844852	
	CI	6	1945	963	0.000	0.000	420	18.2709	
	CI	8	1945	922	0.064	9.001	410	18.23844852	284
Shields Ave From Sussex to Top of Maury									
	CI	8	1945	965	0.124	18.390	405	18.2062059	277
Shields Ave from Top of Maury to Bottom of Maury									
	CI	8	1945	964	0.137	27.196	402	18.18690964	275
Shields Ave from Bottom of Maury to End of Bowman									
	CI	8	1945	308	0.293	46.317	398	18.11277464	271
Bottom of Shields to Savannah (ends at US Army Reserve)									
	CI	8	1945	314	0.418	63.189	397	18.05072242	
	CI	8	1945	627	0.426	64.699	396	18.04581117	
	CI	8	1945	625	0.000	1.497	416	18.26818243	272
Savannah From Sussex to Bottom of Shields									
	DI	12	1965	239	0.798	286.006	123	14.29899166	71
Savannah From Shields to Drake Knoll Road									
	DI	12	1965	226	1.019	355.234	117	14.11768453	69
Savannah to US Army Reserve Line									
	DI	8	1965	316	0.432	67.722	144	14.78775281	
	DI	8	1965	626	0.431	66.208	147	14.79072852	90

Drake Knoll Rd									
	DI	6	1986	800	0.013	3.024	62	11.59725136	
	DI	6	1986	801	0.000	1.497	63	11.60322243	43
Savannah from Drake Knoll to Savannah Circle									
	DI	12	1965	748	1.022	358.262	115	14.11138941	
	DI	12	1965	750	1.022	358.262	115	14.11138941	
	DI	12	1965	673	1.024	362.965	113	14.10228089	
	DI	12	1965	752	0.000	0.000	183	15.0197	
	DI	12	1965	751	1.024	362.965	113	14.10228089	
	DI	12	1965	924	1.028	364.478	112	14.09850597	
	DI	12	1965	929	0.000	0.000	183	15.0197	72
Huling Cove									
	DI	6	1965	674	0.524	185.360	125	14.55092392	74
Savannah - Bike Path Crossing									
	DI	16	2015	273	0.391	242.312	4	6.353042828	3
Savannah from Bike Path to Donovans Road									
	DI	16	1970	908	0.771	491.570	91	13.11995074	
	DI	16	1970	904	0.000	0.000	122	14.2069	
	DI	16	1970	903	0.771	491.570	91	13.11995074	65
Savannah from Bike Path to Kings Hwy (towards water tower)									
	DI	16	1970	272	1.014	633.989	85	12.80008755	56
Intersection of Donovans Road and Savannah									
	DI	16	1970	1056	1.237	767.484	81	12.50156361	54
Savannah from N. Atlantic Drive to Wells									
	DI	16	1970	282	1.237	767.484	81	12.50156361	
	DI	16	1970	344	2.185	767.484	79	12.26201262	
	DI	16	1970	278	2.185	767.484	79	12.26201262	53
	DI	16	1970	1012	0.772	485.371	93		
Line from wells towards Savannah									
	DI	12	2015	321	2.185	767.4837104	1	4.946812622	
	DI	12	2015	562	2.185	767.4837104	1	4.946812622	1
From Well Field to Gills Neck Rd along Kings Hwy									
	DI	12	1945	1002	1.329	463.0615385	371	17.09477477	251
Baybreeze Drive									
	DI	10	1988	365	0.262	62.09683258	57	11.10182629	40
Surf Ave									
	DI	6	1988	755	0.000	0	58	11.28082	
	DI	6	1988	757	0.000	0	58	11.28082	41
Gills Neck at Show Jumper Lane									
	DI	6	2001	771	0.000	0	40	9.16754	
	DI	6	2001	769	0.014	2.557466063	37	9.159355222	22
Intersection of Savannah Dr and Devries Circle									
	DI	12	1965	105	0.412	145.6004525	126	14.65143165	75
Savannah from Devries to School Lane									
	DI	12	1965	227	0.397	135.8660633	127	14.67275683	

	DI	12	1965	740	0.397	135.8660633	127	14.67275683	
	DI	12	1965	741	0.000	0	183	15.0197	89
School Lane									
	CI	6	1950	264	0.000	1.497285068	390	17.45538243	265
Savannah from School to Mcfee St									
	DI	12	1965	620	0.369	130.1914027	131	14.6901423	78
Mcfee Street									
	DI	8	1965	261	0.000	1.532126697	180	15.01691919	
	DI	8	1965	263	0.000	1.1	182	15.0177035	116
Savannah from Mcfee St to Manila Ave									
	DI	12	1965	262	0.354	127.4479638	134	14.69900748	81
Manila Avenue									
	CI	6	1954	379	0.000	1.21040724	334	16.80566311	
	CI	6	1954	357	0.000	2.44841629	332	16.80341612	218
Savannah from Manila Ave to Dewey Ave									
	DI	12	1965	225	0.346	126.1742081	137	14.70326227	83
Dewey Ave from Savannah to 119 Dewey Ave									
	DI	8	1965	392	0.000	2.795022624	179	15.01462703	
	DI	8	1965	394	0.000	3.0239819	178	15.01421147	114
Dewey Ave from 119 Dewey Ave to Kings Hwy									
	CI	8	1965	458	0.018	5.814027149	177	15.00469025	
	CI	8	1965	245	0.035	7.319004525	172	14.99761571	112
Dewey Ave Branch									
	CI	4	1950	207	0.050	1.497285068	389	17.44269628	264
Savannah Rd from Dewey Ave to Beebe Ave									
	DI	12	1965	588	0.351	126.6303167	136	14.70117725	82
Intersection of Savannah Rd and Beebe Ave									
	DI	12	1965	283	0.275	96.18552036	142	14.77563521	87
Beebe Healthcare Line (Corner of Savannah and Beebe)									
	CI	4	1985	591	0.200	8	66	11.703464	46
Beebe Healthcare Hydrant (across from Lewes Election Distribution Office)									
	DI	12	1965	739	0.000	0	183	15.0197	117
Savannah from Beebe Healthcare to Beebe Healthcare Hydrant									
	DI	12	1965	738	0.265	89.78687783	145	14.7898774	91
Beebe Ave									
	CI	6	1922	471	0.072	4.916742081	463	21.98268407	
	CI	6	1922	243	0.080	6.438914027	461	21.97786411	313
Savannah Rd from Beebe Hydrant to 424 Savannah Rd Boiler Room Line									
	DI	12	1965	216	0.265	89.78687783	145	14.7898774	91
424 Savannah Rd Boiler Room Line									
	DI	8	1965	269	0.369	133.1877828	129	14.68470387	76
Savannah Rd from 424 Savannah Rd Boiler Room to Beebe Healthcare Bus Stop									
	DI	12	1965	736	0.252	85.67963801	148	14.80053215	
	DI	12	1965	737	0.000	0	183	15.0197	100
Savannah Rd from Beebe Healthcare Bus Stop to Beebe Healthcare Sign									
	DI	12	1965	267	0.252	85.67963801	148	14.80053215	93

