Pulaski County Sewerage Authority

Sanitary Sewer Collection System Condition Assessment and Rate Analysis

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Draper Aden Associates
Engineering • Surveying • Environmental Services

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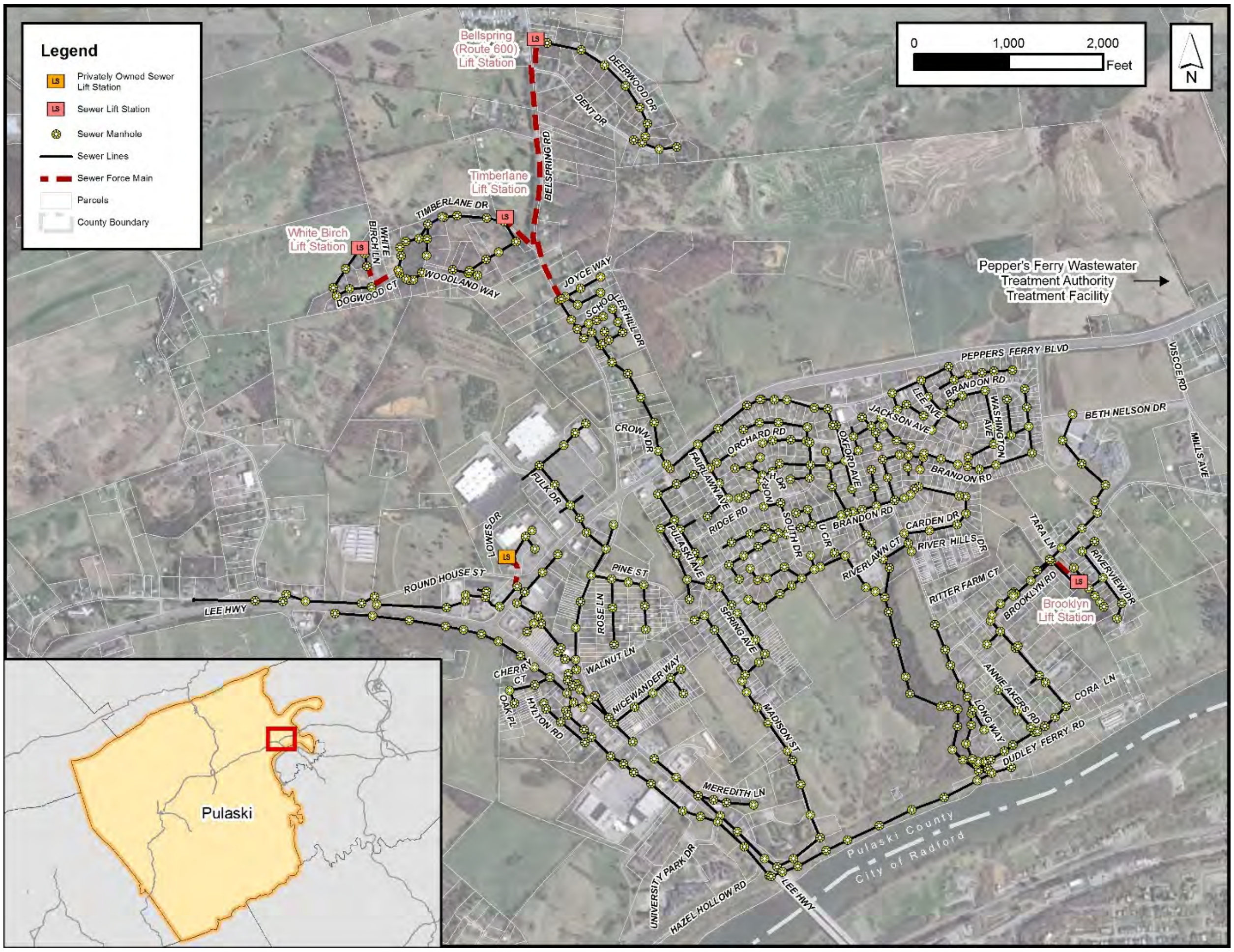
1.0 INTRODUCTION

This sanitary sewer collection system condition assessment was undertaken for the Pulaski County Sewerage Authority's (PCSA) system in the community of Fairlawn, located in Pulaski County, Virginia. The intent of the condition assessment for the Fairlawn system was to identify deficiencies in the system, study the effects of inflow and infiltration (I/I), and identify the improvements that are needed to enhance the functionality of the system.

The PCSA provides wastewater collection services to approximately 850 customers in the Fairlawn area. The PCSA contracts with the Pulaski County Public Service Authority (PCPSA) to operate and maintain the PCSA sewer collection system. The original sanitary sewer collection system was constructed in the 1960's, and six (6) significant expansions have occurred since the initial construction. A vast majority of the collection system is constructed of Vitrified Clay Pipe (VCP), and the remaining portion is constructed of Polyvinyl Chloride (PVC). The system consists of approximately 88,000 linear feet (LF) of 8-inch through 12-inch diameter gravity sewer, approximately 460 manholes, and four (4) sewage lift stations. A location and system overview map can found in Figure 1-1 on the following page.

Figure 1-1: Location and System Overview Map



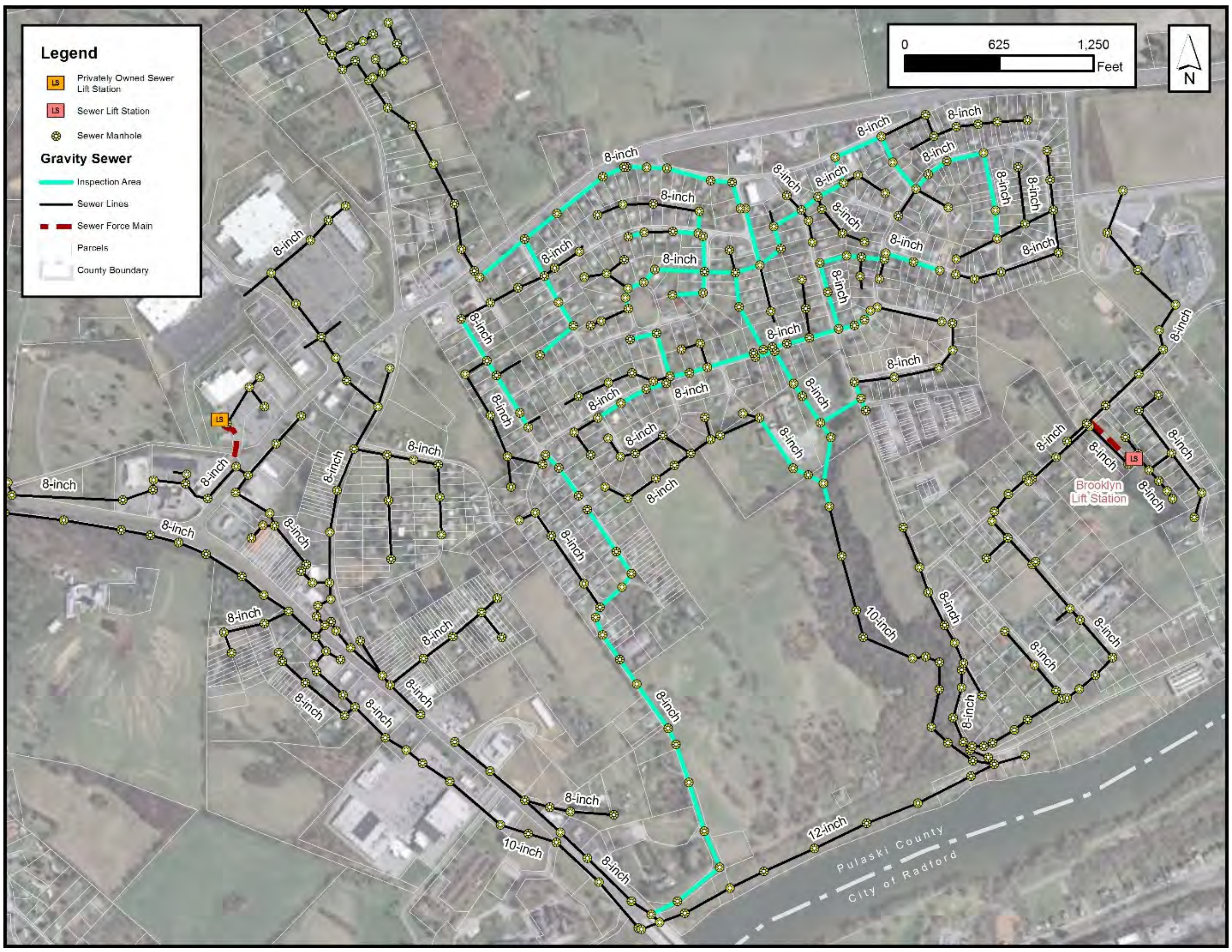
Wastewater from the Fairlawn collection system flows to the New River Pump Station, which is owned and operated by the Pepper's Ferry Regional Wastewater Treatment Authority (PFRWA). The wastewater is then pumped to the Pepper's Ferry Regional Wastewater Treatment Facility. Wastewater from portions of Fairlawn, Pulaski County, the Town of Pulaski, the Town of Dublin, Montgomery County, and the City of Radford is treated at this facility prior to being discharged into the New River.

Given the age of the Fairlawn system and the materials of construction, PCSA has chosen a proactive approach to perform a limited physical condition assessment of the collection system. The assessment includes closed-circuit television (CCTV) inspections, lift station inspections, and flow monitoring data analysis. The primary goal of the assessment is to determine the remaining life of the PCSA assets, which will facilitate the development of a Capital Improvement Plan (CIP) for replacement and/or rehabilitation of the PCSA assets. Additionally, a rate study has also been performed to determine customer rate increases that will be necessary to fund the replacement or rehabilitation projects.

2.0 CCTV INSPECTIONS

Draper Aden Associates (DAA) teamed with RedZone Robotics (RedZone) to perform the closed-circuit television (CCTV) inspection of approximately 14,000 LF of the PCSA collection system. Figure 2-1 below depicts the portion of the collection system that was targeted for inspection – This targeted area contains some of the older lines within the system and was therefore assumed to have the highest risk of failure.

Figure 2-1: PCSA Collection System Inspection Overview



In order to complete the inspections, Solo robots, which are autonomous inspection robots, were deployed by RedZone personnel in January 2018. In total, RedZone completed inspections for 84 gravity sewer lines, which account for a total of 14,123 LF of sewer. The inspected gravity sewer lines were mostly VCP with small sections of PVC. The captured inspection videos were then reviewed and coded by RedZone in accordance with NASSCO[1] Pipeline Assessment and Certification Program (PACP) standards. It should be noted, however, that while 14,123 LF were inspected in the field, only 13,951 LF were able to be coded due to robot/inspection errors (i.e., false starts, cobwebs, etc.) and variances in actual sewer lengths from those observed in the field.

The coded inspection videos were subsequently uploaded into the ICOM3 Software Program, which is a platform to review CCTV inspections, review identified defects, and develop recommendations for repairing the identified critical defects. Detailed inspection information (i.e., inspection logs, etc.) for each inspected gravity sewer can be accessed through the ICOM3 software and is not detailed in this report. This report summarizes the review and condition assessment of the inspections completed as part of this study and details the recommended rehabilitation options for the identified high priority/severe sewer defects.

A map summarizing the inspection status of each gravity sewer within the inspection area can be found in **Appendix A**. This map highlights the gravity sewer lines where the inspection was completed, incomplete, not possible due to pipe size limitations, or not possible due to other constraints (i.e., drop connections, access constraints, unable to locate, etc.). Additionally, a table detailing the inspection limitations, which lead to incomplete inspections, can be found in Section 2.4 of this report.

2.1 Condition Ratings

After reviewing the CCTV videos, each inspected gravity sewer was assigned a PACP rating between 0 and 5 to describe the structural condition of the pipe, as well as a PACP rating between 0 and 5 to describe the condition on the pipe with respect to operation and maintenance (O&M). These condition ratings are from the NASSCO Pipeline Assessment and Certification Program (PACP) and are based on the criteria found in Table 2-1 on the following page.

[1] National Association of Sewer Service Companies

Table 2-1: Gravity Sewer Condition Ratings

Condition Rating		Description
0	Excellent	No observed defects.
1	Great	Minor defects, failure unlikely in the foreseeable future.
2	Good	Defects that have not begun to deteriorate, pipe unlikely to fail for at least 20 years.
3	Fair	Moderate defects that will continue to deteriorate, pipe may fail in 10 to 20 years.
4	Poor	Severe defects that will become Grade 5 defects within the foreseeable future. Pipe will probably fail within 5 to 10 years.
5	Immediate Attention	Defects requiring immediate attention because the pipe has failed or will likely fail within the next 5 years.

Each inspected gravity sewer was given a condition rating based on the highest ranked observed defect. For example, line segment 34-33 has a structural rating and O&M rating of 3100 and 4122, respectively. These ratings indicate that the most severe structural defect is a '3' and that this level of defect occurs once throughout the line segment - Hence, the initial '31' in the structural rating. Additionally, the '00' in the second portion of the structural rating indicates that there were no other observed defects. From an O&M standpoint, this rating indicates that the most severe defect is a '4' and that this level of defect has one occurrence – Hence, the initial '41' in the O&M rating. The second most severe O&M defect is a '2' and occurs twice - Hence the final '22' in the structural rating. The Overall PACP rating is a combination of the two highest observed defect severities from either the structural rating or the O&M rating. In this particular instance, this sewer pipe is given the rating '4' and accounts for both the highest structural and O&M ratings. With this Overall PACP rating, this pipe would be considered to have a level 4 condition rating.

Of the inspected and coded line segments within the inspection area, approximately 69.1%, or 58 gravity sewer lines, received an overall condition rating of level 0, level 1, level 2, or level 3. These gravity sewer lines are in excellent, great, good, or fair condition and are not in critical need of rehabilitation/repairs (within the next 10-20 years). The remaining 30.9%, or 26 gravity sewer lines, received a level 4 or level 5 overall condition rating. These pipes either are in poor condition or require immediate attention. A map and summary table detailing the identified overall condition ratings for each inspected sewer line can be found in **Appendix B** and **Appendix C**, respectively; however, Table 2-2 below provides a quantitative summary of the overall condition ratings for the inspection area:

Table 2-2: Summary of Overall Condition Ratings

Lines Inspected	Level 0 (Excellent)		Level 1 (Great)		Level 2 (Good)		Level 3 (Fair)		Level 4 (Poor)		Level 5 (Immediate Attention)	
	Lines	%	Lines	%	Lines	%	Lines	%	Lines	%	Lines	%
84	7	8.3	1	1.2	26	31.0	24	28.6	17	20.2	9	10.7

2.2 Severe Defects and Priority Rating

The inspected gravity sewer lines with an overall condition rating level 4 or level 5 were considered to have 'severe defects' and were further reviewed by DAA. Based on DAA's assessment of the observed severe defects, rehabilitation recommendations were identified when necessary. While reviewing the gravity sewer lines with 'severe defects', DAA also identified the lines that are most critical to the functionality of the entire system and assigned a priority rating. The priority rating was calculated by assigning a consequence of failure value to each line with severe defects. The consequence of failure values range from 1-5 with '1' representing the lines that carry the smallest amount of flow serving the fewest customers and '5' representing the lines that carry the most flow or are most critical to the functionality of the system. By multiplying the consequence of failure value by the overall rating of the gravity sewer line, DAA calculated the priority rating. A map identifying the gravity sewer lines with severe defects and the calculated priority rating is found in **Appendix D**.

2.3 O&M Defects Versus Structural Defects

When evaluating the sewer system, it is important to distinguish between operation and maintenance defects (i.e., roots, grease, etc.) and structural defects (i.e., fractures, breaks, holes, collapsed pipe, etc.), since the rehabilitation or replacement recommendation depends on the type of defect as noted in Section 2.5 of this report. Of the inspected and coded gravity sewer lines, 6 lines were identified to have at least one 'severe' structural defect (i.e., level 4 or level 5 structural defects) and 26 were identified to have at least one 'severe' O&M defect (i.e., level 4 or level 5 O&M defect). Table 2-3 below provides a summary of these observed severe structural and O&M defects.

Table 2-3: Summary of Severe Structural and O&M Defects

Lines with Severe Defects	Lines with Severe Structural Defects	Lines with Severe O&M Defects	Lines with both Severe Structural and O&M Defects
26	20	2	4

2.4 Inspection Limitations

While performing inspections, RedZone personnel encountered various situations that prevented inspections from being completed. These limitations included pipe size[2], inability to locate/access the manholes, and high-risk runs under structures. Table 2-4 on the following page details the inspection limitations for each line that was not able to be inspected. It is important to note that some of these pipes had O&M related inspection issues such as a surcharged manhole, concrete blocking an entrance to a pipe, and a large offset preventing full inspection. These issues will need to be addressed in order to complete the inspections for these lines - The costs for addressing those issues has not been included in this report.

[2] Solo inspection robots are only capable of inspecting 8-inch through 12-inch diameter sewer lines. For sewer lines that are outside of this diameter range, it is recommended to perform conventional CCTV inspections.

Table 2-4: Inspection Limitations

Line ID	Inspection Limitation
117-116	Could not locate either manhole
145A-145	Could not locate either manhole
146-145A	Could not locate either manhole
147-146	Could not locate either manhole
275-265	Could not locate either manhole
276-275	Could not locate either manhole
277-276	Could not locate either manhole
28-27	Could not complete run - Line runs underneath a house
285-284	Could not locate either manhole
290-285	Could not locate either manhole
291-290	Could not locate either manhole
292-291	Could not locate either manhole
30-29	Drop connection at Manhole 29; Could not locate Manhole 30
31-30	Cement slab in Manhole 31 prevents access to pipe; Could not locate Manhole 30
32-31	Pipe surcharged due to cement slab in Manhole 31; Could not locate Manhole 32
33-32	Roots covering entrance of pipe from Manhole 33; Could not locate Manhole 32
133-16	Segment does not exist
112-111	6-inch diameter sewer pipe - Too small for Solo robot inspection
77-76	Could not complete run - Line runs underneath a school
52-55	Could not locate either manhole
55-57	Could not locate either manhole
57-58	Could not locate either manhole
61-60	Could not locate Manhole 61 – Manhole replaced with a cleanout; Drop connection at Manhole 60
69-62	Could not locate Manhole 62; Upstream run not complete
62-61	Could not locate either manhole - Manholes replaced with PVC cleanout pipe
100-99	Robot will get stuck due to offset in pipe; Upstream run ended at offset in pipe.
71-62	Could not locate either manhole - Manholes replaced with PVC cleanout pipe
72-71	Could not locate either manhole - Manholes replaced with PVC cleanout pipe
73-72	Could not locate either manhole - Manholes replaced with PVC cleanout pipe
74-73	Could not locate either manhole - Manholes replaced with PVC cleanout pipe
91-90	Could not complete run - Line runs underneath a house

2.5 Rehabilitation Recommendations

Based on our review of the pipeline inspection videos and associated PACP ratings, there are several gravity sewers that are recommended to be rehabilitated. The rehabilitation options range from a 4-foot internal pipe patch or cured in-place pipe (CIPP) lining of the entire sewer line to replacement of a portion of or the entire sewer line; however, the majority of the defects are O&M defects such as roots, debris, and grease that should be addressed by cleaning and root cutting to prevent future backups that would result in frequent work orders. A detailed cost breakdown for each of the recommended rehabilitation options is shown below in Table 2-5. It should be noted, however, that the cost estimates identified below do not include engineering fees associated with design services related to the sewer rehabilitation.

Table 2-5: Breakdown of Recommended Rehabilitation Options and Associated Costs

Sewer Rehabilitation	Quantity	Units	Unit Price
Pipe Patch	1	EA	$1,000.00
Point Repair - 10 feet (Within Pavement)	1	EA	$5,000.00
Pipe Lining - CIPP	1	LF	$50.00
Pipe Replacement (Within Pavement)[3]	1	LF	$160.00
Pipe Replacement (Outside of Pavement)	1	LF	$90.00
Cleaning	1	LF	$2.00
Root Cutting	1	LF	$5.00

As previously noted, DAA has identified 26 sewer lines that contain severe defects and require immediate attention - A breakdown of the recommended high priority improvements and/or required maintenance is detailed below[4]:

- Cleaning and/or root removal: 15 sewer lines
- Rehabilitate with CIPP liner: 9 sewer lines (1,680 LF)
- Repair with either an internal pipe patch, point repair, or section repair: 6 sewer lines (2 Pipe Patches and 5 Point Repairs)

[3] While there are no current recommendations for sewer line replacement, the costs have been included should the PCSA decide to replace pipes in lieu of lining.
[4] Some sewer lines are recommended to be rehabilitated with both a point repair and cleaning – This explains why the sum of the recommended repairs exceeds 26.

