STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

PETITION OF COMMUNITY UTILITIES OF INDIANA, INC. FOR APPROVAL OF (1) EXPENDITURES FOR CONSTRUCTION OF ADDITIONS AND IMPROVEMENTS TO PETITIONER'S WASTEWATER UTILITY PROPERTIES, AND (2) THE INCLUSION OF THE VALUE OF SUCH NEW FACILITIES, INCLUDING PLAN DEVELOPMENT AND IMPLEMENTATION COSTS, IN PETITIONER'S RATE BASE IN FUTURE CASES.	)	**CAUSE NO. 45389**

PETITIONER'S SUBMISSION OF DIRECT TESTIMONY OF SEAN CARBONARO

VOLUME 3

Professional

Engineering

Services

Twin Lakes Metering and Modeling

Report

Community Utilities of Indiana, Inc.

July 2018

STRAND ASSOCIATES®

Report for

Community Utilities of Indiana, Inc.

Twin Lakes Metering and Modeling

Prepared by:

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July 2018

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APPENDICES

EXECUTIVE SUMMARY

This particular study focuses on the Twin Lakes Service Area located in Lake and Porter Counties, near the town of Winfield in northwestern Indiana. The area consists of separate sanitary and storm sewer systems and serves approximately 8,000 residents through approximately 3,200 services within the Lakes of the Four Seasons subdivision and some surrounding neighborhoods. Sewerage from the collection area is treated by the Twin Lakes Wastewater Treatment Plant (WWTP) owned and operated by Community Utilities of Indiana, Inc (CUII).

During large rain events over the last several years, flow rates observed at the WWTP have been well above the daily average flow, suggesting the presence of significant sources of infiltration and inflow (I/I), prompting this study.

In July 2017, CUII hired Strand Associates, Inc.® (Strand) to provide consulting engineering services for the Twin Lakes Metering and Modeling Study. As noted in the agreement between Strand and CUII, the scope of Strand's services generally consisted of the following:

1. Flow monitoring and data analysis.
2. Global positioning system (GPS) satellite collection survey.
3. Hydraulic computer modeling and results analysis.

Section 2 of this report describes the flow monitoring program for the Twin Lakes Service Area. The service area was divided into 18 subbasins and each subbasin was monitored with a flow meter (FM). Flow metering data was collected over a 125-day monitoring period from July 5, 2017 to November 7, 2017. Rainfall data was collected simultaneously during the flow metering period by two tipping-bucket rain gauges (RG). Figures ES-1 and ES-2 show the extents of the collection system along with the location of the flow meters and rain gauges.

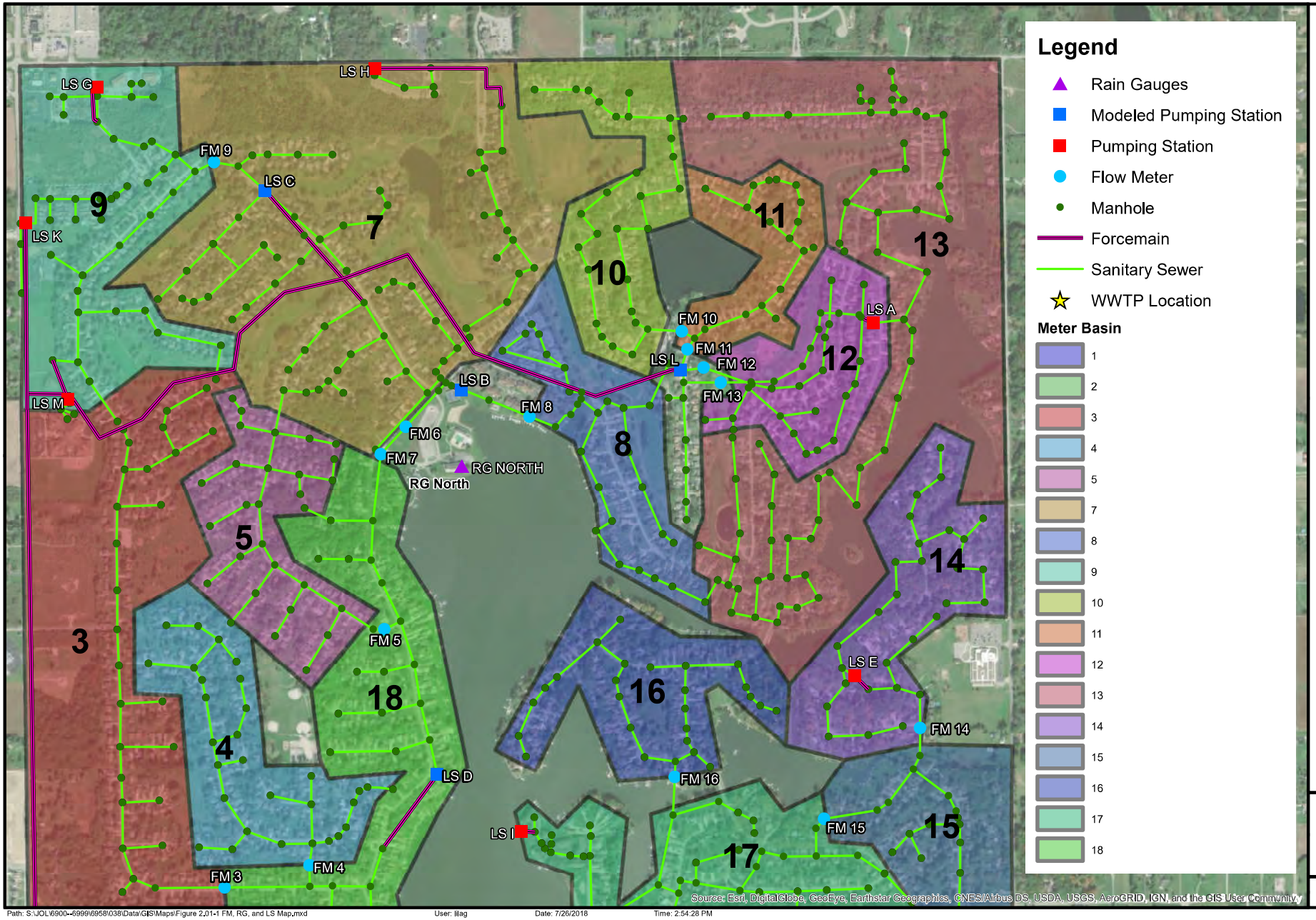
Section 3 of this report summarizes the flow metering data analysis. Each flow metering basin was assigned one of the two RGs based on geographical proximity. The data collected at the RG was used to analyze each rainfall event. The rainfall intensity for the most intense portion of the rainfall event was used to estimate a maximum recurrence interval according to the *Rainfall Frequency Atlas of the Midwest* by Huff and Angel.

In general, most of the rainfall events during the flow monitoring period were not very intense, with all events having less than a one-year recurrence interval. However, the July 21, August 3, and October 14 events were more significant than the others. Additionally, all the events appear fairly uniform. As a result, these three events were used for the data analysis.

A dry weather flow analysis was performed to determine the baseline flow characteristics of each FM basin. For a day to be considered a "dry" day, it had to satisfy two criteria.

1. It had to have less than 0.10 inch of rain over a 24-hour period.

2. There had to be at least 48 hours of dry weather preceding it.



Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\Figure 2.01-1 FM, RG, and LS Map.mxd User: lllag Date: 7/26/2018 Time: 2:54:28 PM

FM, RG, PUMPING STATION, AND METER SUBBASIN LOCATION-NORTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC
LAKE AND PORTER COUNTIES, IN

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ES 6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment ESC-10
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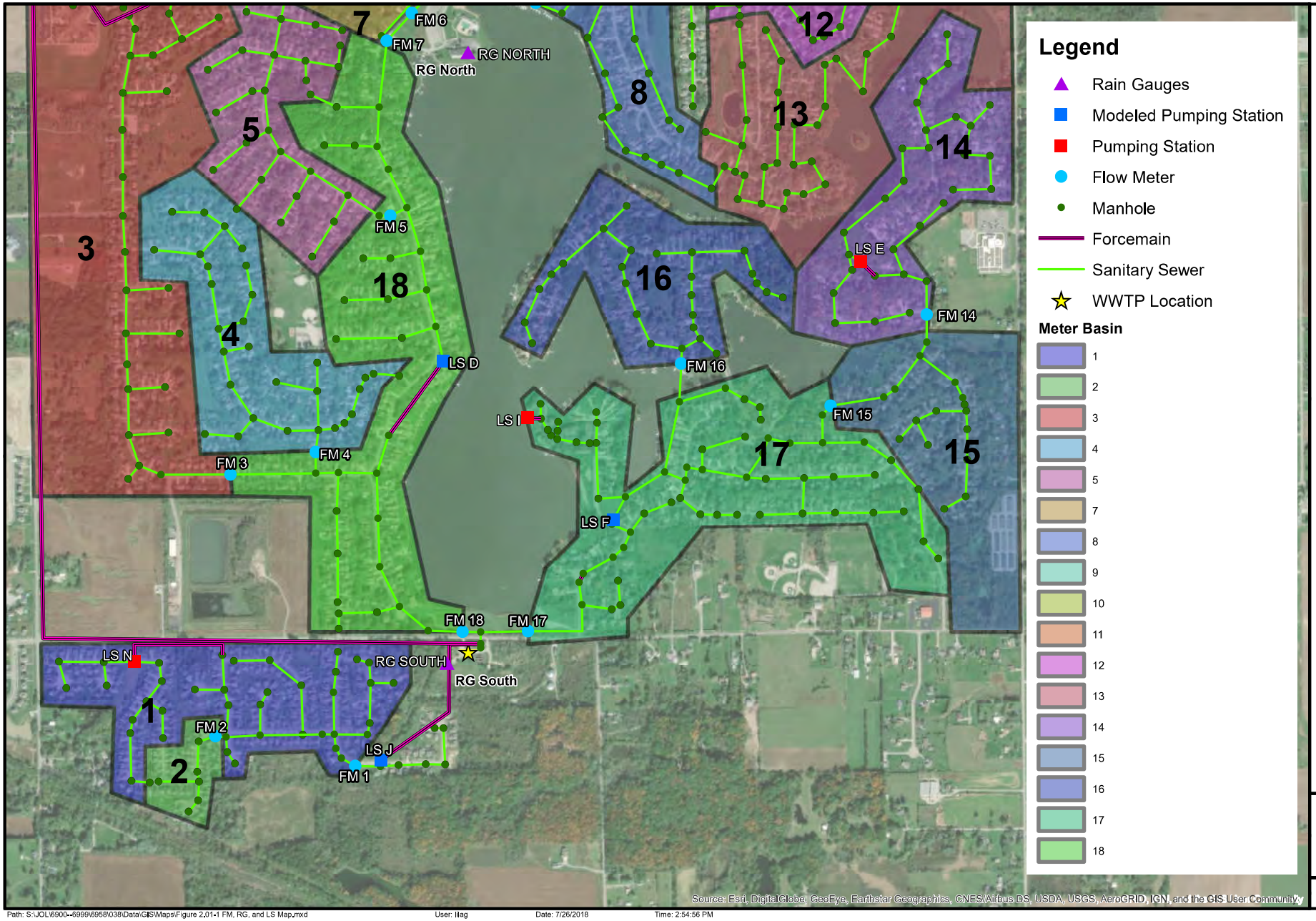

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FM, RG, PUMPING STATION, AND METER SUBBASIN LOCATION-SOUTH

TWIN LAKES SERVICE AREA METERING AND MODELING
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Table ES-1 shows the results of the dry weather flow analysis.

FM Basin	Dry Weather Flow (gallons per minute [gpm])		
	Overall	Weekday	Weekend
FM 1	41.2	38.8	46.4
FM 2[1]			
FM 3	15.3	15.0	16.1
FM 4	22.3	21.5	24.3
FM 5	24.5	24.1	25.7
FM 6	-0.6	-2.4	3.8
FM 7	57.2	53.3	66.0
FM 8	42.5	41.5	44.9
FM 9	24.0	24.5	23.2
FM 10	17.5	17.1	18.3
FM 11	16.7	16.5	17.6
FM 12	17.8	17.6	18.3
FM 13	42.9	43.4	42.7
FM 14	10.1	10.7	8.7
FM 15	17.2	16.2	19.5
FM 16	11.7	11.6	11.9
FM 17	135.0	131.7	143.3
FM 18	32.2	36.2	22.1

[1] Data from FM 2 were not analyzed because flows were too low to be measured.

Table ES-1 Dry Weather Base Flow Analysis

Two wet weather flow analyses were performed on each flow metering basin for each of the three study rainfall events on July 21, August 3, and October 14. The first was an inflow analysis in which the peak flow observed during a rainfall event at each flow metering location was divided by the average dry weather flow of the corresponding meter to produce the peaking factor for each FM basin. The second analysis takes into account infiltration, which is clear water entering the sanitary sewer system through sewer defects because of high groundwater.

Figures ES-3 and ES-4 provide a summary of these two analyses.

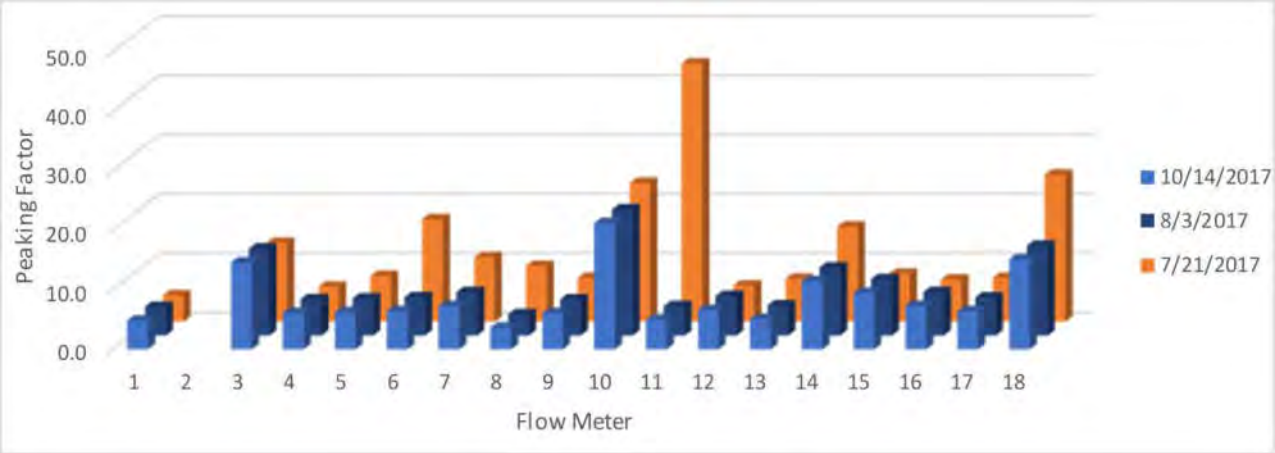

Figure ES-3 Peaking Factors at Each FM

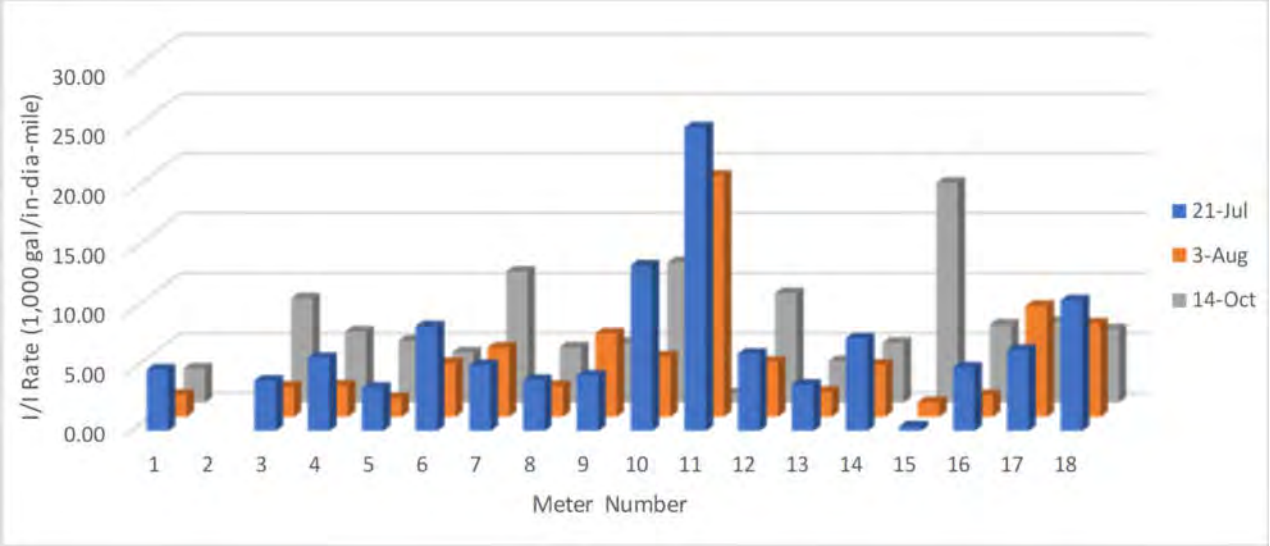

Figure ES-4 Total I/I Rates at Each FM

To prioritize the basins most in need of further evaluation, a ranking system was developed to determine the basins exhibiting the highest susceptibility to I/I. However, it is important to also factor in where the I/I is occurring and how it affects the overall performance of the collection system. Additionally, sources of inflow are traditionally both easier and less expensive to locate and repair than sources of infiltration. As a result, the basins with the highest potential for inflow problems should also be given priority over basins with sources of primarily infiltration.

Table ES-2 provides the recommended basin prioritization for investigating and removing I/I.

Priority FM Basin	Peaking Factor Rank	I/I Rate Rank	Overall Rank
10	1	1	1
7	6	3	4
14	3	6	3
3	4	10	5
6	5	7	6
18	2	2	2

Table ES-2 Basin Prioritization

Section 4 of this report summarizes the hydraulic modeling methods and results. Microcomputer-based simulation modeling was performed on the Twin Lakes Service Area collection system using XPSWMM sofrware. The purpose of the hydraulic model is to create a planning tool to identify capacity problems throughout the conveyance system (not just at the FMs), to evaluate potential system improvements to address capacity problems, and to assess the impacts of future growth and development in the community. The extents of the Twin Lakes Service Area Hydraulic Model include intercepting sewers, trunk and collector sewers, and the major lift stations, rather than modeling the entire collection system, which can be found in Figure ES-5.

Flow metering data collected throughout the conveyance system was used to calibrate and validate the accuracy of the hydraulic computer model. Average dry weather flow data was used in the model to establish the current baseline flow characteristics of the conveyance system. The calibration goal during the modeling process is to create a hydrograph that has a maximum flow and average flow within ±20 percent of the metered flow at each meter location. The results of the dry weather calibration process are summarized in Table ES-3.