Savannah Rd from Beebe Healthcare Sign to Emergency Entrance	DI	12	1965	194	0.191	68.1800905	152	14.84772293	96
Savannah Rd from Emergency Entrance to Coleman Line	DI	12	1965	173	0.219	78.91221719	151	14.82104387	95
Beebe Healthcare Sign towards Market Street	DI	6	1960	281	0.203	17.4520362	221	15.74950853	
	DI	6	1960	285	0.100	10	224	15.789092	
	DI	6	1960	201	0.088	8.11040724	225	15.79560743	134
Emergency Entrance Hydrant Line	DI	6	2001	962	0.000	0	40	9.16754	25
Beebe Healthcare Sign to Market Street	DI	6	1960	199	0.101	10.14117647	223	15.7884929	135
Savannah Rd from Coleman to just before E 4th Street	DI	12	1965	176	0.375	130.7447964	130	14.68776641	77
Savannah Rd at intersection of E 4th Street	DI	12	1965	1060	0.368	129.3542986	132	14.69189022	79
Savannah Rd from E 4th Street to W 4th Street	DI	12	1965	175	0.590	206.8316742	124	14.49515259	73
Savannah Rd from W 4th Street to Fire Department	DI	12	1965	174	0.301	110.9995475	138	14.74211895	84
Fire Department Line	CI	4	1965	354	0.050	1.497285068	176	15.00429628	
	CI	4	1965	352	0.064	3.0239819	174	14.99809664	113
Savannah Rd from Fire Department to 3rd Street	DI	12	1965	350	0.298	104.959276	139	14.75399636	
	DI	12	1965	347	0.281	101.938914	141	14.76382132	85
E 4th Street to Kings Hwy	DI	12	1965	346	0.227	83.26108597	150	14.81132204	94
Frog Hill Rd to Savannah Rd	DI	10	1985	589	0.129	31.14162896	64	11.6795197	45
Frog Hill/Market Street to Hospital Back Entrance	DI	8	1985	355	0.134	20.63393665	65	11.69721969	
	DI	12	1985	198	0.295	73.78823529	61	11.56017183	44
Lab Express Lewes Fire Hydrant (Market St)	CI	6	1985	618	0.000	1.497285068	77	11.76578243	50
Market Street from Fire Hydrant to Hospital Sign Line	CI	6	1960	196	0.177	16.46425339	222	15.75781586	133
Market street from Hospital Sign line to Hospital Entrance Line	CI	6	1960	195	0.087	6.271040724	226	15.79906017	
	CI	4	1922	343	0.127	4.832126697	460	21.9690086	297
Market Street from Hospital Entrance Line to W 4th Street South	CI	4	1922	168	0.300	12.33031674	458	21.91151219	311
St Paul Street	CI	4	1952	158	0.044	1.610859729	377	17.1189702	
	CI	4	1952	461	0.063	3.018552036	373	17.11161507	254
W 4th Street From Park to St Paul Street									

	DI	8	1965	147	0.155	24.41357466	164	14.93630232	105
W 4th Street From St Paul to Mulberry									
	DI	8	1965	159	0.155	24.20226244	165	14.93668585	106
Intersection of W 4th Street and Mulberry									
	DI	8	1965	161	0.191	29.98959276	160	14.91692439	101
W 4th Street From Intersection of 4th and Mulberry to Connector									
	DI	8	1965	162	0.234	36.86334842	157	14.89359101	
	DI	8	1965	718	0.000	0	183	15.0197	
	DI	8	1965	717	0.234	36.86334842	157	14.89359101	103
W 4th Street Connector									
	DI	8	1965	166	0.164	25.27782805	163	14.93244791	102
W 4th Street (South) Connector towards Mulberry									
	CI	6	1904	163	0.000	0	506	24.93586	343
W 4th Street (South) Connector Towards Market									
	CI	6	1904	165	0.298	26.79140271	499	24.81203105	336
W 4th Street (South) from Market towards Savannah									
	CI	6	1904	169	0.176	15.97013575	501	24.86241555	339
W 4th Street from Connector to Market									
	DI	8	1965	164	0.080	14.43846154	169	14.97337922	110
W 4th Street from Market to Chestnut									
	DI	8	1965	643	0.318	48.35384615	153	14.85170648	
	DI	8	1965	719	0.000	0	183	15.0197	104
Intersection of W 4th Street and Market Hydrant Line									
	DI	6	1965	720	0.318	48.35384615	153	14.85170648	97
W 4th Street from Chestnut to end of W 4th Street South									
	DI	8	1965	863	0.472	75.33393665	140	14.76376486	86
(Both) W 4th Street to Savannah									
	DI	8	1965	179	0.595	92.80904977	135	14.70084647	
	DI	8	1965	172	0.608	94.32895928	133	14.69500202	80
Chestnut from W 4th Street to 3rd Street									
	DI	8	2005	864	0.154	25.46696833	21	8.432218991	
	DI	8	2005	865	0.154	23.96561086	22	8.434943955	12
Market St from W 4th Street to Church St									
	DI	8	1989	211	0.229	33.76244344	55	10.99926492	38
Market St from Church to 3rd									
	DI	8	1989	138	0.125	19.24162896	56	11.05167823	39
Church St									
	CI	8	1965	193	0.068	13.01266968	170	14.97882428	
	CI	4	2001	210	0.332	13.01266968	32	9.060147733	52
Mulberry St from W 4th Street to Church St									
	CI	8	1965	131	0.034	7.187330317	173	14.99808328	
	CI	8	1965	191	0.035	6.329864253	175	14.99929671	111
Mulberry Hydrant at Church St Intersection									
	CI	6	1965	132	0.000	1.497285068	181	15.01698243	115
Mulberry from Church to 3rd Street									
	CI	8	1965	136	0.092	14.17737557	167	14.97076728	108

3rd Street from Savannah to Chestnut									
	DI	12	1954	733	0.000	0	337	16.80786	222
	DI	12	1954	139	0.200	64.4	304	16.640458	
3rd St from Chestnut St to Market St									
	CI	12	1954	208	0.245	87.6520362	292	16.58694088	187
3rd St from Market St to Mulberry St									
	CI	12	1954	135	0.176	65.87828054	307	16.64371798	197
Intersection of 3rd St and Mulberry St									
	CI	12	1954	293	0.218	78.539819	296	16.61022264	190
3rd St from Mulberry St to Park Ave									
	CI	12	1954	133	0.193	68.63710407	302	16.634482	
	CI	12	1954	187	0.184	65.61312217	306	16.64225632	195
3rd St from Mulberry St to Park Ave Hydrant									
	CI	6	1954	134	0.000	1.497285068	333	16.80514243	219
Market St from 3rd St to 2nd St									
	DI	8	1954	209	0.264	39.52081448	316	16.66949889	205
2nd St from Shipcarpenter St to Mulberry St									
	DI	10	1977	129	0.193	47.58235294	88	12.93381637	59
2nd St from Shipcarpenter St to Mulberry St Hydrant									
	DI	6	2006	722	0.000	0	15	8.35474	10
W Market Street									
	DI	12	2001	338	0.083	29.84751131	34	9.092451771	20
Canal Square Line									
	DI	8	2001	143	0.000	1.497285068	38	9.164822428	23
Neils Street									
	CI	12	1955	339	0.100	33.97511312	291	16.55837717	185
Front Street from Savannah to Neils									
	CI	12	1955	182	0.200	60	285	16.485884	
Intersection of Shipcarpenter and Pilottown									
	CI	4	1922	294	0.050	1.497285068	467	21.99437628	315
Front Street from Shipcarpenter to dead end									
	CI	10	2006	569	0.000	0	15	8.35474	
	CI	10	2006	330	0.133	30.11312217	13	8.266369253	9
Front Street from Savannah to Canal Crossing									
	CI	12	1955	387	0.690	241.900905	238	16.03195823	144
Front Street from Savannah to Canal Crossing									
	CI	12	1955	726	0.000	0	309	16.6453	
	CI	12	1955	725	0.690	241.900905	238	16.03195823	
	CI	12	1955	943	0.676	240.3972851	240	16.03834457	151
Front Street Between Canal Crossings									
	CI	12	1955	106	0.205	75.54162896	276	16.45630447	173
Gills Neck Between Canal Crossing and Rodaline									
	CI	12	1955	383	0.321	112.9058824	268	16.35923021	
	CI	12	1955	727	0.321	112.9058824	268	16.35923021	167
Gills Neck Between Canal Crossing and Rodaline Hydrant									
	DI	6	1955	728	0.000	0	309	16.6453	199