A map summarizing the recommended rehabilitation and/or maintenance for the gravity sewer lines that contain severe defects is found in **Appendix E**. A table detailing the gravity sewer lines with severe defects, recommended rehabilitation and/or maintenance, and associated costs is found in **Appendix F**. Should PCSA proceed with all of the recommended repairs, a total maintenance and construction cost of approximately $124,500 can be anticipated for the recommended improvements.

2.6 Future Condition Assessment and Rehabilitation Activities

It is recommended that the PCSA continue to perform condition assessment activities for the remaining portions of the sewer collection system, which is comprised of approximately 75,000 LF of gravity sewer (Note: approximately 14,000 LF was inspected as part of this phase). To accomplish this objective, it is recommended that the PCSA complete bi-annual CCTV inspections and rehabilitation projects over the next 10 years. Each subsequent phase of the condition assessment activities is assumed to be comprised of approximately 15,000 LF of gravity sewer. The estimated rehabilitation costs for subsequent phases (i.e., Phases 2-6) is approximately 70% of the estimated rehabilitation costs of this initial phase (i.e., Phase 1). This is based on the fact that the portion of the system that was assessed as part of this initial phase (i.e., Phase 1) is the oldest portion of the system and likely contains the most severe defects that require rehabilitation.

Table 2-6 on the following page details the projected CCTV and rehabilitation costs for the remaining portions of the PCSA sewer collection system.

Table 2-6: Projected CCTV and Rehabilitation Costs

Project	Year					
	Phase 1		Phase 2		Phase 3	
	2018	2019	2020	2021	2022	2023
CCTV Inspection (15,000 LF)	$30,000	-	$30,000	-	$30,000	-
Maintenance and Repairs	-	$124,500	-	$90,000	-	$90,000
Project	**Year**					
	Phase 4		**Phase 5**		**Phase 6**	
	2024	**2025**	**2026**	**2027**	**2028**	**2029**
CCTV Inspection (15,000 LF)	$30,000	-	$30,000	-	$30,000	-
Maintenance and Repairs	-	$90,000	-	$90,000	-	$90,000

As can be seen above, the total condition assessment and rehabilitation costs of the next 10 years is projected to be $754,500. It should be noted that this projected cost includes the $30,000 for the CCTV inspections that have already been completed as part of Phase 1.

3.0 LIFT STATION INSPECTIONS

Prior to this analysis, PCSA noted that the four (4) existing submersible sewage lift stations in the system were exhibiting signs of aging. A basic inspection was performed of each lift station to determine the extent of corrosion and general wear and tear of the lift station components, including basin, rail systems, piping, valves, etc. Photos and a brief summary the identified defects at each lift station can be viewed in **Appendix G**.

Inspections were conducted by DAA personnel and coordinated with PCPSA representatives in January 2018 and April 2018. The following four (4) lift stations were inspected as part of this condition assessment:

- Brooklyn Lift Station
- Bellspring (Rt. 600) Lift Station
- Timberlane Lift Station
- White Birch Lift Station

As was noted as part of the inspections, a priority grading of high, moderate, and low was used to determine the severity and need for replacement. A grade of 'high' priority was given to deficiencies requiring immediate action as they pose a threat to operation and/or safety or could fail at any given time. A grade of 'moderate' was given to deficiencies that should be addressed in the near future as they are likely to fail within the next five (5) years and may cause an operational failure or safety concern if the deficiency is not addressed or progresses at the current rate. A grade of 'low' was given to items that are suggested to be addressed; however, they are unlikely to fail in the near future and would not cause any catastrophic failure if the deficiency continued or worsened.

In addition to identifying the deficiencies, an opinion of probable cost was created for each item requiring maintenance or upgrades. These high-level estimates were calculated assuming the deficiencies would be addressed by PCPSA forces and would not be publicly procured.

3.1 Lift Station Inspection Results

In general, all the lift stations showed signs of corrosion, grease deposits, infiltration, and other minor deficiencies. Medium to heavy corrosion was observed on the valves, rails, and wet well/vault covers at all four (4) lift stations. The following sections provide a detailed breakdown of the inspection results for each lift station.

3.1.1 Brooklyn Lift Station

The Brooklyn Lift Station is located on Brooklyn Road across from Tara Lane. This lift station collects sewage from the surrounding area on Brooklyn Road from Dudley Ferry Road to the Riverlawn Elementary School. This lift station features a circular concrete basin wet well with two (2) submersible Hydromatic (5 HP) pumps, a square valve vault, and a pre-fabricated aluminum control building on a wooden skid foundation. The pump controls have recently been replaced and are supported on the top of the wet well in a weatherproof enclosure rather than the control building. The auto dialer and additional relays are housed within the control building. An emergency generator connection is located approximately five (5) feet outside of the fenced area.

At the time of the inspection, the Brooklyn Lift Station appeared to be operating without any major operational concerns. Table 3-1 on the following page highlights the identified deficiencies, priority ranking, recommended action, and associated costs for the Brooklyn Lift Station.

Table 3-1: Brooklyn Lift Station Deficiencies and Recommended Actions

Priority	Deficiency	Recommended Action	Cost Estimate ($)
High	**No Audible or Visual Alarm** – In the case of an autodialer failure or power outage to the autodialer, local audible and visual alarms are recommended	Install alarm light and speaker	$1,500
Moderate	**Heavy Corrosion on Wet Well Access Hatch** – This could be a safety and security issue. As the top continues to degrade, metal could fall and damage the pumps and could lead to a catastrophic safety concern.	Replace wet well access hatch	$2,500
Low	**Valve Vault Access Hatch Missing Hinges and Latch** – This could be a safety and security issue, but is not likely to fail or cause operational issues.	Replace valve vault access hatch	$2,500
Low	**Control Building Flooring** – Hole in floor could be a safety and security concern issue, but is not likely to cause operational issues.	Patch/replace flooring	$2,000
Low	**Wet Well Infiltration** – Evidence of infiltration/seepage through wet well walls	Install wet well liner or coat with epoxy coating	$10,000
		Total:	**$18,500**

3.1.2 Bellspring (Rt. 600) Lift Station

The Bellspring Lift Station is located on Bellspring Road (Route 600) across from the trailer park. This lift station collects sewage from the surrounding area and pumps to the gravity sewer at the intersection of Joyce Way and Bellspring Road. This lift station features a circular concrete basin wet well with two (2) submersible pumps, a circular valve vault, and an outdoor pump control panel housing the autodialer as well. An emergency generator connection was not locatable.

At the time of the inspection, the Bellspring Lift Station appeared to be operating without any major operational concerns. Table 3-2 on the following page highlights the identified deficiencies, priority ranking, recommended action, and associated costs for the Bellspring Lift Station.

Table 3-2: Bellspring Lift Station Deficiencies and Recommended Actions

Priority	Deficiency	Recommended Action	Cost Estimate ($)
High	**No Emergency Generator Connection** – In the case of a power failure, a generator connection is recommended to maintain service and decrease the potential for overflows.	Install emergency generator connection	$4,500
Moderate	**Wet Well Access Hatch Does Not Close** - This could be a safety and security issue	Modify or replace wet well access hatch	$1,500
Moderate	**Submersible Pumps** - One of the pumps did not appear to pump as well as the other. The operator stated that one of the pumps was recently replaced. Typically, the pumps operate in an alternating sequence to distribute the wear and tear equally. Often, if a pump meets its usable life without a catastrophic failure, the corresponding pump is likely to need replacement in the near future.	Prepare for replacement of older pump in the near future	$2,000
Moderate	**Valve Vault Hatch is Undersized** - This could be a safety and operational/maintenance issue as access is very limited.	Replace with an appropriately sized valve vault hatch	$3,500
Low	**Deep Installation Hand Valve** - This valve will require a special extension operator and will be more likely to break than a traditional square nut operator.	Replace valve	$2,000
Low	**Missing Post Caps and Falling Barbed Wire in Fence** - Fence posts without caps can collect rainwater and cause rust and degradation to the fence shortening its usable life.	Install fence post caps and reattach falling barbed wire	$500
Low	**Concrete Section Between Lift Station and Valve Vault is being Undermined** - The soil is eroding away beneath the concrete in this section, which may lead to a failure in the concrete section.	Repair/replace concrete section	$2,000
		Total:	**$16,000**

3.1.3 Timberlane Lift Station

The Timberlane Lift Station is located on Timberlane Drive, just off of Bellspring Road (Rt. 600). This lift station collects gravity flow from the majority of the Timberlane Subdivision - Sewer for the remaining portion of the subdivision is conveyed to the White Birch Lift Station, which is then pumped and discharged into the gravity collection system that flows to the Timberlane Lift Station. This lift station features a circular concrete basin wet well with a square top, two (2) submersible Hydromatic pumps (3 HP), a circular valve vault with a square top, and a prefab aluminum control building on a wooden skid foundation. The pump controls are supported on the top of the wet well in a weatherproof enclosure rather than the adjacent storage building. A portable emergency generator is located on site under an aluminum carport.

At the time of the inspection, the Timberlane Lift Station appeared to be operating without any major operational concerns. Table 3-3 below highlights the identified deficiencies, priority ranking, recommended action, and associated costs for the Timberlane Lift Station.

Table 3-3: Timberlane Lift Station Deficiencies and Recommended Actions

Priority	Deficiency	Recommended Action	Cost Estimate ($)
High	**Flat or Low Tire Pressure on Emergency Generator** – If this is the only generator for multiple pump stations, the tires need to be operable in case of an emergency	Replace/repair tire	-
High	**Heavy Corrosion on Force Main Discharge Valves** - If these valves are corroded to the point that they are inoperable, the check valves will not be able to be replaced without emptying the force main.	Replace corroded valves	$2,500
High	**Heavy Corrosion on Valves and Piping in Valve Vault** - As these check valves, gate valves, and air release valve corrode, they become inoperable and can lead to other potential failures.	Replace valves and piping within the valve vault; Replace the penetration seals between the valve vault and wet well to keep hydrogen sulfide from entering the valve vault	$12,000
Moderate	**Exposed Power Cords** - Power cords are permanently plugged into an outdoor receptacle. This could be a safety and security issue, as outdoor receptacles are not meant to be used as a permanent power source.	Install conduit to end point	$1,000
Low	**Tree Debris in Wet Well and Valve Vault** - While surrounding trees make for a good buffer they are causing increased debris to enter the wet well / treatment process.	Remove tree debris and conduct tree pruning / maintenance	-
		Total:	**$15,500**

3.1.4 White Birch Lift Station

The White Birch Lift Station is located at the end of White Birch Lane, just beyond the cul-de-sac. This lift station collects sewage from the surrounding area and pumps to the Timberlane Lift Station gravity sewer collection basin. This lift station features a single circular concrete basin wet well with two (2) submersible pumps, exterior valve with valve box, and an outdoor pump control panel housing the autodialer. An emergency generator connection is located at the cul-de-sac.

At the time of the inspection, the White Birch Lift Station appeared to be operating without any major operational concerns. Table 3-4 below highlights the identified deficiencies, priority ranking, recommended action, and associated costs for the White Birch Lift Station.

Table 3-4: White Birch Lift Station Deficiencies and Recommended Actions

Priority	Deficiency	Recommended Action	Cost Estimate ($)
High	**No Audible or Visual Alarm** – In the case of an autodialer failure or power outage to the autodialer, local audible and visual alarms are recommended.	Install alarm light and speaker	$1,500
High	**Power Disconnect Switch is not Secured** – This could be a safety and security issue. Anyone would be able to turn off the pump station without the PCSA knowing.	Secure the disconnect switch with a lock	-
Moderate	**Submersible Pumps** - One of the pumps did not appear to pump as well as the other.	Prepare for replacement pump in the near future	$2,000
Moderate	**Moderate Corrosion on Wet Well Access Hatch** - This could be a safety and security issue. As the top continues to degrade, metal could fall and damage the pumps and could lead to a catastrophic safety concern.	Replace wet well access hatch	$2,500
Low	**Falling Barbed Wire on Fence** – Falling barbed wire could be a safety and security concern.	Repare falling barbed wire	$500
Low	**Drainage Pipe is Full of Debris and Joint is Separating** - This drainage pipe collects the majority of the surface flow coming off White Birch Lane and is intended to direct the flow past the pump station. It appears that the pipe is nearly full of sediment and one of the joints is separating. As the flow continues to collect in this pipe and discharge through the joint, surface water from this area will flow towards the pump station becoming a possible source of inflow.	Replace or clean drainage pipe	$1,000
		Total:	**$7,500**

3.2 Lift Station Recommendations Summary

In order to ensure that the lift stations continue to operate consistently, DAA recommends that the high priority deficiencies be addressed immediately. The moderate priority level deficiencies should be considered in a case-by-case basis as to whether they should be addressed now or planned for within the next five (5) years. Low priority items are at the PCSA's discretion, as they should not affect the lift station operation if they are not addressed in the near future. In order to control the heavy grease build-up that was sporadic throughout the system, it recommended that a degreasing agent be utilized. Table 3-5 below provides a detailed breakdown of the overall opinion of probable cost to address the high, moderate, and low priority lift station deficiencies. As can be seen below, the total estimated cost to address all of the recommended lift station deficiencies is approximately $57,500.

Table 3-5: Summary of Opinion of Probable Costs for Recommended Lift Station Repairs

Priority	Cost Estimate ($)
High	$22,000
Moderate	$15,000
Low	$20,500
Total	**$57,500**

4.0 FLOW MONITORING ANALYSIS

The PCSA Board has expressed concerns regarding the additional costs associated with conveying and treating the inflow and infiltration (I/I) that enters the PCSA sewer collection system following rain events. Inflow is characterized as surface water that enters the sanitary sewer system through manhole covers, roof drains, storm drains, and other direct channels. Infiltration, however, is characterized as groundwater that enters the sanitary sewer system through cracks, joints, lateral connections, and other underground defects. Both sources of I/I increase sewer flows, and therefore increase the total treatment costs from the Pepper's Ferry Regional Wastewater Treatment Authority (PFRWTA), which treats sewer from the PCSA collection system.

On behalf of the PCSA, DAA performed an analysis of available flow monitoring data to quantify and characterize the I/I in the PCSA sewer collection system. The PFRWTA provided daily flow data and corresponding rainfall data for the PCSA collection system for 12 consecutive months (October 2016 – September 2017). The sewer flows were measured at the PCSA's influent line at New River Pump Station, and the rainfall data was measured at the PFRWTA facility. These two facilities are approximately 1.5 miles apart. The following sections provide a detailed analysis of the collected flow and rainfall data during the monitoring period.

4.1 Flow Data Analysis

The available flow data from the New River Pump Station was analyzed by comparing sewer flows during periods of dry weather and periods of wet weather. Wet weather days are defined as days that experience rainfall plus the three (3) days that follow a rain event. These three (3) days that follow a rain event may not experience actual rainfall; however, these days are still considered to be wet weather days as the subsurface may continue to be saturated and contribute infiltration to the collection system. Dry weather days are defined as days with no recorded rainfall and exclude the three (3) days that follow a rain event.

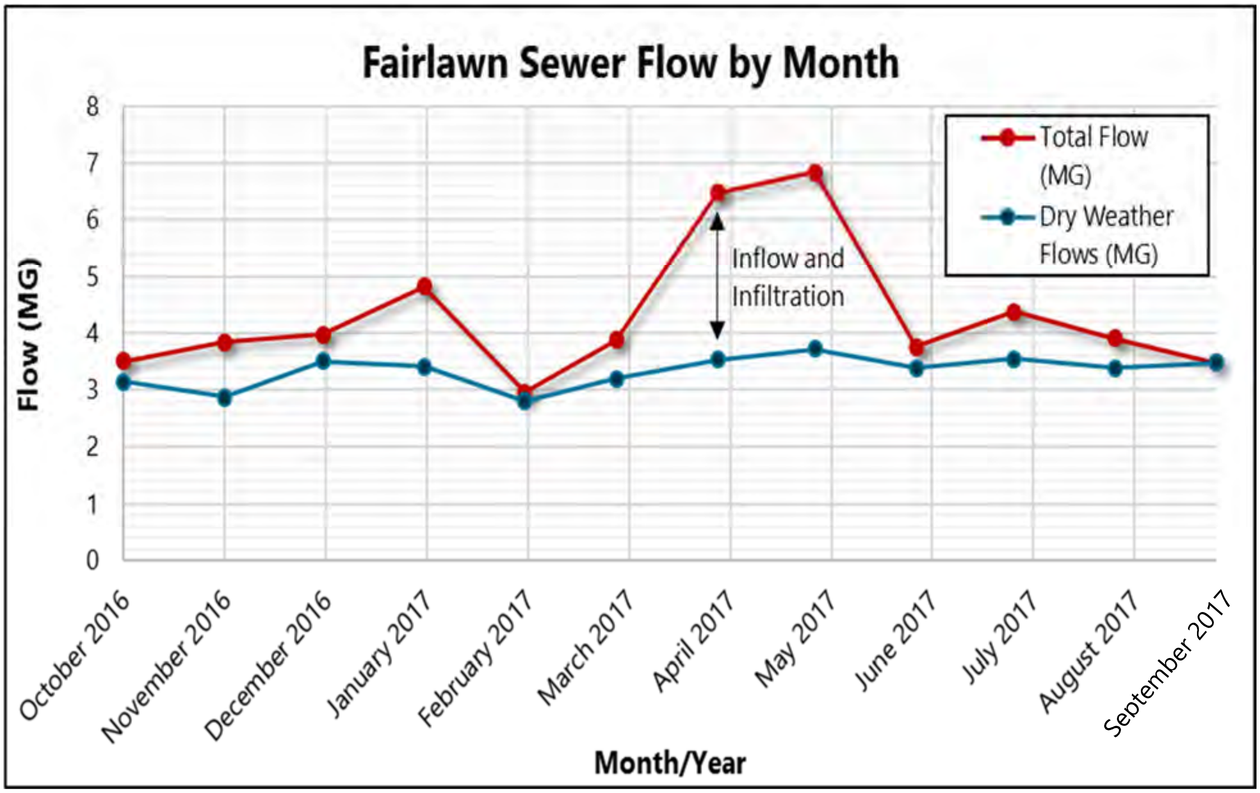
By segregating dry weather flows from the overall totalized flows, the baseline sewer flows can be established. The difference between the dry weather flows and the overall totalized flows represent the I/I volume that is entering the PCSA collection system. The collected flow data from

October 2016 through September 2017 indicates that the overall totalized flow for the PCSA system was 0.142 million gallons per day (MGD), or 51.8 million gallons (MG) per year. The average dry weather flow was approximately 0.110 MGD, or 40.0 MG per year. Hence, the total flows attributed by I/I during the monitoring period is approximately 0.032 MGD, or 11.8 MG per year. This correlates to annual peaking factor of 1.3, which indicates that an additional 30% of sewer flow is attributed to I/I sources. The calculated dry weather flows and observed overall totalized flows are listed in Table 4-1 below. Figure 4-1 on the following page details the annual trends of dry weather flows and totalized overall flows during the monitoring period.

Table 4-1: Comparison of Dry Weather and Overall Totalized Flows

Month	Avg. Dry Weather Flow (MGD)	Overall Average Flow (MGD)	Total Dry Weather Flow (MG)	Overall Total Flow (MG)
October 2016	0.101	0.113	3.140	3.505
November 2016	0.096	0.128	2.880	3.847
December 2016	0.113	0.128	3.509	3.973
January 2017	0.110	0.155	3.415	4.817
February 2017	0.100	0.105	2.808	2.952
March 2017	0.103	0.125	3.192	3.877
April 2017	0.118	0.216	3.537	6.488
May 2017	0.120	0.221	3.722	6.849
June 2017	0.113	0.125	3.385	3.755
July 2017	0.114	0.141	3.545	4.378
August 2017	0.109	0.126	3.388	3.908
September 2017	0.116	0.116	3.485	3.485
Average/Total	**0.110**	**0.142**	**40.005**	**51.834**

Figure 4-1: Comparison of Dry Weather and Overall Totalized Flows



As can be seen in the figure above, the majority of the I/I that entered the PCSA collection system occurred during the months of March through June. This seems logical as it correlates with the spring, which is typically the wettest period of the year.

In order to better understand potential I/I sources, all of the observed rainfall events that occurred during the monitoring period and the corresponding sewer flows are detailed in Table 4-2 on the following page. Additionally, the sewer flow peaking factor for each rainfall event was calculated by dividing the observed sewer flow during the rainfall event by the average dry weather flow.