	Average Flow			Maximum Flow		
Meter	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference
FM 1[1]	41.20	41.36	0%	55.83	57.00	2%
FM 3	15.35	15.05	-2%	38.44	37.25	-3%
FM 4	22.30	22.08	-1%	31.26	30.52	-2%
FM 5	24.53	23.89	-3%	39.33	38.15	-3%
FM 6	41.65	67.19	61%	243.43	230.70	-5%
FM 7	86.14	77.49	-10%	307.34	267.05	-13%
FM 8	42.48	42.10	-1%	58.87	57.90	-2%
FM 9	23.97	29.39	23%	50.77	49.82	-2%
FM 10	17.49	17.33	-1%	23.43	22.89	-2%
FM 11	34.19	34.54	1%	47.21	46.23	-2%
FM 12	17.78	18.17	2%	24.57	24.24	-1%
FM 13	42.89	53.88	26%	125.78	125.22	0%
FM 14	10.15	10.62	5%	20.30	19.75	-3%
FM 15	27.30	27.37	0%	41.07	42.64	4%
FM 16	11.72	12.17	4%	21.34	21.99	3%
FM 17	173.98	168.08	-3%	387.85	386.44	0%
FM 18	217.43	215.37	-1%	297.97	297.58	0%

[1] Includes flow metering basin FM 2

Table ES-3 Dry Weather Calibration

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SEWER SYSTEM MODELING EXTENTS

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
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The second step in the calibration process was to modify the hydraulic parameters within the model until the wet weather flow computed by the model matched the actual flows metered during a selected wet weather event. The model was calibrated based on flow data collected for one of the three study events. To confirm the model was both accurate and had the ability to predict the conveyance system's response to other unmetered wet weather events, a validation process was performed using a second study event in the model without adjusting any parameters. If the modeling validation results matched the second event's metering results, the model was considered both calibrated and validated and it could be assumed, within reason, that the model was both accurate and able to predict the system's response to other flow scenarios. The results of the wet weather calibration and validation are summarized in Tables ES-4 and ES-5, respectively.

Meter	Maximum Flow			Total Flow		
	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference	Metered Flow (gallons)	Modeled Flow (gallons)	Percent Difference
1	159	184	15%	138,406	142,779	3%
3	133	160	21%	68,206	75,871	11%
4	100	120	21%	77,341	82,876	7%
5	133	141	6%	103,835	115,883	12%
6	279	383	37%	129,090	137,409	6%
7	392	423	8%	294,694	301,749	2%
8	261	228	-13%	120,807	111,078	-8%
9	186	178	-4%	153,498	146,224	-5%
10	285	319	12%	91,698	102,855	12%
11	660	726	10%	200,180	218,442	9%
12	95	88	-8%	63,987	62,076	-3%
13	235	236	0%	95,233	166,055	74%
14	102	115	13%	72,066	55,199	-23%
15	119	137	15%	77,397	92,109	19%
16	76	71	-7%	42,434	49,204	16%
17	1,154	1,091	-6%	592,895	522,263	-12%
18	1,176	1,088	-7%	785,148	812,229	3%

[1]Includes flow metering basin FM2

Table ES-4 Wet Weather Calibration

Meter	Maximum Flow			Total Flow		
	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference	Metered Flow (gallons)	Modeled Flow (gallons)	Percent Difference
1	186	156	-16%	234,577	190,247	-19%
3	204	159	-22%	111,054	99,087	-11%
4	133	108	-19%	137,898	115,674	-16%
5	190	153	-19%	118,678	122,235	3%
6	724	432	-40%	274,550	237,647	-13%
7	623	557	-11%	524,343	437,422	-17%
8	211	240	14%	186,144	164,884	-11%
9	178	201	13%	257,921	226,355	-12%
10	410	402	-2%	200,832	165,517	-18%
11	1,019	932	-9%	372,163	350,663	-6%
12	109	113	3%	90,996	95,325	5%
13	312	302	-3%	199,422	235,816	18%
14	163	135	-17%	156,258	90,655	-42%
15	140	154	10%	146,207	142,846	-2%
16	84	90	7%	92,311	77,163	-16%
17	1,213	1,103	-9%	865,592	759,567	-12%
18	1,425	1,333	-6%	1,337,672	1,179,849	-12%

[1] Includes flow metering basin FM 2

Table ES-5 Wet Weather Validation

To understand how the collection system reacts to wet weather events that were not metered, the model was run using several theoretical storm scenarios. The following theoretical storms were used for the basis of the modeling results and recommendations described in the remaining sections of this report:

1. 2-year, 2-hour rainfall event
2. 5-year, 2-hour rainfall event
3. 10-year, 2-hour rainfall event
4. 50-year, 2-hour rainfall event
5. 100-year, 2-hour rainfall event

Running these additional scenarios allowed the model to predict what type of reaction the system would have under larger storm events than those metered.

Rather than list and tabulate flow data for each model run at different locations throughout the Twin Lakes Service Area, a series of figures were created for each model to provide a visual representation of where potential problem areas exist according to the model. Each figure shows sewers highlighted as follows:

1. Yellow represents a surcharged sewer. A surcharged sewer is one where the level of flow exceeds the elevation of the top of the sewer.

2. Orange represents a sewer where there is a potential for basement backups. This is defined as any sewer where the depth of flow within the sewer is within eight feet of the ground surface elevation. If a sewer was shallower than eight feet and did not surcharge, it was not included as a sewer with the potential to cause basement backups. It should be noted that this is a very general determination of basement backup potential. As such, any areas that exhibit potential for basement backup should be field investigated to verify a basement backup potential truly exists. For example, a number of sewers run in backyards and in the golf course in the Lake of the Four Seasons. While the sewer may surcharge to within eight feet of ground elevation, the nearest homes may be constructed significantly higher than the ground at the nearest sewer. In that particular case, a basement backup potential may not actually exist.

3. Red represents a sewer where a sanitary sewer overflow (SSO) occurred, meaning the level within the sewer exceeded the ground surface elevation.

Figures 4.07-1 through 4.07-10 in Section 4 represent each modeling scenario created within the model as follows:

1. Figures 4.07-1 and 4.07-2, 2-Year, 2-Hour Storm
2. Figures 4.07-3 and 4.07-4, 5-Year, 2-Hour Storm
3. Figures 4.07-5 and 4.07-6, 10-Year, 2-Hour Storm
4. Figures 4.07-7 and 4.07-8, 50-Year, 2-Hour Storm
5. Figures 4.07-9 and 4.07-10, 100-Year, 2-Hour Storm

Section 5 of this report identifies and evaluates a number of alternatives to address wet weather issues within the collection system and provides recommendations. These include both I/I removal and infrastructure improvements.

Tables ES-6 and ES-7 summarize the infrastructure improvements costs associated with all alternatives evaluated by the model.

	Percent Reduction in I/I				
	0%	20%	40%	60%	100%
No Lift Station Improvements	$7,855,000	$7,590,000	$3,351,000	$2,128,000	$0
Rerouting Lift Station C Only	$6,534,000	$5,907,000	$3,285,000	$1,719,000	$0
Rerouting Lift Station D Only	$7,024,000	$6,120,000	$3,351,000	$2,128,000	$0
Rerouting both Lift Stations C and D	$5,748,000	$4,692,000	$3,285,000	$1,719,000	$0
Rerouting Lift Station B Only	$6,139,000	$5,498,000	$2,956,000	$1,719,000	$0
Rerouting both Lift Stations B and C	$5,517,000	$4,528,000	$2,956,000	$1,719,000	$0
Rerouting Lift Stations B, C, and D	$5,122,000	$4,297,000	$2,956,000	$1,719,000	$0

Table ES-6 Alternative 1 Collection System Improvement Costs

	Percent Reduction in I/I				
	0%	20%	40%	60%	100%
No Lift Station Improvements	$7,410,000	$6,957,000	$3,417,000	$2,128,000	$0
Rerouting Lift Station C Only	$6,103,000	$5,259,000	$3,337,000	$1,719,000	$0
Rerouting Lift Station D Only	$6,572,000	$5,486,000	$3,417,000	$2,128,000	$0
Rerouting both Lift Stations C and D	$5,320,000	$4,060,000	$3,337,000	$1,719,000	$0
Rerouting Lift Station B Only	$5,697,000	$4,866,000	$3,009,000	$1,719,000	$0
Rerouting both Lift Stations B and C	$5,088,000	$3,896,000	$3,009,000	$1,719,000	$0
Rerouting Lift Stations B, C, and D	$4,680,000	$3,665,000	$3,009,000	$1,719,000	$0

Table ES-7 Alternative 2 Collection System Improvement Costs

Recommendations include the following:

1. Implementing an I/I Removal Program

An I/I program starts with a study to identify the sources of I/I into the separate sewer system. Common sources of I/I include connected downspouts and foundation drains, sump pump connections, storm and sanitary cross connections, manhole defects, and pipe defects. The I/I study will identify which of these potential sources are present in the service area. There are several methods of identifying sources of I/I; the most common being manhole inspections, smoke testing, dye testing, and sewer televising.

After the sources of I/I are identified, sewer televising is used to plan rehabilitation to address the sources. This plan could potentially include a downspout and foundation drain disconnection program, manhole repair program, point sewer repairs, and sanitary sewer lining.

The rehabilitation performed based on the I/I investigations could not only reduce the amount of I/I entering the system, but more importantly, it could also prevent a costly sewer infrastructure failure in the future and could also reduce the amount of I/I entering the system enough to reduce the size of the necessary infrastructure improvements.

2. Collect Data Associated with Collection System

It is recommended that CUII complete a detailed survey of the entire collection system to develop a GIS database. The GIS database would be a central location where all the information associated with the Twin Lakes Service Area would be located.

Additionally, it is recommended that CUII perform a detailed study on each of its lift stations. This detailed study should include a detailed survey to create accurate as-built drawings showing the dimensions and elevations of the wet well, incoming sewers, and outgoing force main; and the study should also determine the current operating setpoints for each lift station and should include a lift station calibration to better understand the current pumping capacities of each lift station.

3. Develop and Implement a System Improvement Plan

An I/I removal program is not sufficient to alleviate all issues within the collection system. As such, additional capital improvements to the collection system are required. CUII should evaluate the information provided in this report as well as the information developed by its other consultants regarding lift station improvements to identify the most cost-effective approach to alleviating wet weather issues within its collection system. This evaluation would help to develop a System Improvement Plan.

SECTION 1
INTRODUCTION

1.01 BACKGROUND

This particular study focuses on the Twin Lakes Service Area located in Lake and Porter Counties, near the town of Winfield in northwestern Indiana. Figure 1.01-1 shows the location of the service area. The area consists of separate sanitary and storm sewer systems and serves approximately 8,000 residents through approximately 3,200 services within the Lakes of the Four Seasons subdivision and some surrounding neighborhoods. Sewerage from the collection area is treated by the Twin Lakes Wastewater Treatment Plant (WWTP) owned and operated by Community Utilities of Indiana, Inc. (CUII).

During large rain events over the last several years, flow rates observed at the WWTP have been well above the daily average flow, suggesting the presence of significant sources of infiltration and inflow (I/I), prompting this study.

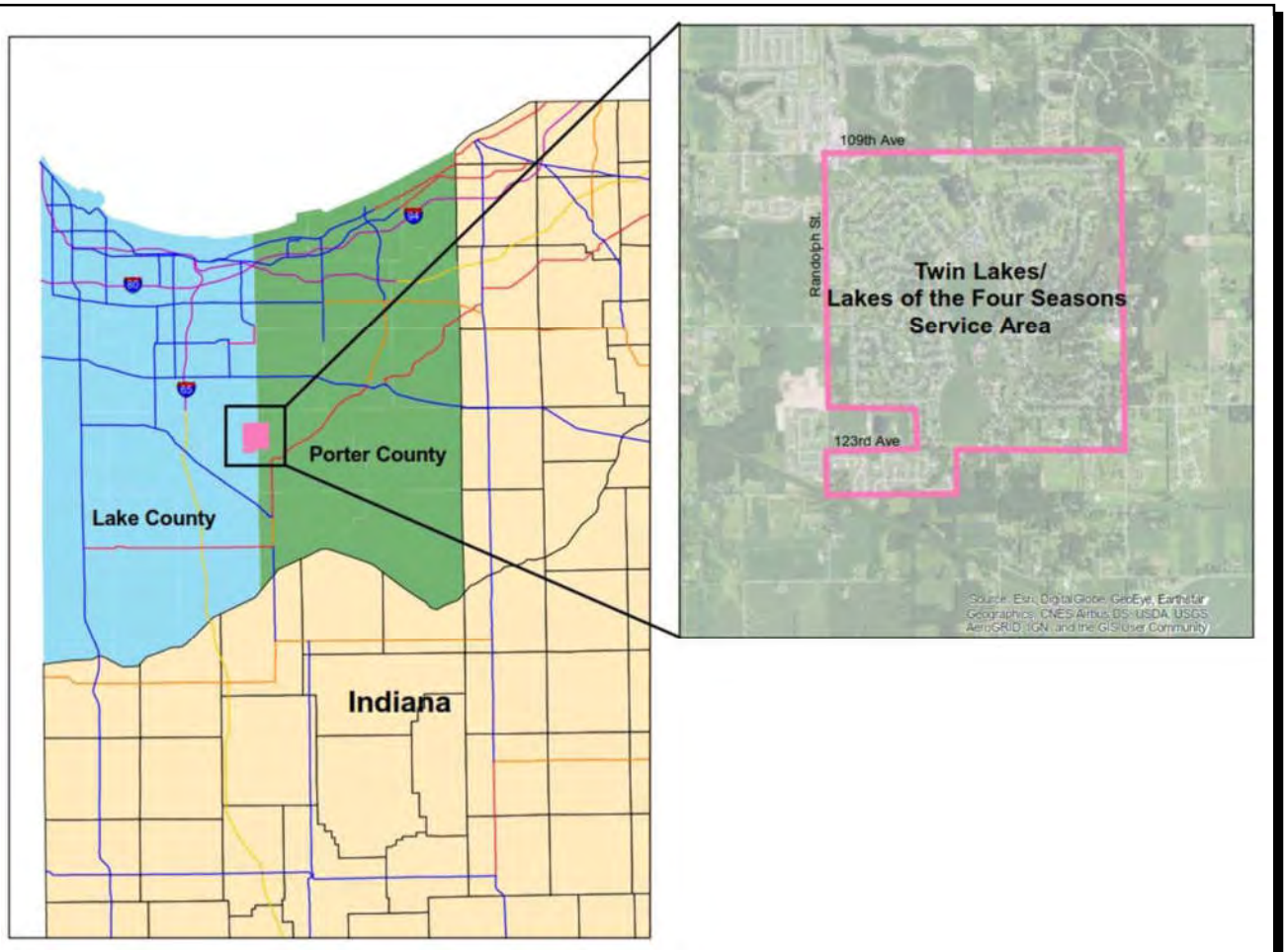


Figure 1.01-1 Twin Lakes Service Area Location

Inflow is defined as clear water entering the sanitary sewer system because of rainfall or surface runoff from sources such as roof leaders, yard or area drains, foundation drains, manhole (MH) covers, and cross connections with storm sewers. Infiltration is clear water entering the sanitary sewer system because of high ground or surface waters through sewer defects, such as defective sewer joints, cracked or broken sewer pipes, or cracked MH walls.

In July 2017, CUII hired Strand Associates, Inc.® (Strand) to provide consulting engineering services for the Twin Lakes Metering and Modeling Study. As noted in the agreement between Strand and CUII, the scope of Strand's services generally consisted of the following:

1. Flow monitoring and data analysis.
2. Global positioning system (GPS) satellite collection survey.
3. Hydraulic computer modeling and results analysis.

1.02 SCOPE OF STUDY

The Twin Lakes Metering and Modeling program generally consists of the following items:

A. Flow Monitoring and Data Analysis

Flow monitoring and data analysis involved the following tasks:

1. Identification of flow monitoring and rain gauge sites.
2. Installation, maintenance, and removal of flow metering and rain gauge equipment.
3. Data analysis.

B. GPS Collection Survey

A GPS survey of the service area collection system was performed. The purpose of this survey was to gather precise location and elevation information to use in the development of a computer-based hydraulic model.

Information collected from the GPS survey included horizontal and vertical information pertaining to sanitary MHs and pumping stations, sewer pipe sizes, and materials where available.

It is important to note that the entire collection system was not GPS surveyed; only the portions of the collection system that was modeled were GPS surveyed, which amounted to approximately 120 MHs and six of the 13 pumping stations. This is explained in greater detail later in this report.

C. Hydraulic Computer Modeling and Results Analysis

GPS survey information was used to create a computer-based hydraulic model of the collection system. XPSWMM software was used to create the hydraulic computer model. Pumping station data was also gathered for creation of the model. Flow metering data was used to calibrate and validate the hydraulic model.

The model was used to identify flow characteristics under current dry weather and various wet weather conditions. The model was further used to identify problem areas and to study potential improvements to address the problems.

1.03 ABBREVIATIONS

CUII	Community Utilities of Indiana, Inc
FM	flow meter
ft	feet
ft/sec	feet per second
gal	gallon
GIS	geographical information system
gpm	gallons per minute
GPS	global positioning system
hp	horsepower
I/I	infiltration/inflow
in	inch
in-dia-mi	inch-dia-mi
LS	lift station
MH	manhole
OPCC	opinion of probable capital cost
PS	pumping station
RG	rain gauge
SSO	sanitary sewer overflow
USEPA	United States Environmental Protection Agency
WWTP	wastewater treatment plant

SECTION 2
FLOW MONITORING PROGRAM

2.01 EXISTING COLLECTION SYSTEM

The Twin Lakes Service Area covers approximately 2,100 acres in unincorporated Lake and Porter Counties, located near the town of Winfield, Indiana, primarily in the Lakes of the Four Seasons subdivision. The collection system is owned and operated by CUII. Sewer system pipe sizes range from 8- to 18-inch diameter.

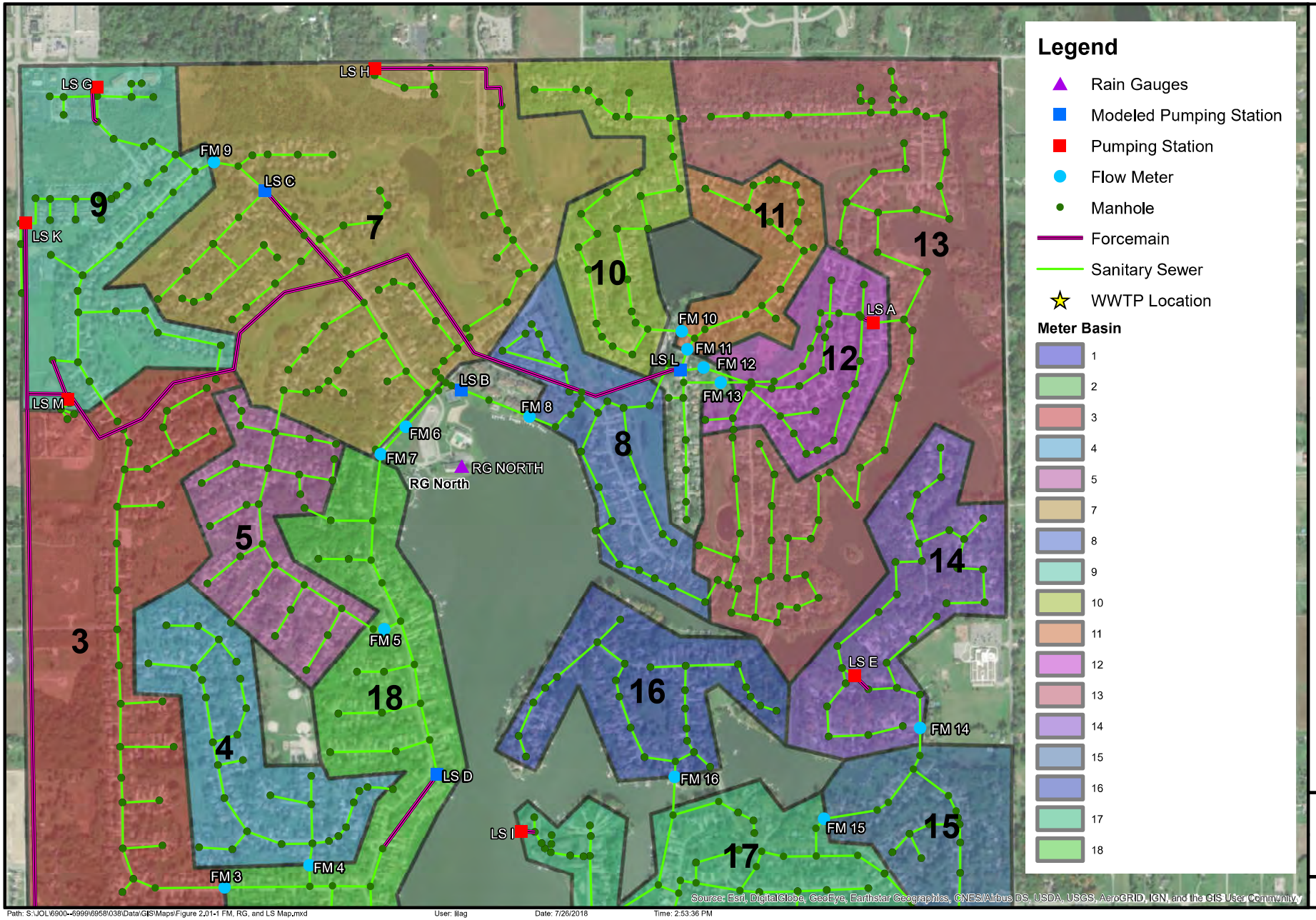
There are 14 lift stations within the Twin Lakes Service Area, all of which are owned and operated by CUII.