Gills Neck from Rodaline to Schley									
	CI	12	1955	303	0.288	101.7153846	272	16.38788411	
	CI	12	1955	730	0.288	101.7153846	272	16.38788411	170
Gills Neck from Rodaline to Schley Hydrant									
	DI	12	1955	731	0.000	0	309	16.6453	199
Gills Neck North from Canal Crossing to Schley									
	DI	12	1961	663	0.524	185.360181	196	15.20116392	
	DI	12	1961	945	0.524	185.360181	196	15.20116392	121
Intersection of Gills Neck and Schley									
	DI	12	1961	325	0.632	222.1923077	193	15.10711269	
	DI	12	1961	659	0.074	26.05520362	207	15.6040206	125
12 DI Schley									
	DI	12	1961	378	0.563	197.6479638	195	15.16903269	120
12 CI Schley									
	CI	12	1955	376	0.324	112.500905	270	16.3593938	
	CI	12	1955	144	0.370	130.1683258	262	16.31566989	161
6 CI Schley									
	CI	6	1952	297	0.203	17.66606335	369	17.04971436	250
Rodaline from Gills to E 3rd Street									
	CI	6	1950	300	0.144	13.45158371	388	17.39734129	263
Rodaline from E 3rd to Schley									
	CI	12	1952	459	0.369	131.6728507	331	16.80073347	
	CI	12	1952	296	0.050	1.497285068	376	17.11757628	240
Schley from Rodaline to Franklin									
	DI	14	2005	895	0.974	467.1230769	10	7.423406122	
	DI	18	2005	896	0.590	467.1230769	11	7.520323697	6
Rodaline from 6 CI to 12 CI									
	CI	14	1952	319	0.329	152.3683258	328	16.77334295	216
Rodaline from 12 CI to 12 DI									
	CI	14	1952	375	0.549	266.3773756	287	16.51087179	
	CI	14	1952	894	0.796	380.5149321	249	16.24119571	168
Rodaline from 12 DI to Water Tower									
	CI	14	1952	377	0.750	361.9158371	254	16.28661061	156
Intersection of Franklin and Schley									
	DI	12	2006	899	0.359	127.9723982	12	8.03183845	7
Franklin from Schley to Dead End									
	DI	12	2005	897	0.000	1.497285068	23	8.514582428	14
Franklin from Schley to Dead End 2									
	CI	4	2001	898	0.050	1.497285068	36	9.152136283	21
Franklin towards Washington									
	DI	18	2005	893	0.700	563.6113122	8	7.317539468	
	DI	18	2005	891	0.700	563.6113122	8	7.317539468	
	DI	18	2005	884	0.700	563.8357466	7	7.31713212	5
Franklin Hydrant North	DI	8	2005	892	0.000	0	29	8.5173	17

Franklin Hydrant South	DI	6	2005	675	0.000	0.3	24	8.5167555	16
Franklin Junction									
	DI	18	2005	883	0.796	626.5393665	6	7.178981367	
	DI	18	2010	942	0.796	626.5393665	5	6.366181367	4
Franlkin Junction to Kings Hwy Junction (Kings #16)									
	DI	16	1970	941	0.772	485.3705882	93	13.13086005	
	DI	16	1970	915	0.772	485.3705882	93	13.13086005	
	DI	16	1970	914	0.772	485.3705882	93	13.13086005	61
Kings Hwy Junction towards Bike Path (Kings #16)									
	DI	16	1970	927	0.423	267.6466063	110	13.61437493	67
Franklin Junction to Kings Hwy (Kings #12-1)									
	CI	12	1945	920	0.404	141.158371	394	17.91263695	
	CI	12	1945	921	0.000	0	420	18.2709	
	CI	12	1945	177	0.404	141.158371	394	17.91263695	270
Kings Hwy #12-1 From Coleman to Madison									
	CI	12	1945	917	0.569	201.0832579	392	17.76227187	267
Kings Hwy #12-1 From Madison to Kings Hwy Junction									
	CI	12	1945	918	0.691	245.3257919	391	17.65111348	266
Kings Hwy #12-1 From Kings Junction towards Wells									
	CI	12	1945	274	0.160	51.02	399	18.1378859	
Franklin Junction towards Washington									
	DI	18	2005	882	0.085	76.90542986	20	8.356344491	
	DI	18	2005	881	0.000	0	29	8.5173	13
near franklin junction Kings Hwy (Main)									
	DI	10	2005	880	0.314	76.90542986	14	8.298399667	8
Franklin to Washington									
	CI	10	1904	192	0.314	76.90542986	493	24.71695967	334
Washington from Franklin to Lewes Public Library									
	CI	8	2000	356	0.000	1.6	45	9.327196	28
Washington from Franklin to Kings (Hwy Main)									
	CI	10	1904	189	0.295	73.78823529	494	24.72753183	
	DI	10	1904	190	0.000	0	506	24.93586	
	CI	10	1904	974	0.295	73.78823529	494	24.72753183	
	CI	10	1904	220	0.295	73.78823529	494	24.72753183	335
Kings Hwy (main) from Washington to W 4th Street Connection									
	DI	10	2001	345	0.310	75.04162896	31	8.953051072	18
Kings Hwy (main) from W 4th Street Connection to Lewes Presbyterian Church									
	CI	10	1904	829	0.010	25.01	503	24.88794105	
Lewes Presbyterian									
	DI	8	2001	830	0.000	0.5	39	9.1666325	24
Kings Hwy (main) from Lewes Presbyterian to Franklin									
	CI	10	1904	217	0.136	31.95113122	500	24.84358182	337
Kings Hwy (main) from Franklin to E 3rd Street									
	CI	10	1904	340	0.462	114.7248869	492	24.61094466	333
Kings Hwy (main) from Washington to E 4th Street									
	CI	8	1904	219	0.071	9.74479638	505	24.90011544	341

Kings Hwy (main) from E 4th Street to Jefferson									
	CI	6	1904	240	0.099	10.1561086	504	24.89239724	
	CI	6	1904	1062	0.000	0	506	24.93586	342
Kings Hwy (main) from Jefferson to Coleman									
	CI	6	1904	631	0.149	12.08823529	502	24.87631858	340
Kings Hwy (main) from Coleman to Beebe									
	CI	6	1910	242	0.143	12.76832579	479	23.90109569	
	CI	6	1970	212	0.143	12.76832579	118	14.14749569	305
Kings Hwy (main) from Beebe to Monroe									
	CI	6	1910	244	0.202	18.26244344	474	23.87638051	321
Monroe from Kings Hwy to Railroad									
	CI	6	1910	291	0.176	17.12986425	475	23.88495064	322
End of Monroe									
	CI	6	1954	828	0.234	18.42760181	317	16.71532618	206
Kings Hwy (main) from Monroe to Dewey									
	CI	6	1910	290	0.094	7.92760181	484	23.92245346	329
Kings Hwy (main) from Dewey to Manila									
	CI	6	1910	246	0.117	11.62081448	483	23.90992151	327
Kings Hwy (main) from Manila to Adam									
	CI	6	1910	247	0.167	15.15294118	477	23.89082455	324
Adams Ave from Kings to Railroad									
	CI	6	1945	248	0.074	7.13438914	412	18.23920759	281
Adams Ave form Railroad to Dead End									
	CI	6	1945	286	0.000	1.497285068	416	18.26818243	285
Railroad from Adams to Monroe									
	CI	6	1954	287	0.110	10.01266968	325	16.76202892	
	CI	6	1954	940	0.110	10.01266968	325	16.76202892	214
Kings Hwy (main) from Adams to Mcfee									
	CI	6	1910	249	0.124	11.29909502	482	23.90879108	326
Kings Hwy (main) at Mcfee Intersection									
	CI	6	1910	152	0.136	12.23665158	480	23.90388931	
	DI	6	1910	745	0.000	0	491	23.9605	
	CI	6	1910	251	0.156	13.61900452	478	23.89646589	328
Kings Hwy (main) from Mcfee to Devries Cir.									
	CI	6	1922	744	0.156	13.61900452	459	21.94574589	
	CI	4	1922	258	0.392	15.00769231	457	21.88356625	312
Kings Hwy (main) Devries Cir to Dead End									
	CI	4	1922	277	0.065	2.429864253	464	21.98902638	
	CI	4	1922	786	0.000	0	469	22.00978	
	CI	4	1922	785	0.065	2.429864253	464	21.98902638	
	CI	4	1922	784	0.000	0	469	22.00978	316
Kings Hwy (6") Devries Cir to First Baptist Church									
	DI	6	1922	360	0.041	3.976470588	466	21.99216235	
	CI	6	1922	607	0.000	1.497285068	468	22.00706243	317
Kings Hwy (main) Devries Cir to First Baptist Church									
	DI	12	1976	260	0.037	12.65113122	100	13.19932074	