Table 4-2: Observed Rainfall Events

Month	Rainfall Events														
	1			2			3			4			5		
	Rainfall (in)	Sewer Flow (MGD)	Peaking Factor	Rainfall (in)	Sewer Flow (MGD)	Peaking Factor	Rainfall (in)	Sewer Flow (MGD)	Peaking Factor	Rainfall (in)	Sewer Flow (MGD)	Peaking Factor	Rainfall (in)	Sewer Flow (MGD)	Peaking Factor
October 2016	1.210	0.320	3.2	0.170	0.101	1.0	-	-	-	-	-	-	-	-	-
November 2016	0.820	0.143	1.5	0.253	0.253	2.6	-	-	-	-	-	-	-	-	-
December 2016	0.360	0.122	1.1	0.220	0.136	1.2	0.960	0.416	3.7	0.340	0.122	1.1	0.260	0.121	1.1
January 2017	0.500	0.137	1.2	0.260	0.111	1.0	0.280	0.139	1.3	0.280	0.106	1.0	0.840	1.021	9.3
February 2017	0.440	0.127	1.3	0.460	0.238	2.4	-	-	-	-	-	-	-	-	-
March 2017	0.540	0.238	2.3	0.400	0.145	1.4	0.480	0.188	1.8	1.000	0.481	4.7	-	-	-
April 2017	0.900	0.319	2.7	2.400	1.683	14.3	-	-	-	-	-	-	-	-	-
May 2017	0.520	0.233	1.9	1.050	0.297	2.5	0.780	0.258	2.2	1.750	1.230	10.2	-	-	-
June 2017	0.880	0.236	2.1	0.680	0.244	2.2	0.200	0.159	1.4	-	-	-	-	-	-
July 2017	1.380	0.365	3.2	0.500	0.162	1.4	1.100	0.226	2.0	-	-	-	-	-	-
August 2017	0.720	0.141	1.3	0.600	0.187	1.7	0.400	0.192	1.8	-	-	-	-	-	-
September 2017	0.160	0.116	1.0	0.280	0.132	1.1	-	-	-	-	-	-	-	-	-

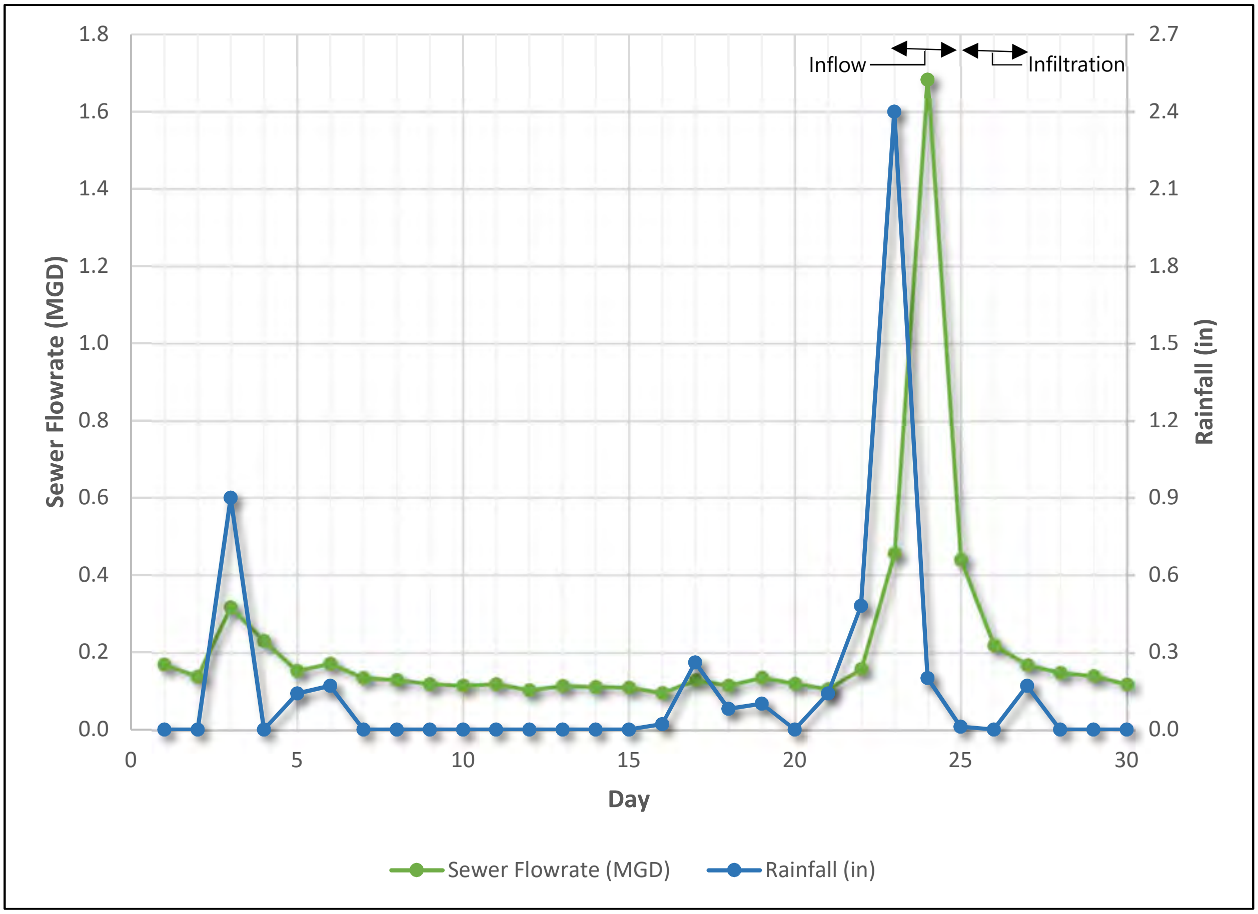
As can be seen in Table 4-2, rainfall events with a total rainfall accumulation of less than 0.5 inches did not correspond to a noteworthy increase in observed sewer flows. This could partly be due to the subsurface' s capacity to 'hold' water during unsaturated soil conditions. Larger rainfall events (i.e., greater than 0.5 inches of accumulation) corresponded to more substantial increases in sewer flows, yielding higher peaking factors. The correlation between the amount of rainfall and the witnessed sewer flow peaking factors are summarized in Table 4-3 below.

Table 4-3: Rainfall Peaking Factors

Rainfall Event	Average Peaking Factor
±0.5-inch	1.7
±1.0-inch	3.1
±1.5-inch	3.2
±2.0-inch	12.3

As can be seen above, the larger the rainfall event, the larger the corresponding sewer flow peaking factor. This typically suggests that there are likely multiple sources of inflow (i.e. surface water that enters the sanitary sewer system through manhole covers, roof drains, storm drains, and other direct channels); however, when analyzing the daily flow and rainfall charts in **Appendix H**, which detail the sewer flow response to each rainfall event, it is clear that infiltration (i.e., groundwater that enters the sanitary sewer system through cracks, joints, lateral connections, and other underground defects) is also a contributor to the overall I/I. Figure 4-2 on the following page breaks down the potential I/I sources based on the system's response to a rain event that occurred on April 23, 2017, which had a total rainfall accumulation of 2.4 inches.

Figure 4-2: Sewer Flow Response to April 2017 Rain Event



As indicated above, the immediate sewer response following the rain event is primarily attributed to sources of inflow. The delay in returning to normal dry weather flows is then likely attributed to sources of infiltration. Sources of inflow are more easily identifiable and are the least costly to rehabilitate as they often can be addressed with a single point repair. Sources of infiltration, on the other hand, are typically systemic as they are a function of system age and pipe material.

4.2 I/I Reduction Recommendations

As noted in the previous section, a total of 11.8 MG of I/I from the PCSA collection system was treated by the PFRWTA facility during the monitoring period. Using the fiscal year 2019 treatment charge of $1,500/MG and the sewer conveyance charge for use of the New River Pump Station of $180/MG, the total annual expenses incurred by the PCSA for conveyance and treatment of I/I is approximately $19,825. This cost is equivalent to lining approximately 400 LF of sewer. Hence, assuming that the PFRWTA facility has the available capacity to treat the additional sewer flows from I/I, it is not recommended that the PCSA spend additional monies to investigate I/I sources and/or perform system rehabilitation for the sole purpose of reducing I/I. These activities are both timely and costly. Furthermore, based on past experience, even when replacing and/or lining all of the gravity sewer within a basin, a reduction of only 30-40% is typically achieved. This is partly due to the fact that private laterals are also a large contributor to the I/I observed in the system.

Instead, it is recommended that the PCSA continue to focus on evaluating the condition of the PCSA sewer collection system and complete rehabilitation that focuses on improving the operation and maintenance of the system as a whole as outlined in Section 2.6 of this report. Depending on the extent of the needed system repairs, the overall I/I may be reduced; however, this would be a secondary benefit as the primary reason for these improvements is to maintain the system.

5.0 RATE ANALYSIS

In conjunction with the condition assessment, the PCSA evaluated the impact that the proposed sewer system rehabilitation projects would have on the Authority's budget and user charges. At the same time, the Authority was interested in evaluating options for developing a sewer rate based on actual water usage.

5.1 Background Information

The PCSA has historically charged a flat rate for residential usage. Commercial users pay a minimum charge, plus a charge per 1,000 gallons of water used. The existing rate schedule is shown below.

Table 5-1: Existing Monthly Rate Schedule

Residential Sewer	$23.00
Commercial Sewer	$23.00 Minimum
Additional per 1,000 gallons or portion thereof	$4.00
Non-User Fee	$10.00

Residential customers are charged a flat fee, regardless of the amount of water used. The PCSA was interested in evaluating the merits of developing a set of rates and fees that were more reflective of water usage – customers who use more water (and therefore contribute more wastewater) would pay higher fees than the customers who use less water.

Water usage (based on water meter readings provided by the Pulaski County Public Service Authority) is summarized in Tables 5-2 and 5-3 on the following page.

As shown in Table 5-2, approximately 61% of the residential customers use 3,000 gallons of water, or less, each month and 75% use 4,000 gallons of water, or less. Table 5-3 summarizes the average usage of the commercial customers. More than 53% of the commercial customers use 3,000 gallons, or less per month. Thirty percent (30%) of the commercial customers use in excess of 10,000 gallons per month: approximately 12 commercial customers average between 50,000 and 100,000 gallons per month. Five (5) commercial customers average between 100,000 and 170,000 gallons per month.

Table 5-2: Summary of Average Residential Usage

Monthly Water Usage	# of Users	% of Users	Total Gallons in This Group (Avg. Month)	% of Usage	Total Annual Revenue	% of Revenue
<1,000 gallons per month	135	16%	48,750	2%	$37,260	16%
1,000 - 2,000 gallons per month	182	22%	278,153	10%	$50,232	22%
2,001 - 3,000 gallons per month	187	23%	462,531	16%	$51,612	23%
3,001 - 4,000 gallons per month	115	14%	402,131	14%	$31,740	14%
4,001 - 5,000 gallons per month	85	10%	376,483	13%	$23,460	10%
5,001 - 6,000 gallons per month	50	6%	271,969	10%	$13,800	6%
6,001 - 7,000 gallons per month	28	3%	178,387	6%	$7,728	3%
7,001 - 8,000 gallons per month	18	2%	133,172	5%	$4,968	2%
8,001 - 9,000 gallons per month	2	0%	16,251	1%	$552	0%
9,001 - 10,000 gallons per month	3	0%	28,150	1%	$828	0%
+ 10,000 gallons per month	25	3%	617,219	22%	$6,900	3%
Total:	**830**	**100%**	**2,813,196**	**100%**	**$229,080**	**100%**

Table 5-3: Summary of Average Commercial Usage

Monthly Water Usage	# of Users	% of Users	Total Gallons in This Group (Avg. Month)	% of Usage	Total Revenue Annually	% of Revenue
<1,000 gallons per month	45	41%	10,448	0%	$12,922	9%
1,000 - 2,000 gallons per month	10	9%	14,054	1%	$3,435	2%
2,001 - 3,000 gallons per month	3	3%	7,335	0%	$1,180	1%
3,001 - 4,000 gallons per month	5	5%	17,668	1%	$2,228	2%
4,001 - 5,000 gallons per month	5	5%	21,048	1%	$2,390	2%
5,001 - 6,000 gallons per month	2	2%	10,638	0%	$1,063	1%
6,001 - 7,000 gallons per month	3	3%	20,166	1%	$1,796	1%
7,001 - 8,000 gallons per month	2	2%	14,995	1%	$1,272	1%
8,001 - 9,000 gallons per month	1	1%	8,767	0%	$697	0%
9,001 - 10,000 gallons per month	1	1%	9,414	0%	$728	1%
+ 10,000 gallons per month	33	30%	2,235,443	94%	$116,409	81%
Total:	**110**	**100%**	**2,369,976**	**100%**	**$144,119**	**100%**

5.2 Projected Expenses

In order to develop a revised rate structure, the Authority needed to review the current and projected costs of owning, operating and maintaining the Fairlawn Sewer System. Table 5-4 shows the FY2018 and FY2019 budgets and provides a projection of future operating and capital expenses. In reviewing the following table, it is important to recognize that the Authority's actual revenues and expenses will vary from those projected herein – it will be incumbent upon the Authority Board of Directors to regularly review the actual revenues and expenditures and adjust the projections as needed.

As shown in Table 5-4 on the following page, if the Authority undertakes the recommended CCTV inspections and sewer rehabilitation projects as recommended in this report, the annual deficits will be at least $100,000 per year, if there is no rate increase.

Table 5-4: Current and Projected Revenues and Expenses (With no Increases in Rates)

	2018 (Budget)	2019 (Budget)	Projections					
			2020	2021	2022	2023	2024	
Revenues:								
Sewer Fees	$395,280	$395,280	$395,280	$395,280	$395,280	$395,280	$395,280	
Interest Income		$4,200	$ -	$ -	$ -	$ -	$ -	
Connection Fees		$5,100	$5,100	$5,100	$5,100	$5,100	$5,100	
Miscellaneous		$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	
Total Operating Revenues	**$395,280**	**$406,880**	**$402,680**	**$402,680**	**$402,680**	**$402,680**	**$402,680**	
Operating Expenses:								
Audit	$4,500	$5,900	$6,195	$6,505	$6,830	$7,171	$7,530	+5% per year
Auto Expense	$300	$-	$-	$-	$-	$-	$-	
Bonus	$400	$-	$-	$-	$-	$-	$-	
<u>Capital Projects:</u>								
Pump Station Improvements	$-	$18,667	$18,667	$18,667	$-	$-	$-	$56,000 over 3 years
CCTV Inspection (5 phases)	$-	$-	$30,000	$-	$30,000	$-	$30,000	5,000 LF per year
Sewer Line Rehab (Phase 1)	$-	$45,833	$45,833	$45,833	$-	$-	$-	$125,000 - over 3 years
Sewer Line Rehab (Phase 2)	$-	$-	$-	$45,000	$45,000	$-	$-	$90,000 over 2 years
Sewer Line Rehab (Phase 3)	$-	$-	$-	$-	$-	$45,000	$45,000	$90,000 over 2 years
Sewer Line Rehab (Phases 4 and 5)	$-	$-	$-	$-	$-	$-	$-	$45,000 per year
Contingency	$40,000	$-						
Chemicals and Supplies	$500	$-	$-	$-	$-	$-	$-	
Consulting Fees	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	$7,500	
Electricity	$2,000	$1,500	$1,545	$1,591	$1,639	$1,688	$1,739	+3% per year
Fairlawn Bookkeeping and Tax Service	$18,500	$19,670	$19,867	$20,065	$20,266	$20,469	$20,673	+1% per year

Grease Trap Monitoring	$500	$500	$525	$551	$579	$608	$638	+5% per year
Insurance	$2,000	$2,500	$2,525	$2,550	$2,576	$2,602	$2,628	+1% per year
Legal	$10,000	$12,500	$15,000	$15,000	$15,000	$15,000	$15,000	
Loan Payment	$-	$21,866	$10,134	$-	$-	$-	$-	
Maintenance - Labor and Equipment	$50,000	$50,000	$55,000	$60,500	$66,550	$73,205	$80,526	10% increase per year
Maintenance - Materials	$20,000	$20,000	$20,600	$21,218	$21,855	$22,510	$23,185	3% increase per year
Miscellaneous	$4,000	$3,500	$3,570	$3,641	$3,714	$3,789	$3,864	2% increase per year
Office Supplies and Printing	$1,500	$1,750	$1,768	$1,785	$1,803	$1,821	$1,839	1% increase per year
Payroll Taxes	$4,000	$1,500	$1,545	$1,591	$1,639	$1,688	$1,739	3% increase per year
Peppers Ferry Regional WWTP	$206,580	$220,000	$233,200	$247,192	$262,024	$277,745	$294,410	6% increase per year
Postage	$4,000	$4,000	$4,040	$4,080	$4,121	$4,162	$4,204	1% increase per year
Telephone - Pump Stations, Fax, Office	$3,400	$3,750	$3,863	$3,978	$4,098	$4,221	$4,347	3% increase per year
Wages	$15,000	$13,000	$13,390	$13,792	$14,205	$14,632	$15,071	3% increase per year
Water	$500	$800	$840	$882	$926	$972	$1,021	5% increase per year
Total Operating Expenses	**$395,180**	**$454,736**	**$495,606**	**$521,923**	**$510,325**	**$504,783**	**$560,914**	
Net Revenue (Loss)	**$100**	**$(47,856)**	**$(92,926)**	**$(119,243)**	**$(107,645)**	**$(102,103)**	**$(158,234)**	
% Increase Needed in Revenue		**12.1%**	**23.5%**	**30.2%**	**27.2%**	**25.8%**	**40.0%**	

5.3 Rate Scenarios Considered

In reviewing options for sewer charges the following goals were established:

- Generate adequate revenue to pay treatment costs and other operating expenses;
- Generate adequate revenue to address additional condition assessment activities on an ongoing basis;
- Fund pump station improvements over the next 3-5 years
- Fund sewer line rehabilitation on an ongoing basis;
- Bill customers based on water usage; and
- Develop rates that are fair and equitable.

In evaluating the options for sewer charges based on water usage, several variables were considered:

- Establishment of a minimum charge and consideration of various rates for that minimum charge (the analysis considered minimum charges that ranged from less than $20 per month to $26 per month).
- Consideration for the amount of water usage that would be included in the minimum charge (scenarios ranged from 0 gallons in the minimum usage to 5,000 gallons).
- The charge per 1,000 gallons for usage in excess of the minimum charge (options ranged from $1.00 per thousand gallons to more than $4.00).
- In all scenarios, the goal was to set rates that would yield annual revenue of approximately $433,000 per year, based on current average water usage.
- Under each scenario considered, the impact on various groups of users was analyzed (ie, the impact on the users who use very little water, the average users and users who use larger volumes of water on a regular basis).
- Under each scenario, the goal was to develop rates that were fair to all users.

After developing many scenarios, the rates shown on the following pages were selected as the preferable option.

5.4 Recommended Rates

The following tables depict the recommended rates for non-users, for residential users, and for commercial users.

Table 5-5: Recommended Non-User Rate

	Current Rate	Recommended Rate
Non-User Charge (per month)	$ 10.00	$ 13.00

Table 5-6: Recommended Residential Rates

	Current Rate	Recommended Rate
Base Rate (per month)	$ 23.00	$ 24.00
Consumption Charge ($ per 1,000 gallons)	N/A	$ 1.25
Gallons in Minimum	N/A	1,000

Table 5-7: Monthly Increase – Residential Customers

Water Usage	Current Charge	Recommended Charge	Increase
up to 1,000 gallons	$ 23.00	$ 24.00	$ 1.00
2,000	$ 23.00	$ 25.25	$ 2.25
3,000	$ 23.00	$ 26.50	$ 3.50
4,000	$ 23.00	$ 27.75	$ 4.75
5,000	$ 23.00	$ 29.00	$ 6.00
6,000	$ 23.00	$ 30.25	$ 7.25
7,000	$ 23.00	$ 31.50	$ 8.50
8,000	$ 23.00	$ 32.75	$ 9.75
9,000	$ 23.00	$ 34.00	$ 11.00
10,000	$ 23.00	$ 35.25	$ 12.25
15,000	$ 23.00	$ 41.50	$ 18.50

Table 5-7 shows what the increase on the sewer bill will be for customers using up to 15,000 gallons of water per month. The shaded rows represent the usage of approximately 60% of the residential customer base – and as shown, these customers will see increases of $1.00 to $3.50 per month. Customers using more than 1,000 gallons per month, will pay $1.25 per thousand gallons for each 1,000 gallons of water used.

The commercial rates are increased by 10%. The current and recommended rates are shown in the following tables.