Sewerage flows through a combination of gravity sewers and lift station force mains to the Twin Lakes WWTP owned and operated by CUII. Figures 2.01-1 and 2.01-2 show the service area including the location of lift stations (LS) and the WWTP.

2.02 BASIN DELINEATION AND FLOW METERING LOCATIONS

The service area was divided into 18 subbasins with each subbasin monitored with a flow meter (FM). The FMs, which are owned by CUII, were maintained, and data was collected over a 125-day monitoring period from July 5, 2017 to November 7, 2017. Table 2.02-1 provides an inventory of the flow metering and rain gauge (RG) locations and the upstream pipe sizes (FM size).

Figures 2.01-1 and 2.01-2 show the location of the FMs and the extents of each of the 18 subbasins (Figure 2.01-1 shows the northern half of the collection system, and Figure 2.01-2 shows the southern half of the collection system). Figure 2.02-1 shows a schematic of the FMs and the lift stations in the conveyance system. This figure provides perspective on how the meters and lift stations are interconnected.



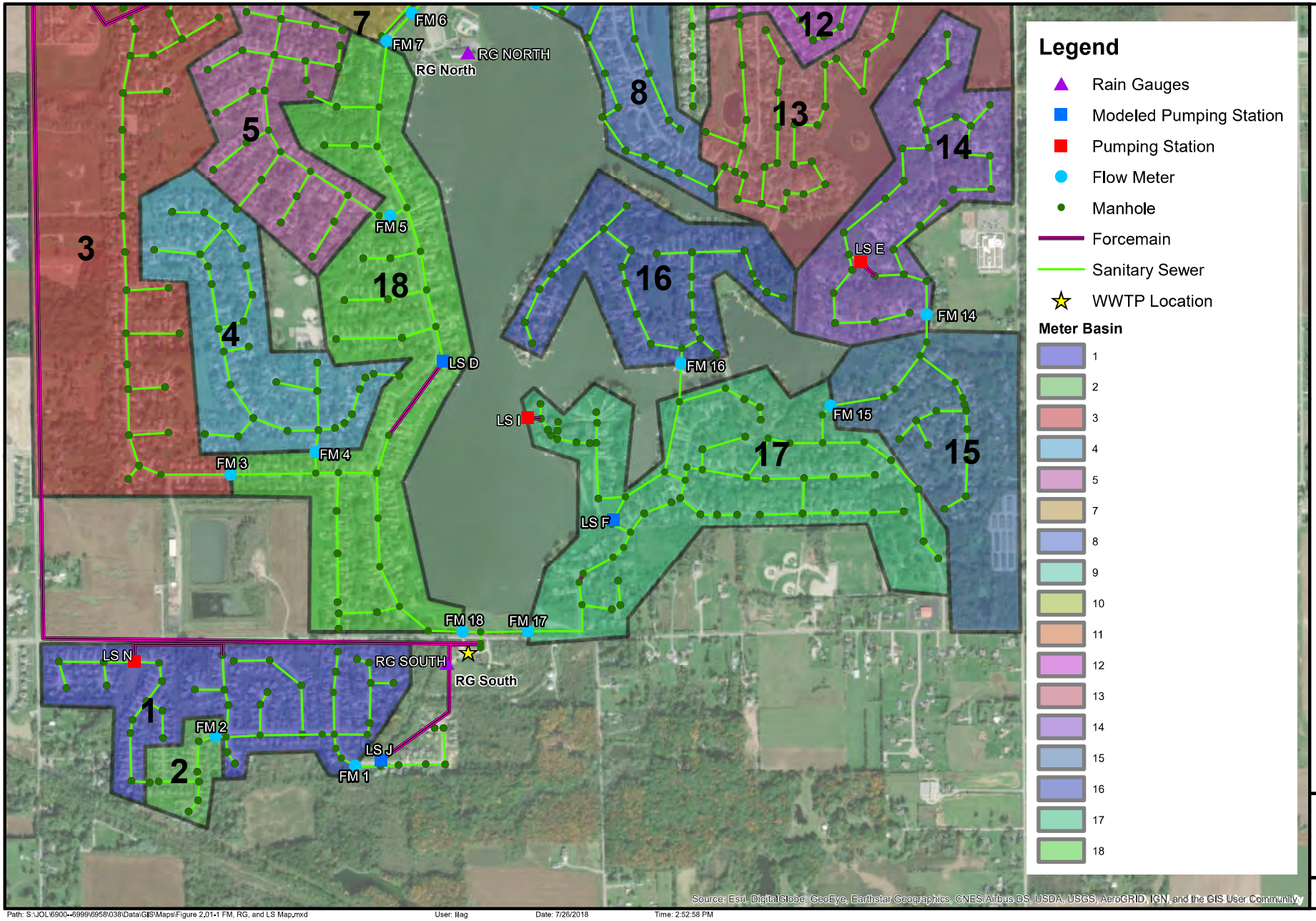
Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\Figure 2.01-1 FM, RG, and LS Map.mxd User: lllag Date: 7/26/2018 Time: 2:53:36 PM

FM, RG, PUMPING STATION, AND METER SUBBASIN LOCATION-NORTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

Figure 2.01-1
6958-038

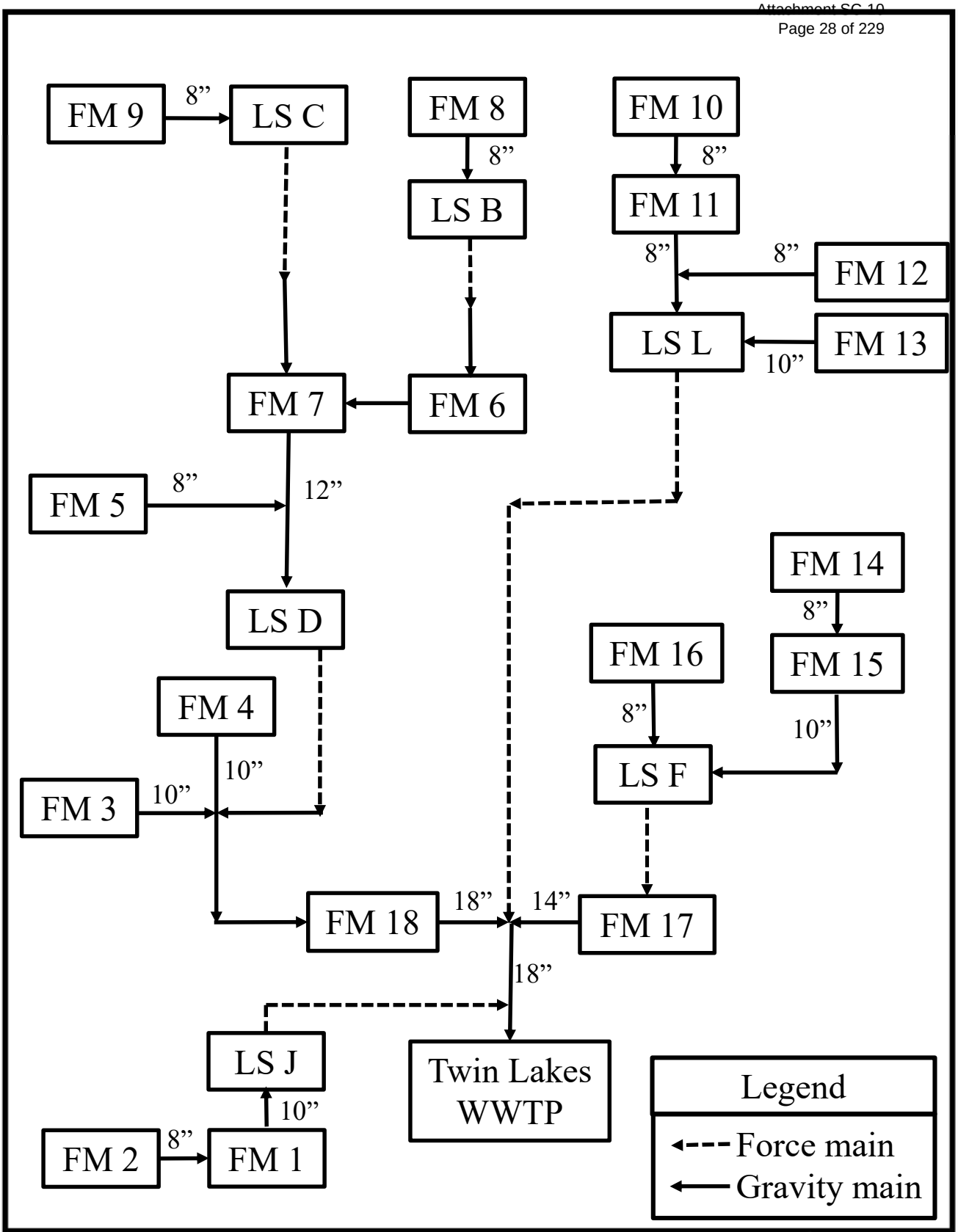


FM, RG, PUMPING STATION, AND METER SUBBASIN LOCATION-SOUTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC
LAKE AND PORTER COUNTIES, IN

Figure 2.01-1
6958-038

Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\Figure 2.01-1 FM, RG, and LS Map.mxd User: lllag Date: 7/26/2018 Time: 2:52:58 PM



SYSTEM SCHEMATIC
TWIN LAKES METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, INDIANA

STRAND ASSOCIATES®

FIGURE 2.02-1
6958.038

Meter Number	Meter Location	Sewer Size (inches)	Installation Date
1	Near 12487 Brookside Drive where Brookside Drive becomes East 124th Court	10	July 6, 2017
2	12430 Shelby Pace	8	July 6, 2017
3	Near 4137 Kingsway Drive	10	July 5, 2017
4	Near 3200 Windy Hill Road	10	July 6, 2017
5	3480 Sunrise Drive	8	July 5, 2017
6	Near 4330 North Lakeshore Drive	10	July 6, 2017
7	4352 North Lakeshore Drive	12	July 5, 2017
8	South side of townhomes near 2525 East Lakeshore Drive approximately 300 feet east of the community pool.	8	July 6, 2017
9	Intersection of St. Andrews Court and Kingsway Drive	8	July 5, 2017
10	1096 Shoreline Road	8	July 5, 2017
11	Near 1517 Happy Valley Road	8	July 5, 2017
12	Approximately 150 feet southeast of FM 11, on the south side of the tree line in the backyards	8	July 6, 2017
13	300 feet east of Happy Valley Road and 450 feet north of Deer Valley Road on the golf course, west of the cart path	10	July 6, 2017
14	Intersection of Hidden Valley Drive and Greenvalley Drive	8	July 5, 2017
15	Near 2350 Greenvalley Drive	10	July 6, 2017
16	In backyards near 1750 Broadacre Road	8	July 5, 2017
17	200 feet west of the boat launch parking lot on the south side of Lake Holiday	14	July 6, 2017
18	Directly north of the more westerly treatment plant driveway along East 123rd Avenue on the south side of Lake Holiday	18	July 6, 2017
RG–North	Seasons Lakehouse roof	N/A	July 6, 2017
RG–South	Twin Lakes WWTP	N/A	July 17, 2017

Table 2.02-1 FM and RG Locations

2.03 SANITARY LIFT STATIONS

As noted above, CUII. owns and operates 14 lift stations for the Twin Lakes Service Area. While all 14 stations were considered to be studied, it was determined that an emphasis should be placed on 6 of the 14 lift stations in particular. This emphasis was based on the extents of the model identified, which is described in more detail later in this report.

The following subsections provide a short description of each lift station that was modeled as part of this study. It is important to note that drawings and pump curves for the existing lift stations do not exist and were not provided by CUII. Rather, approximate physical information and pump make and model were provided for each station. Additionally, the stations are not outfitted with FMs; therefore, the station capacities are approximations based on flow metering results and any pump curve information that was able to be obtained via an internet search using information provided by CUII.

A. Lift Station C

This lift station is located in the northwestern portion of the collection system near the intersection of St. Andrews Court and Kingsway Drive. Sewerage from the FM 9 subbasin and other small local sewers flows by gravity to the lift station, which is pumped via two 11.3 horsepower (hp) submersible pumps manufactured by Barnes Pump to a manhole along Lakeshore Drive, upstream of FM 7.

B. Lift Station L

This lift station is located in the northeastern portion of the collection system on Happy Valley Road between Deer Valley Road and Shoreline Drive. Flow metering basins FM 10, 11, 12, and 13 are tributary to this lift station. Flow is pumped via two 60 hp Barnes submersible pumps several hundred feet to the manhole directly upstream of the Twin Lakes WWTP and bypassing the rest of the collection system.

C. Lift Station B

This lift station is located directly downstream of FM 8, behind the townhomes on East Lake Shore Drive. Flow is pumped to a nearby gravity sewer, upstream of FM 6. The lift station is equipped with two 11.3 hp Barnes submersible pumps, similar to Lift Station C.

D. Lift Station D

This lift station is located between Lots 854 and 855 along West Lakeshore Drive and downstream of Lift Station C; Lift Station B; and FMs 5, 6, and 7; and upstream of FM 18. Sewerage is pumped to an adjacent gravity sewer via two 15 hp Barnes submersible pumps.

E. Lift Station F

This station serves the southeast portion of the collection system including the FM 14, 15, and 16 metering basins. The lift station is equipped with two 11.3 hp Barnes submersible pumps. Sewerage is pumped to an adjacent gravity sewer upstream of FM 17.

F. Lift Station J

This station serves the portion of the collection system outside the Lake of the Four Seasons development, southwest of the Twin Lakes WWTP. FM Basins 1 and 2 are tributary to this lift station. Flow is pumped via two 11.3 hp Barnes submersible pumps to a manhole just upstream of the Twin Lakes WWTP.

2.04 RG LOCATIONS

Rainfall data was collected from two RGs located as shown in Figures 2.01-1 and 2.01-2. Both RGs were owned by CUII. The locations of the RGs can be described as follows:

1. RG South was located at the Twin Lakes WWTP near the sludge storage tank.

2. RG North was located on the roof of the Seasons Lakehouse along Lakeshore Drive.

The RGs collected rainfall over the four-month flow metering period. The data collected was used to develop a relationship between rainfall totals, rainfall intensity, and sewerage flows in the collection system.

2.05 FLOW MONITORING OPERATIONS

The flow monitoring and RG operations began July 5, 2017, with the installation of in-pipe area-velocity FMs and two tipping bucket RGs manufactured by ISCO Technologies. As previously stated, all equipment used was owned by CUII and installed by Strand.

Figure 2.05-1 ISCO In-Pipe Area-Velocity FM

An in-pipe area-velocity FM uses a submerged transducer mounted near the bottom of the sewer pipe entering a selected manhole location to measure depth and velocity of flow. The transducer is equipped with a pressure sensor that measures the weight of water flowing over the top of it and converts the weight to a depth of flow. The same transducer uses Doppler RADAR to measure velocity. Since the upstream pipe size at each flow metering location is known and programmed into the FM, a cross sectional-area of flow is calculated within the FM using the depth measurement. Flow is then calculated by multiplying the velocity readings and the FMs calculated cross-sectional area of flow. Pictures of the FM, a typical FM installation, and RGs, respectively, are shown in Figures 2.05-1, 2.05-2, and 2.05-3.

After the initial installation, the FMs and RGs were visited on a weekly basis by CUII. The stored data was downloaded from the meters to a laptop, and a visual check of the data and site conditions was made to verify that meters were correctly operating.

Throughout the flow monitoring period, if operational problems were found within the meters, manhole entries were made by Strand staff to correct the problems. Following each week's data collection, a more thorough review of the data was performed. This evaluation included a mass balance of flows comparing upstream and downstream data to confirm the meters were working properly relative to each other.

Figure 2.05-2 In-Pipe Area-Velocity FM Installation

Near the end of the four-month monitoring period, the collected flow data was evaluated. The monitoring period was originally scheduled to last 90 days; however, the flow monitoring period was extended because of a lack of rainfall events. Meter removal started on November 7, 2017, after a total period of 125 days.

Figure 2.05-3 ISCO Tipping Bucket RG

SECTION 3
FLOW MONITORING DATA ANALYSIS

The following section presents an analysis of the flow metering and rainfall data collected during the flow metering program for the Twin Lakes Service Area.

3.01 RAINFALL DATA ANALYSIS

As previously discussed, the flow monitoring period began on July 5, 2017 and ended November 7, 2017. There were 16 rainfall events over the 125-day monitoring period, as detailed in Table 3.01-1. The distribution of these rainfall events over the monitoring period is shown in Figure 3.01-1.

It is important to note that there were various equipment issues that occurred throughout the flow monitoring period with both RGs. As such, there are rainfall events where one or both RGs were not functional. In fact, there were approximately four weeks between the August 23, 2017, and September 18, 2017, that both RGs were not functional; however, there were no significant rainfall events that occurred during that time based on information gathered from archived rainfall data found online for nearby municipalities. Additionally, the South RG was installed a few weeks after the North RG as noted in the previous report section.

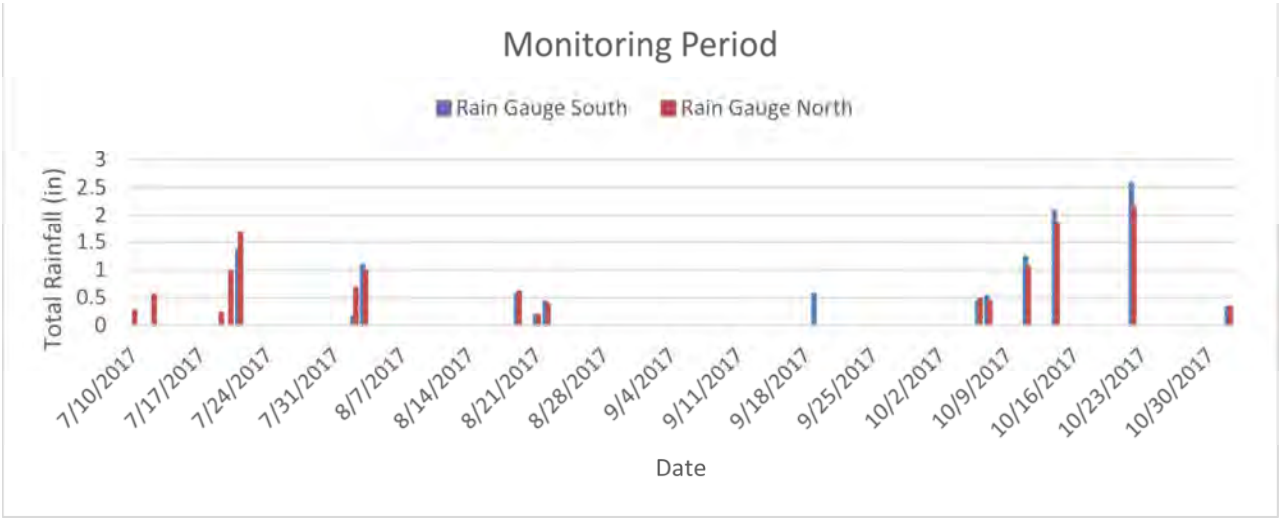


Figure 3.01-1 Distribution of Rainfall Events over the Monitoring Period

Each flow metering basin was assigned one of the two RGs based on geographical proximity. For example, RG South was used for Meter 18 because it lies in the southern portion of the system and is closest to RG South. The data collected at the RG was used to analyze each rainfall event. The rainfall intensity for the most intense portion of the rainfall event was used to estimate a maximum recurrence interval according to the *Rainfall Frequency Atlas of the Midwest* by Huff and Angel. The recurrence interval is a theoretical interpretation of the probability of a similar rainfall event occurring in any given year. For example, a two-month rainfall event is one that would be expected to occur six times (has a 600 percent chance of happening) in one year.