	DI	12	1976	746	0.000	0	102	13.23154	
	DI	12	1976	778	0.050	13.40045249	99	13.19453203	
	DI	12	1976	362	0.061	17.17511312	98	13.18493807	
	DI	12	1976	606	0.230	85.48280543	90	13.01821531	63
Kings Hwy from First Baptist Church past Henlopen Garden									
	DI	8	1974	593	0.575	92.48461538	103	13.24353835	
	DI	8	1974	595	0.615	93.99276018	101	13.23074358	
	DI	8	1974	594	0.262	43.12352941	104	13.41210283	
	DI	8	1974	629	0.000	3.9	105	13.5495815	
	DI	8	1974	774	0.000	3.9	105	13.5495815	64
Cape Henlopen High Scool									
	DI	6	2006	782	0.000	0	15	8.35474	
	DI	6	2006	776	0.000	0	15	8.35474	
	DI	6	2006	772	0.000	0	15	8.35474	10
Canal Crossing East from Gills Neck to Gills Neck North									
	CI	12	1955	660	0.532	188.4561086	244	16.1688476	147
Canal Crossing West from Gills Neck to Gills Neck North									
	CI	12	1961	944	0.443	164.8511312	198	15.25884569	122
Canal Crossing East from Gills Neck North to Anglers Road									
	CI	12	1955	614	0.532	188.4561086	244	16.1688476	147
Canal Crossing West from Gills Neck North to Anglers Roa									
	CI	12	1961	787	0.992	350.2113122	143	14.78378368	88
Canal Crossing Connection after Anglers Road									
	DI	8	1961	615	0.064	10.00180995	208	15.63567188	128
Canal Crossing West from Anglers road to Connection									
	CI	12	1961	104	0.867	302.9343891	159	14.90113522	99
East Market Street from Anglers to Mass.									
	CI	6	1904	873	0.000	0	506	24.93586	
	CI	6	1904	641	0.336	29.52443439	497	24.79747027	
	CI	6	1904	4	0.318	28.02624434	498	24.80476107	338
East Market Street from Mass. To Cedar									
	CI	6	1910	9	0.210	19.0040724	472	23.87286295	319
East Market Street from Cedar to Bay Ave									
	CI	6	1910	889	0.136	11.36877828	481	23.90557879	325
Bayview Ave - End									
	CI	6	1910	91	0.000	1.507894737	490	23.95776317	332
Canal Crossing East from Connection to Mass.									
	CI	12	1955	679	0.509	176.9348416	246	16.19558747	149
Canal Crossing West from Connection to Mass.									
	CI	12	1961	206	0.897	311.4167421	155	14.87819664	
	CI	12	1961	358	0.894	309.9113122	156	14.88161473	98
Mass. From Savannah to Dead End (WWTP)									
	CI	6	1961	680	0.000	0.8	213	15.668488	130
Canal Crossing East from Mass. To Cedar Connection									
	CI	12	1995	102	0.464	161.3738866	46	9.732868586	30
Canal Crossing East from Cedar Connection to Lewes House									

	CI	12	1955	99	0.581	210.7921053	242	16.11597051	
	CI	12	1955	86	0.456	157.0089069	250	16.24518508	
	DI	12	1955	696	0.581	210.7921053	242	16.11597051	146
Canal Crossing East from Lewes House to Cape Henlopen									
	CI	12	1955	97	0.588	215.1293522	241	16.10625774	145
Canal Crossing West from Mass. To Cedar Connection									
	CI	12	1961	327	0.778	276.5842105	168	14.97144878	109
Canal Crossing West from Cedar Connection to Cape Henlopen									
	CI	12	1961	95	0.629	219.7522267	194	15.11223018	119
East Savannah from Mass. To Cedar Connection									
	CI	4	1910	101	0.214	8.800404858	476	23.89053446	323
East Savannan from Cedar Connection to Lewes House									
	CI	4	1910	90	0.264	10.12267206	473	23.87550554	320
East Savannah From Lewes House to Bayview Dr									
	CI	4	1910	88	0.064	2.744939271	487	23.93941213	331
Canal Crossing West from Cape Henlopen to Cape Henlopen									
	CI	12	1961	96	0.456	157.1682186	199	15.26953593	123
Canal Crossing West 8" from Cape to Cape									
	CI	8	1941	93	0.378	61.06093117	432	18.71495779	294
Canal Crossing West 8" From Cape to Bayview									
	CI	8	1941	694	0.200	37.29534413	436	18.80293295	
	CI	8	1941	92	0.200	37.29534413	436	18.80293295	295
Bay Ave from E Savannah to Midland Ave									
	CI	6	1945	232	0.300	24.2111336	401	18.15118279	274
Midland Ave from Bay to Cedar									
	CI	6	1945	11	0.300	25.72449393	400	18.14843604	273
Midland Ave from Cedar to Mass.									
	CI	6	1953	12	0.256	21.15384615	341	16.86739801	226
Midland Ave South of Mass.									
	DI	6	1945	333	0.000	1.497285068	416	18.26818243	285
Cedar St from Midland to E Market									
	CI	6	1945	10	0.089	6.121719457	409	18.23727403	280
Mass from E Savannah to Midland									
	CI	10	1953	7	0.138	38.539819	340	16.86572619	225
Mass. From Midland to E Market									
	CI	10	1953	6	0.101	26.16832579	346	16.89732362	228
Mass from E Market to Cedar									
	CI	10	1953	5	0.126	29.50361991	342	16.88498413	
	CI	10	1953	153	0.115	28.32579186	343	16.88986484	227
Mass. From Cedar to Bay Ave									
	CI	6	1953	808	0.164	12.87828054	347	16.90567309	229
Cape Henlopen North from E Savannah to Pilot Point									
	CI	8	1941	94	0.774	121.0534413	426	18.50580633	
	CI	8	1941	89	0.774	122.3206478	424	18.50350635	290
Cape Henlopen North from Pilot Point to Texas Ave									
	CI	8	1941	473	0.764	120.1465587	428	18.51016219	