Table 5-8: Recommended Commercial Rates

	Current Rate	Recommended Rate
Base Rate (per month)	$ 23.00	$ 25.30
Consumption Charge	$ 4.00	$ 4.40
Gallons in Minimum	N/A	N/A

Table 5-9: Monthly Increase – Commercial Customers

Water Usage	Current Charge	Recommended Charge	Increase
<1,000 Gallons	$ 23.00	$ 25.30	$ 2.30
1,000	$ 27.00	29.70	$ 2.70
2,000	$ 31.00	34.10	$ 3.10
3,000	$ 35.00	38.50	$ 3.50
4,000	$ 39.00	42.90	$ 3.90
5,000	$ 43.00	47.30	$ 4.30
6,000	$ 47.00	51.70	$ 4.70
7,000	$ 51.00	56.10	$ 5.10
8,000	$ 55.00	60.50	$ 5.50
9,000	$ 59.00	64.90	$ 5.90
10,000	$ 63.00	69.30	$ 6.30
20,000	$ 103.00	113.30	$ 10.30
30,000	$ 143.00	157.30	$ 14.30
40,000	$ 183.00	201.30	$ 18.30
50,000	$ 223.00	245.30	$ 22.30
100,000	$ 423.00	465.30	$ 42.30
150,000	$ 623.00	685.30	$ 62.30

Approximately 40% of the non-residential customers use 1,000 gallons of water, or less, per month; approximately 30% use 2,000 – 10,000 gallons per month and 30% use in excess of 10,000 gallons per month.

5.5 Summary and Future Actions

The rates recommended herein represent a reasonable and fair approach to implementing usage-based sewer charges. In addition, the recommended rates are projected to generate revenues that are adequate to support the current and projected operating costs of the Fairlawn system – while providing additional funds to address pump station and sewer line rehabilitation as well as additional condition assessment activities so that, over time, the Authority can inspect and make needed repairs throughout the collection system.

It will be important for the Authority to continue to monitor revenues on a monthly, quarterly and annual basis to measure the actual revenue that the recommended rates generate. Should customers achieve significant water conservation – the sewer fees may be less than projected. At the same time, the Authority must continue to monitor costs – operating costs, treatment costs and the actual cost of system rehabilitation. Should any costs be greater than the projections indicate, or if the revenue is less than projected – additional adjustments to the budget, the capital plan, or the rates will need to be considered.

6.0 SUMMARY AND RECOMMENDATIONS

The PCSA collection system consists of approximately 88,000 LF of gravity sewer. Approximately one-sixth of the system (15,000 LF) was inspected during this condition assessment; this area was identified as the oldest area in the system making it the highest priority for inspection. The inspection yielded a condition assessment that detailed the necessary maintenance, rehabilitation, and repair work to keep the system operational and safe. The total cost for these repairs is estimated to be approximately $124,500.00.

In order to continue the upkeep of this system, PCSA would benefit from inspecting the remaining portions of the PCSA collection system to identify all defects and needed rehabilitation. In order to accomplish the subsequent sewer inspection and rehabilitation tasks, it is recommended that PCSA allocate funds for inspections and maintenance/construction measures on a bi-annual basis. By following a year focused on inspecting a portion of the system with a year devoted to the maintenance, rehabilitation, and repair of that portion of the sewer system, PCSA can successfully maintain the functionality and safety of the system. It is recommended that PCSA complete five (5) additional phases of inspection over ten (10) years.

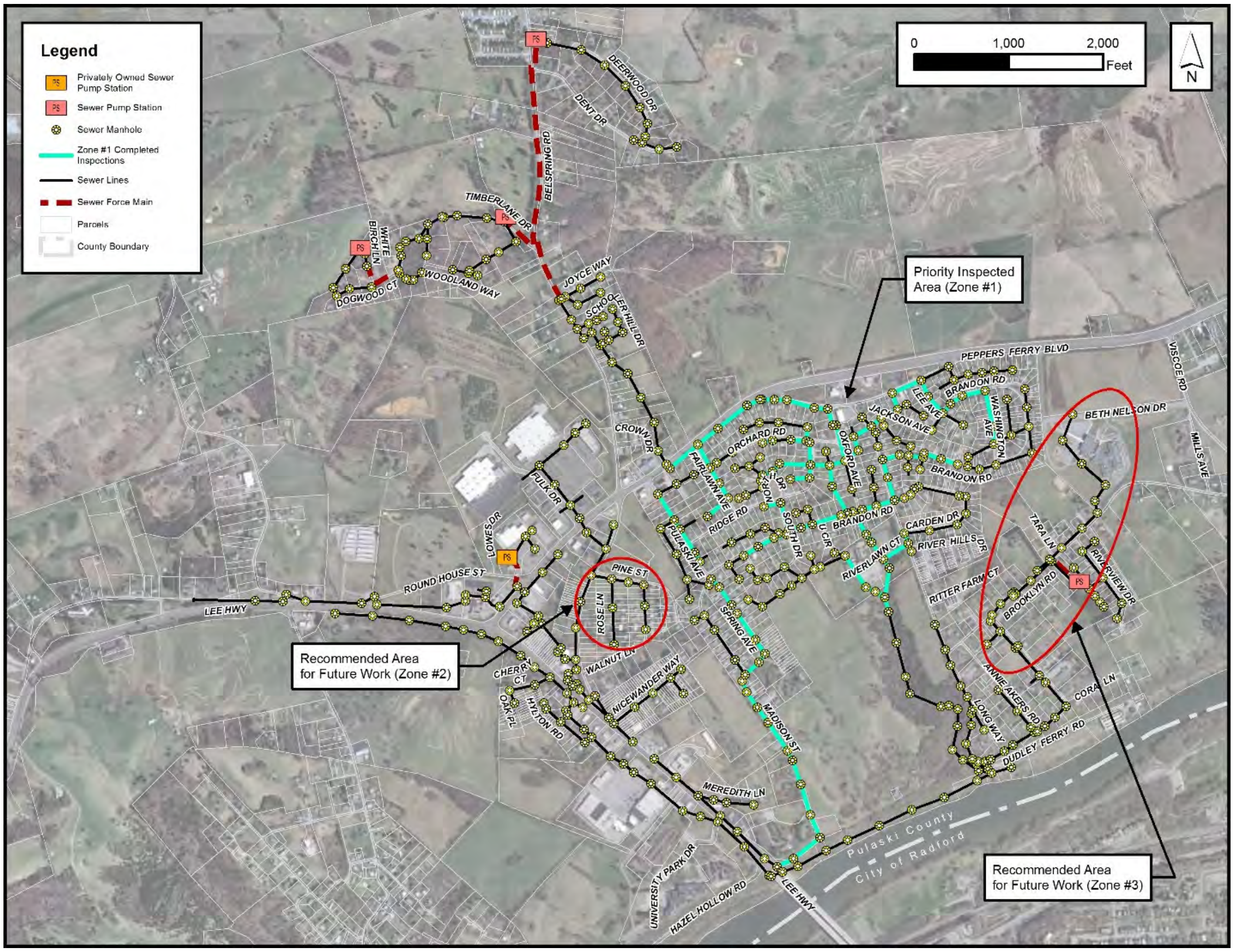
Similar to the inspection completed for this report, each phase would include the inspection and evaluation approximately 15,000 LF of the system and would cost approximately $30,000. The year between each inspection phase would be focused on completing the necessary repair and rehabilitation project identified by the prior year's condition assessment report. It is estimated that these project costs would total approximately $90,000 per year. This estimate is based on the cost for recommended repairs in this report. The portion of the system inspected in this phase was identified as the oldest and highest risk portion of the system, so the rehabilitation and repair costs for subsequent phases is expected to be approximate 75% of the cost identified in this report, or approximately $90,000 per phase. Table 6-1 on the following page details the probable cost schedule for completing the inspection and maintenance for the gravity system.

Table 6-1: Probable Cost Schedule for Inspection and Maintenance of Gravity System

Project	Year					
	Phase 1		Phase 2		Phase 3	
	2018	2019	2020	2021	2022	2023
CCTV Inspection (15,000 LF)	$30,000	-	$30,000	-	$30,000	-
Maintenance and Repairs	-	$124,500	-	$90,000	-	$90,000
Project	**Year**					
	Phase 4		**Phase 5**		**Phase 6**	
	2024	**2025**	**2026**	**2027**	**2028**	**2029**
CCTV Inspection (15,000 LF)	$30,000	-	$30,000	-	$30,000	-
Maintenance and Repairs	-	$90,000	-	$90,000	-	$90,000

Figure 6-1 on the following page highlights two (2) areas of the gravity collection system (i.e., phases) that have been identified by PCSA as areas of focus for the next inspection phases. The inspection area completed under this report has been considered to be Phase 1.

Figure 6-1: Future Work Phases



While pipe rehabilitation will assist with reducing I/I, flow monitoring data suggests that inflow is likely a larger contributor to the system due to the immediate response time of increased flow during rain events. PCSA would benefit from ensuring that inflow is controlled by replacing manhole frames and covers to ensure they are watertight, ensuring roof and storm drains are not connected to the system, and replace cleanout caps. These replacements will supplement the effect of the rehabilitation and repairs to reduce I/I in the system.

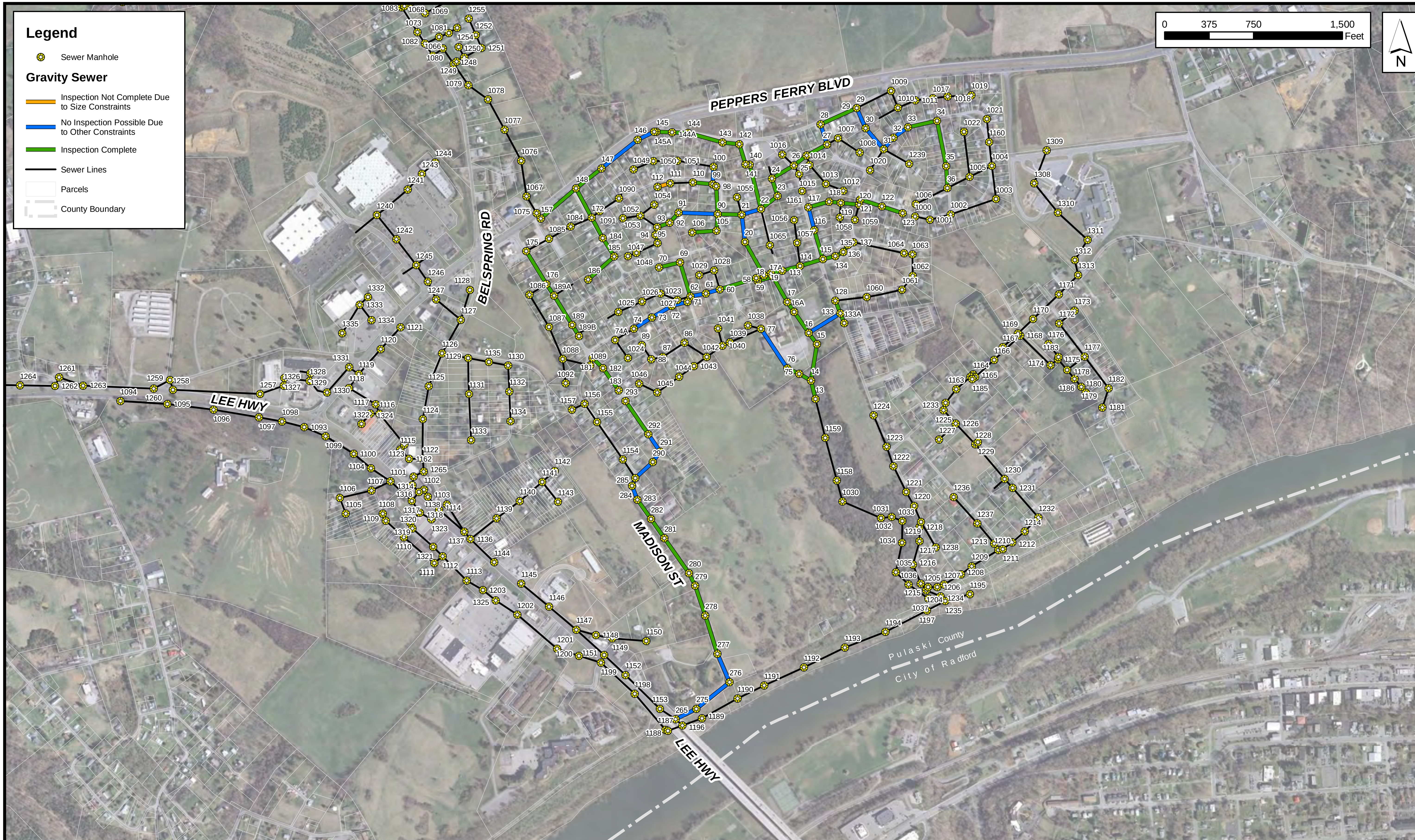
In addition to the inspection and condition assessment of the gravity sewer lines, it is recommended that PCSA complete the recommended repairs to the four (4) pump stations to ensure the continued operation of the system. The recommendations were classified as high, moderate, or low priorities to indicate the severity and urgency of addressing each recommendation. The repairs meriting a high priority grade totaled approximately $22,000 and should be addressed as a part of the Phase 1 repairs. The moderate priority recommendations totaled approximately $14,800 and should be addressed over the next five (5) years. Finally, the low priority recommendations totaled approximately $19,200 and should be addressed at the PCSA's discretion.

In order to accomplish the recommended repairs and maintenance of the PCSA Fairlawn gravity collection system, rate adjustments will be needed. The recommended rates are projected to generate revenues that are adequate to support the current and projected operating costs of the Fairlawn system – while providing additional funds to address pump station and sewer line rehabilitation as well as additional condition assessment activities so that, over time, the Authority can inspect and make needed repairs throughout the collection system. The rates recommended in Section 5.0 of this report represent a reasonable and fair approach to implementing usage-based sewer charges.

It will be important for the Authority to continue to monitor revenues on a monthly, quarterly and annual basis to measure the actual revenue that the recommended rates generate. Should customers achieve significant water conservation – the sewer fees may be less than projected. At the same time, the Authority must continue to monitor costs – operating costs, treatment costs and the actual cost of system rehabilitation. Should any costs be greater than the projections indicate, or if the revenue is less than projected – additional adjustments to the budget, the capital plan, or the rates will need to be considered.

APPENDIX A

Gravity Sewer Inspection Status (Map)



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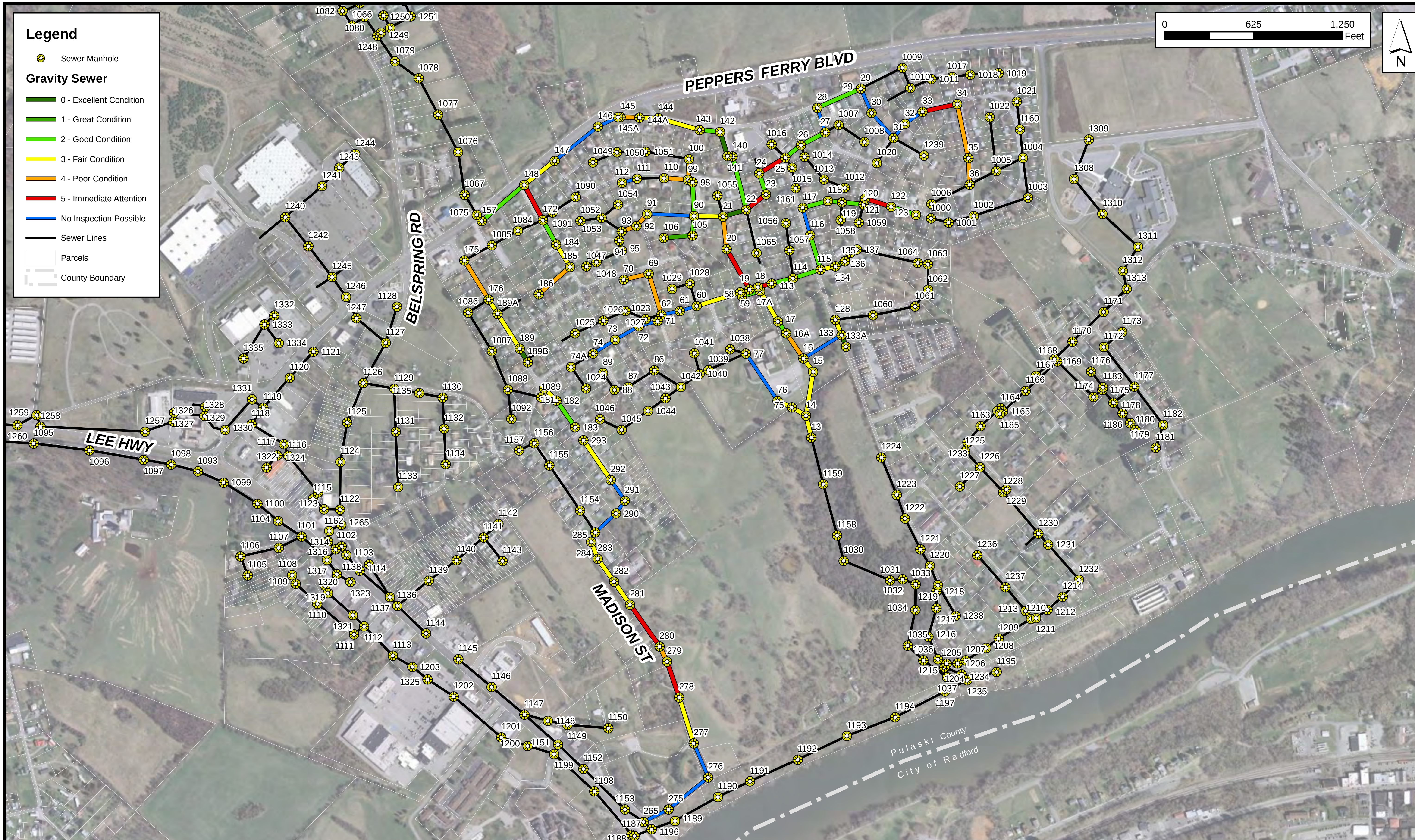
Gravity Sewer Inspection Status Map

Pulaski County Sewerage Authority

Appendix A

APPENDIX B

Overall Condition Ratings (Map)



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Overall Condition Ratings Map

Pulaski County Sewerage Authority

Appendix B

APPENDIX C

CCTV Inspections and Condition Ratings (Table)