Table 3.01-1 Rainfall Event Details

Date	RG North				RG South			
	Total Rainfall (inches)	Total Duration (hours)	Maximum Rainfall Intensity	Maximum Rainfall Recurrence Interval	Total Rainfall (inches)	Total Duration (hours)	Maximum Rainfall Intensity	Maximum Rainfall Recurrence Interval
7/10/2017	0.26	2.75	0.17 inches in 1 hour	<2 months, 1 hour				
7/12/2017	0.55	15.25	0.31 inches in 1 hour	<2 months, 1 hour				
7/19/2017	0.22	1.25	0.21 inches in 1 hour	<2 months, 1 hour				
7/20/2017	0.97	5.75	0.59 inches in 30 min	2.9 months, 30 min				
7/21/2017	1.67	11.25	1.53 inches in 6 hour	6.1 months, 6 hour	1.35	11.25	1.35 inches in 12 hour	2.7 months, 12 hour
8/2/2017	0.68	0.75	0.42 inches in 30 min	2.7 months, 15 min	0.16	1	0.16 inches in 1 hour	<2 months, 2 hour
8/3/2017	0.97	10	0.7 inches in 30 min	4.8 months, 30 min	1.09	10	0.55 inches in 30 min	2.4 months, 30 min
8/19/2017	0.61	2	0.61 inches in 2 hour	<2 months, 2 hour	0.56	1.75	0.47 inches in 1 hour	<2 months, 1 hour
8/21/2017	0.18	0.75	0.18 inches in 1 hour	<2 months, 1 hour	0.19	1	0.14 inches in 15 min	<2 months, 15 min
8/22/2017	0.38	6.25	0.37 inches in 6 hour	<2 months, 6 hour	0.43	6.25	0.42 inches in 6 hour	<2 months, 6 hour
9/19/2017					0.57	4.75	0.5 inches in 3 hour	<2 months, 3 hour
10/6/2017	0.48	16.25	0.33 inches in 1 hour	<2 months, 1 hour	0.43	15.5	0.25 inches in 1 hour	<2 months, 1 hour
10/7/2017	0.44	16.5	0.26 inches in 1 hour	<2 months, 1 hour	0.53	16.75	0.27 inches in 1 hour	<2 months, 1 hour
10/11/2017	1.05	10.5	0.97 inches in 6 hour	<2 months, 6 hour	1.23	10	1.14 inches in 6 hour	2.6 months, 6 hour
10/14/2017	1.86	26.5	1.65 inches in 18 hour	4.2 months, 18 hour	2.08	26	1.95 inches in 18 hour	7 months, 18 hour
10/22/2017	2.17	51.75	2.06 inches in 48 hour	5 months, 48 hour	2.57	51.5	2.45 inches in 48 hour	8.7 months, 48 hour
11/1/2017	0.33	26.5	0.33 inches in 48 hour	<2 months, 48 hour	0.32	16.5	0.22 inches in 3 hour	<2 months, 3 hour

The shaded light gray indicates the events chosen for data analysis.

The shaded dark gray indicates a period when the associated rain gauge was not working properly

A rainfall event used for data analysis would ideally be uniform across the collection system service area. A uniform event would result in approximately equal RG data at both RG locations. If the data collected at each RG is approximately equal, it can be inferred that rainfall between the RGs was approximately equal and uniform across the entire collection system. This allows us to assume that metered subbasins that are not next to an RG received approximately the same rainfall observed at an RG.

In general, most of the rainfall events during the flow monitoring period were not very intense, with all events having less than a one-year recurrence interval. However, the July 21, August 3, and October 14 events were more significant than the others. Additionally, all of these events appear fairly uniform. As a result, these three events were used for the data analysis described later in this section.

3.02 FM EVALUATIONS

The following discussion provides an evaluation of each metering location, the data collected, and concerns identified based on the studied rainfall events. This evaluation does not comprise the FM basins, but only the meter locations. Conditions at the meter are not necessarily indicative of conditions upstream in the subbasin.

The following evaluation is best considered in conjunction with the dry and wet weather flow analyses in the following subsections. Appendix A also presents data from each rainfall event and the resultant flow response at each meter.

A. FM 1

This meter collected reliable data throughout the flow monitoring period and was functioning during all three study events. While this meter did experience peak wet weather flows approximately five times that of dry weather flows for all three study events, the flow metering data suggests there was no surcharging at this FM during any of the events, and the level within the sewer only rose a few inches.

B. FM 2

This meter had difficulty collecting flow data throughout the flow metering program because of low flows in the system. Most FMs cannot accurately measure velocity when the depth of flow is less than one inch. Attempts were made to routinely recalibrate the meter; however, they were not successful. Therefore, all analyses described later in this section will exclude FM 2.

C. FM 3

This meter collected reliable data throughout the flow monitoring period and showed a wet weather response during the study events; however, the response was not enough to increase the levels within the sewer above the crown of the pipe.

D. FM 4

This meter collected reliable data throughout the flow monitoring period and was fully functional for each study event. On July 11 and July 30, measured flow depths increased significantly over approximately

24 hours before dropping again during a dry weather period. It is unknown what caused the level increases; however, the meter returned to normal levels and was recalibrated at various times during the monitoring period.

E. FM 5

This meter collected excellent data throughout the flow monitoring period and was functional for all three study events. Additionally, this meter had a fairly pronounced wet weather response during all three events with peaking factors ranging between five and eight. Although the level within the sewer increased during wet weather events during the flow metering period, the level never exceeded the crown of the pipe.

F. FM 6

The data at this meter was high quality in general, with the exception of a period of time from August 31 to September 19 when the flow sensor was dislodged from its bracket within the host pipe. However, this meter was located immediately downstream of Lift Station B. As a result, there is a very pronounced fluctuation in flows associated with pumps turning on and off within the lift station. The meter frequently recorded zero flow during the period of time the lift station's pumps were off.

G. FM 7

This meter is located downstream of Lift Station C. As such, this meter experienced large fluctuations in flow similar to FM 6. The data collected was high quality despite the large flow fluctuations and this meter was fully functional during all three study events. This meter showed significant wet weather responses, specifically during the July 21 event when the level measured by the meter increased to more than 80 inches.

There was a spike in flow and level on September 20; however, the spike was of extremely short duration and flows returned to normal within an hour. Since both RGs were not functional during this time, it is not known if this spike is a result of a wet weather event; however, the response was different than all other wet weather responses, suggesting it could have been caused by some other anomaly, such as debris on the FM sensor.

H. FM 8

This meter collected high quality data throughout the first two months of the monitoring period. From the beginning of September through the end of the flow monitoring period, there were several instances where data was missing or poor. This was because debris collected on the meter. This meter was visited multiple times throughout the monitoring period for recalibration and cleaning. The quality of the data improved immediately after the cleanings and recalibrations, but continued to get fouled as time progressed. The meter was functional during the July 21 and August 3 events but was only working intermittently during the October 14 event.

I. FM 9

This meter collected intermittent data throughout the flow metering period. The intermittent data was caused by a few factors. The velocities in this location were fairly low and, as a result, solids would settle out and foul the sensor causing the data to drop out. This was a particularly difficult situation because this location was fairly deep and impossible to clean from the ground surface. Also, the depth of flow at this location was low, around one inch. As previously discussed, most meters have difficulty reliably measuring flow when there is an inch or less of flow over the sensor. Finally, this flow metering location is located close to Lift Station C. This caused large fluctuations in flows that correlated to the pumps turning on and off at Lift Station C.

This FM was moved on August 28 to alleviate some of the issues discussed above. Unfortunately, it appeared to have little effect on the quality of the flow metering data. This meter was functional during all three study events.

J. FM 10

This meter collected excellent data throughout the flow monitoring period and was fully functional throughout the entire monitoring period. This meter experienced significant wet weather responses and had the highest peaking factors of all the meters.

K. FM 11

This meter collected reliable data throughout the flow monitoring period. This meter showed a significant wet weather response during the July 21 event and surcharged. Calibration of this meter proved difficult and the meter had to be recalibrated several times throughout the monitoring period.

L. FM 12

This meter collected reliable data throughout the flow monitoring period. This meter showed a response during each study event and surcharged to a level of nearly 30 inches during the July 21 event.

M. FM 13

This meter was located upstream of Lift Station L and experienced large fluctuations in flow because of the pumps turning on and off at the lift station. It appeared to collect reliable data throughout the flow monitoring period and was functional during all three wet weather events. This meter showed a fairly significant wet weather response to all three wet weather events and surcharged during the July 21 event.

N. FM 14

This meter collected good data throughout the flow monitoring period and was functional during all three study events and showed a wet weather response. There appears to be an anomaly in the flow data that occurred on August 9 when the measured level increased from around 1 inch to 4 1/2 inches for one 15-minute increment data point and then decreased back down to 2 inches. This occurred during a day

when no rainfall was measured, so this data point appears to be an outlier and caused by something other than rain.

O. FM 15

This meter collected good data throughout the flow monitoring period. This meter showed a response during each study event and no surcharging occurred.

P. FM 16

This meter collected excellent data throughout the flow monitoring period and was fully functional during all three rainfall events. This meter showed a response during each study event and no surcharging occurred.

Q. FM 17

This meter collected excellent data throughout the flow monitoring period and was fully functional during all three study rainfall events.

R. FM 18

This meter collected good data throughout the flow monitoring period. This meter experienced high peaking factors and surcharging during all three study events.

3.03 DRY WEATHER FLOW ANALYSIS

A dry weather flow analysis was performed to determine the baseline flow characteristics of each FM basin. Flows for each day during a representative two-week period of dry weather were compiled for each basin. Flow data was collected at 15-minute intervals and averaged over the two-week period. The average incremental flows were then used to determine an average flow over a 24-hour period. This average daily flow represents the baseline flow characteristics of each basin for the data analyses to follow. Additionally, these dry weather flows were used in the development and calibration of the collection system model, which is discussed in Section 4.

For a day to be considered a “dry” day, it had to satisfy two criteria. First, it had to have less than 0.10 inch of rain over a 24-hour period, and second, there had to be at least 48 hours of dry weather preceding it.

Table 3.03-1 shows the results of the dry weather flow analysis.

FM Basin	Dry Weather Flow (gallons per minute [gpm])		
	Overall	Weekday	Weekend
FM 1	41.2	38.8	46.4
FM 2[1]			
FM 3	15.3	15.0	16.1
FM 4	22.3	21.5	24.3
FM 5	24.5	24.1	25.7
FM 6	-0.6	-2.4	3.8
FM 7	57.2	53.3	66.0
FM 8	42.5	41.5	44.9
FM 9	24.0	24.5	23.2
FM 10	17.5	17.1	18.3
FM 11	16.7	16.5	17.6
FM 12	17.8	17.6	18.3
FM 13	42.9	43.4	42.7
FM 14	10.1	10.7	8.7
FM 15	17.2	16.2	19.5
FM 16	11.7	11.6	11.9
FM 17	135.0	131.7	143.3
FM 18	32.2	36.2	22.1

[1] Data from FM 2 were not analyzed because flows were too low to be measured.

Table 3.03-1 Dry Weather Base Flow Analysis

The flow monitoring period was not exceptionally dry. There were rainfall events occurring regularly throughout the monitoring period; however, there was a two-week period of dry weather between September 5 and September 19. This two-week period was used for the dry weather analysis described above.

It should be noted the flows for each basin were isolated to accurately analyze the baseline flow characteristics specific to the individual basins. This was accomplished by subtracting the flows of any upstream basins from the flows of downstream basins. For instance, flows from FM 14 contribute to FM 15, since FM 15 is located downstream of FM 14 (see Figure 2.02-1). Therefore, the flow metering data collected at the upstream FM, FM 14, was subtracted from the data collected at the downstream meter, FM 15, to isolate flows associated with the downstream FM basin.

It is important to note the minimum dry weather flow at FM 6 is a negative value. A possible explanation, is the effect of Lift Station B on FMs 6 and 8, combined with the fact that there are a limited number of flow inputs between FM 6 and FM 8. As previously mentioned in Section 2, flow metering data was collected every 15 minutes. However, the pumps at Lift Station B most likely turn on and off more often than every 15 minutes. Furthermore, when the pumps at this lift station are

off, flows are greatly reduced within the collection system. Therefore, it is possible when the data points were collected and saved within the FMs the flow data could be reflective of the fact the pumps at Lift Station B were off, causing flow to be measured lower at FM 6 than FM 8, thus skewing the data at that time.

When comparing the total cumulative flow during dry weather days observed at each FM, which removes the anomaly previously described, FM 8 flow was slightly greater than FM 6, as expected.

3.04 WET WEATHER FLOW ANALYSIS

Two wet weather flow analyses were performed on each flow metering basin for each of the three study rainfall events on July 21, August 3, and October 14. The first was an inflow analysis in which the peak flow observed during a rainfall event at each flow metering location was divided by the average dry weather flow of the corresponding meter to produce the peaking factor for each FM basin. This analysis is generally a good measure of inflow. When inflow is present, wet weather flow will generally peak quickly to multiple times higher than the average dry weather flows. Therefore, the basins with the highest peaking factors are an indication of the basins that are most susceptible to sources of inflow. A peaking factor under four is generally considered acceptable in a separate sanitary sewer system. To identify inflow specific to each subbasin, inflow from upstream meters was subtracted from downstream meters, similar to that discussed above, and compared to the specific dry weather flows for each metering basin. Therefore, the peaking factors for each meter are specific only to that FM basin and all upstream influence has been removed.

It is important to note the inflow analysis for FM 6 does not use the incremental dry weather flow as it is a negative number. In this particular case, the overall average dry weather flow was used for the peaking factor analysis.

The detailed results of this analysis can be found in Table 3.04-1 and in Figure 3.04-1.

Metered Basin	Average Dry Weather Flow (gpm)	July 21, 2017		August 3, 2017		October 14, 2017	
		Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor	Peak Flow (gpm)	Peaking Factor
FM 1	41.2	186	4.5	154	3.7	202	4.9
FM 2[1]							
FM 3	15.3	204	13.3	133	8.6	225	14.6
FM 4	22.3	133	6.0	100	4.5	138	6.2
FM 5	24.5	190	7.8	133	5.4	154	6.3
FM 6	41.9	724	17.3	202	4.8	272	6.5
FM 7	57.2	623	10.9	265	4.6	419	7.3
FM 8	42.5	402	9.5	261	6.1	154	3.6
FM 9	24.0	178	7.4	186	7.7	147	6.1
FM 10	17.5	410	23.4	285	16.3	373	21.3
FM 11	16.7	728	43.6	41	2.5	83	5.0
FM 12	17.8	109	6.2	95	5.4	119	6.7
FM 13	42.9	312	7.3	235	5.5	221	5.1
FM 14	10.1	163	16.1	102	10.0	117	11.5
FM 15	17.2	140	8.2	19	1.1	164	9.5
FM 16	11.7	84	7.2	76	6.5	86	7.3
FM 17	135.0	1,006	7.5	260	1.9	869	6.4
FM 18	32.2	800	24.8	371	11.5	489	15.2

[1] Data from FM 2 was not analyzed because flows were too low to be measured.

Table 3.04-1 Inflow Analysis

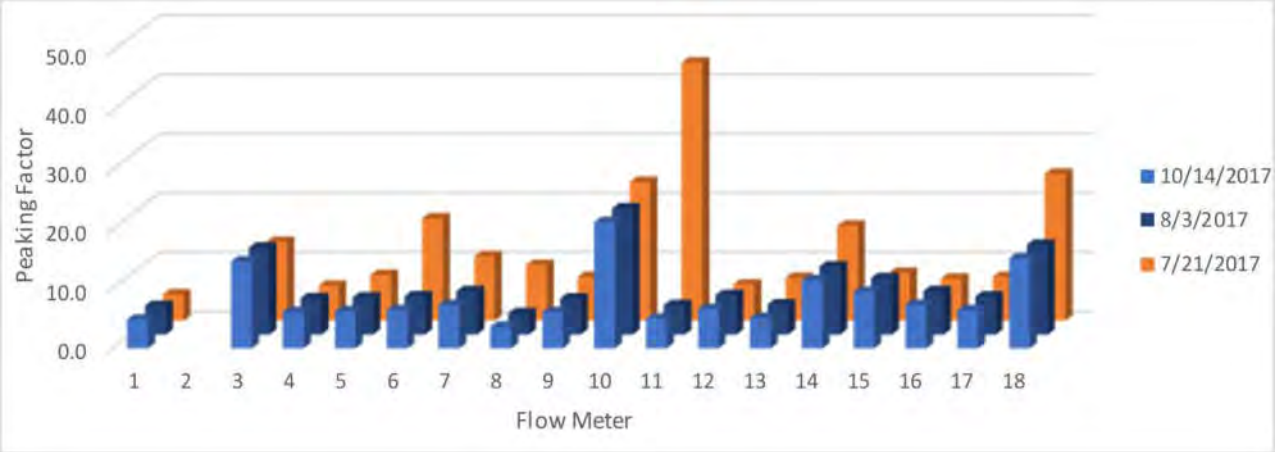


Figure 3.04-1 Peaking Factors at Each FM

Additionally, Table 3.04-2 compares the maximum depth read by the FM to the sewer size at each meter location, providing an indication of the type of sewer surcharging experienced in the system during each study event. All values are shown in inches. Figure 3.04-2 shows a graphical representation of surcharging at each FM and illustrates where capacity problems may exist in the conveyance system.

Metered Basin	July 21, 2017	August 3, 2017	October 14, 2017	Diameter (inches)
FM 1	2.3	2.2	2.0	10
FM 2[1]				8
FM 3	4.1	3.3	4.5	10
FM 4	3.2	2.8	3.1	10
FM 5	4.1	3.3	3.8	8
FM 6	72.4	4.3	4.3	10
FM 7	81.1	6.7	8.5	12
FM 8	8.4	4.7	26.5	8
FM 9	30.5	5.9	16.7	8
FM 10	16.2	6.3	10.9	8
FM 11	10.0	4.6	2.6	8
FM 12	28.7	6.2	6.8	8
FM 13	26.1	4.6	20.1	10
FM 14	4.3	3.5	3.7	8
FM 15	3.3	2.9	4.2	10
FM 16	3.3	3.0	3.2	8
FM 17	19.0	15.3	28.2	14
FM 18	25.9	21.0	31.2	18

[1] Data from FM 2 were not analyzed because flows were too low to be measured.