	CI	8	1941	111	0.764	120.584413	427	18.50936748	292
Cape Henlopen North from Texas Ave to Port Lewes Court									
	CI	8	1941	867	0.764	119.6269231	429	18.51110532	
	CI	8	1941	117	1.040	163.0975709	422	18.36246539	289
Cape Henlopen North from Port Lewes Court to W Cape Shores Dr									
	CI	8	1941	334	0.964	152.0633603	423	18.40171719	288
Cape Henlopen North from W Cape Shores Dr To E Cape Shores Dr									
	CI	8	1941	480	0.244	39.49230769	435	18.78779922	
	CI	8	1941	494	0.551	85.41700405	430	18.62693349	
	CI	8	1941	682	0.551	85.41700405	430	18.62693349	
	CI	8	1941	670	0.344	55.63947368	433	18.73323411	
	CI	8	1941	329	0.344	55.63947368	433	18.73323411	293
Cape Henlopen North from E Cape Shores Dr to End of roa									
	CI	8	1941	200	0.200	25	438	18.825249	296
Pilot Point									
	DI	8	1974	820	0.000	1.507894737	107	13.55392317	
	DI	8	1974	110	0.000	0	109	13.55666	
	DI	8	1974	109	0.000	1.507894737	107	13.55392317	66
Texas Ave									
	CI	6	1941	866	0.000	0.959716599	439	18.91939811	
	CI	6	1941	735	0.000	0	440	18.92114	298
Port Lewes Court									
	DI	6	1985	335	0.094	9.50242915	67	11.72758011	
	DI	6	1985	819	0.056	3.794736842	69	11.7475008	
	DI	6	1985	823	0.064	5.707692308	68	11.74203473	
	DI	6	1985	824	0.014	2.855060729	73	11.75984126	
	DI	6	1985	825	0.014	2.855060729	73	11.75984126	47
E Cape Shores Drive									
	DI	8	1990	511	0.533	80.63947368	54	10.67476637	37
Cape Henlopen South from E Savannah to Georgia									
	CI	12	1955	551	1.042	370.7663968	214	15.70909291	
	CI	12	1955	341	1.038	367.9722672	215	15.71528911	131
Cape Henlopen South from Georgia to SPI									
	CI	12	1955	341	1.038	367.9722672	215	15.71528911	
	CI	12	1955	108	1.035	366.7161943	217	15.71823356	
	CI	12	1955	475	1.029	365.1933198	218	15.72253147	
	CI	12	1955	472	1.029	362.8283401	219	15.72682391	
	CI	12	1955	114	1.020	359.3431174	220	15.73534816	
	CI	12	1955	116	0.864	304.865587	230	15.87379915	
	CI	12	1955	98	0.711	258.93583	237	15.9958156	
	CI	12	1955	698	1.100	400	209	15.641462	
	CI	12	1955	700	1.100	400	209	15.641462	
	CI	12	1955	363	1.100	400	209	15.641462	132
Cedar from Mass. To Rehoboth Ave									
	CI	10	1953	604	0.090	21.04751131	348	16.90936085	230
Cedar from Rehoboth Ave to E Canal Street									

	CI	10	1953	18	0.085	19.96063348	349	16.9128193	231
Cedar from E Canal to Lewes Ave									
	CI	10	1953	19	0.052	15.84162896	352	16.92852414	234
E Canal									
	CI	6	1951	809	0.071	7.463348416	383	17.26393627	259
Lewes Ave									
	CI	10	1956	24	0.000	1.497285068	279	16.48002243	176
Cedar from Lewes to W Canal Street									
	CI	10	1953	23	0.047	15.20135747	357	16.93094342	237
W Canal									
	CI	6	1951	803	0.055	3.559276018	385	17.27513658	260
Cedar from W Canal to Milton Ave									
	CI	10	1953	20	0.045	15.72171946	356	16.93057041	236
Cedar from Milton to Vermont Ave									
	CI	10	1953	602	0.047	16.54841629	353	16.9286128	235
Vermont									
	CI	6	1953	27	0.000	1.647511312	363	16.96742977	244
Cedar from Vermont to Delmar Ave									
	CI	10	1954	25	0.061	18.93574661	324	16.75806252	213
Cedar from Delmar to New Hampshire Ave									
	CI	10	1954	600	0.074	20.39819005	323	16.75220808	212
New Hampshire Ave									
	CI	6	1955	30	0.000	0.619909502	308	16.64417486	198
Cedar from New Hampshire to Houston Ave									
	CI	10	1954	28	0.092	22.52262443	322	16.74378065	211
Cedar from Houston to Rhode Island Ave									
	CI	10	1954	598	0.095	24.03303167	321	16.74035352	210
Rhode Island Ave									
	CI	6	1954	33	0.000	0.238914027	336	16.80742637	221
Cedar from Rhode Island to Delaware Ave									
	CI	10	1954	31	0.100	25.79276018	320	16.73578814	209
Delaware Ave									
	CI	6	1952	36	0.000	0.260180995	379	17.13250777	256
Cedar from Delaware to Connecticut Ave									
	CI	10	1954	34	0.100	27.37285068	319	16.73292028	208
Connecticut Ave									
	CI	6	1952	39	0.000	0.229864253	381	17.1325628	258
Cedar from Connecticut to New York Ave									
	CI	10	1954	37	0.100	29.06153846	318	16.72985531	207
New York Ave									
	CI	6	1952	42	0.000	0.239366516	380	17.13254555	257
Cedar from New York to Clayton Ave									
	CI	10	1956	40	0.100	30.33257919	275	16.40242837	172
Clayton Ave									
	CI	4	1956	49	0.050	1.497285068	277	16.46733628	174
Cedar Clayton to Newark Ave									

	CI	10	1956	48	0.118	31.83574661	274	16.39512854	171
Newark Ave									
	CI	4	1956	642	0.050	1.497285068	277	16.46733628	174
New Jersey Ave									
	CI	6	1956	45	0.000	0.586425339	283	16.48167564	180
Cedar Newark to Oregon Ave.									
	CI	10	1956	43	0.129	35.44117647	271	16.38595602	169
Oregon Ave									
	CI	4	1945	47	0.000	0.79321267	419	18.26946032	287
Cedar from Oregon to Kentucky									
	CI	10	1956	46	0.000	0.79321267	282	16.48130032	179
Kentucky Ave									
	CI	6	1953	65	0.000	3.413122172	360	16.96422518	241
Cedar from Kentucky to Ohio									
	CI	10	1956	63	0.200	42.65067873	265	16.35481302	164
Ohio Ave									
	CI	6	1953	62	0.000	3.054751131	361	16.96487563	242
Cedar from Ohio to Felton Ave									
	CI	10	1956	60	0.200	41.09819005	266	16.35763079	165
Felton Ave									
	CI	6	1956	811	0.000	0	284	16.48274	181
Cedar from Felton to Indiana Ave									
	CI	10	1956	810	0.200	41.09819005	266	16.35763079	165
Indiana Ave									
	CI	6	1954	59	0.000	0.474660633	335	16.80699849	220
Cedar from Indiana to Illinois Ave									
	CI	10	1956	57	0.200	43.09049774	264	16.35401475	163
Illinois Ave									
	CI	6	1954	692	0.005	3.738461538	329	16.79970322	
	CI	6	1954	56	0.005	3.738461538	329	16.79970322	217
Cedar from Illinois to Odessa Ave									
	CI	10	1956	54	0.200	48.33936652	263	16.34448805	162
Odessa Ave									
	CI	6	1956	66	0.000	1.497285068	279	16.48002243	176
Michigan Ave									
	CI	6	1953	53	0.100	8.959728507	354	16.92890009	
	CI	6	1953	690	0.100	8.959728507	354	16.92890009	
	CI	6	1953	900	0.191	16.08552036	344	16.89288028	232
Cedar from Odessa to Pennsylvania Ave									
	CI	10	1956	52	0.241	60.31900452	260	16.31234465	160
Pennsylvania Ave									
	CI	6	1956	70	0.000	1.497285068	279	16.48002243	176
Cedar from PA to N Washington Ave									
	CI	10	1956	69	0.264	63.33484163	259	16.30115643	158
N Washington Ave									
	CI	6	1952	72	0.000	1.6	378	17.130076	255