Appendix C: CCTV Inspections and Condition Ratings

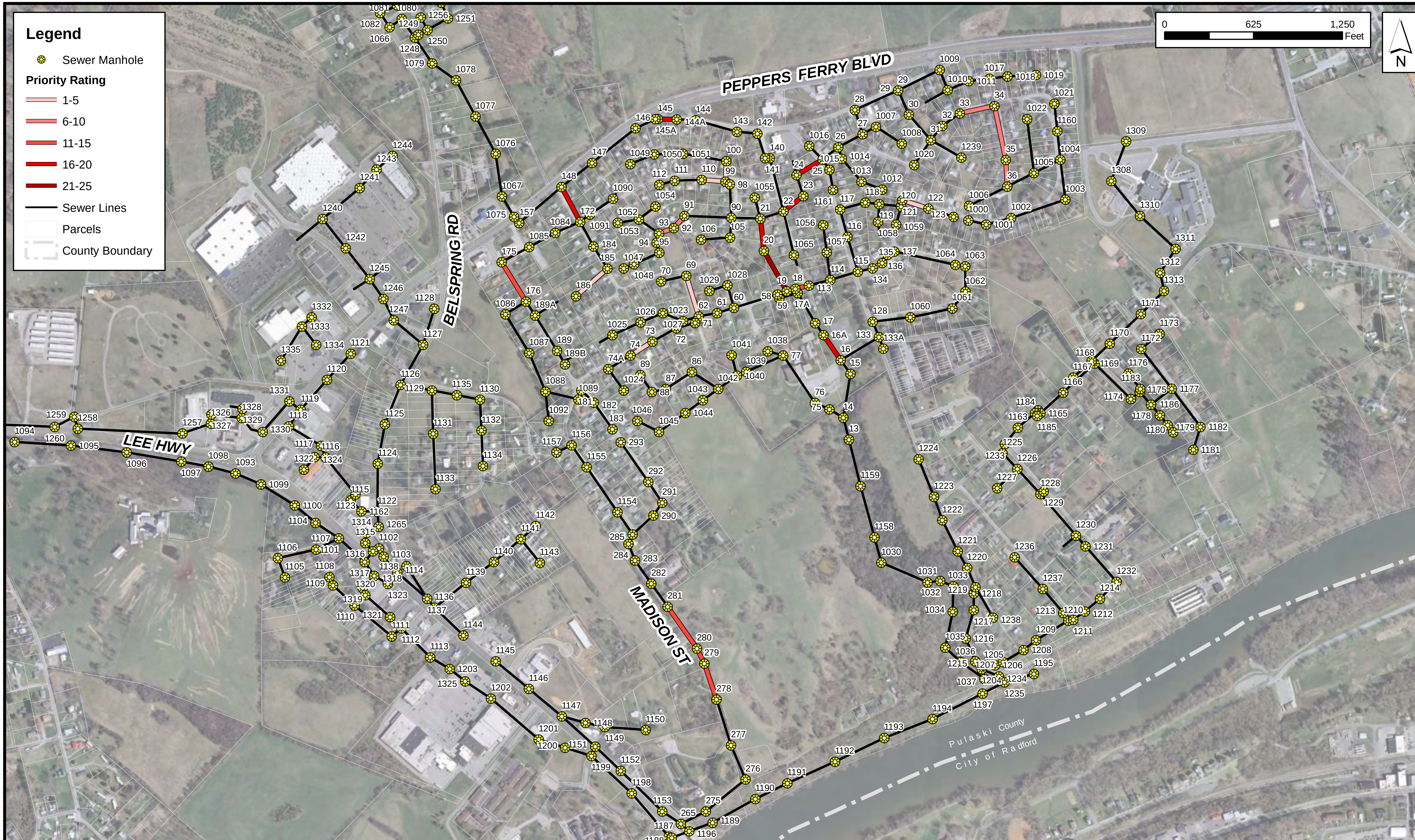
CCTV Inspection																	
Line Segment	Upstream MH	Downstream MH	Pipe Size (Inches)	Pipe Shape	Pipe Material	Map Length	Length Surveyed	Number of Inspections	Structural Quick	OM Quick	Overall Quick	Structural Index	OM Index	Overall Index	Structural Rating	OM Rating	Overall Rating
14-13	14	13	10	Circular	Vitrified Clay Pipe	158.63	170.2		0000	3215	3215	0	1.57	1.57	0	3	3
16-15	16	15	10	Circular	Ductile Iron Pipe	117.21	157.2		3100	0000	3100	3	0	3	3	0	3
17-16A	17	16A	10	Circular	Vitrified Clay Pipe	102.2	110.3		0000	2900	2900	0	2	2	0	2	2
18-113	18	113	8	Circular	Vitrified Clay Pipe	100	82.3		5131	2B00	5131	4	2	2.22	5	2	5
18-17A	18	17A	10	Circular	Ductile Iron Pipe	31.7	58.9	2	0000	2800	2800	0	2	2	0	2	2
19-18	19	18	10	Circular	Ductile Iron Pipe	62	69.5		0000	2A00	2A00	0	2	2	0	2	2
20-19	20	19	10	Circular	Vitrified Clay Pipe	325.6	509.7	2	0000	5141	5141	0	2.5	2.25	0	5	5
21-20	21	20	8	Circular	Vitrified Clay Pipe	229.9	11.2		0000	4300	4300	0	4	4	0	4	4
22-140	22	140	8	Circular	Vitrified Clay Pipe	387	401.6		2400	2114	2514	2	1.2	1.56	2	2	2
22-21	22	21	8	Circular	Vitrified Clay Pipe	169.5	43.7		0000	0000	0000	0	0	0	0	0	0
23-22	23	22	8	Circular	Vitrified Clay Pipe	176.9	172.9		5231	1100	5231	4.33	1	3.5	5	1	5
24-23	24	23	8	Circular	Vitrified Clay Pipe	155	160.1		1100	2E00	2E11	1	2	1.97	1	2	2
25-24	25	24	8	Circular	Vitrified Clay Pipe	215	197	2	0000	5431	5431	0	3.3	3.3	0	5	5
26-25	26	25	8	Circular	Vitrified Clay Pipe	139.3	143.3		0000	2400	2400	0	2	2	0	2	2
27-26	27	26	8	Circular	Vitrified Clay Pipe	194.1	190.4		2100	0000	2100	2	0	2	2	0	2
29-28	29	28	8	Circular	Vitrified Clay Pipe	334.7	340.9		0000	2F00	2F00	0	2	2	0	2	2
33-33A	33	33A	10	Circular	Ductile Iron Pipe	0	90.6		0000	412B	412B	0	2.11	2.11	0	4	4
33A-34	33A	34	10	Circular	Ductile Iron Pipe	0	109.9		3200	2C00	322C	3	2	2.08	3	2	3
34-33	34	33	8	Circular	Vitrified Clay Pipe	251.2	293.2	3	3100	5142	5142	3	3	3	3	5	5
35-34	35	34	8	Circular	Vitrified Clay Pipe	388.4	381.2	2	3100	4331	4332	3	3	3	3	4	4
36-35	36	35	8	Circular	Vitrified Clay Pipe	186.9	177.1		4121	211D	4122	3	1.03	1.16	4	2	4
58-17A	58	17A	10	Circular	Ductile Iron Pipe	133.3	151.1		0000	2E00	2E00	0	2	2	0	2	2
59-58	59	58	10	Circular	Vitrified Clay Pipe	30.4	32.9		0000	0000	0000	0	0	0	0	0	0
60-59	60	59	8	Circular	Vitrified Clay Pipe	319.8	357.5	2	0000	3122	3122	0	1.8	1.8	0	3	3
62-69	69	62	8	Circular	Vitrified Clay Pipe	298.85	40.9		0000	4233	4233	0	3	3	0	4	4
69-70	70	69	8	Circular	Vitrified Clay Pipe	181.35	65.6	2	0000	4132	4132	0	3	3	0	4	4
74-73	74	73	8	Circular	Vitrified Clay Pipe	0	71.7		0000	4131	4131	0	2.67	2.67	0	4	4
14-75	75	14	10	Circular	Vitrified Clay Pipe	115.11	77.5		0000	322A	322A	0	2.13	2.13	0	3	3
75-76	76	75	8	Circular	Vitrified Clay Pipe	110.34	156.1		2100	3100	3121	2	3	2.5	2	3	3
90-84	90	84	10	Circular	Ductile Iron Pipe	0	66.6		3100	2700	3127	3	2	2.13	3	2	3
90-21	90	21	8	Circular	Vitrified Clay Pipe	203.6	217.1		3100	3221	3321	3	1.83	2	3	3	3
90-91	90	91	8	Circular	Vitrified Clay Pipe	329.1	127.8		0000	332C	332C	0	1.6	1.6	0	3	3
91-92	91	92	8	Circular	Vitrified Clay Pipe	114.2	88.5	2	2100	4122	4123	0	2.67	2.67	2	4	4
92-93	92	93	8	Circular	Vitrified Clay Pipe	111.1	119.9	2	0000	4136	4136	0	3.5	3.5	0	4	4
93-94	94	93	8	Circular	Vitrified Clay Pipe	65.59	72.3		0000	2100	2100	0	2	2	0	2	2
94-95	95	94	8	Circular	Vitrified Clay Pipe	74.2	74.6		0000	0000	0000	0	0	0	0	0	0
99-98	99	98	8	Circular	Vitrified Clay Pipe	0	50.7		2100	1100	2111	2	1	1.5	2	1	2
98-90	98	90	8	Circular	Vitrified Clay Pipe	236.56	146.5	2	0000	2100	2100	0	2	2	0	2	2
100-99	100	99	8	Circular	Vitrified Clay Pipe	145.98	150.8	2	4122	2C1C	412D	2.67	1.5	1.57	4	2	4
90-105	105	90	8	Circular	Vitrified Clay Pipe	138.73	141.4		0000	2D1A	2D1A	0	1.67	1.67	0	2	2
105-106	106	105	8	Circular	Vitrified Clay Pipe	203.94	214.8		0000	1D00	1D00	0	1	1	0	1	1
99-110	110	99	8	Circular	Vitrified Clay Pipe	167.51	157.3		2100	413B	413B	2	2.42	2.4	2	4	4
113-114	113	114	8	Circular	Vitrified Clay Pipe	154.2	155		2100	1100	2111	2	1	1.5	2	1	2
114-115	114	115	8	Circular	Vitrified Clay Pipe	202.4	183.5		2100	0000	2100	2	0	2	2	0	2
115-116	115	116	8	Circular	Vitrified Clay Pipe	254.1	214.4		0000	2218	2218	0	1.2	1.2	0	2	2

Appendix C: CCTV Inspections and Condition Ratings

CCTV Inspection																	
Line Segment	Upstream MH	Downstream MH	Pipe Size (Inches)	Pipe Shape	Pipe Material	Map Length	Length Surveyed	Number of Inspections	Structural Quick	OM Quick	Overall Quick	Structural Index	OM Index	Overall Index	Structural Rating	OM Rating	Overall Rating
118-117	118	117	8	Circular	Vitrified Clay Pipe	183.6	194.2		2100	2F00	2F00	2	2	2	2	2	2
119-118	119	118	8	Circular	Vitrified Clay Pipe	97.5	95.6		0000	2A11	2A11	0	1.93	1.93	0	2	2
120-119	120	119	8	Circular	Vitrified Clay Pipe	154.3	159.9		2100	1200	2112	2	1	1.33	2	1	2
121-120	121	120	8	Circular	Vitrified Clay Pipe	43.2	44.5		0000	0000	0000	0	0	0	0	0	0
122-121	122	121	8	Circular	Vitrified Clay Pipe	191.6	101.7		0000	5121	5121	0	3.5	3.5	0	5	5
123-122	123	122	8	Circular	Vitrified Clay Pipe	185.2	238	2	0000	2100	2100	0	2	2	0	2	2
128-133	128	133	8	Circular	Vitrified Clay Pipe	115.83	113.5		3100	2C00	312C	3	2	2.04	3	2	3
115-134	134	115	8	Circular	Vitrified Clay Pipe	107.18	139.7		3100	3113	3213	3	1.5	1.8	3	3	3
134-135	135	134	8	Circular	Vitrified Clay Pipe	75.9	70.2		0000	2A1A	2A1A	0	1.52	1.52	0	2	2
135-136	136	135	8	Circular	Vitrified Clay Pipe	71.47	25.5	2	2100	4131	4131	0	2.33	2.33	2	4	4
140-141	140	141	8	Circular	Vitrified Clay Pipe	34.7	32.6		2100	0000	2100	2	0	2	2	0	2
141-142	141	142	8	Circular	Vitrified Clay Pipe	179.9	172.4		0000	0000	0000	0	0	0	0	0	0
142-143	142	143	8	Circular	Vitrified Clay Pipe	144.1	143.2		2100	2D00	2D00	2	2	2	2	2	2
143-144	143	144	8	Circular	Vitrified Clay Pipe	301.6	316.2		0000	3121	3121	0	2	2	0	3	3
144-144A	144	144A	8	Circular	Vitrified Clay Pipe	133.6	135.8		0000	322D	322D	0	2.03	2.03	0	3	3
148-147	148	147	8	Circular	Vitrified Clay Pipe	272.8	214.3		3100	3214	3314	3	1.67	1.86	3	3	3
148-157	148	157	8	Circular	Vitrified Clay Pipe	391.2	387.7		0000	2J1A	2J1A	0	1.8	1.8	0	2	2
172-148	172	148	8	Circular	Vitrified Clay Pipe	0	272.3		5141	3122	5141	4.5	1.22	1.55	5	3	5
176-175	176	175	8	Circular	Vitrified Clay Pipe	324.9	314.5		0000	4131	4131	0	1.83	1.83	0	4	4
182-181	182	181	8	Circular	Vitrified Clay Pipe	122.2	109.8		0000	3218	3218	0	1.4	1.4	0	3	3
183-182	183	182	8	Circular	Vitrified Clay Pipe	228.4	242		0000	2700	2700	0	2	2	0	2	2
184-172	184	172	10	Circular	Polyvinyl Chloride	195.69	198.6		0000	2B00	2B00	0	2	2	0	2	2
185-184	185	184	8	Circular	Vitrified Clay Pipe	184.66	209		2100	3216	3221	2	1.5	1.56	2	3	3
186-185	186	185	8	Circular	Vitrified Clay Pipe	293.56	282.4		0000	4133	4133	0	1.68	1.68	0	4	4
189-189A	189	189A	8	Circular	Vitrified Clay Pipe	291.4	282.7		3100	3122	3222	3	1.57	1.75	3	3	3
277-278	277	278	10	Circular	Vitrified Clay Pipe	338.4	347.6		0000	3212	3212	0	2	2	0	3	3
278-279	278	279	8	Circular	Polyvinyl Chloride	265.6	221.8	2	0000	5233	5233	0	3	3	0	5	5
279-280	279	280	8	Circular	Polyvinyl Chloride	119	60.8	2	0000	4135	4135	0	2.6	2.6	0	4	4
280-281	280	281	8	Circular	Polyvinyl Chloride	359.4	137.9	2	0000	5141	5141	0	3	3	0	5	5
281-282	281	282	8	Circular	Vitrified Clay Pipe	197.8	125.4		0000	312C	312C	0	1.62	1.62	0	3	3
282-283	282	283	8	Circular	Polyvinyl Chloride	198.1	319.7	2	0000	332E	332E	0	3	3	0	3	3
283-284	283	284	8	Circular	Polyvinyl Chloride	125.9	2.2		0000	3100	3100	0	3	3	0	3	3
292-293	292	293	8	Circular	Vitrified Clay Pipe	338.7	351.6		0000	321A	321A	0	1.27	1.27	0	3	3
133A-133	133A	133	10	Circular	Polyvinyl Chloride	87.75	86.5		0000	0000	0000	0	0	0	0	0	0
144A-145	144A	145	8	Circular	Vitrified Clay Pipe	133.3	123.8		0000	432A	432A	0	2.35	2.35	0	4	4
16A-16	16A	16	10	Circular	Vitrified Clay Pipe	214.7	207		4122	2111	4123	2.67	1.5	2.2	4	2	4
17A-17	17A	17	10	Circular	Ductile Iron Pipe	246.9	204.7	2	0000	332C	332C	0	2.08	2.08	0	3	3
189A-176	189A	176	8	Circular	Vitrified Clay Pipe	117.3	170.2	2	0000	3124	3124	0	2	2	0	3	3
189B-189	189B	189	8	Circular	Vitrified Clay Pipe	111.2	89.2		0000	0000	0000	0	0	0	0	0	0

APPENDIX D

Priority Rating of Severe Defects (Map)



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Priority Rating of Severe Defects

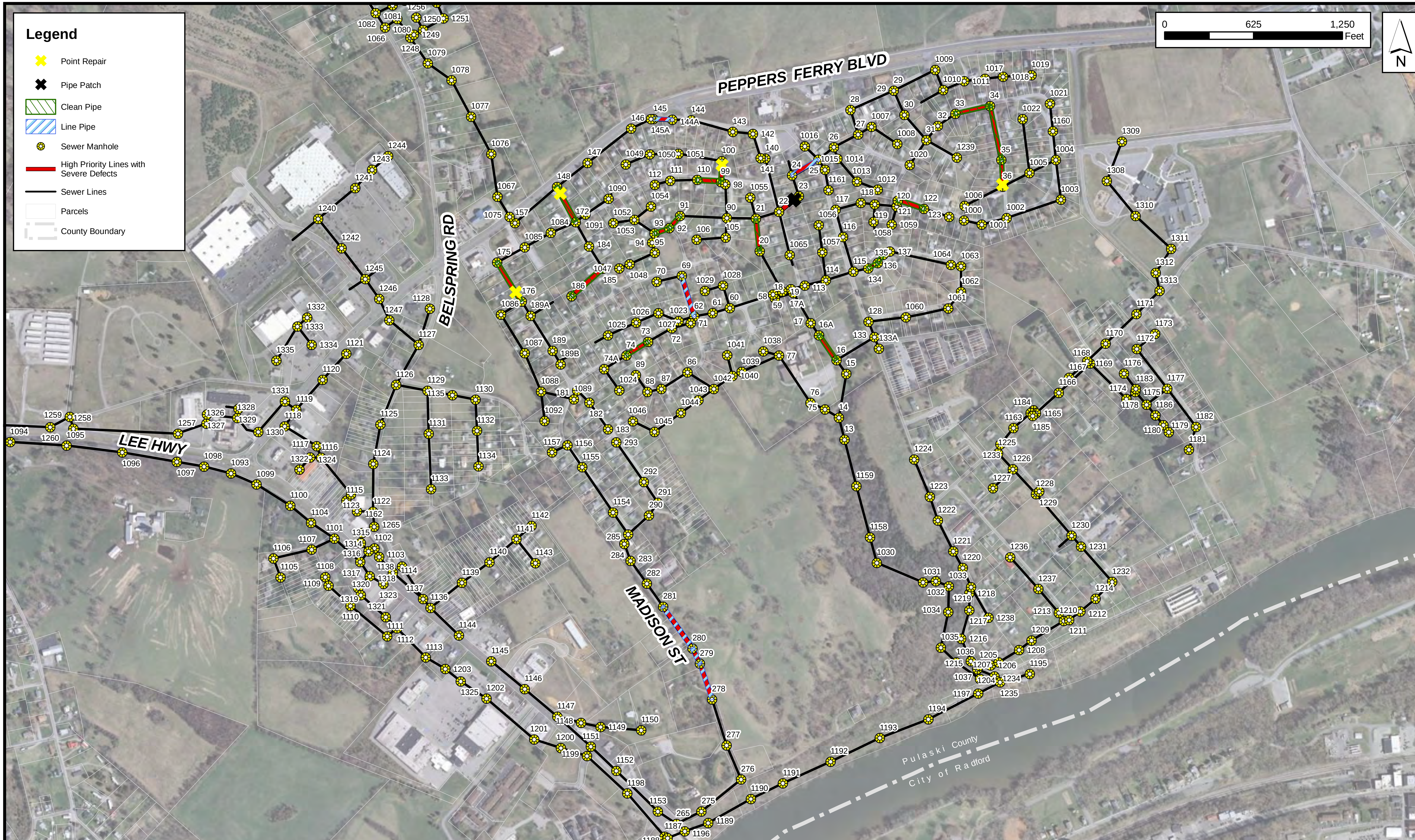
Pulaski County Sewerage Authority

Appendix D

APPENDIX E

High Priority Rehabilitation and

Maintenance Recommendations (Map)



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High Priority Rehabilitation and Maintenance Recommendations Map

Pulaski County Sewerage Authority

Appendix E

APPENDIX F

Severe Defects, Recommended Repairs, Priority

Ratings, and Estimated Rehabilitation Costs (Table)

Appendix F: Severe Defects, Recommended Repairs, Priority Rating, and Estimated Rehabilitation Costs