Table 3.04-2 Surcharging at Each Flow Metering Location

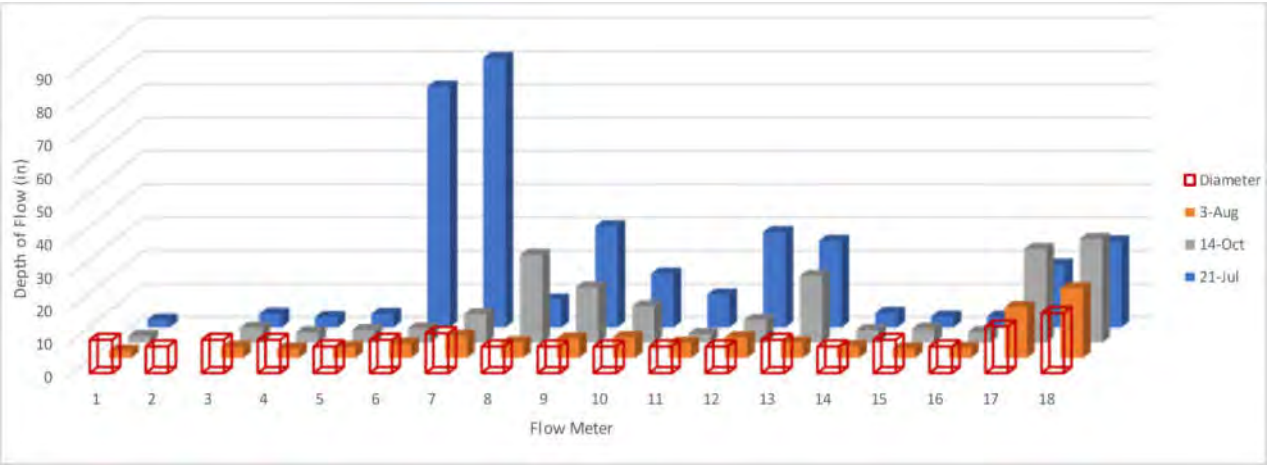


Figure 3.04-2 Surcharging at Each FM

The second analysis takes into account infiltration, which is clear water entering the sanitary sewer system through sewer defects because of high groundwater. The volume of infiltration is directly related to sewer length and diameter. A FM basin with large diameter pipes will potentially have a higher volume of infiltration than a small metering basin with small diameter pipes. However, a larger total infiltration volume does not necessarily indicate a larger infiltration problem.

To equalize basin size and pipe diameter variables between metering basins, each basin was separated into inch-diameter-miles (in-dia-mi) of sewer as shown in Table 3.04-3.

Metering Basin	Length of Sewer		Equivalent Sewer Length
	Feet	Miles	In-Dia-Mi
FM 1	10,751	2.04	16.44
FM 2[1]	1,269	0.24	1.92
FM 3	8,915	1.69	13.51
FM 4	7,657	1.45	11.60
FM 5	9,091	1.72	13.77
FM 6	1,523	0.29	15.95
FM 7	22,975	4.35	35.18
FM 8	8,625	1.63	13.07
FM 9	9,582	1.81	14.52
FM 10	7,234	1.37	10.96
FM 11	4,140	0.78	6.32
FM 12	3,653	0.69	5.54
FM 13	17,126	3.24	26.25
FM 14	7,577	1.44	11.48
FM 15	4,002	0.76	6.65
FM 16	6,245	1.18	9.46
FM 17	15,761	2.98	26.24
FM 18	13,110	2.48	31.98

Table 3.04-3 Breakdown of Flow Metering Basins

Again, the upstream meters were removed from the calculation to isolate each FM basin separately. While this analysis tends to isolate basins with high amounts of infiltration, this analysis does include any inflow combined with infiltration within a basin. As a result, it is not strictly an infiltration-only analysis. Infiltration issues normally are characterized by elevated flows over a longer period of time as clear water seeps into the sewer system over time.

For this analysis, the volume of I/I was calculated by summing the flows higher than the average daily flow for the meter basin from the beginning of the rainfall event until the sewer returned to normal flow levels. The I/I volume was converted to a volume in thousands of gallons (gal) per in-dia-mi of sewer. Table 3.04-4 and Figure 3.04-3 show the results if this analysis.

Metered Basin	July 21, 2017		August 3, 2017		October 14, 2017	
	I/I Volume (1,000 gal)	I/I Rate (1,000 gal/ in-dia-mi)	I/I Volume (1,000 gal)	I/I Rate (1,000 gal/ in-dia-mi)	I/I Volume (1,000 gal)	I/I Rate (1,000 gal/ in-dia-mi)
FM 1	84.27	5.13	30.23	1.84	46.84	2.85
FM 21						
FM 3	56.67	4.20	34.07	2.52	117.55	8.70
FM 4	70.84	6.11	30.31	2.61	68.76	5.93
FM 5	49.80	3.62	21.52	1.56	71.39	5.18
FM 6	139.74	8.76	71.34	4.47	67.19	4.21
FM 7	193.36	5.50	203.65	5.79	385.41	10.95
FM 8	55.54	4.25	33.55	2.57	60.57	4.63
FM 9	67.28	4.63	101.30	6.98	72.71	5.01
FM 10	151.85	13.85	55.22	5.04	128.57	11.73
FM 11	160.21	25.36	127.32	20.15	4.88	0.77
FM 12	35.76	6.46	25.38	4.59	50.66	9.15
FM 13	101.67	3.87	55.13	2.10	90.61	3.45
FM 14	88.95	7.75	49.68	4.33	57.59	5.02
FM 15	2.67	0.40	8.15	1.23	122.01	18.36
FM 16	50.09	5.29	17.09	1.81	61.81	6.53
FM 17	178.03	6.78	243.02	9.26	176.77	6.74
FM 18	348.97	10.91	249.16	7.79	195.64	6.12

[1] Data from FM 2 was not analyzed because flows were too low to be measured.

Table 3.04-4 Total I/I Analysis

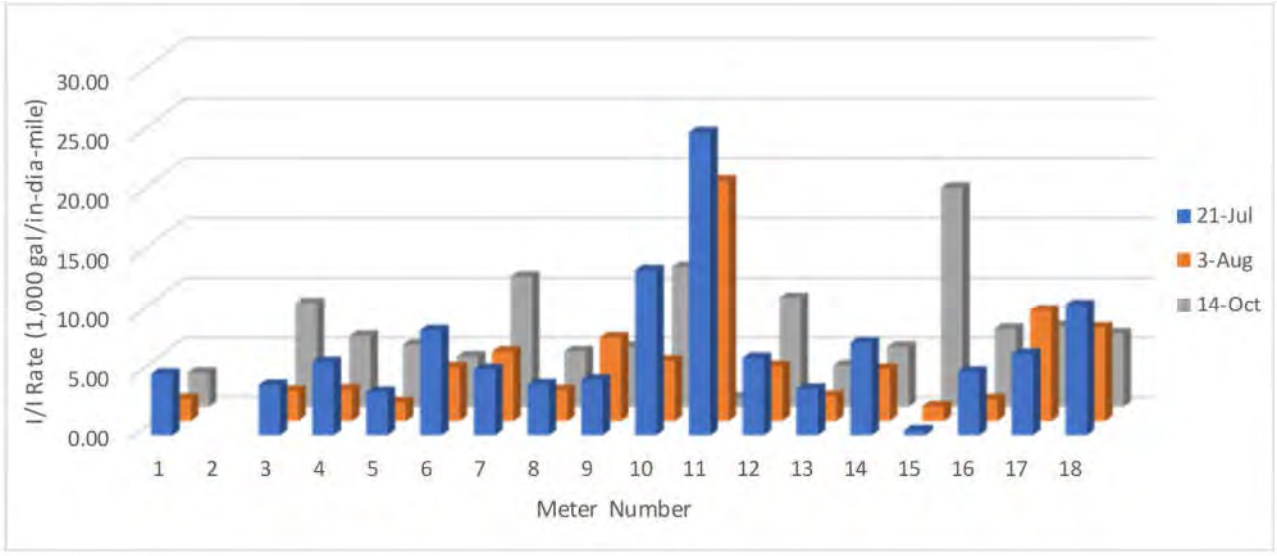


Figure 3.04-3 Total I/I Rates at Each FM

3.05 FLOW MONITORING CONCLUSIONS

The analyses performed as described in this report provide the necessary data to determine the basins most needing improvement by using a prioritization methodology.

A. Ranking Methodology

To prioritize the basins most in need of further evaluation, a ranking system was developed to determine the basins exhibiting the highest susceptibility to I/I. During the rainfall analyses, a peaking factor and an I/I rate were developed for each flow metering basin for each of the study rainfall events.

Basins were given a score of 1 through 17 (FM 2 was excluded). The meter basin with the highest peaking factor or I/I rate received a score of 1 and the lowest ranking meter basin received a score of 17. All scores for each rainfall event were then averaged together to get an overall score. The meters were then ranked based on the overall average score with the basin having the lowest overall score receiving a rank of 1 and the basin with the highest overall score receiving a rank of 17, which dictated the prioritization.

B. Ranking Results

Tables 3.05-1, 3.05-2, and 3.05-3 show the results of the three sets of rankings. Table 3.05-1 shows rankings based on the peaking factors. Table 3.05-2 shows rankings based on the I/I flow rates. Table 3.05-3 shows the overall basin rankings taking into account both analyses.

Rank	Flow Metering Basin	Average Score	July 21, 2017		August 3, 2017		October 14, 2017	
			Peaking Factor	Score	Peaking Factor	Score	Peaking Factor	Score
1	10	1.67	23.44	3	16.30	1	21.30	1
2	18	2.00	24.82	2	11.51	2	15.18	2
3	14	4.00	16.09	5	10.04	3	11.50	4
4	3	4.33	13.32	6	8.65	4	14.65	3
5	6	8.00	17.30	4	4.83	11	6.50	9
6	16	8.67	7.15	14	6.49	6	7.35	6
6	7	8.67	10.89	7	4.63	12	7.34	7
7	5	10.00	7.76	10	5.42	9	6.28	11
7	9	10.00	7.42	12	7.75	5	6.13	13
8	15	10.33	8.16	9	1.08	17	9.54	5
8	11	10.33	43.56	1	2.48	15	4.99	15
9	8	10.67	9.46	8	6.14	7	3.63	17
10	12	11.00	6.16	15	5.36	10	6.67	8
11	13	11.67	7.27	13	5.49	8	5.14	14
12	17	12.33	7.45	11	1.92	16	6.44	10
13	4	13.67	5.97	16	4.47	13	6.18	12
14	1	15.67	4.51	17	3.73	14	4.89	16

Table 3.05-1 Peaking Factor Rankings

Rank	Flow Metering Basin	Average Score	July 21, 2017		August 3, 2017		October 14, 2017	
			I/I Rate	Score	I/I Rate	Score	I/I Rate	Score
1	10	3.33	13.85	2	5.04	6	11.73	2
2	17	4.67	6.78	6	9.26	2	6.74	6
2	18	4.67	10.91	3	7.79	3	6.12	8
3	7	5.67	5.50	9	5.79	5	10.95	3
4	12	6.00	6.46	7	4.59	7	9.15	4
5	11	6.67	25.36	1	20.15	1	0.77	18
6	14	8.33	7.75	5	4.33	9	5.02	11
7	6	8.67	8.76	4	4.47	8	4.21	14
8	4	9.00	6.11	8	2.61	10	5.93	9
9	9	9.33	4.63	12	6.98	4	5.01	12
10	3	10.33	4.20	14	2.52	12	8.70	5
11	16	10.67	5.29	10	1.81	15	6.53	7
12	15	11.67	0.40	17	1.23	17	18.36	1
13	8	12.33	4.25	13	2.57	11	4.63	13
14	1	13.67	5.13	11	1.84	14	2.85	16
15	5	14.00	3.62	16	1.56	16	5.18	10
16	13	14.33	3.87	15	2.10	13	3.45	15

Table 3.05-2 I/I Rate Rankings

Rank	Flow Metering Basin	Overall Score	Peaking Factor Average Score	I/I Rate Average Score
1	10	5.00	1.67	3.33
2	18	7	2.00	4.67
3	14	12.33	4.00	8.33
4	7	14.33	8.67	5.67
5	3	15	4.33	10.33
6	6	16.67	8.00	8.67
7	12	17	11.00	6.00
8	17	17.00	12.33	4.67
8	11	17.00	10.33	6.67
9	16	19.33	8.67	10.67
10	9	19	10.00	9.33
11	15	22.00	10.33	11.67
12	4	23	13.67	9.00
12	8	23	10.67	12.33
13	5	24.00	10.00	14.00
14	13	26.00	11.67	14.33
15	1	29.33	15.67	13.67

Table 3.05-3 Overall Rankings

These ranking tables used in conjunction with Figures 3.04-1, 3.04-2, and 3.04-3 help to narrow down which metering basins are most susceptible to I/I and where additional investigations should be focused. However, it is important to also factor in where the I/I is occurring and how it effects the overall performance of the collection system. For example, FM basin FM 12 has an overall ranking of 7. However, all flow from FM 12 ends up being pumped around the collection system directly to the WWTP through Lift Station L. As a result, the high flows from the FM 12 basin do not affect a large majority of the rest of the collection system and should not necessarily be prioritized higher than another basin that has a greater effect on the overall collection system.

Additionally, sources of inflow are traditionally both easier and less expensive to locate and repair than sources of infiltration. As a result, the basins with the highest potential for inflow problems should also be given priority over basins with sources of primarily infiltration.

Priority FM Basin	Peaking Factor Rank	I/I Rate Rank	Overall Rank
10	1	1	1
7	6	3	4
14	3	6	3
3	4	10	5
6	5	7	6
18	2	2	2

Table 3.05-4 Basin Prioritization

Taking into account the previous rankings and the impact to the collection system that different flow metering basins have on the overall performance of the collection system, we recommend the following basins be prioritized for further investigation to identify and remove sources of I/I, as shown in Table 3.05-4.

These meters were given this priority for the following reasons:

1. While flow metering basin FM 10 does not have an effect on a large portion of the collection system, it appears to have the most sources of I/I by a significant margin based on the data. Additionally, the flow metering data and, as shown in the following sections, the modeling data suggest there is potential for significant localized conveyance issues during wet weather events. Finally, although the flow bypasses much of the collection system, it still contributes large amounts of I/I to the WWTP, which has wet weather capacity issues.

2. FM 18 should be prioritized next. The prioritization is based on previous rankings and its location within the collection system, upstream of the WWTP and downstream of where localized conveyance issues are known to occur.

3. Flow metering basin FM 7 is given the next priority because of its effect on known problem areas within the collection system. According to CUII staff the interceptor upstream of Lift Station D often surcharges. FM 7 ranked high overall compared to the other flow metering basins (ranked four overall) and is upstream of Lift Station D, meaning the I/I within the FM 7 basin contributes to the issues upstream of Lift Station D. For this reason, Basin FM 7 is given a higher prioritization than some of the other basins that received higher rankings.

4. Flow metering basin FM 14 should be prioritized next because it has the third overall ranking based on the wet weather analyses performed and it is an upstream basin, meaning the I/I generated within this basin affects other parts of the collection system.

5. Flow metering basins FM 3 and FM 6 should be prioritized next. FM 3 specifically because it is upstream of one of the main interceptors to the WWTP with known capacity issues, and because there are reported localized conveyance issues during wet weather. FM 6 is prioritized next for the same reasons as FM 7.

There appears to be widespread I/I within the collection system. As such, CUII should pursue further I/I reduction throughout the collection system. Prioritizations provided above are meant to represent a starting point to identify the most significant sources of I/I.

The following additional conclusions can be drawn based on the flow monitoring data collected over the full flow monitoring period:

1. All parts of the collection system are capable of collecting and conveying the average dry weather flows throughout the system.

2. Relatively small rainfall events cause localized conveyance issues throughout various parts of the collection system, specifically upstream of Lift Stations L and D. This is discussed in greater detail in the following sections using the collection system model.

SECTION 4
HYDRAULIC MODELING METHODS AND RESULTS

Microcomputer-based simulation modeling was performed on the Twin Lakes Service Area collection system using XPSWMM software. The purpose of the hydraulic model is to create a planning tool to identify capacity problems throughout the conveyance system, rather than just at the FMs; to evaluate potential system improvements to address capacity problems; and to assess the impacts of future growth and development in the community. A summary of the modeling methods and results is provided in this section.

4.01 MODEL DEVELOPMENT

The extents of the Twin Lakes Service Area Hydraulic Model include intercepting sewers, trunk and collector sewers, and the major lift stations, rather than modeling the entire collection system.

The modeling process began with identifying major conveyance system components using sewer maps provided by CUII in AutoCAD. The maps were used to guide a GPS survey of the collection system components to be modeled. The survey collected horizontal and vertical coordinates for manhole and pumping station structures in the system. Pipe inverts, diameters, and materials were measured and observed at each surveyed manhole. The survey and piping information was then used to create a hydraulic computer model to-scale with real-life spatial relationships. Figure 4.01-1 shows the extents of the hydraulic model for the service area.

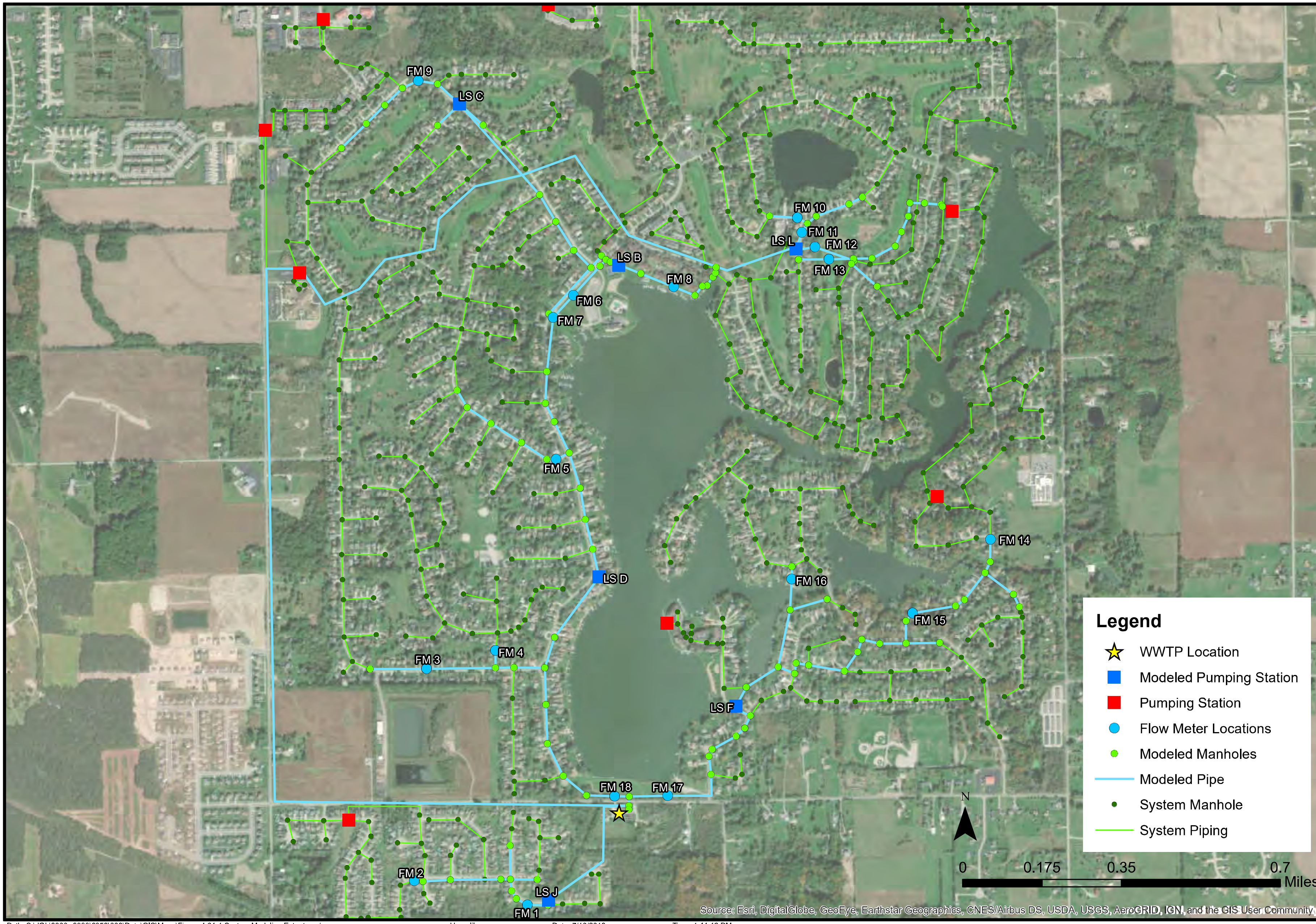
4.02 DRY WEATHER FLOW CALIBRATION

Flow metering data collected throughout the conveyance system was used to calibrate and validate the accuracy of the hydraulic computer model.