Cedar from N Washington to California Ave									
	CI	10	1958	71	0.264	66.44705882	236	15.97038776	143
California Ave									
	CI	6	1952	75	0.067	5.404072398	372	17.10614246	253
Cedar from California Ave to Missouri Ave									
	CI	10	1958	73	0.283	73.3638009	234	15.95291942	141
Missouri Ave									
	CI	6	1953	78	0.000	3.052488688	362	16.96487973	243
Cedar from Missouri to Iowa Ave									
	CI	10	1958	76	0.278	71.81628959	235	15.95709962	142
Iowa Ave									
	CI	6	1953	647	0.064	5.160633484	358	16.94493862	238
Cedar From Iowa to Newport Ave									
	CI	10	1958	79	0.311	78.48778281	233	15.93653343	140
Cedar from Newport to Nebraska Ave									
	CI	6	1940	85	0.181	17.52986425	444	19.00616746	
	CI	6	1953	83	0.181	17.52986425	345	16.89288746	268
Nebraska Ave									
	CI	6	1953	270	0.115	11.060181	350	16.92120193	
	CI	6	1953	507	0.115	11.060181	350	16.92120193	233
Cedar from Nebraska to Maine Ave									
	CI	6	1940	374	0.071	6.484162896	449	19.05410207	307
Maine Ave									
	CI	6	1940	633	0.064	4.971493213	450	19.05856191	308
Cedar from Maine to End									
	CI	6	1940	84	0.000	0	451	19.0837	
	CI	6	1940	686	0.000	0	451	19.0837	
	CI	6	1940	687	0.000	0	451	19.0837	309
Newport Ave from Cedar to Breakwater St									
	CI	12	1958	366	0.270	97.53800905	232	15.91235763	139
Breakwater St									
	CI	6	1978	367	0.000	1.497285068	86	12.90370243	57
Newport Ave from Breakwater to Ch Mason Way									
	CI	12	1958	368	0.274	99.0479638	231	15.90858845	138
Ch Mason Way									
	DI	8	1987	369	0.000	1.497285068	60	11.44066243	42
Bay Ave from Maine to Nebraska									
	CI	6	1960	658	0.000	3.461538462	228	15.82621731	136
Bay Ave from Nebraska to Iowa									
	CI	6	1940	80	0.158	13.00950226	447	19.0200864	304
Bay Ave from Iowa to Mussouri									
	CI	6	1940	77	0.181	16.66334842	445	19.00785448	302
Bay Ave from Missouri to California									
	CI	6	1940	74	0.138	12.10769231	448	19.02686621	306
Bay Ave from California to N Washington									
	CI	6	1940	68	0.181	15.98868778	446	19.00907898	303

Bay Ave from N Washington to Michigan Ave	CI	6	1940	380	0.191	16.08552036	443	19.00616028	301
Iowa Ave from Hydrant to Cedar	CI	6	1953	81	0.064	5.160633484	358	16.94493862	238
Kings Hwy 12 to 4 Connector North	CI	4	1955	100	0.144	5.855263158	293	16.59842184	188
Kings Hwy 12 to 4 Connector South	CI	4	1955	103	0.067	2.844736842	300	16.62316179	192
Savannah from Mass. East to Mass West	DI	12	1955	107	0.505	176.5040486	247	16.19737691	150
Cape Henlopen Hydrant at Port Lewes	CI	12	1955	112	0.000	9.50242915	301	16.62805309	193
Cape Henlopen Connector near Port Lewes	CI	12	1955	113	0.164	54.49230769	286	16.50503265	182
Intersection of Johnson and Dupont	DI	6	2001	185	0.186	16.1918552	33	9.091064471	19
Kings Highway 12 to 12 Connector	DI	8	1961	328	0.356	55.3048583	206	15.47967593	127
Schley to Kings Hwy	DI	16	1970	348	0.772	485.3705882	93	13.13086005	61
Kings Highway Connector at Mass. East	DI	10	1955	364	0.061	14.46862348	294	16.60375171	189
Cape Henlopen Connector near Habor Point Ct.	CI	12	1955	382	0.114	45.93117409	289	16.53320011	184
Kings Highway Connector at Mass. West	DI	10	1955	462	0.198	46.19230769	288	16.51155852	183
Cape Henlopen from Pilot Point to Connector	CI	8	1941	476	0.774	121.6518219	425	18.50472027	291
Cape Henlopen Connector near Pilot Point	DI	8	1953	477	0.000	0.881578947	365	16.96881993	246
Cape Henlopen Connector near Virginia Ave	DI	8	1953	560	0.000	1.277327935	364	16.96810165	245
Cape Henlopen Connector near Tennessee Ave	CI	8	1955	566	0.000	1.960121457	305	16.64174238	196
Cape Henlopen Connector near South Cape Shores Drive	CI	12	1955	672	0.400	141.06417	255	16.28823653	157
Sotuh Cape Shores Drive 12	CI	12	1955	681	0.000	0	309	16.6453	199
South Cape Shores Drive 8	DI	8	1941	683	0.000	0	440	18.92114	299
Cape Henlopen From Cape Shores Connector to Hydrant	DI	12	1955	684	1.100	400	209	15.641462	129
Nebraska Ave from Hydrant to Cedar	CI	6	1953	685	0.000	0	366	16.97042	247
Michigan Ave Hydrant									

	CI	6	1953	691	0.000	0	366	16.97042	247
Illinois Ave Hydrant to Cedar									
	CI	6	1954	693	0.000	0	337	16.80786	222
East Savannah Road Hydrant									
	CI	6	1941	695	0.000	0	440	18.92114	299
East Savannah Road Hydrant near Cedar									
	DI	6	1955	697	0.000	0	309	16.6453	199
Cape Henlopen Hydrant near Cape Shores									
	DI	6	1955	699	0.000	0	309	16.6453	199
Cape Henlopen to SPI Branch									
	CI	6	1955	701	0.000	0	309	16.6453	199
Iowa Ave Hydrant									
	CI	6	1953	702	0.000	0	366	16.97042	247
Ocean View Blvd Near Flamingo Ct									
	DI	6	1997	708	0.000	0	47	9.81778	31
Seagull Drive Hydrant between Ocean View and Canary Dr									
	DI	6	1997	710	0.000	0	47	9.81778	31
Intersection of Johnson Ave and Paynter Ave									
	CI	6	1995	713	0.058	4.51040724	51	10.11997025	34
Intersection of Johnson Ave and Paynter Ave Hydrant									
	DI	6	1995	714	0.000	0	53	10.1429	36
Savannah Road Hydrant near Shields									
	DI	6	1965	753	0.000	0	183	15.0197	117
Blue Marlin Hydrants									
	DI	6	2001	763	0.000	0	40	9.16754	
	DI	6	2001	765	0.000	0	40	9.16754	25
Kings Hwy Connector South of Devries									
	DI	12	1970	913	0.618	217.7348416	111	13.65570597	68
Hospital Parking Lot Hydrant									
	DI	6	1985	959	0.000	0	78	11.7685	51

Appendix C:

Pipe Sample Photographs

Pipe Sample Photographs

East Market

Install Year: 1904 Average Flow: 29.18 gpm Average Velocity: 0.34 ft/s

Madison Avenue and Kings Highway

Install Year: 1910 Average Flow: 10.75 gpm Average Velocity: 0.13 ft/s

Ferry

Install Year: 1941 Average Flow: 119.6 gpm Average Velocity: 0.8 ft/s

Delaware

Install Year: 1952 Average Flow: 0.33 gpm Average Velocity: 0.0 ft/s

Rodney Avenue

Install Year: 1948 Average Flow: 1.59 gpm Average Velocity: 0.0 ft/s

School Lane and Savannah Road

Install Year: 1950 Average Flow: 1.59 gpm Average Velocity: 0.0 ft/s

Big Oyster Hydrant

Install Year: 1904 Average Flow: 29.18 gpm Average Velocity: 0.34 ft/s

Hornkill Avenue

Install Year: 1960 Average Flow: 3.2 gpm Average Velocity: 0.02 ft/s

Kings Highway Lodge Entrance

Install Year: 1945 Average Flow: 51.02 gpm Average Velocity: 0.16 ft/s

New Road

Install Year: 1951 Average Flow: 1.86 gpm Average Velocity: 0.0 ft/s

Pilottown Road

Install Year: 1955 Average Flow: 136.37 gpm Average Velocity: 0.39 ft/s

Masons Way

Install Year: 1987 Average Flow: 1.59 gpm Average Velocity: 0.0 ft/s

Cape Henlopen

Install Year: 1955 Average Flow: 305.91 gpm Average Velocity: 0.87 ft/s

Cedar Lane

Install Year: 1954 Average Flow: 15.37 gpm Average Velocity: 0.04 ft/s

Coleman and Savannah

Install Year: 1960 Average Flow: 3.41 gpm Average Velocity: 0.04 ft/s

New Road at Pilottown

Install Year: 1951 Average Flow: 2.01 gpm Average Velocity: 0.0 ft/s

Railroad Avenue at Monroe

Install Year: 1954 Average Flow: 15.33 gpm Average Velocity: 0.18 ft/s

109 Savannah Road

No Longer In Use

West 4th Street

Install Year: 1965 Average Flow: 46.32 gpm Average Velocity: 0.28 ft/s

Queen Anne at Pilottown Road

Install Year: 1954 Average Flow: 98.82 gpm Average Velocity: 0.28 ft/s

Madison at Railroad

No Longer In Use

413 Savannah Road

Install Year: 1965 Average Flow: 54.64 gpm Average Velocity: 0.15 ft/s

Burton and 4th

Install Year: 1957 Average Flow: 6.4 gpm Average Velocity: 0.07 ft/s

Canal Front

Install Year: 2006 Average Flow: 0.0 gpm Average Velocity: 0.0 ft/s

BeeBee Hospital

Install Year: 1945 Average Flow: 74.07 gpm Average Velocity: 0.21 ft/s

Shipcarpenter

Install Year: 1904 Average Flow: 44.25 gpm Average Velocity: 0.5 ft/s

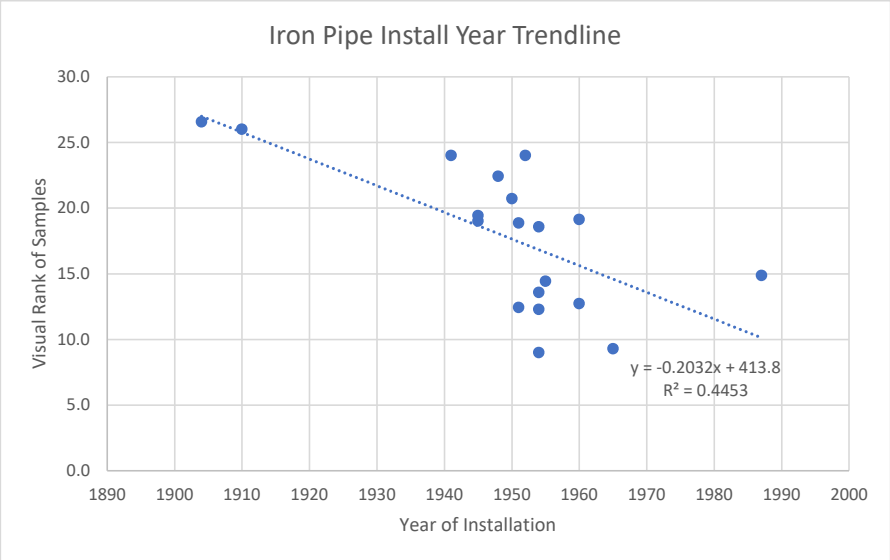
Pilottown and Shipcarpenter

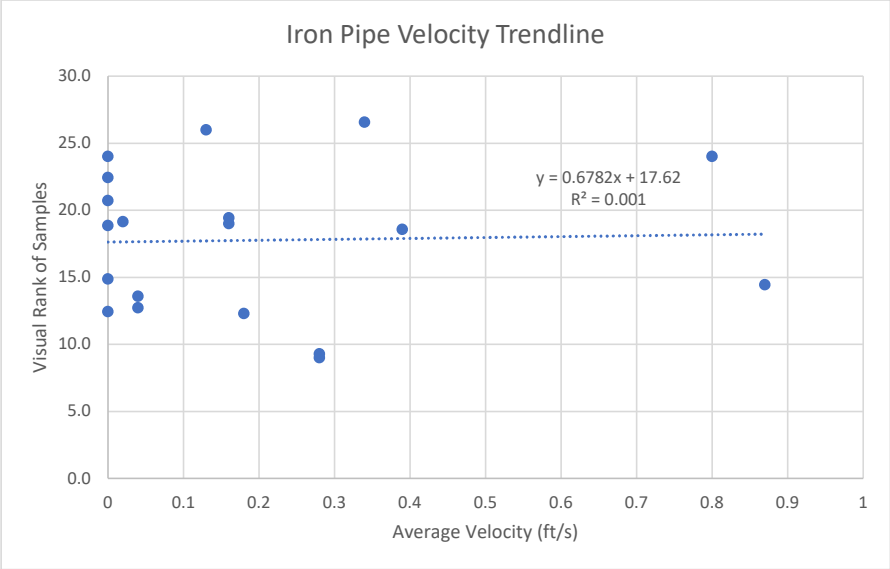
Install Year: 1904 Average Flow: 44.25 gpm Average Velocity: 0.5 ft/s

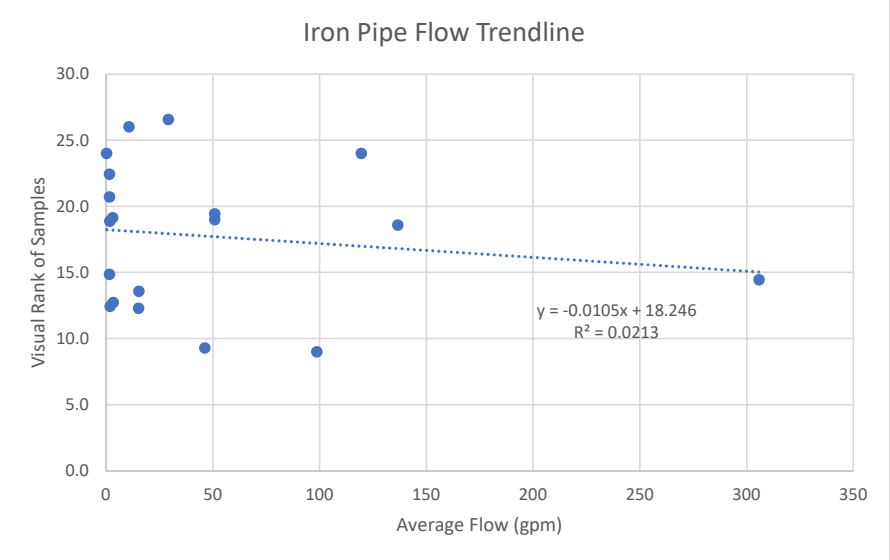
Appendix D:

- **Sample Pipe Trendlines: Age, Velocity & Flow**
- **Sample Pipe Trendlines: Node Age (Water Age)**
- **Sample Pipe Trendlines: Roughness Coefficient**
- **Sample Pipe Trendlines 1950-1960: Age, Velocity & Flow**