Line ID	Upstream MH	Downstream MH	Pipe Size (Inches)	Pipe Shape	Pipe Material	Map Length	Length Surveyed	Structural Quick	OM Quick	Overall Quick	Structural Index	OM Index	Overall Index	Structural Rating	OM Rating	Overall Rating	Consequence of Failure	Priority Rating	Observations / Recommendations Summary	Defect Type	Pipe Patch (Count)	Point Repair (Count)	Section Repair (Count)	Line Pipe (LF)	Replace Pipe (LF)	Cleaning (Count)	Roots (Count)	Estimated Rehabilitation Costs ($)
110-99	68	74	8	Circular	Vitrified Clay Pipe	0	157.3	2100	413B	413B	2	2.42	2.4	2	4	4	1	4	**Clean Pipe** to remove roots throughout pipe.	O						X	X	$818
100-99	67	68	8	Circular	Vitrified Clay Pipe	0	150.8	4122	2C1C	412D	2.67	1.5	1.57	4	2	4	1	4	**Clean Pipe** to remove grease and roots throughout. **Point Repair** to fix offset at material change 125.4' US MH68. Watch Fractures 10.2' US MH 68 - consider pipe patch.	O/S		1				X	X	$5,930
33-33A	33	33A	10	Circular	Ductile Iron Pipe	0	90.6	0000	412B	412B	0	2.11	2.11	0	4	4	2	8	**Clean Pipe** to remove grease throughout pipe.	O						X		$185
172-148	112	148	8	Circular	Vitrified Clay Pipe	0	272.3	5141	3122	5141	4.5	1.22	1.55	5	3	5	4	20	**Point Repair** to fix hole and fractures 240.6' - 246.1' DS MH112. **Clean Pipe** to remove roots and grease throughout pipe.	O/S		1				X	X	$5,827
69-62	62	69	8	Circular	Vitrified Clay Pipe	0	40.9	0000	4233	4233	0	3	3	0	4	4	1	4	**Clean Pipe** to remove grease and roots throughout. **Line Pipe**.	O				298.9		X	X	$14,945
122-121	122	121	8	Circular	Vitrified Clay Pipe	191.6	101.7	0000	5121	5121	0	3.5	3.5	0	5	5	1	5	**Clean Pipe** to remove rootball 102.3' US MH121. Reinspect to ensure structural integrity.	O						X	X	$483
144A-145	144A	145	8	Circular	Vitrified Clay Pipe	133.3	123.8	0000	432A	432A	0	2.35	2.35	0	4	4	4	16	**Clean Pipe** to remove grease throughout pipe and rootballs 95.2', 99.5', and 119.3' DS MH 144A. **Line Pipe**.	O				123.8		X	X	$6,190
16A-16	16A	16	10	Circular	Vitrified Clay Pipe	214.7	207	4122	2111	4123	2.67	1.5	2.2	4	2	4	5	20	**Clean Pipe** to remove grease throughout pipe. Watch fractures - not critical.	O						X		$248
176-175	176	175	8	Circular	Vitrified Clay Pipe	324.9	314.5	0000	4131	4131	0	1.83	1.83	0	4	4	3	12	**Control Infiltration** at lateral 88.6' DS MH176 - grout or point repair. **Clean Pipe** to remove grease and roots.	O		1				X	X	$6,232
18-113	18	113	8	Circular	Vitrified Clay Pipe	100	82.3	5131	2B00	5131	4	2	2.22	5	2	5	3	15	**Point Repair** 72.6' US MH113 to fix hole at material change. Consider pipe patch 12.3' US MH113 to fix fractures.	S		1						$5,000
20-19	20	19	8	Circular	Vitrified Clay Pipe	325.6	43.7	0000	5141	5141	0	2.5	2.5	0	5	5	5	25	**Clean Pipe** to remove grease and roots throughout pipe. Consider lining pipe.	O						X	X	$1,001
21-20	21	20	8	Circular	Vitrified Clay Pipe	229.9	11.2	0000	4300	4300	0	4	4	0	4	4	5	20	**Clean Pipe** to remove grease and reinspect to see full pipe length.	O						X		$460
23-22	23	22	8	Circular	Vitrified Clay Pipe	176.9	172.9	5231	1100	5231	4.33	1	3.5	5	1	5	4	20	**Pipe Patches** at 126.9' and 140.6' US MH22 to fix holes and fractures.	S	2							$2,000
25-24	25	24	8	Circular	Vitrified Clay Pipe	215	125.6	0000	5431	5431	0	3.3	3.3	0	5	5	4	20	**Clean Pipe** to remove grease and debris throughout pipe. **Line Pipe.**	O				215		X		$10,750
279-278	278	279	8	Circular	Polyvinyl Chloride	265.6	215	0000	5133	5133	0	2.1	2.1	0	5	5	3	15	**Clean Pipe** to remove grease and roots throughout pipe. **Line Pipe**.	O				265.6		X	X	$13,280
279-278	278	279	8	Circular	Polyvinyl Chloride	265.6	6.8	0000	5111	5111	0	3	3	0	5	5	3	-	See Above.									
280-279	279	280	8	Circular	Polyvinyl Chloride	119	42.2	0000	4134	4134	0	2.6	2.6	0	4	4	3	12	**Clean Pipe** to remove grease and roots throughout pipe. **Line Pipe**.	O				119		X	X	$5,950
281-280	280	281	10	Circular	Vitrified Clay Pipe	359.4	119.4	0000	412C	412C	0	2.04	2.04	0	4	4	3	15	**Clean Pipe** to remove grease and roots throughout pipe. **Line Pipe.**	O				359.4		X	X	$17,970
281-280	280	281	8	Circular	Polyvinyl Chloride	359.4	18.5	0000	5111	5111	0	3	3	0	5	5	3	-	See Above.									
34-33	34	33	8	Circular	Vitrified Clay Pipe	251.2	29.7	0000	5131	5131	0	2.33	2.33	0	5	5	2	10	**Clean Pipe** to remove grease and roots throughout pipe. **Clean MH33** to remove roots and grease from channel/bench.	O						X	X	$702
34-33	34	33	8	Circular	Vitrified Clay Pipe	251.2	29.8	0000	4132	4132	0	2.27	2.27	0	4	4	2	-	See Above.									
34-33	34	33	8	Circular	Vitrified Clay Pipe	251.2	233.7	3100	4122	4131	3	1.83	2	3	4	4	2	-	See Above.									
35-34	35	34	8	Circular	Vitrified Clay Pipe	388.4	378.7	3100	4231	4232	3	2.1	2.14	3	4	4	2	8	**Clean Pipe** to remove grease and roots throughout pipe. Consider pipe patch 11.3' DS MH 35 to fix fractures. Consider lining pipe to control infiltration.	O/S						X	X	$2,719
35-34	35	34	8	Circular	Vitrified Clay Pipe	388.4	2.5	0000	4121	4121	0	3	3	0	4	4	2	-	See Above.									
36-35	36	35	8	Circular	Vitrified Clay Pipe	186.9	177.1	4121	211D	4122	3	1.03	1.16	4	2	4	2	8	**Point Repair** to fix fractures 164.3' - 168.0' US MH35. **Clean Pipe** to remove roots throughout pipe.	O/S		1				X	X	$6,240
74-73	74	73	8	Circular	Vitrified Clay Pipe	0	71.7	0000	4131	4131	0	2.67	2.67	0	4	4	1	4	**Clean Pipe** to remove grease, debris, and roots 67.0' - 73.3' US MH73. Reinspect pipe to ensure structural integrity.	O						X	X	$462
92-91	91	92	8	Circular	Vitrified Clay Pipe	114.2	80	2100	4131	4131	2	2.25	2.2	2	4	4	2	8	**Clean Pipe** to remove grease, debris, and roots throughout pipe. Reinspect pipe to ensure structural integrity. **Line Pipe**.	O				114.2		X	X	$5,710
92-91	91	92	8	Circular	Vitrified Clay Pipe	114.2	8.5	0000	4122	4122	0	2.67	2.67	0	4	4	2	-	See Above.									
93-92	92	93	8	Circular	Vitrified Clay Pipe	111.1	3.5	0000	4131	4131	0	3.5	3.5	0	4	4	2	8	**Clean Pipe** to remove grease and roots throughout the pipe. **Line Pipe**.	O				111.1		X	X	$5,555

Line ID	Upstream MH	Downstream MH	Pipe Size (Inches)	Pipe Shape	Pipe Material	Map Length	Length Surveyed	Structural Quick	OM Quick	Overall Quick	Structural Index	OM Index	Overall Index	Structural Rating	OM Rating	Overall Rating	Consequence of Failure	Priority Rating	Observations / Recommendations Summary	Defect Type	Pipe Patch (Count)	Point Repair (Count)	Section Repair (Count)	Line Pipe (LF)	Replace Pipe (LF)	Cleaning (Count)	Roots (Count)	Estimated Rehabilitation Costs ($)
186-185	119	120	8	Circular	Vitrified Clay Pipe	0	282.4	0000	4133	4133	0	1.68	1.68	0	4	4	1	4	**Clean Pipe** to remove roots and grease throughout pipe. Consider cutting back intruding tap 148.6' US MH120.	O						X	X	$1,988
135-134	91	90	8	Circular	Vitrified Clay Pipe	0	16.6	0000	4131	4131	0	2.33	2.33	0	4	4	1	4	**Clean Pipe** to remove grease and roots throughout pipe. Reinspect pipe to ensure structural integrity.	O						X	X	$252
136-135	29	30	8	Circular	Vitrified Clay Pipe	0	62.9	0000	4122	4122	0	2.67	2.67	0	4	4	1	4	**Clean Pipe** to remove grease 57.2 - 64.5' US MH30. Reinspect pipe to ensure structural integrity. **Line Pipe**.	O				71.5		X		$3,575
																			Total		**2**	**5**	**0**	**1678.5**	**0**	**24**	**19**	**$124,471**

APPENDIX G

Lift Station Inspections (Photos)

Brooklyn Lift Station

Location: Brooklyn Rd.

Construction Date: __

Pump Information: (2) __ HP submersible pumps – ___ gpm @ ___ ft TDH

Pump Manufacturer: _______

Emergency Generator: No

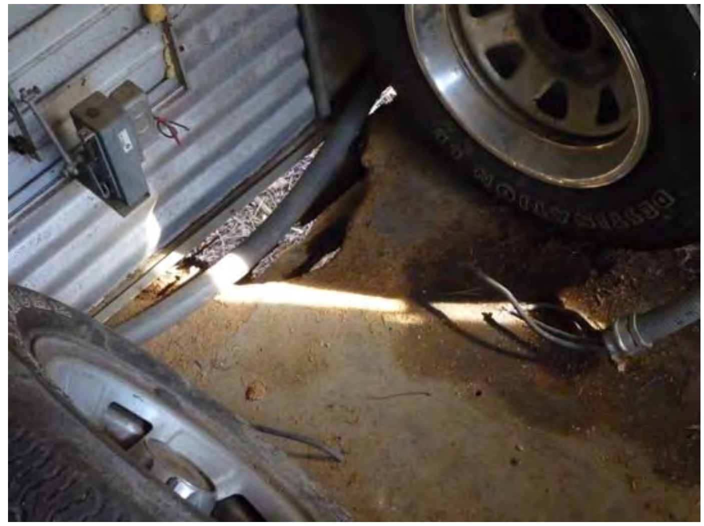
Emergency Generator Connection: Yes

Pictures: January 22, 2018 & April 5, 2018

Deficiencies:

Deficiency	Priority	Probable Cost (Non-Bid)
Missing Hinge and Latch – Valve Vault Hatch	Low	$2,500.00
Building Structure – Hole in Floor	Low	$2,000.00
Corrosion on Wet Well Hatch	Moderate	$2,500.00
Seepage into Pump Station Wall – Install Liner	Low	$10,000.00
No Audible or Visual Alarm (Install Alarm Light and Speaker)	High	$1,500.00

Valve Vault - Hatch



Control Building - Floor

Wet Well – Hatch (Corrosion)

Valve Vault - Valves

Autodialer

Emergency Generator Connection

Timberlane Lift Station

Location: Timberlane Dr.

Construction Date: 12/15/1988

Pump Information: (2) 5 HP submersible pumps – ___ gpm @ ___ ft TDH

Pump Manufacturer: Hydromatic

Emergency Generator: Yes (Portable Generator)

Emergency Generator Connection: Yes

Pictures: January 22, 2018 & April 5, 2018

Deficiencies:

Deficiency	Priority	Probable Cost (Non-Bid)
High Corrosion in Valve Vault (Replace Valves – Seal Pipe Penetrations from H_2S)	High	$12,000.00
Exposed Power Cords (Relocate – Conduit)	Moderate	$300.00
Overgrown Pine Trees (Prune/Maintain)	Low	Maintenance Cost
Emergency Generator Flat Tires (Fill/Maintain)	High	Maintenance Cost
Corroded Hand Wheels Force Main Discharge	High	$2,500.00

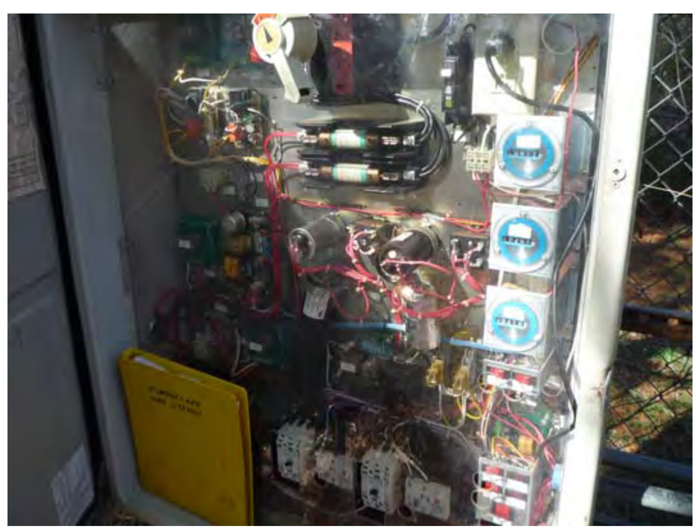
Valve Vault - Corrosion

Exterior Power Cords

Wet Well – Debris

Emergency Generator

Force Main Hand Wheel



Control Panel

White Birch Lift Station

Location: White Birch Ln.

Construction Date: ___

Pump Information: (2) __ HP submersible pumps – ___ gpm @ ___ ft TDH

Pump Manufacturer: ____

Emergency Generator: No

Emergency Generator Connection: Yes

Pictures: January 22, 2018 & April 5, 2018

Deficiencies:

Deficiency	Priority	Probable Cost (Non-Bid)
Fence Barb Wire Falling	Low	$200.00
Exterior Drainage Pipe Full of Debris and Joint Separation (Replace – Clean)	Moderate	$500.00
Corrosion on Wet Well Hatch	Moderate	$2,500.00
Electrical Disconnect Not Secured (Maintain-Lock)	High	Maintenance Cost
No Audible or Visual Alarm (Install Alarm Light and Speaker)	High	$1,500.00
One Pump did not seem to operate as well as other (may need replacement or maintenance soon)	Moderate	$2,000.00

Valve Vault - Corrosion

Drainage Conduit - Full

Electrical Disconnect

Joint Separation

Fiberglass Wet Well

Control Panel

Bellspring (Route 600) Lift Station

Location: Bellspring Rd. (Route 600)

Construction Date: ___

Pump Information: (2) __ HP submersible pumps – ___ gpm @ ___ ft TDH

Pump Manufacturer: ____

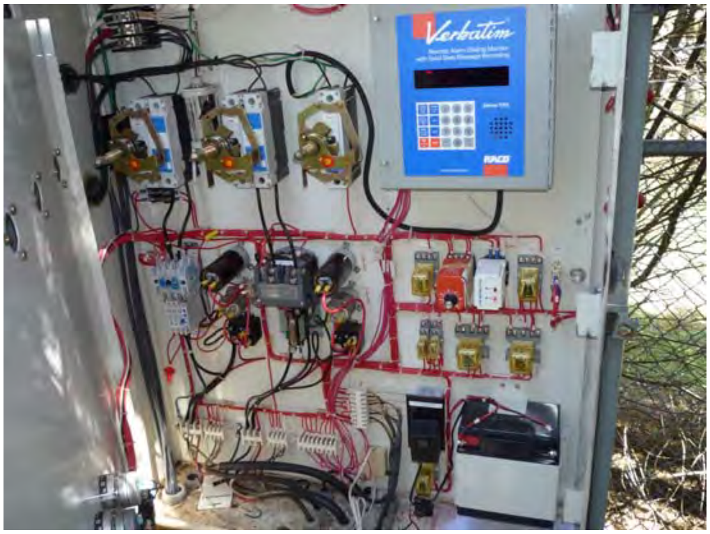
Emergency Generator: No

Emergency Generator Connection: Yes

Pictures: January 22, 2018 & April 5, 2018

Deficiencies:

Deficiency	Priority	Probable Cost (Non-Bid)
Deep Hand Valve (Require special operator)	Low	$2,000.00
Wetwell hatch does not close	Moderate	$1,500.00
Fence Missing Caps – Wire Falling – (Minimal Fixes)	Low	$500.00
Valve Vault Hatch is Undersized (replace top/hatch)	Moderate	$3,500.00
Concrete Piece Between WW&VV is being undermined (may require replacement/removal)	Low	$2,000.00
One Pump did not seem to operate as well as other (may need replacement or maintenance soon)	Moderate	$2,000.00