Average dry weather flow data was used in the model to establish the current baseline flow characteristics of the conveyance system. This was done by further dividing each flow metering basin into tributary subbasins based on the local sewer systems. A ratio was calculated between the area served by each subbasin and the total FM basin area. The ratios were used to approximate how much each subbasin contributes to the average daily flow of its corresponding FM basin. In the model, each subbasin's flow contribution was distributed into the subbasin's manholes to represent flow entering the sanitary system at those points.

With this process complete, the model was run, and the results were graphically compared to the actual flow metering data collected. The overall shape of the flow curves was compared along with the specific maximum, average, and minimum flow values produced by the model and measured by the meters. During the calibration process, if the meter and model did not match satisfactorily, the flow distribution or pattern was adjusted to create concurrence between metered and modeled data.

In some cases, FMs were located downstream of other FMs, so the upstream FM affected the dry weather calibration of the downstream FMs. In these situations, the upstream FM was calibrated first using the process described above before moving to the downstream FM.



Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\Figure 4.01-1 System Modeling Extent.mxd User: lilag Date: 7/10/2018 Time: 1:41:12 PM

SEWER SYSTEM MODELING EXTENTS

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.01-1
6958-038

Table 4.02-1 provides a summary and comparison of the metered dry weather and modeled dry weather results. The dry weather calibration graphs for each flow metering basin can be seen in Appendix B.

	Average Flow			Maximum Flow		
Meter	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference
FM 1[1]	41.20	41.36	0%	55.83	57.00	2%
FM 3	15.35	15.05	-2%	38.44	37.25	-3%
FM 4	22.30	22.08	-1%	31.26	30.52	-2%
FM 5	24.53	23.89	-3%	39.33	38.15	-3%
FM 6	41.65	67.19	61%	243.43	230.70	-5%
FM 7	86.14	77.49	-10%	307.34	267.05	-13%
FM 8	42.48	42.10	-1%	58.87	57.90	-2%
FM 9	23.97	29.39	23%	50.77	49.82	-2%
FM 10	17.49	17.33	-1%	23.43	22.89	-2%
FM 11	34.19	34.54	1%	47.21	46.23	-2%
FM 12	17.78	18.17	2%	24.57	24.24	-1%
FM 13	42.89	53.88	26%	125.78	125.22	0%
FM 14	10.15	10.62	5%	20.30	19.75	-3%
FM 15	27.30	27.37	0%	41.07	42.64	4%
FM 16	11.72	12.17	4%	21.34	21.99	3%
FM 17	173.98	168.08	-3%	387.85	386.44	0%
FM 18	217.43	215.37	-1%	297.97	297.58	0%

[1] Includes flow metering basin FM 2

Table 4.02-1 Dry Weather Calibration

As previously discussed, the flows at FM 2 were too low to collect accurate measurements. As a result, this FM was not used for the flow metering evaluations discussed in Section 3. Similarly, the data is not able to be used for model calibration purposes. Therefore, basin FM 1 was modeled as the combination of basins FM 1 and FM 2 and treated as one basin.

The calibration goal during the modeling process is to create a hydrograph that has a maximum flow and average flow within ±20 percent of the metered flow at each meter location. While it is possible to get within a few percentage points of the maximum and average dry weather flows during dry weather calibration, there are some circumstances that make calibration difficult, specifically when a FM is located near a pumping station, as is the case with FMs 6, 9, and 13. When a FM is close to a pumping station, there are often very large swings in flow from pumps turning on and off. Those swings are very difficult to model exactly and match on an average flow basis, especially when the lift station data available is limited. This is discussed later in this section.

While the average flow calibration of FMs 6, 9, and 13 are not within the desired 20 percent margin of error, the maximum flows are all within 13 percent, with FMs 9 and 13 both within 2 percent. It can be argued that maximum flow is a more important modeling parameter than the average flow parameter since this model is being used to evaluate conveyance issues associated with high flows within the collection system.

4.03 WET WEATHER CALIBRATION

The second step in the calibration process was to modify the hydraulic parameters within the model until the wet weather flow computed by the model matched the actual flows metered during a selected wet weather event. The model was calibrated based on flow data collected for one of the three study events. During the calibration process, several model parameters were adjusted so that the hydraulic model represented the real-life response captured by the flow metering.

To confirm the model was both accurate and had the ability to predict the conveyance system's response to other unmetered wet weather events, a validation process was performed using a second study event in the model without adjusting any parameters. If the modeling validation results matched the second event's metering results, the model was considered both calibrated and validated and it could be assumed within reason that the model was both accurate and able to predict the system's response to other flow scenarios. However, if the results between the validation run and the metering did not match, the model parameters were adjusted incrementally until both the calibration and validation model results closely matched the metered events within the acceptable computer modeling error of ±20 percent.

There were 16 events that represented possible wet weather study events. Of those 16 events, three were used for the wet weather flow metering analyses described in Section 3. These events were appropriate candidates for calibration and validation events.

A. July 21, 2017

This rainfall event was selected as the validation event for several reasons. It was one of the larger events that occurred during the flow monitoring period. It was also a fairly uniform event across the service area with the difference in rainfall between the two rain gauges being less than 20 percent. It had a maximum recurrence interval of approximately a six-month, six-hour storm, meaning it was a steady rain over several hours rather than a short, high-intensity event. Finally, all meters were fully functional during the event and most meters had a noticeable wet weather response.

B. August 3, 2017

This rainfall event was selected as the calibration event because it was the most intense of the three considered events and was fairly uniform. Additionally, all FMs were fully functional at the time. This event produced 0.7 inch of rain in only 30 minutes, which equates to a nearly five-month recurrence interval storm and represents a short, high-intensity event, rather than an extended event such as the July 21 event. Finally, all meters demonstrated a noticeable wet weather response.

C. October 14, 2017

This rainfall event was not selected as either the validation or calibration event despite it being the rainfall event with the largest volume of rain. The rainfall event occurred over a fairly long period of time and was not very intense, which meant the wet weather response was less apparent compared to the other events. Additionally, there were a few meters that collected only intermittent data during this event.

Once wet weather study events were selected, the RTK Unit Hydrograph method was used to generate wet weather hydrographs for input into the model. Because of the complexity of the RTK method, it is not discussed in detail in this report except to note that the hydrograph created for input into the model allows adjustable parameters that include the following:

1. R value: Fraction of precipitation that gets into the conveyance system.

2. T value: Amount of time from the precipitation input to the peak of that hydrograph component.

3. K value: Ratio between the time it takes the hydrograph to peak and the time until the end of the hydrograph.

There is no theoretical way to determine the values of these adjustable parameters. The process is an iterative estimation and check process. The United States Environmental Protection Agency-approved software, Sanitary Sewer Overflow Analysis and Planning Toolbox, was used to assist in determining the RTK values for each FM basin.

Similar to the dry weather calibration process, each FM basin was divided into smaller local sewer subbasins. The subbasin wet weather contribution was distributed based on the ratio of subbasin area to total FM basin area and the number of input nodes within each subbasin. One RTK table was created for each FM basin and each input within that basin had the same RTK Unit Hydrograph characteristics.

After the model calculated the wet weather flows and provided results, the metering results were compared to the modeling results. This was done by comparing the peak flows and total flows identified by the model with those identified by the FMs. Also, the hydrograph created by the model was graphed with the metered hydrograph to ensure both size and shape appeared similar to each other.

There are limitations to the computer modeling that make it difficult to exactly match flow modeling to flow metering results. Modeling of separate sanitary sewer systems is even less precise because of the influence of infiltration on the sewer system, which is dependent upon numerous variables that are constantly changing and are not considered by the model. Model calibration and validation strive to create a hydrograph within the model that has the same shape as the flow-metered hydrograph and has a peak flow and total flow within the ±20 percent margin of error of the metered flow at each flow metering location.

The first flow metering basins to be calibrated were the farthest upstream. Once the model was run, if the model and metering results did not match within the 20 percent margin of error as required, the RTK parameters were adjusted and the model was run again. This was done iteratively until the model was within the desired accuracy. Once the upstream FM basins were calibrated, the calibration process moved downstream in the system until each FM basin within the entire conveyance system had satisfactory concurrence.

In addition to flow, hydraulic grade and velocity are important to hydraulic modeling. During the calibration process, these parameters were also calibrated. Once the flows were established through

the calibration and validation process, other parameters within the model, such as Manning's roughness coefficients, entrance and exit losses, pipe sediment, and other losses, were adjusted to match flow depth and velocities. Depth and velocity modeling results were compared to the metering results in the same fashion as the flow results.

Table 4.03-1 shows the tabulated calibration results. The wet weather calibration graphs for each flow metering basin can be found in Appendix C.

Meter	Maximum Flow			Total Flow		
	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference	Metered Flow (gallons)	Modeled Flow (gallons)	Percent Difference
1	159	184	15%	138,406	142,779	3%
3	133	160	21%	68,206	75,871	11%
4	100	120	21%	77,341	82,876	7%
5	133	141	6%	103,835	115,883	12%
6	279	383	37%	129,090	137,409	6%
7	392	423	8%	294,694	301,749	2%
8	261	228	-13%	120,807	111,078	-8%
9	186	178	-4%	153,498	146,224	-5%
10	285	319	12%	91,698	102,855	12%
11	660	726	10%	200,180	218,442	9%
12	95	88	-8%	63,987	62,076	-3%
13	235	236	0%	95,233	166,055	74%
14	102	115	13%	72,066	55,199	-23%
15	119	137	15%	77,397	92,109	19%
16	76	71	-7%	42,434	49,204	16%
17	1,154	1,091	-6%	592,895	522,263	-12%
18	1,176	1,088	-7%	785,148	812,229	3%

[1]Includes flow metering basin FM2

Table 4.03-1 Wet Weather Calibration

Similar to the dry weather calibration process, meeting the 20 percent margin of error was difficult to achieve at some of the flow metering locations. Some of these locations are near lift stations (FM 6 and FM 13). For others, the calibration was outside the margin of error when applying the validation process described below. Modeled parameters were set to most effectively balance the hydrograph created for the calibration and validation events.

4.04 WET WEATHER VALIDATION

Table 4.04-1 presents a summary of the validation results. Validation graphs for each FM basin can be found in Appendix D.

Meter	Maximum Flow			Total Flow		
	Metered Flow (gpm)	Modeled Flow (gpm)	Percent Difference	Metered Flow (gallons)	Modeled Flow (gallons)	Percent Difference
1	186	156	-16%	234,577	190,247	-19%
3	204	159	-22%	111,054	99,087	-11%
4	133	108	-19%	137,898	115,674	-16%
5	190	153	-19%	118,678	122,235	3%
6	724	432	-40%	274,550	237,647	-13%
7	623	557	-11%	524,343	437,422	-17%
8	211	240	14%	186,144	164,884	-11%
9	178	201	13%	257,921	226,355	-12%
10	410	402	-2%	200,832	165,517	-18%
11	1,019	932	-9%	372,163	350,663	-6%
12	109	113	3%	90,996	95,325	5%
13	312	302	-3%	199,422	235,816	18%
14	163	135	-17%	156,258	90,655	-42%
15	140	154	10%	146,207	142,846	-2%
16	84	90	7%	92,311	77,163	-16%
17	1,213	1,103	-9%	865,592	759,567	-12%
18	1,425	1,333	-6%	1,337,672	1,179,849	-12%

[1] Includes flow metering basin FM 2

Table 4.04-1 Wet Weather Validation

Model validation is often difficult to achieve with accuracy because of a number of factors that change between wet weather events. This is truer for separate sanitary sewer systems such as the Twin Lakes collection system because rainfall is not meant to directly enter the collection system.

Specifically, there was a dry weather period prior to the July 21, 2017 validation event, which meant the antecedent soil conditions may have been dry. But there had been wet weather preceding the August 3, 2017 calibration event, which meant the antecedent soil conditions may have been wetter when compared to those before the validation event. As a result, the pervious areas within the collection system had less ability to soak up rainfall, potentially resulting in more runoff during the calibration event than that compared to the validation event when the dry soil was able to absorb more rainfall. Furthermore, the wet conditions prior to the calibration event could have potentially resulted in more infiltration into the collection system through defects in the sewer. Although the model validation and calibration fell outside the desired margin of error at a few of the meter locations, the flows and hydrograph shapes are similar enough that the model can be considered a good prediction tool.

4.05 MODELING ASSUMPTIONS

The Twin Lakes Service Area has some unique characteristics. These characteristics are especially apparent during wet weather and high flow conditions. Assumptions were made to address these characteristics. Additionally, there were some gaps in the data provided by CUII, and assumptions were made to resolve these data gaps.

A. Wet Weather Flow Distribution

The basis of calibrating and validating a collection system sewer model is a comparison of flow metering data and modeling results as previously described. As such, the only data available for actual conditions within the collection system is at the individual FM locations during the calibration and validation events. While the data collected can offer clues into the conditions upstream of the FM locations, in general, actual conditions at specific points in the system are relatively unknown. For example, the total and peak flow during a rainfall event is known at each FM location, but there is no way to determine how those wet weather flows are actually distributed throughout the basin upstream of the FM. Certain areas of a FM basin may be more susceptible to I/I than others and may contribute to a higher fraction of rainfall to the overall basin.

For the purpose of this model, without exact knowledge as to how the wet weather flows are distributed in any specific FM basin, the flows are distributed proportionally to the amount of the FM basin tributary to each input. This assumption is briefly described in Section 4.03.

B. Lift Station Modeling

As previously discussed, there are 14 lift stations within the Twin Lakes Service Area. Of those 14 lift stations, six are included in the hydraulic model. All six lift stations are duplex submersible lift stations with two pumps at each lift station. A data request was sent to CUII during the development of the model to obtain vital data necessary to accurately model each lift station. The data request included the following:

1. Existing drawings that provide detailed physical information including wet well depth, incoming sewer information including diameter and invert elevation, and force main information including size and elevation leaving the lift station.

2. Pump information including manufacturer, model number, serial numbers, and pump curves.

3. Flow metering data, number of starts or stops, and pump run times.

4. Control information including on/off elevations of each pump in each lift station.

Unfortunately, limited data is available for the lift stations within the Twin Lakes collection system.. The only information available is pump manufacturer, pump horsepower, and field measurements of the wet well dimensions, including diameter and depth. Pump runtimes are collected daily, however, they are 24-hour cumulative values, which provides little value when developing a collection system model.

As a result of the limited available data, several assumptions had to be made to model each lift station because of the lack of available information. An internet search was used to find pump curves based on the pump horsepower and manufacturer information provided. It is unknown whether the pump curves that were found are accurate for what exists in the system.

Additional assumptions had to be made because of lack of information on number of starts, stops, runtime, and control setpoints. The model was adjusted to attempt to match adjacent flow metering data, but this process was extremely difficult. While the model achieved calibration and validation at the flow metering locations, the accuracy of the operation of each lift station modeled is largely unknown.

C. Sewer Information

CUII has limited mapping available of the Twin Lakes Service Area. The mapping that does exist is either very old or does not have any information on pipe sizes and materials. The diameter and material of each length of sewer within the model was assumed based on the limited mapping available and visual observation from the surface during the survey portion of the project.

This is important to note since pipe diameter and material, and specifically its associated Manning's roughness coefficient, have a large impact on the hydraulics within the model.

D. Twin Lakes WWTP

All flow generated within the Twin Lakes Service Area is conveyed and treated at the Twin Lakes WWTP. Historically, the WWTP has caused upstream sewer surcharging from a lack of hydraulic capacity during larger wet weather events. Therefore, the WWTP was modeled as a restricted outfall (matching the WWTP's influent flume) during the calibration and validation process to estimate the current hydraulic constraints of the WWTP and its effect on the collection system.

CUII has indicated that design is underway to increase the hydraulic capacity of the WWTP with new wet weather facilities. It was assumed by CUII that all hydraulic issues at the WWTP would be addressed with the new improvements and would no longer have an impact on the collection system. Thus, as directed by CUII, the downstream boundary condition within the XPSWMM model was changed to a free outfall for the alternative evaluation discussed in Section 5.

4.06 STORM SCENARIOS

To understand how the collection system reacts to wet weather events that were not metered, the model was run using several theoretical storm scenarios. Based on conversations with CUII, the model was run using a 2-, 5-, 10-, 50- and 100-year recurrence interval storm. All theoretical rainfall events modeled as part of this study were developed using rainfall distribution methods and data described in the *Rainfall Frequency Atlas of the Midwest* by Huff and Angel. Because the actual rainfall data collected during the monitoring period and used to calibrate the model was significantly less than the storm scenarios modeled, specifically the 5-, 10-, 50-, and 100-year recurrence interval storms, these modeled scenarios are at best an extrapolation and approximation of how the sewer system may react during these storm scenarios.

A sensitivity analysis was performed to determine which duration storm should be run at the recurrence intervals above. A critical duration analysis compares the results of different storm durations to find the one that results in the worst conditions. Six different duration storms were run through the model: 1-, 2-, 3-, 6-, 12-, and 24-hour storms. The modeling results were analyzed based on the level of surcharging, number of SSOs, and the level of freeboard under each storm. It was determined that the 2-hour duration storm produced the most extreme results.

As such, the following theoretical storms were used for the basis of the modeling results and recommendations described in the remaining sections of this report:

1. 2-year, 2-hour rainfall event
2. 5-year, 2-hour rainfall event
3. 10-year, 2-hour rainfall event
4. 50-year, 2-hour rainfall event
5. 100-year, 2-hour rainfall event

Running these additional scenarios allowed the model to predict what type of reaction the system would have under larger storm events than those metered. These modeling results provided insight into other problems the system might experience under these larger events. Additional scenarios help provide a basis for designing improvements and an evaluation of how the improvements affect the system overall.

4.07 MODELING RESULTS

The final hydraulic computer model was used to expand the understanding of wet weather flow conditions in the collection system gained through the flow monitoring program, to identify potential problem areas within the system, and to investigate potential improvements to address the problems.

The flow monitoring program identified where wet weather conditions influenced peaking and surcharging at the FM locations in the conveyance system. The hydraulic model provided an approximation of the sewer system in the vicinity of the FMs to identify the extent of wet weather influence. The model also allowed for prediction of influence due to more intense rainfall events than were metered over the monitoring period.

Rather than list and tabulate flow data for each model run at different locations throughout the Twin Lakes Service Area, a series of figures were created for each model run to provide a visual representation of where potential problem areas exist according to the model. Each figure shows sewers highlighted as follows:

1. Yellow represents a surcharged sewer. A surcharged sewer is one where the level of flow exceeds the elevation of the top of the sewer.