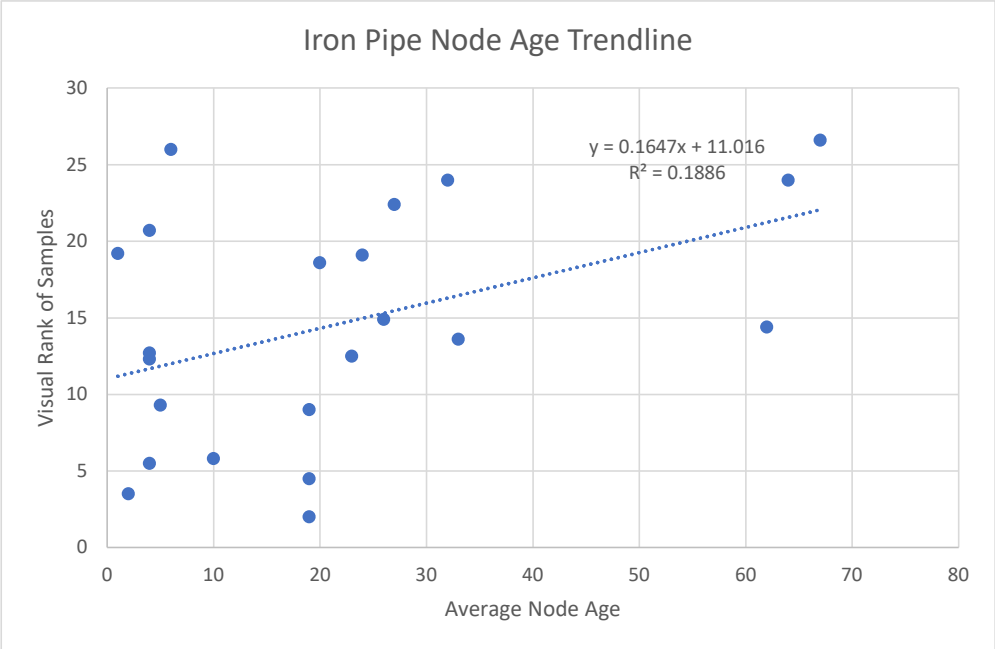
Sample Pipe Trendlines: Age, Velocity, & Flow

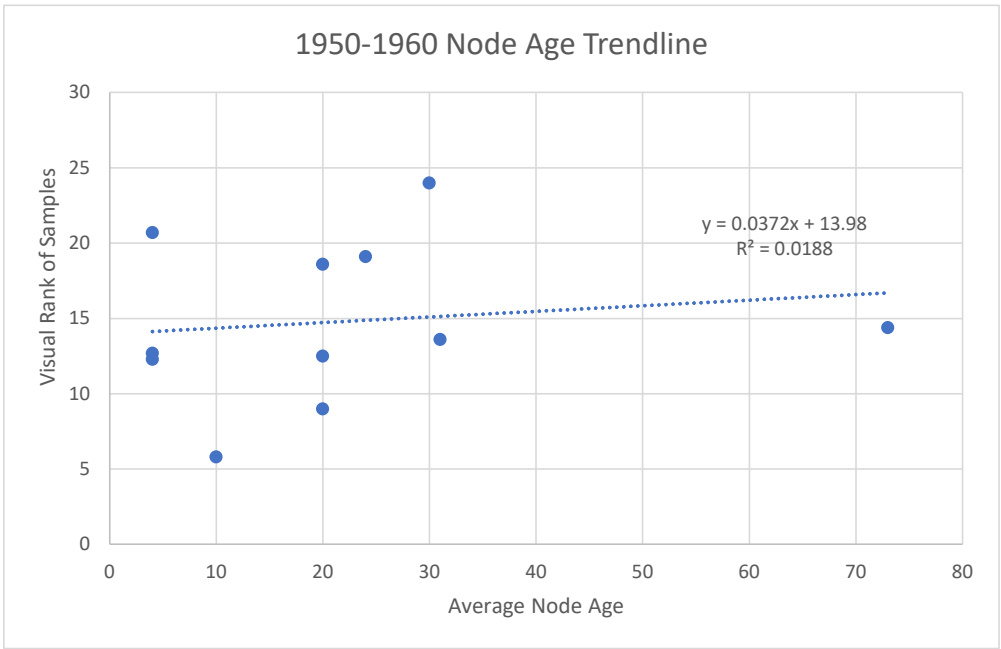




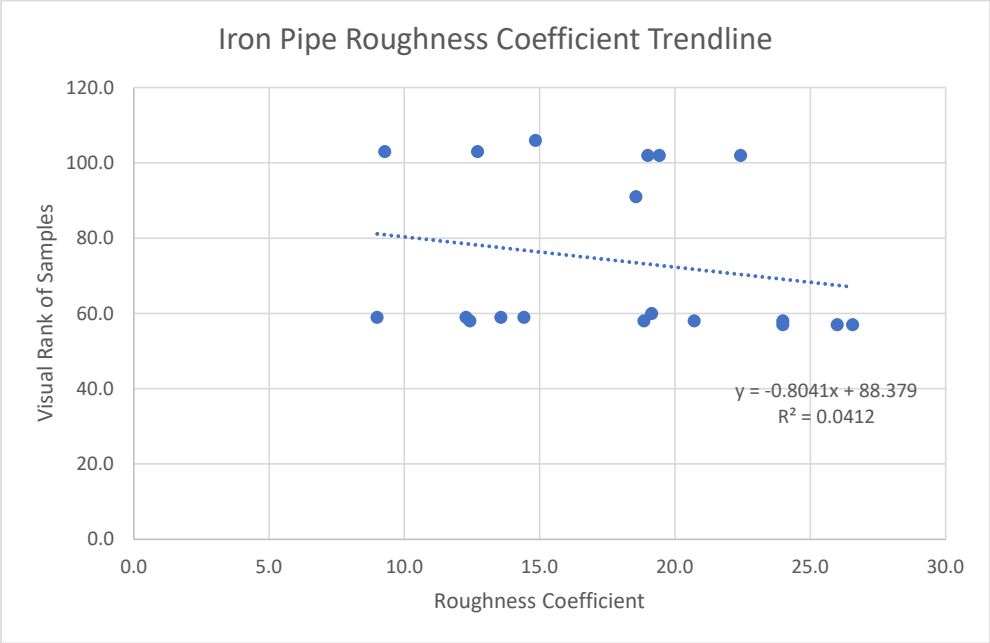


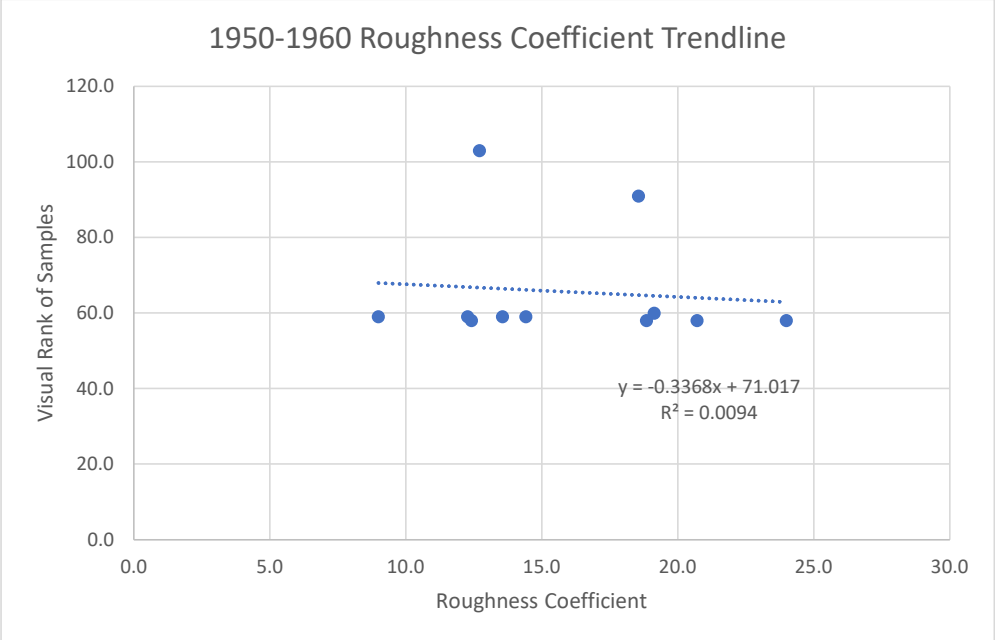
Sample Pipe Trendlines: Node Age (Water Age)





Sample Pipe Trendlines: Roughness Coefficient





Sample Pipe Trendlines 1950-1960: Age, Velocity, & Flow