Control Panel

Deep Hand Wheel Valve

Undersized Valve Vault Hatch

Undermined Concrete

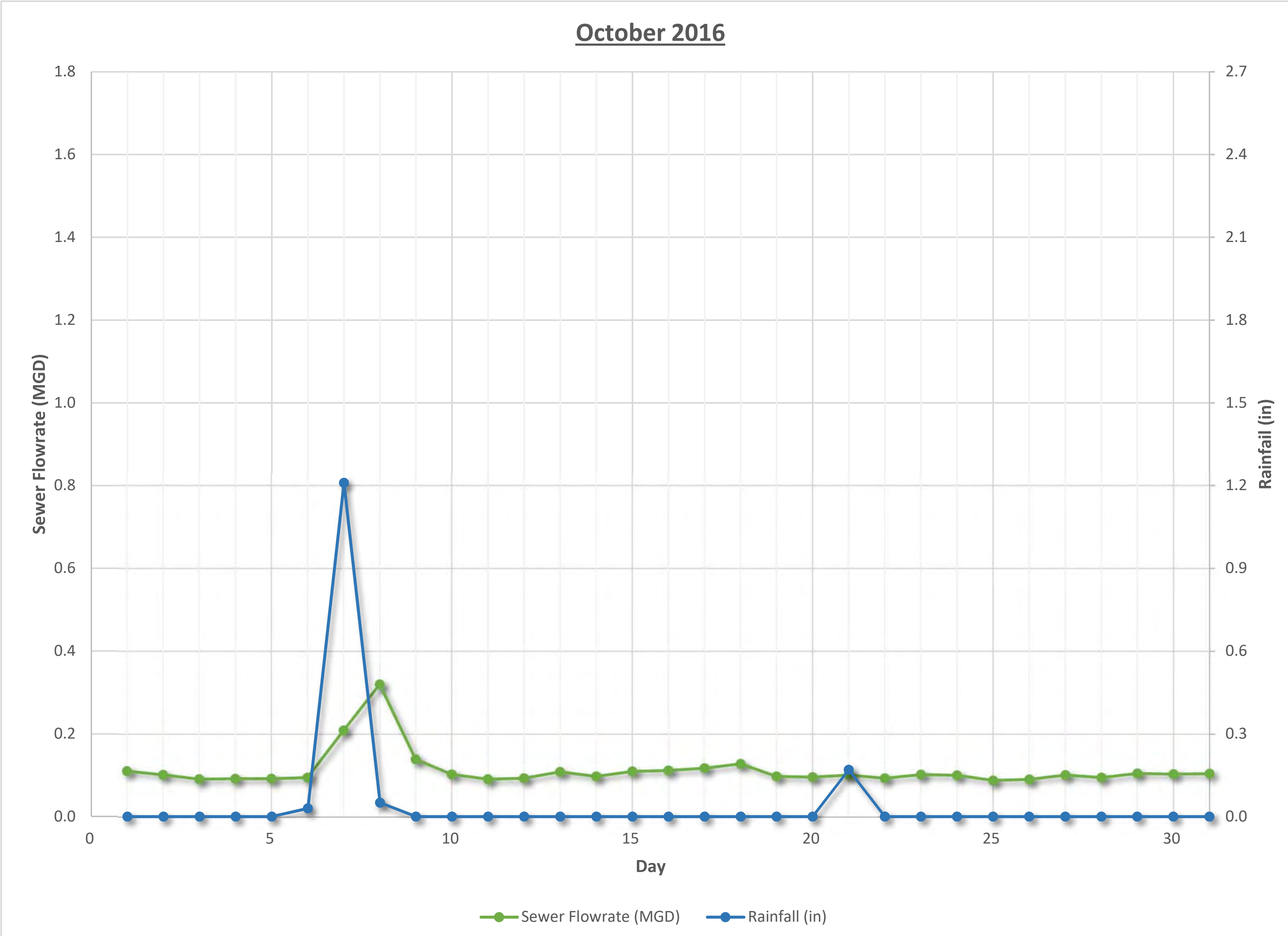
Wet Well Hatch

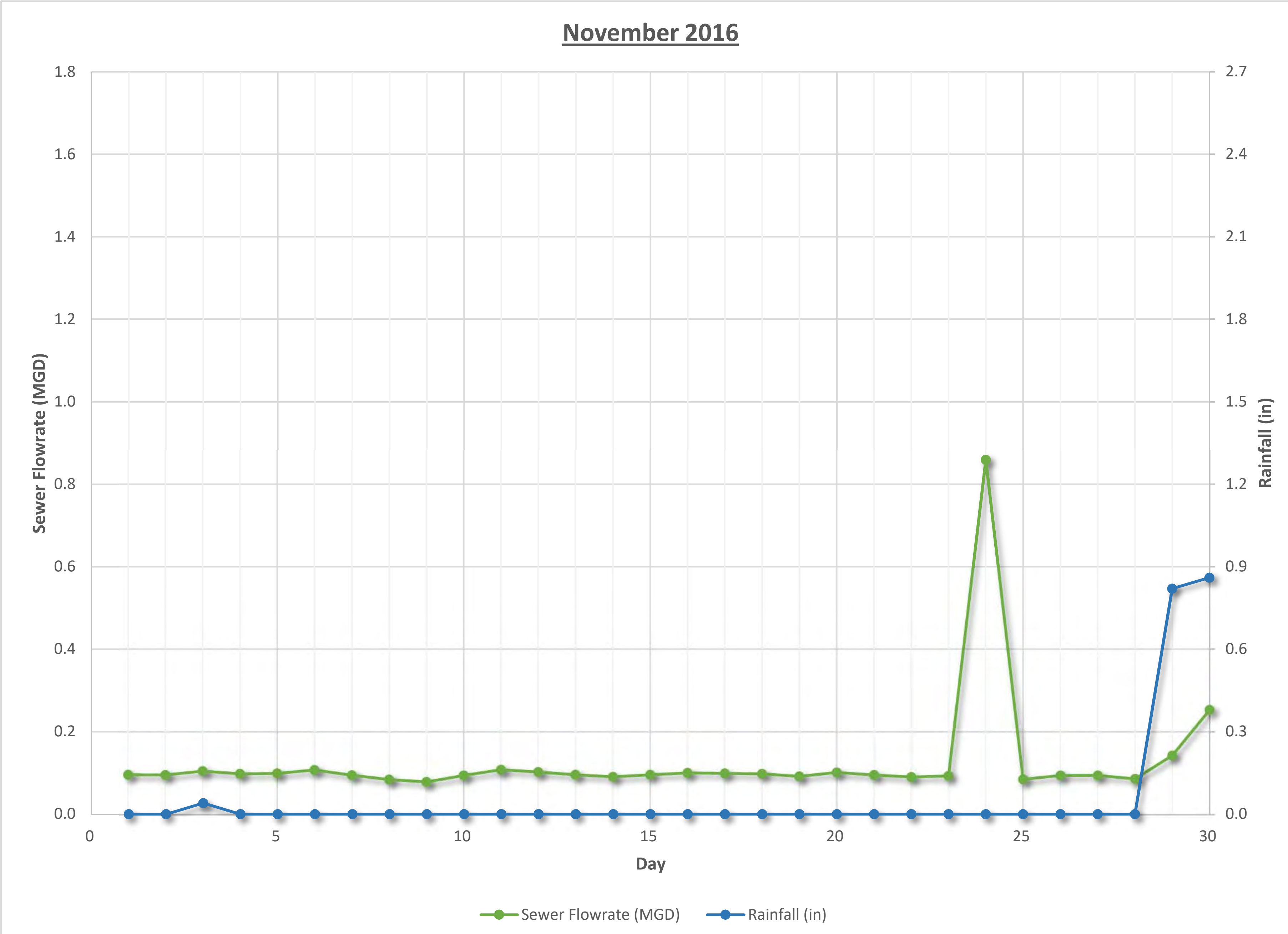
Fence Posts

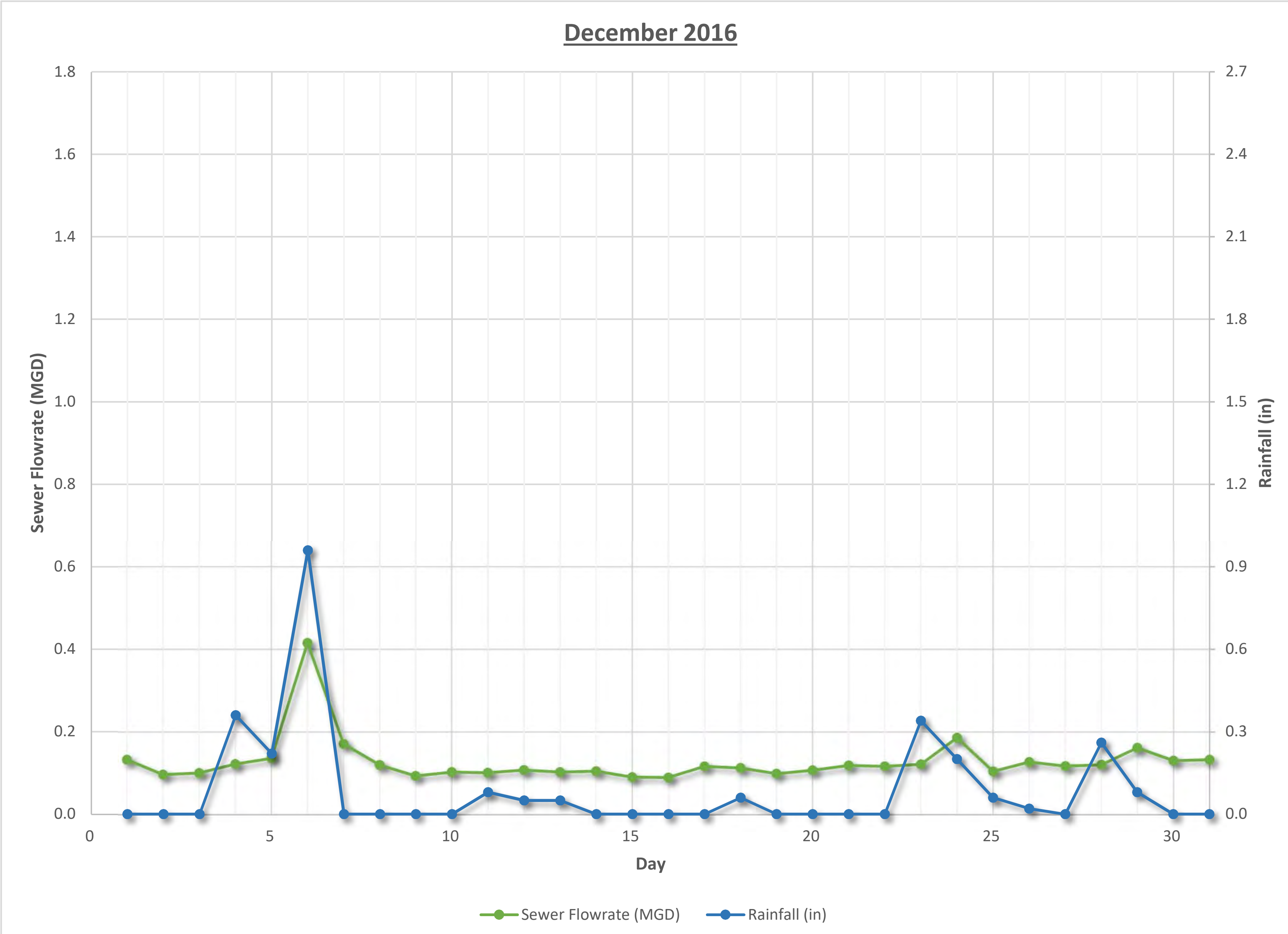
APPENDIX H

Flow Monitoring Data (Charts)

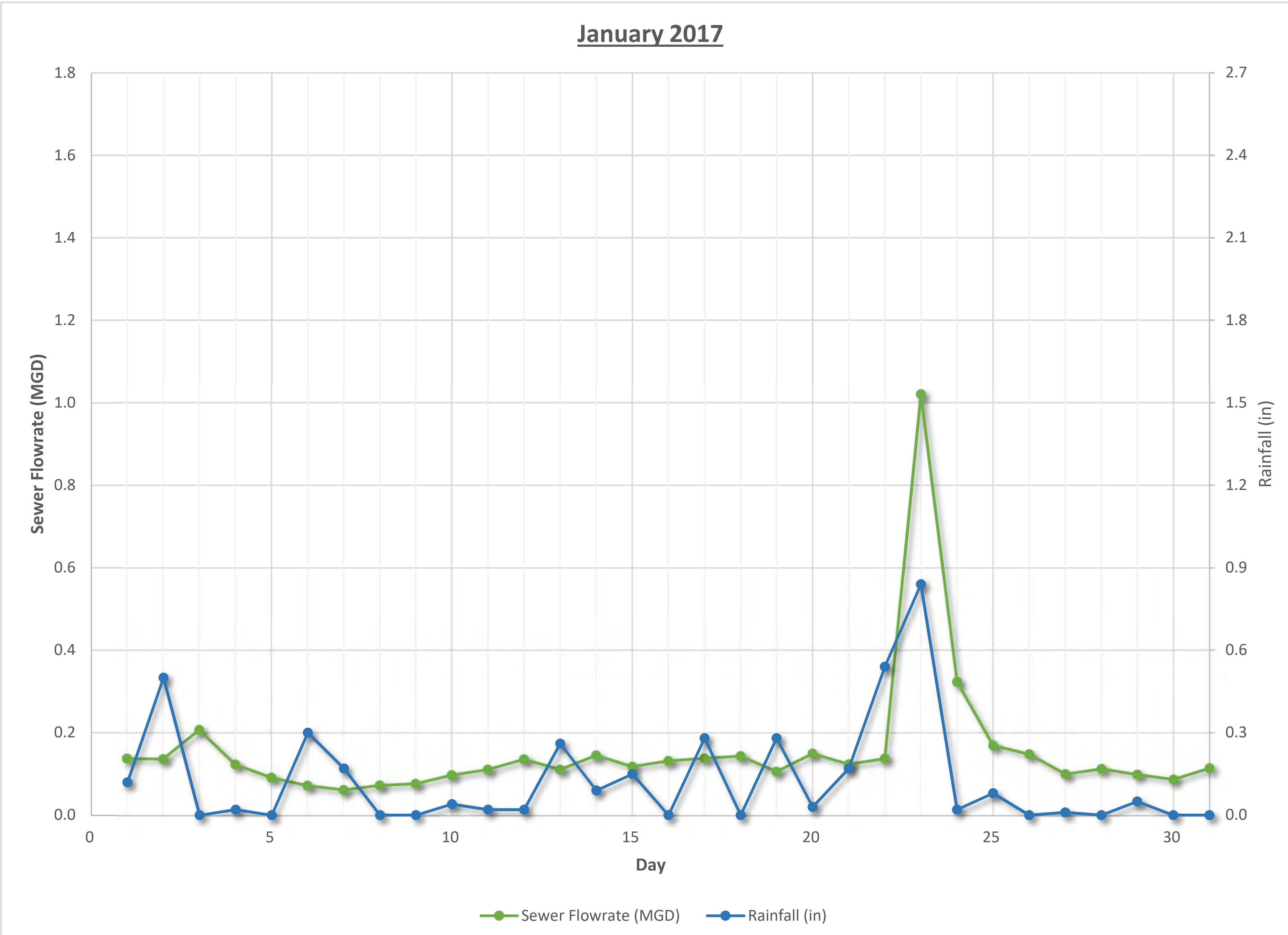
Appendix H: Flow Monitoring Data



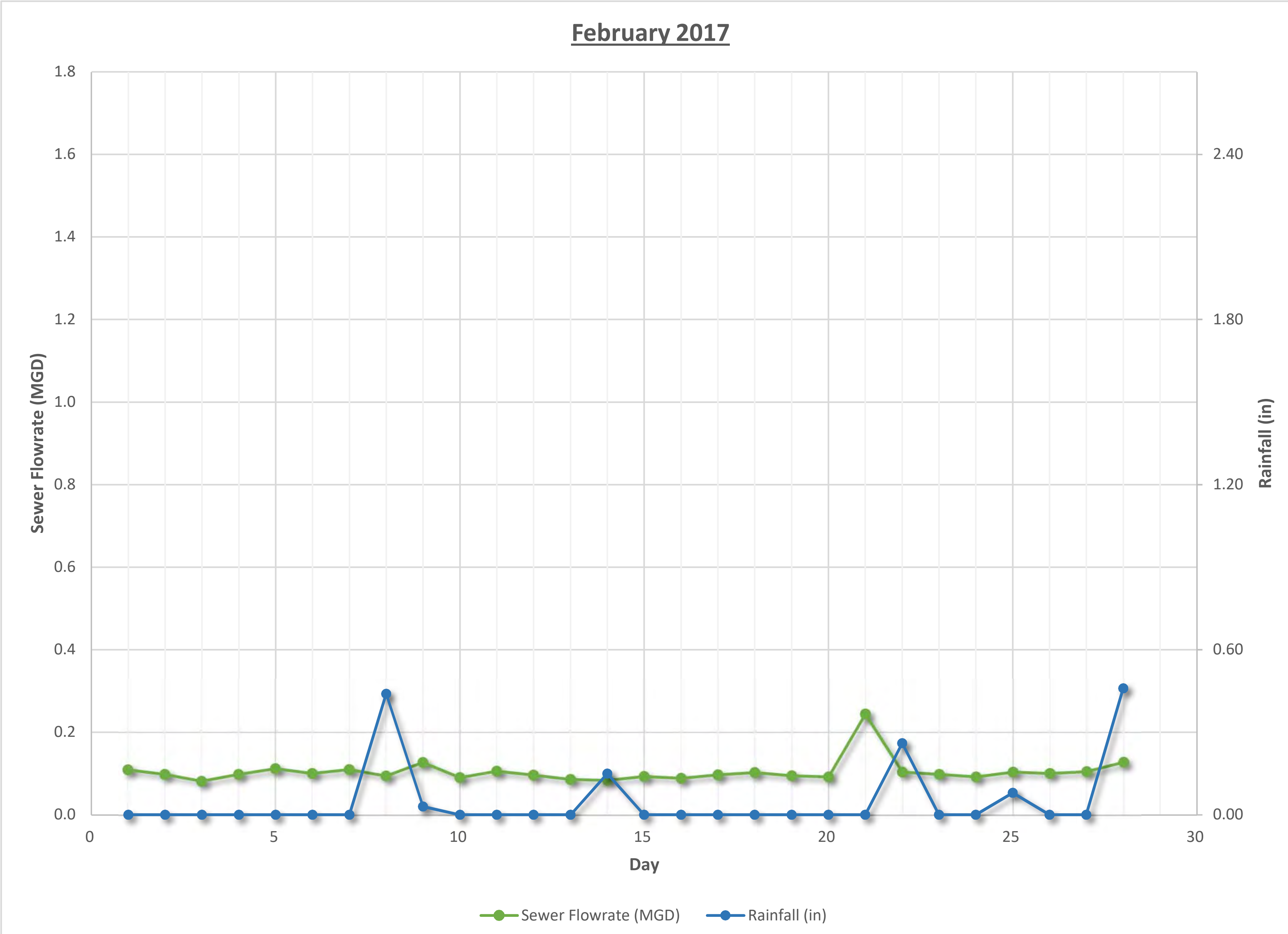

November 2016
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)

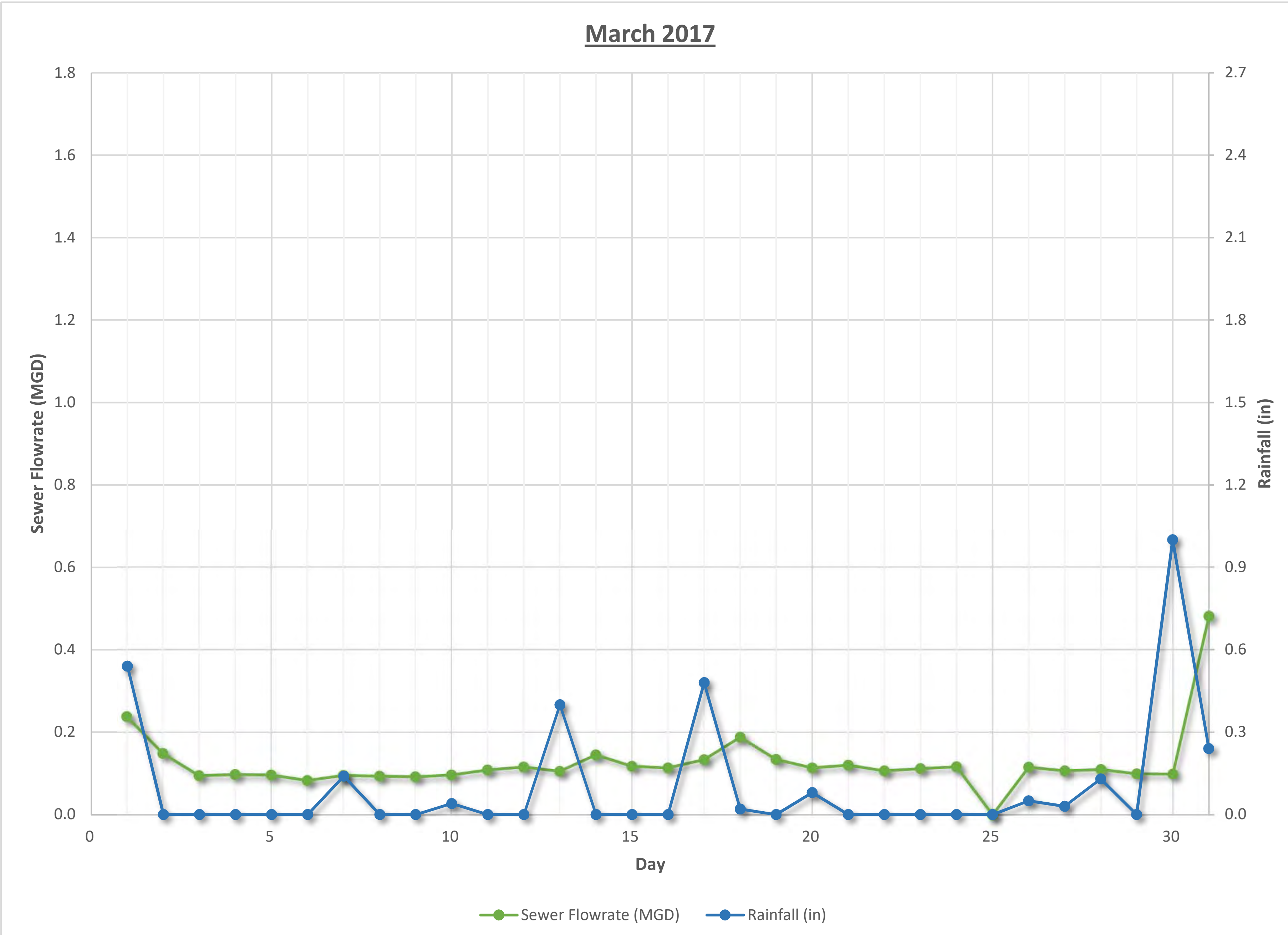


December 2016
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)