2. Orange represents a sewer where there is a potential for basement backups. This is defined as any sewer where the depth of flow within the sewer is within eight feet of the ground surface elevation. If a sewer was shallower than eight feet and did not surcharge, it was not included as a sewer with the potential to cause basement backups. It should be noted that this is a very general determination of basement backup potential. As such, any

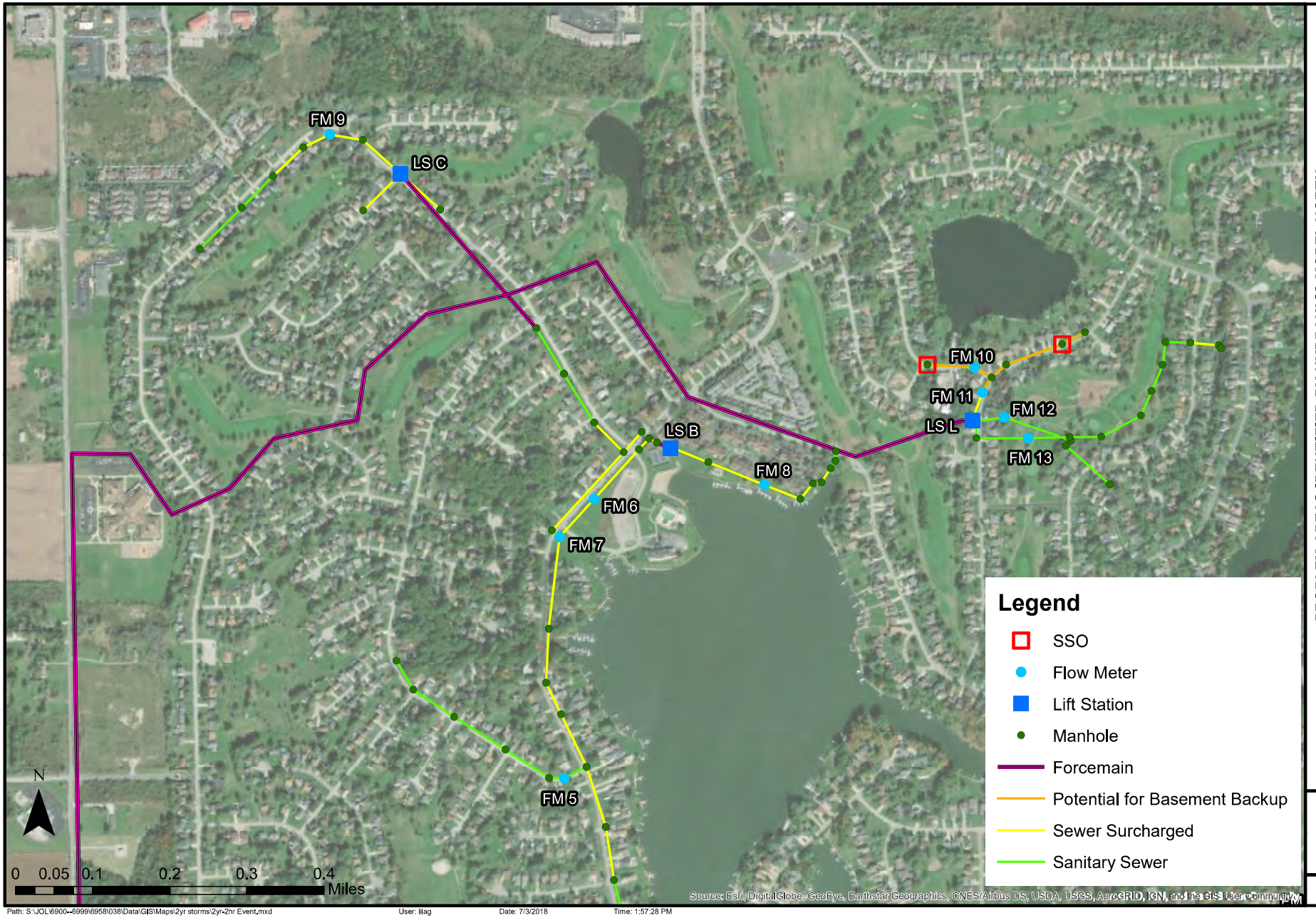
areas that exhibit potential for basement backup should be field-investigated to verify a basement backup potential truly exists. For example, a number of sewers run in backyards and in the golf course in the Lake of the Four Seasons. While the sewer may surcharge to within eight feet of ground elevation, the nearest homes may be constructed significantly higher than the ground at the nearest sewer. In that particular case, a basement backup potential may not actually exist.

3. Red represents where a SSO occurred, meaning the level within the sewer exceeded the ground surface elevation.

Figures 4.07-1 through 4.07-10 represent each modeling scenario created within the model as follows:

1. Figures 4.07-1 and 4.07-2, 2-Year, 2-Hour Storm
2. Figures 4.07-3 and 4.07-4, 5-Year, 2-Hour Storm
3. Figures 4.07-5 and 4.07-6, 10-Year, 2-Hour Storm
4. Figures 4.07-7 and 4.07-8, 50-Year, 2-Hour Storm
5. Figures 4.07-9 and 4.07-10, 100-Year, 2-Hour Storm

It is important to note that the theoretical storm events that were run through the model were significantly larger than the storms observed during the flow monitoring period. As such, the modeling results are based on significant extrapolation. It is reasonable to expect that the modeling results overpredict the actual wet weather conditions expected within the collection system.



PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-NORTH
2 YR 2 HR STORM EVENT
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-1
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment 5C-10
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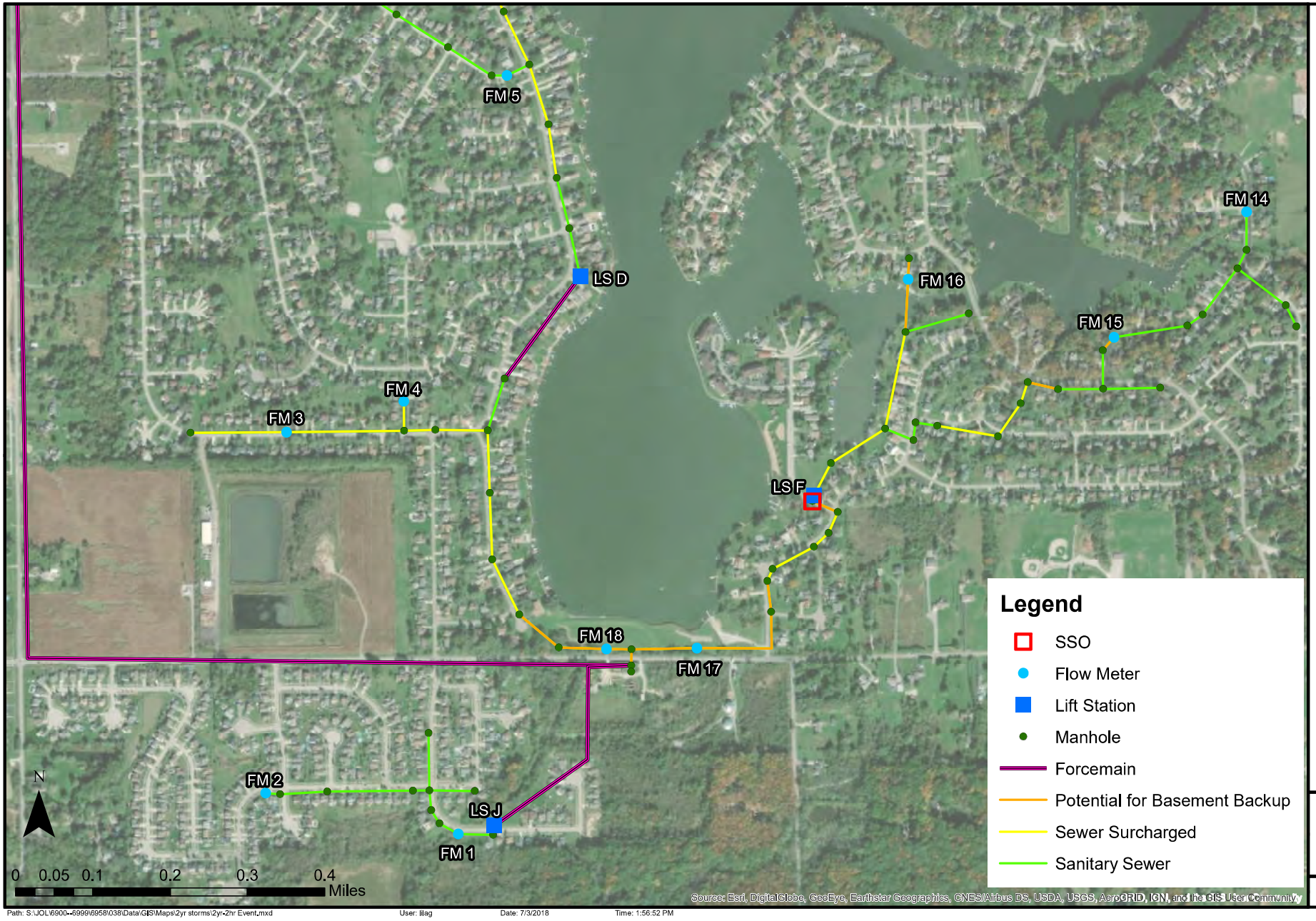

PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-SOUTH
2 YR 2 HR STORM EVENT
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-2
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment ISC-10
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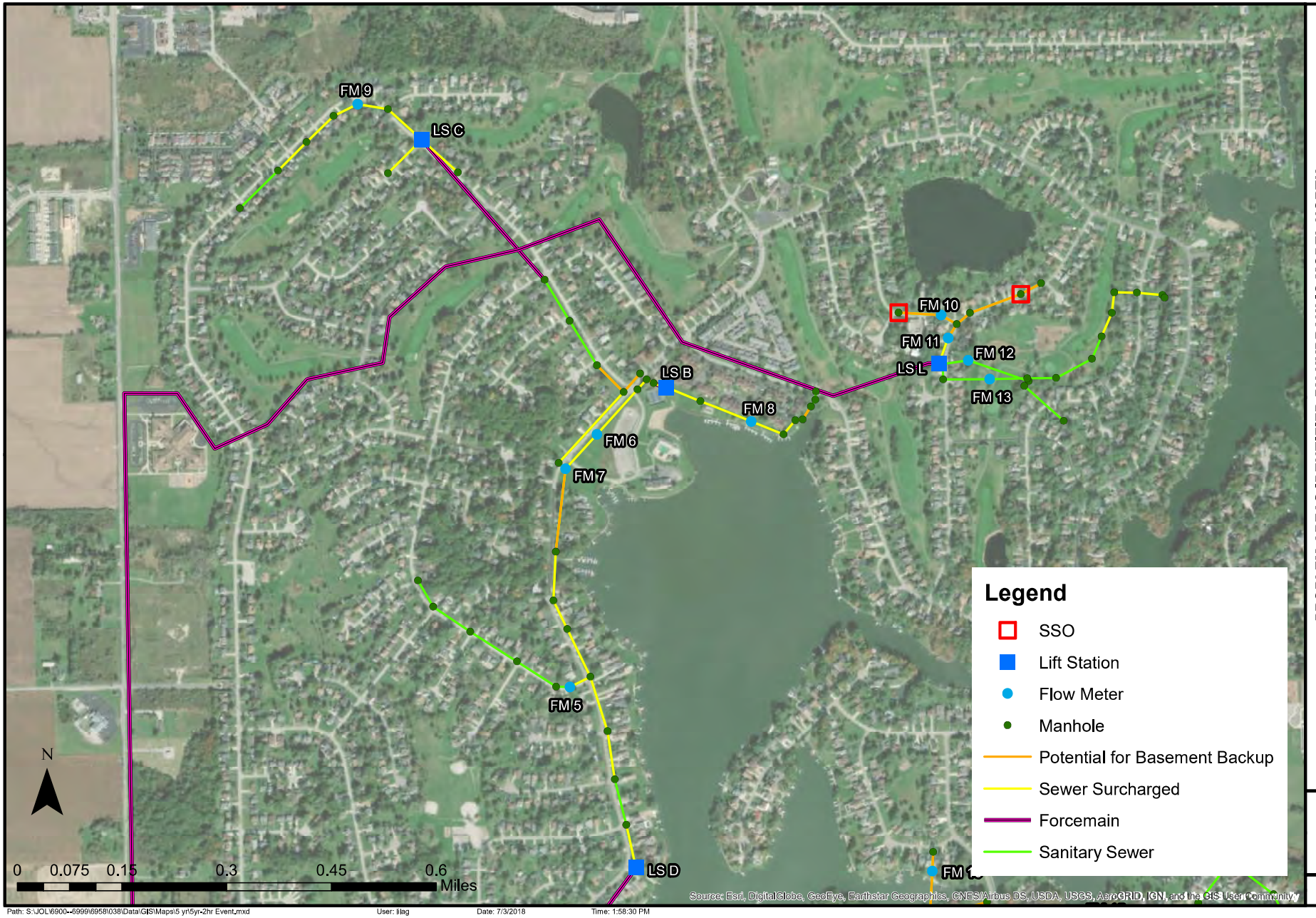
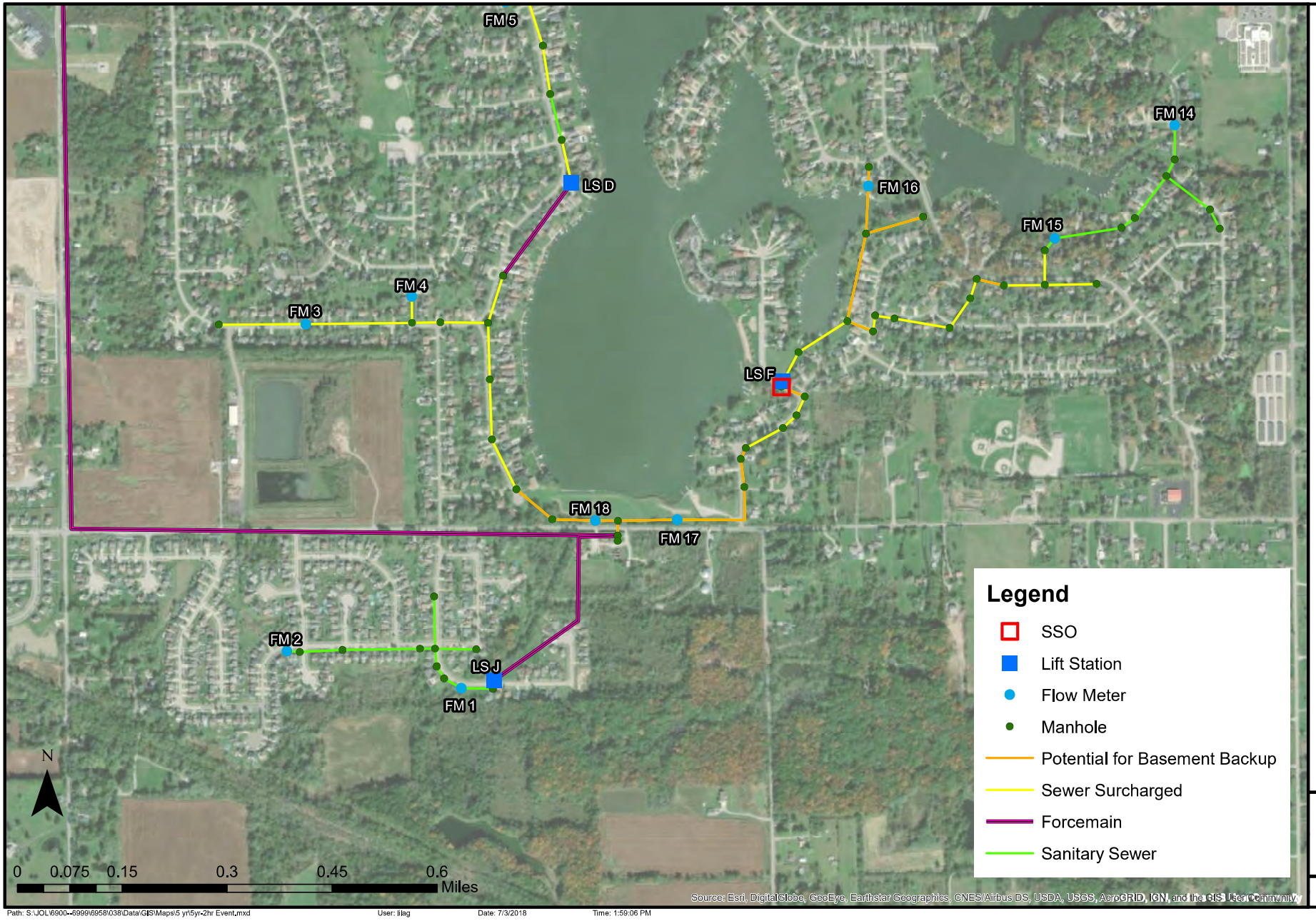


PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-NORTH
5 YR 2 HR STORM EVENT
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-3
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment 4.07-3
Page 64 of 223

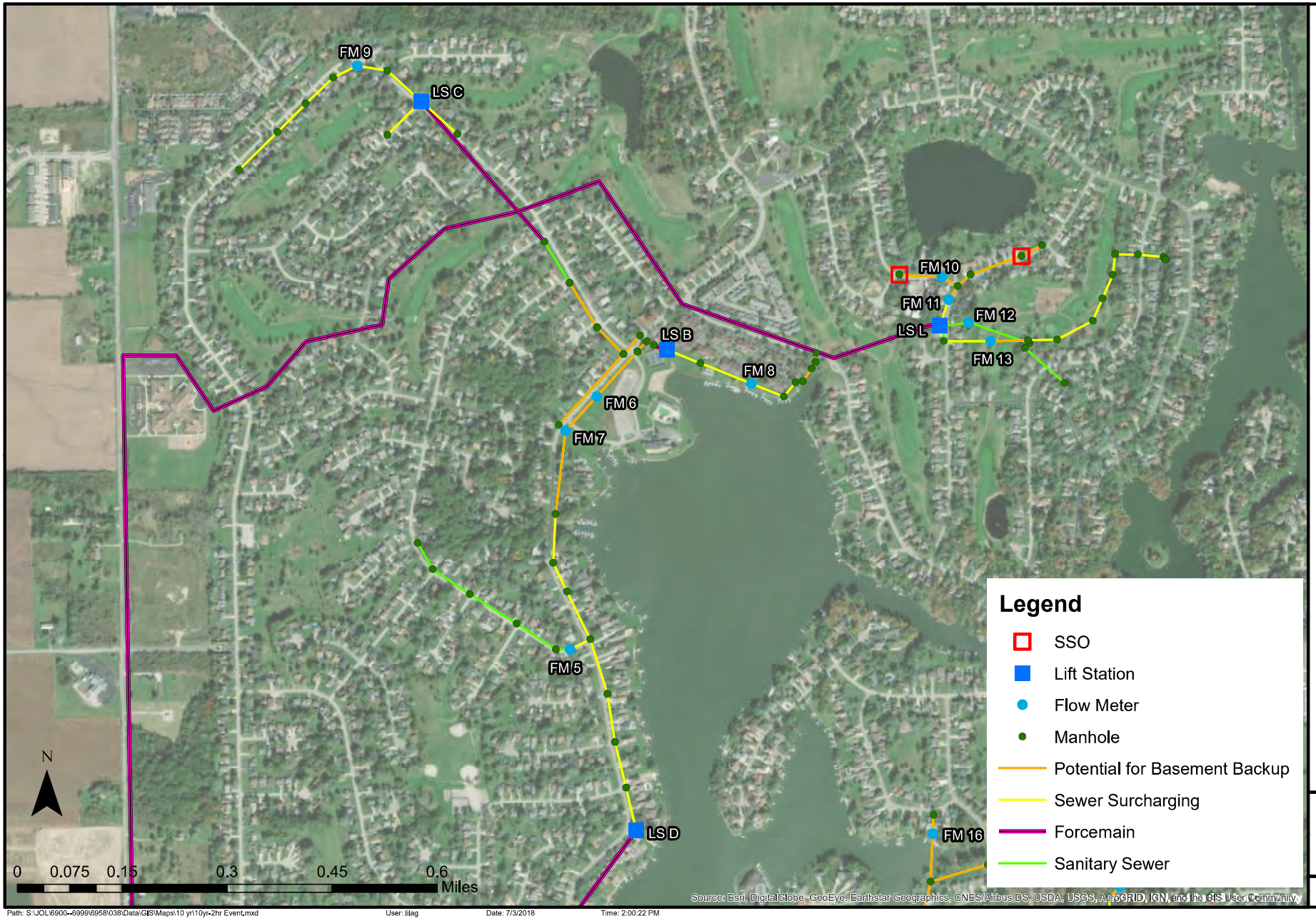


PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-SOUTH
5 YR 2 HR STORM EVENT
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.1-4
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment 2 SCO
Page 65 of 233