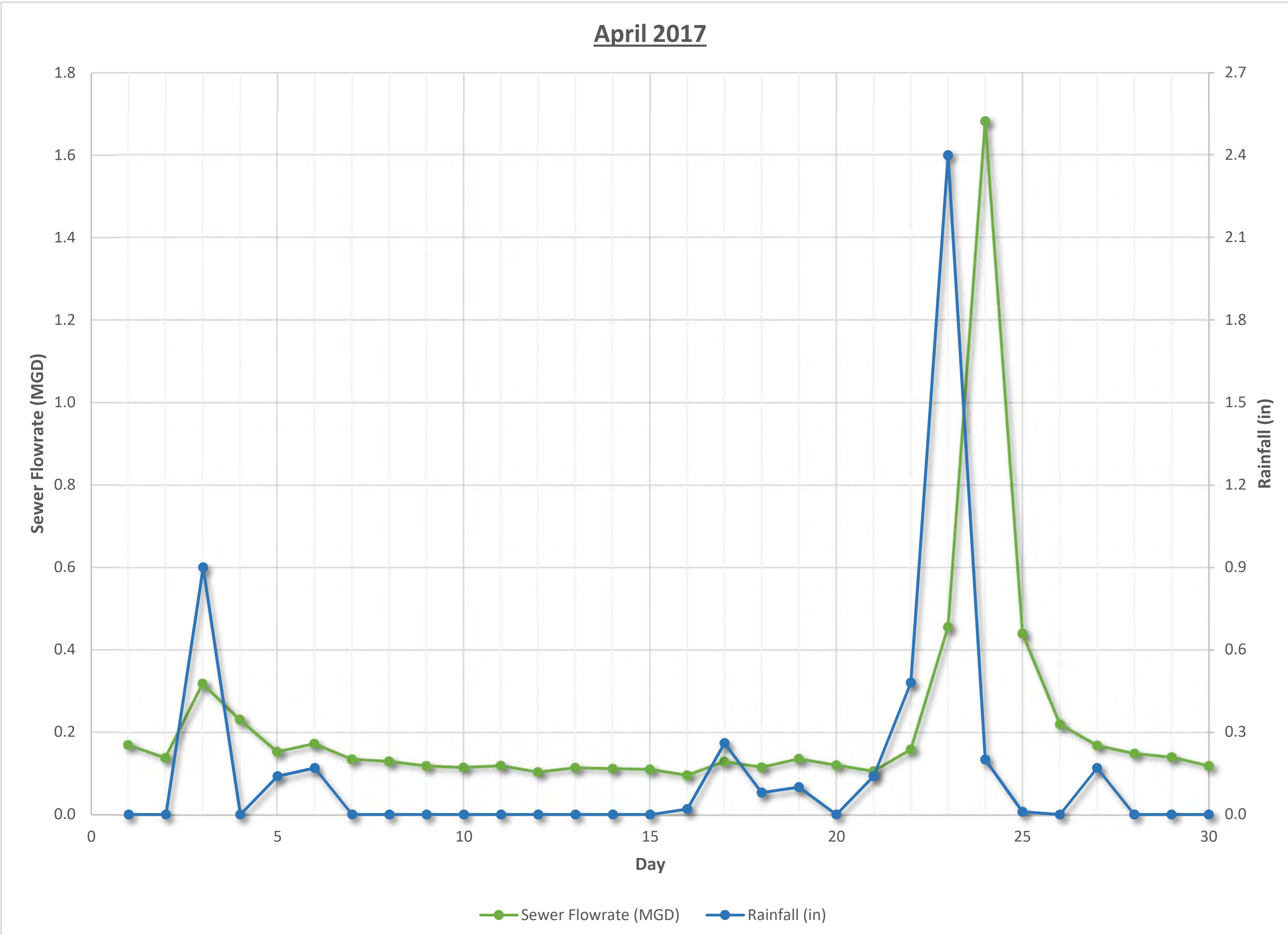


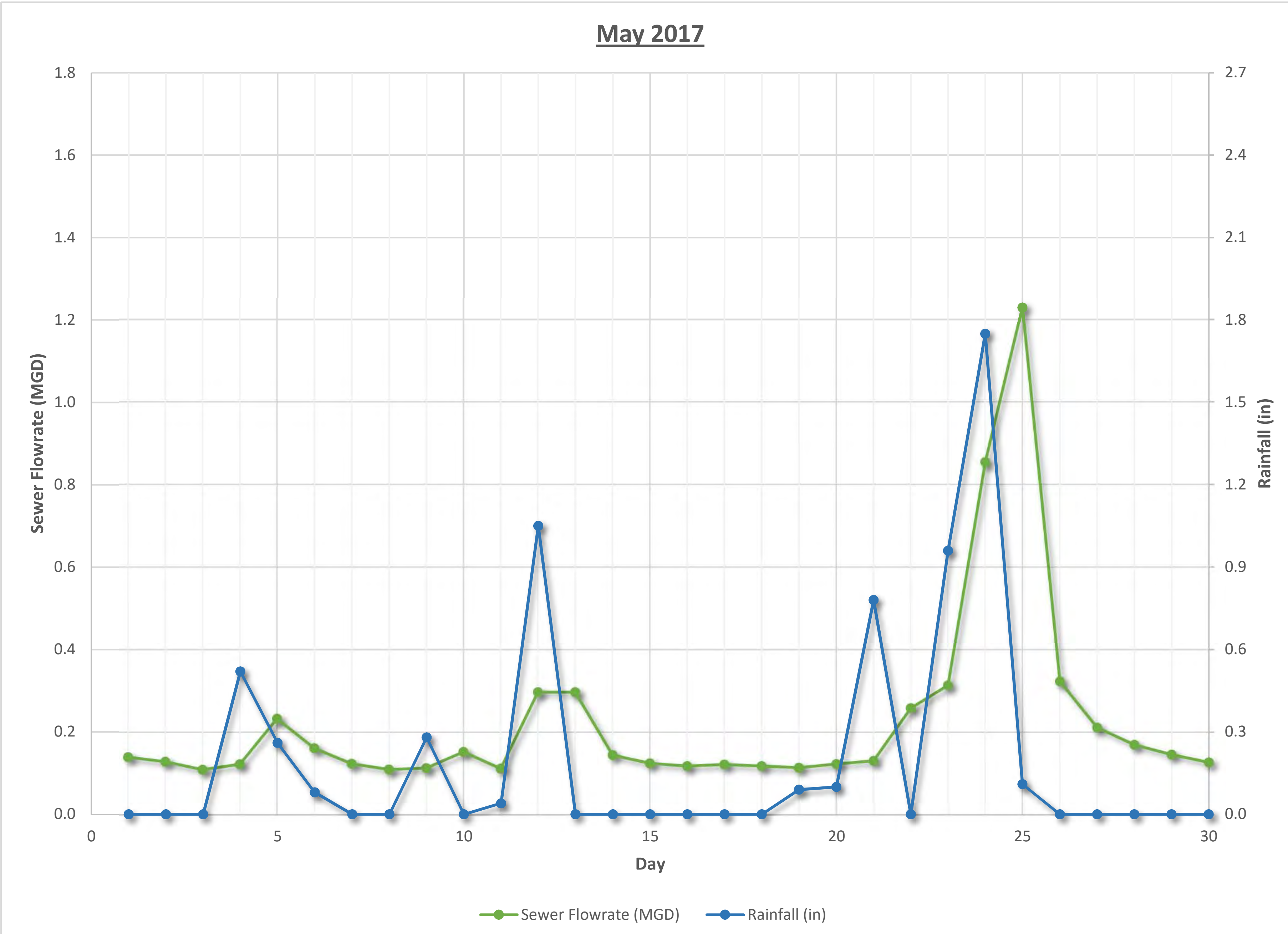
January 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)

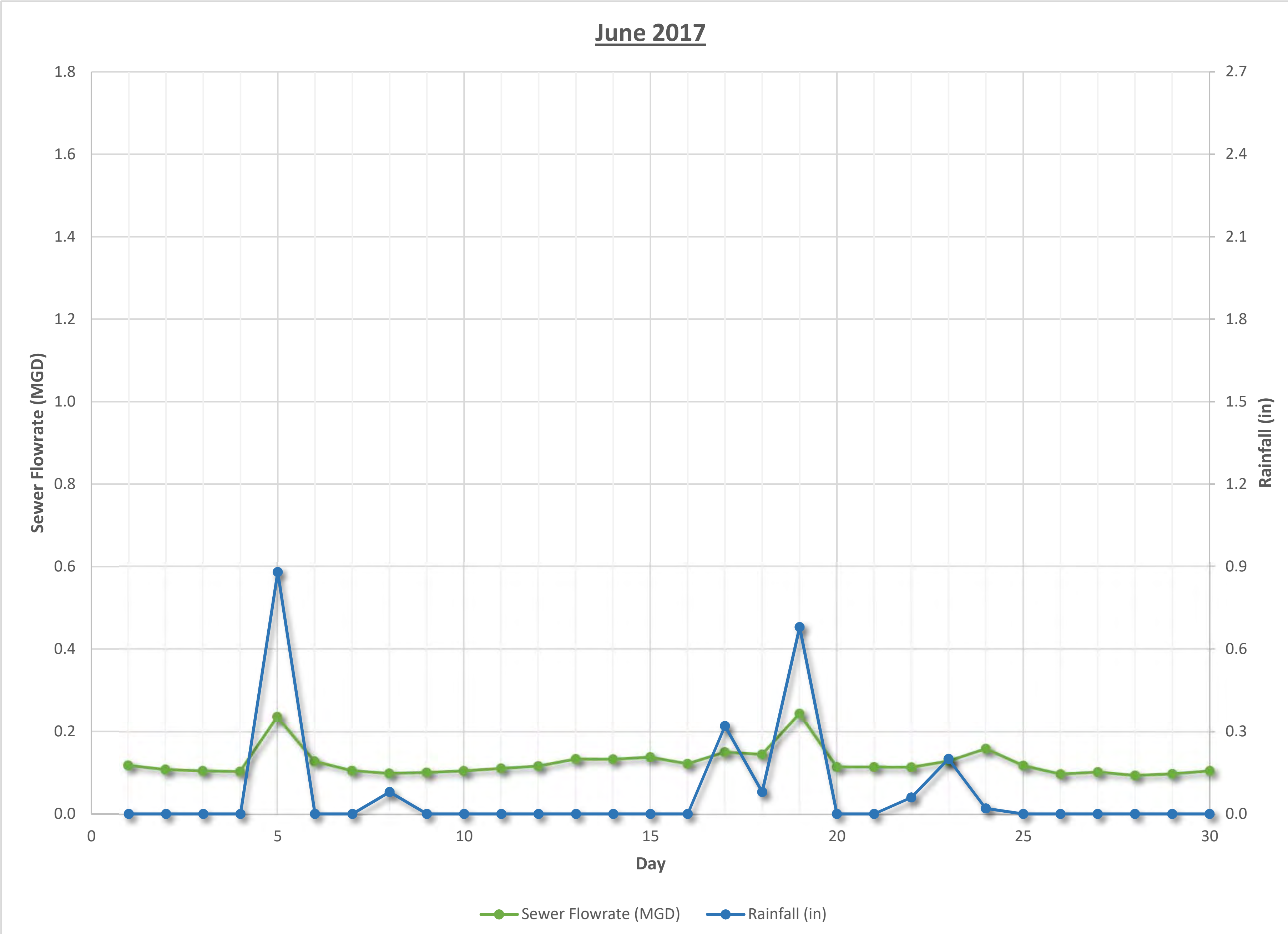

February 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.40
1.80
1.20
0.60
0.00
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)

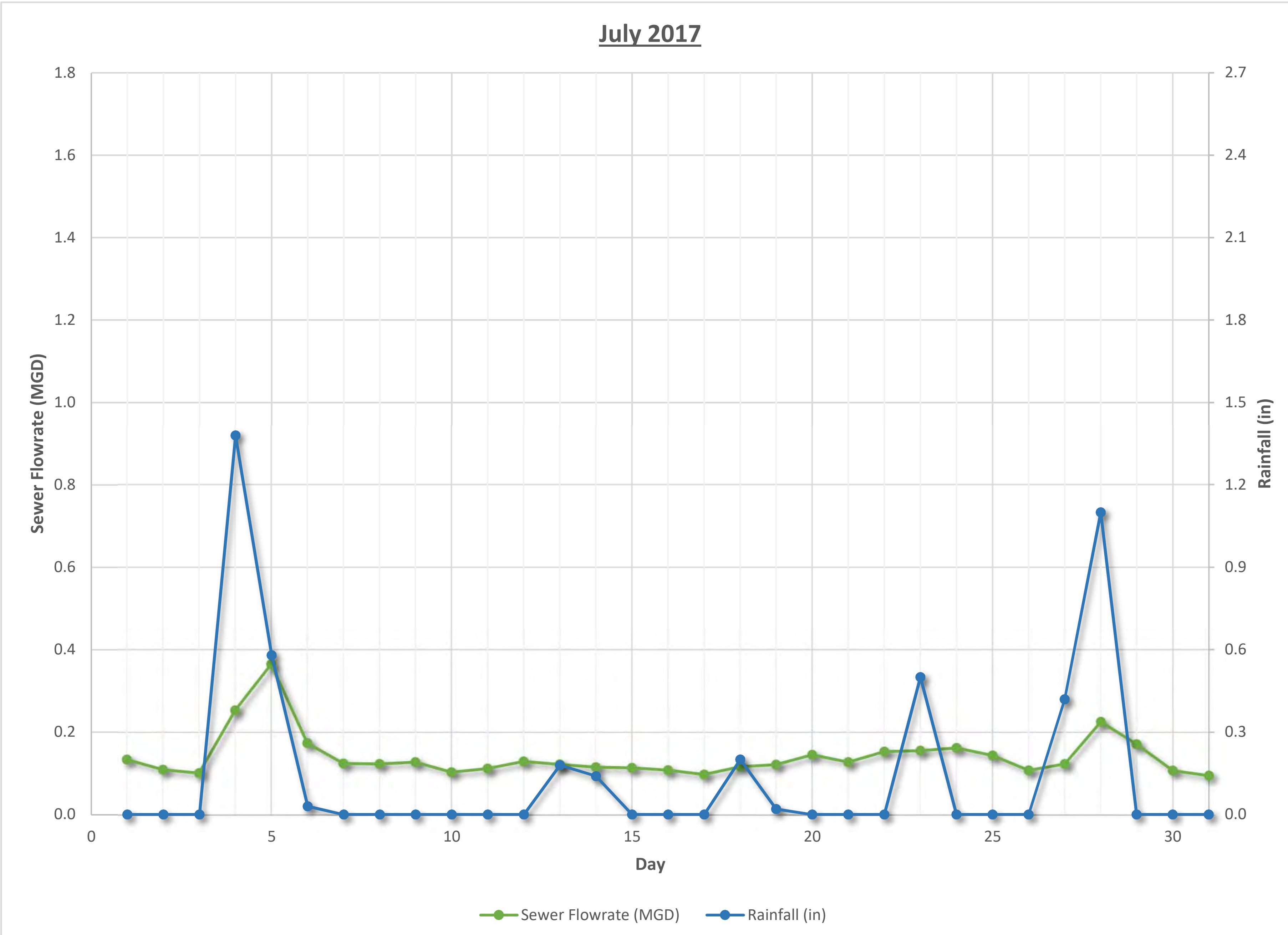


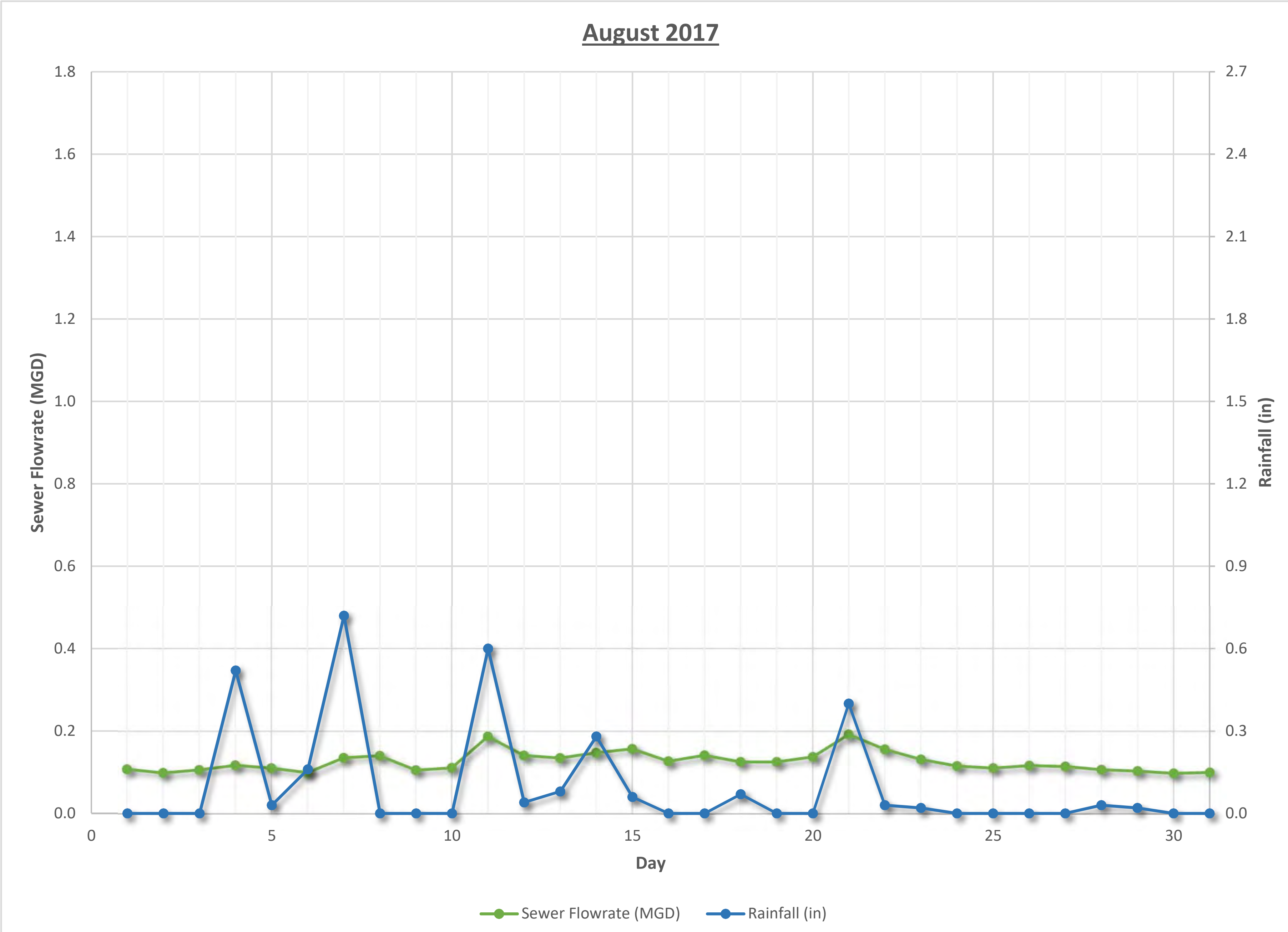
March 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)


April 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)

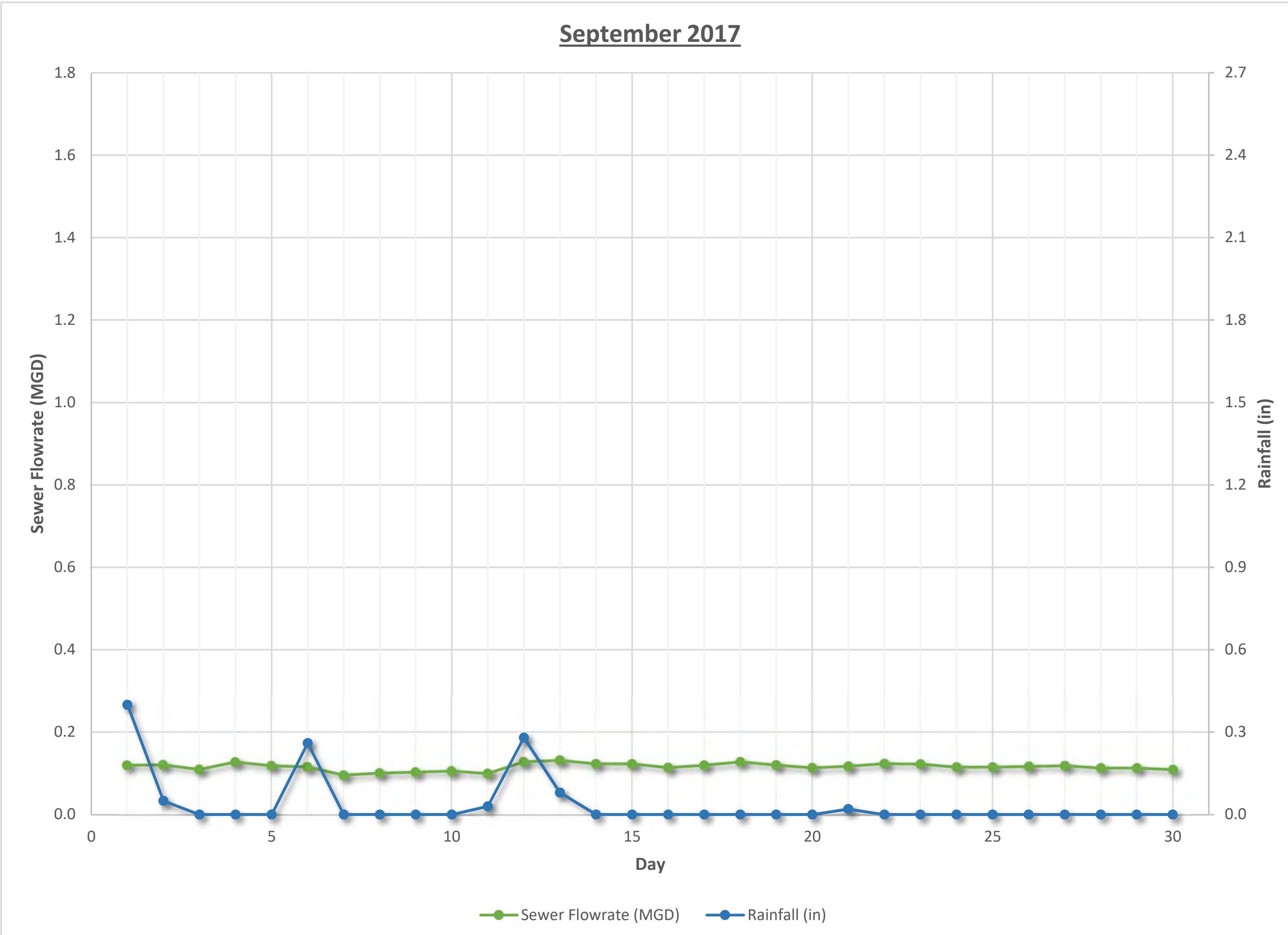

May 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)


June 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)


July 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)



August 2017
Sewer Flowrate (MGD)
Rainfall (in)
Day
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
0
5
10
15
20
25
30
Sewer Flowrate (MGD)
Rainfall (in)


September 2017
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Sewer Flowrate (MGD)
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
Rainfall (in)
0
5
10
15
20
25
30
Day
Sewer Flowrate (MGD)
Rainfall (in)