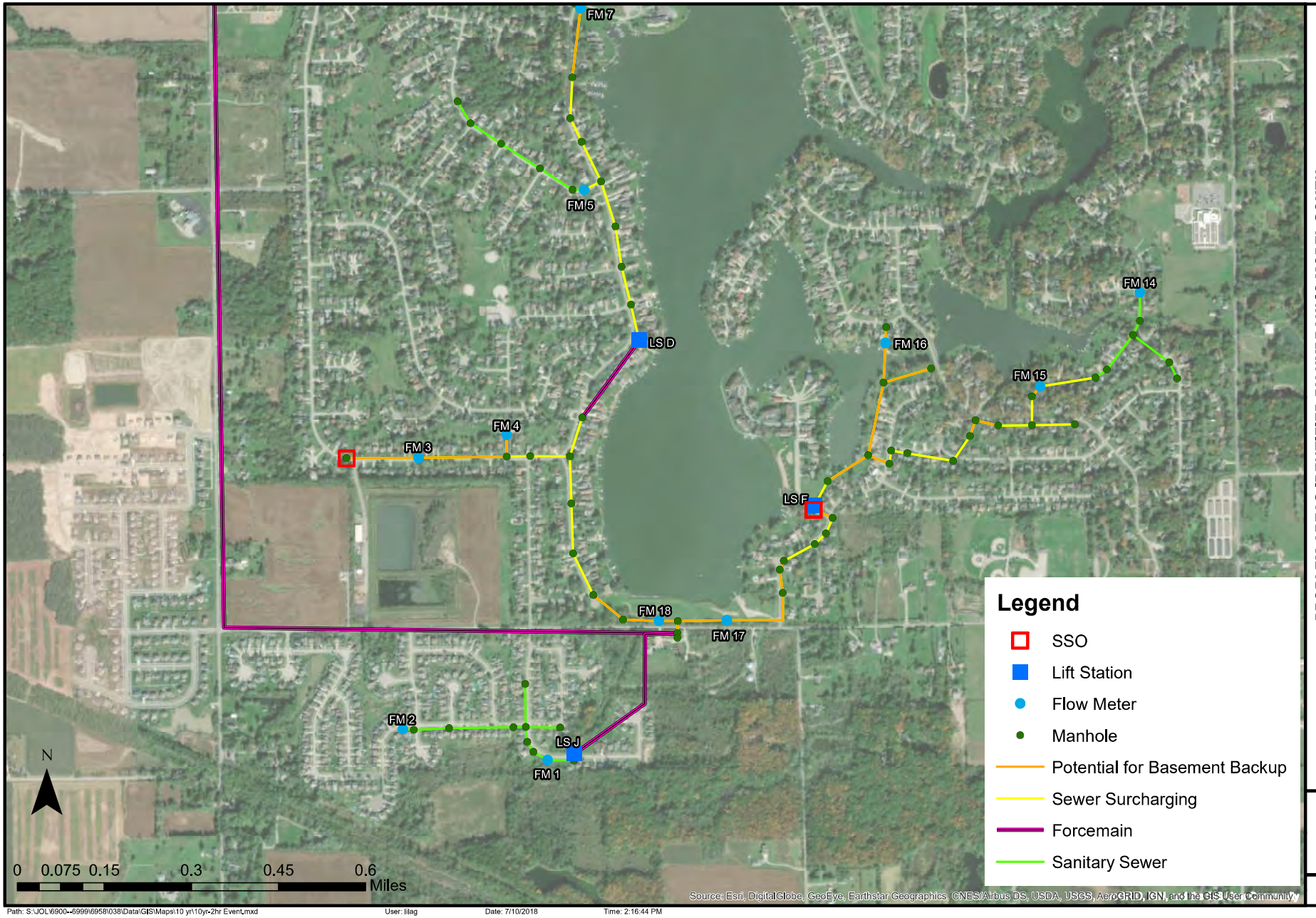


PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-NORTH
10 YR 2 HR EVENT RESULTS
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-5
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment 1SCO
Page 66 of 223

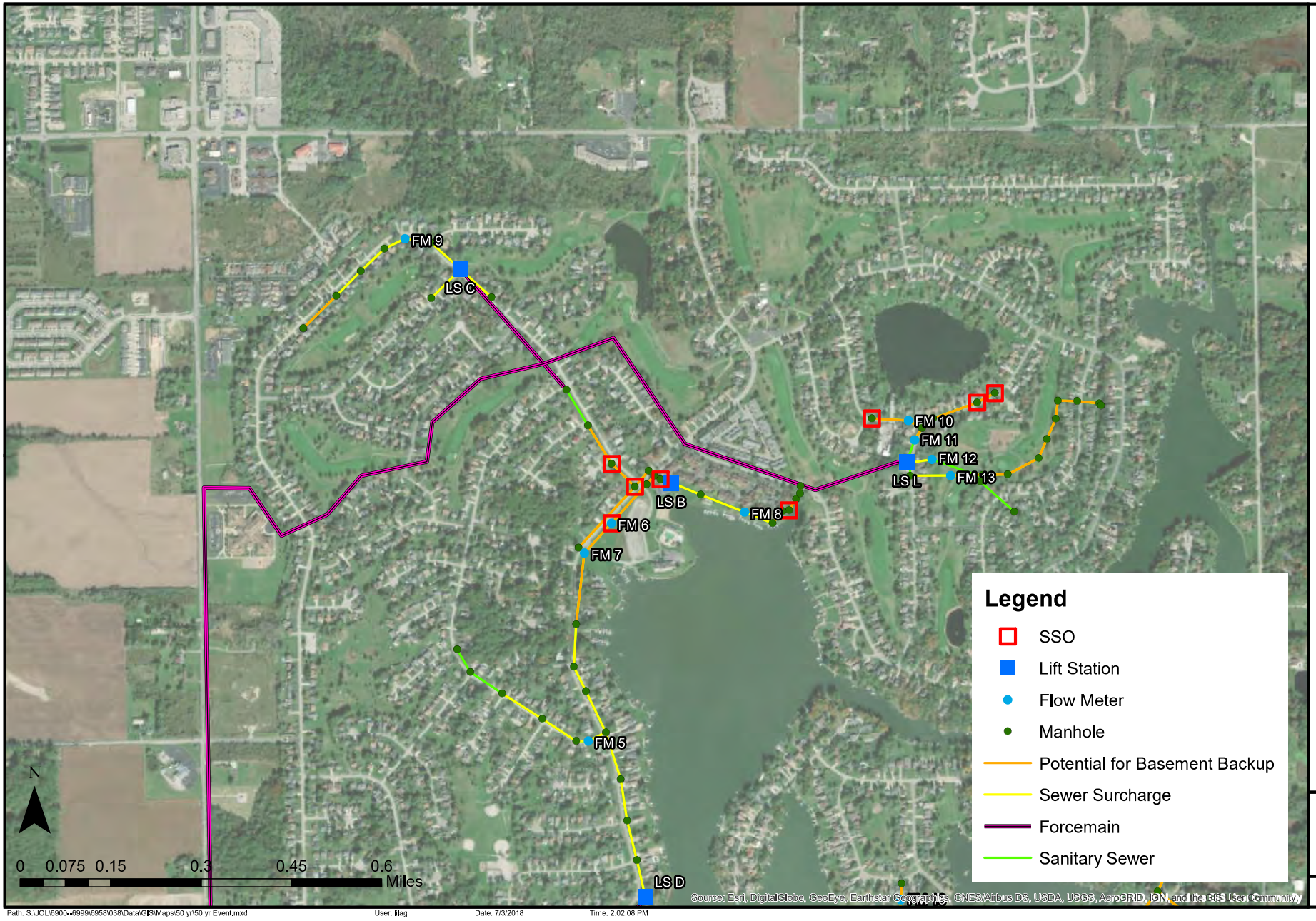


PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-SOUTH
10 YR 2 HR EVENT RESULTS
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-6
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment 5(C)-10
Page 67 of 223



PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-NORTH
50 YR STORM
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-7
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment DSC-10
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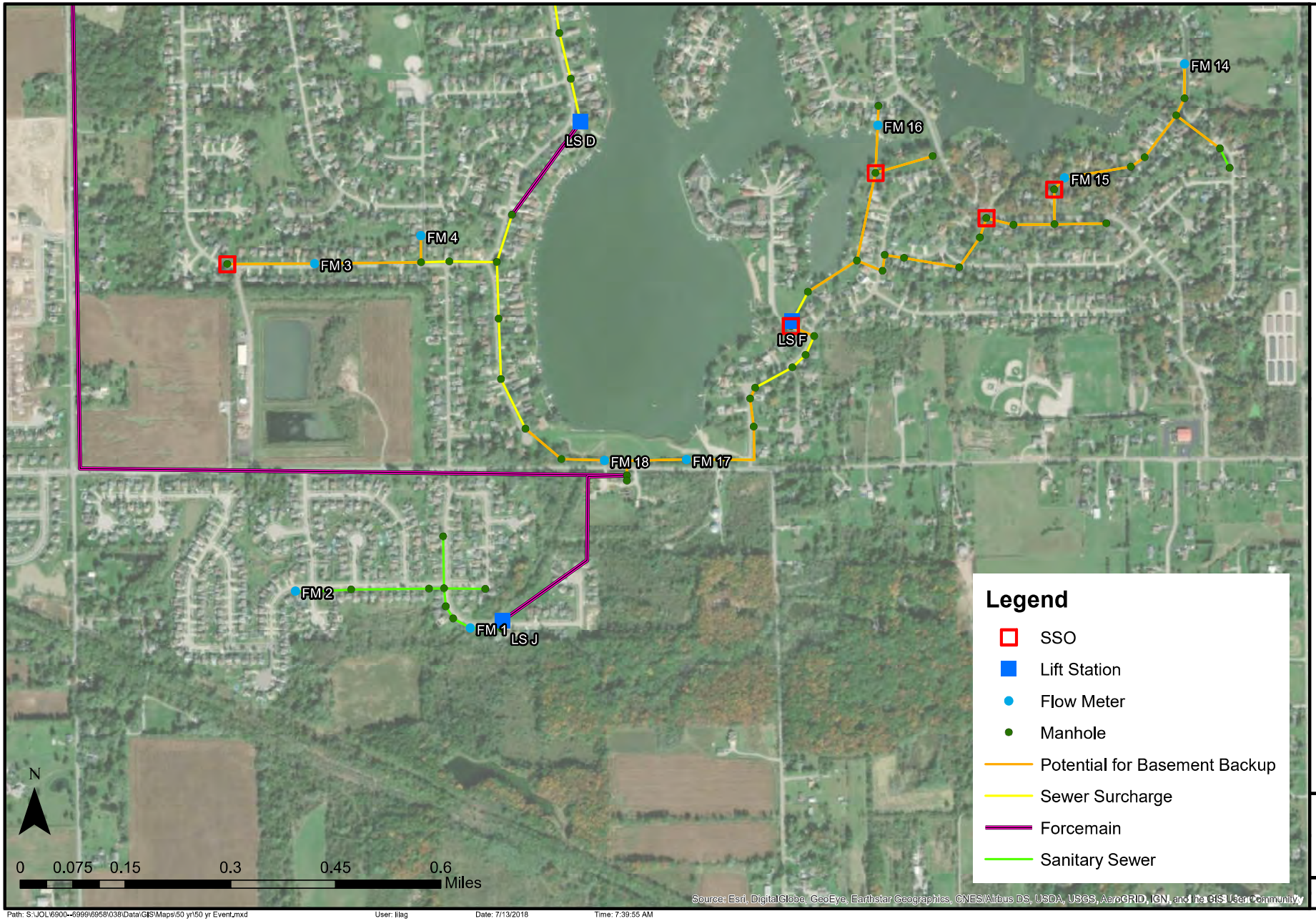

PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-SOUTH
50 YR STORM
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-8
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment ISDH
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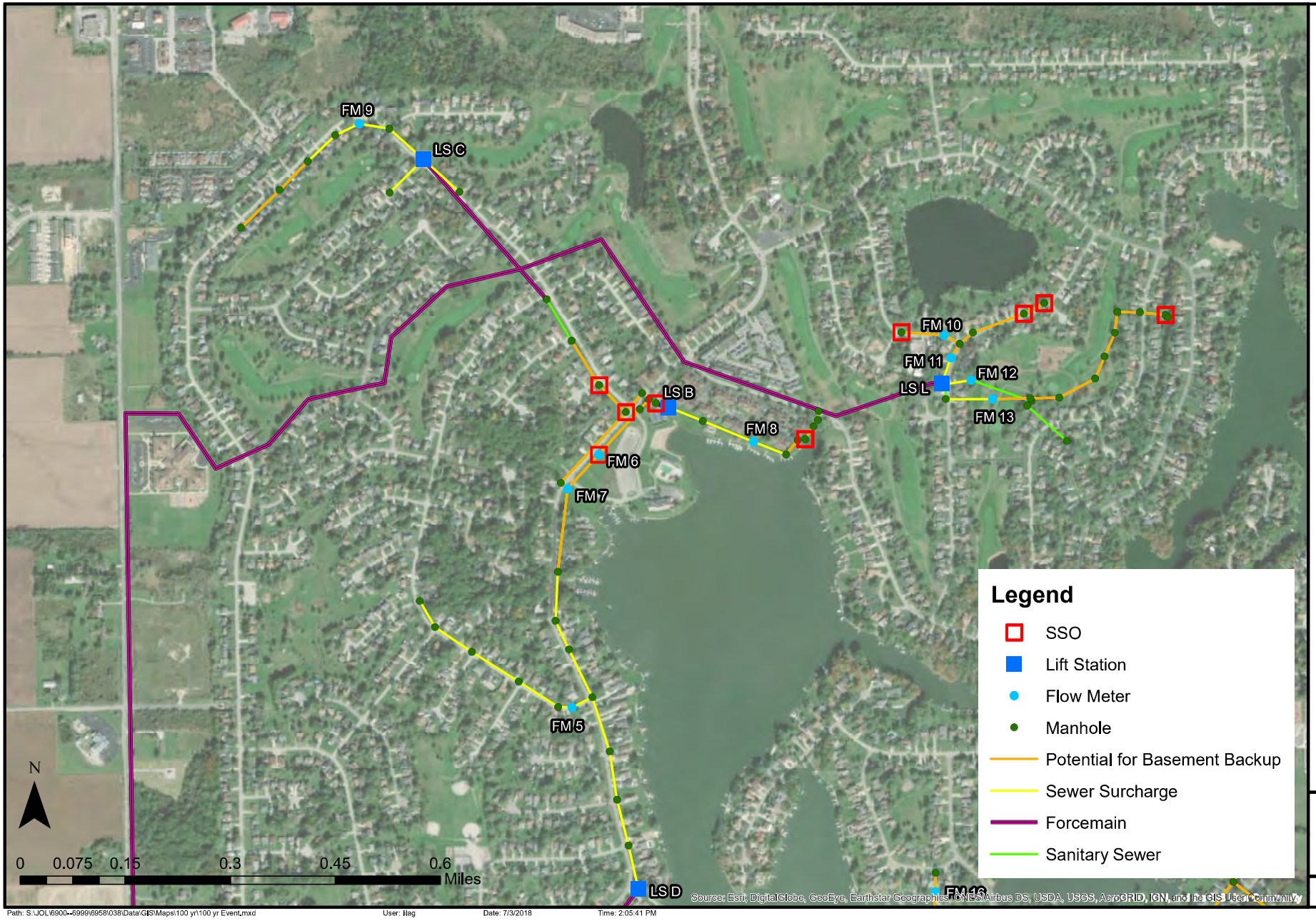

PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-NORTH
100 YR 2 HR STORM
TWN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 4.07-9
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment ESC-10
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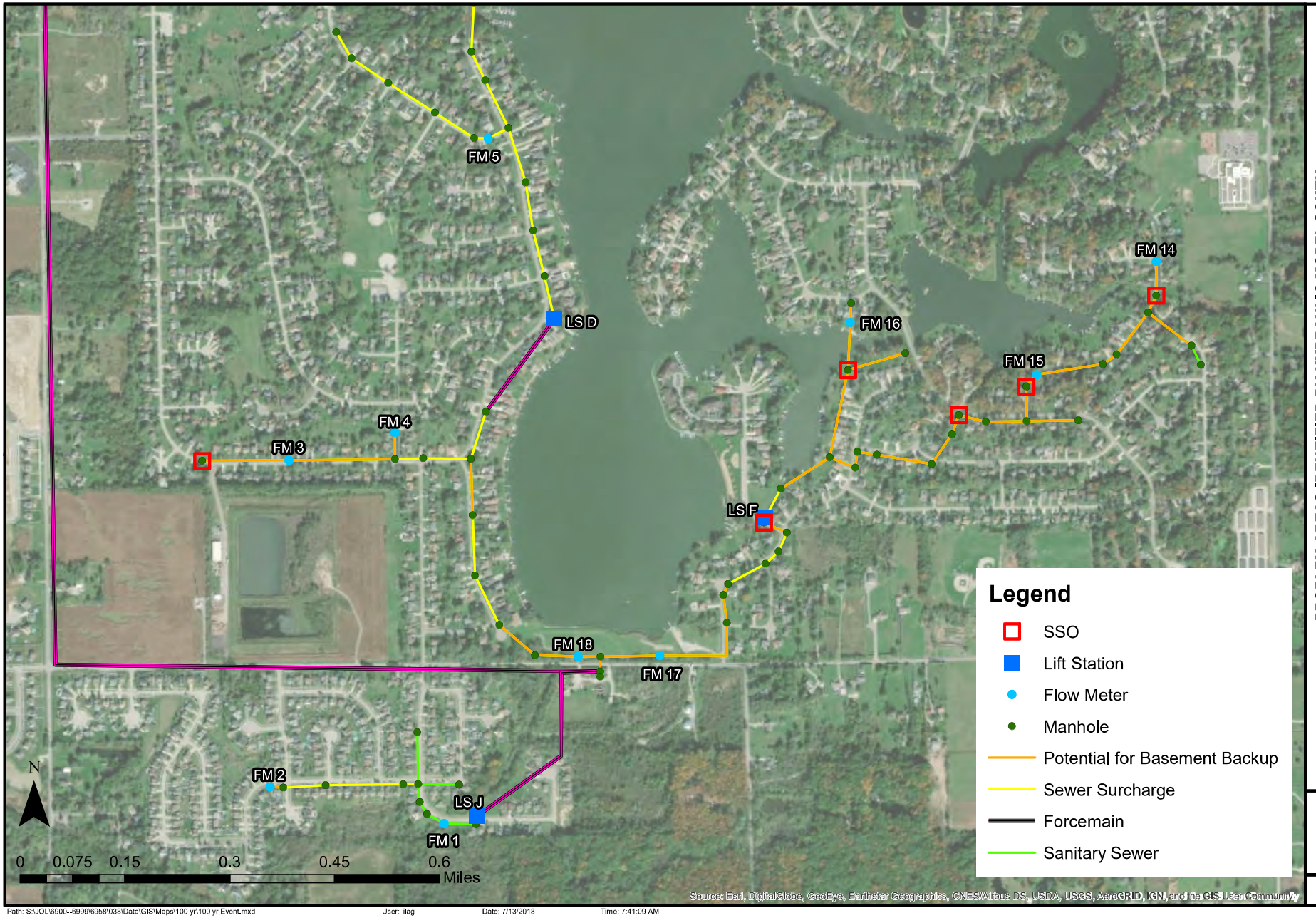

PROBLEM AREAS IDENTIFIED BY HYDRAULIC MODEL-SOUTH
100 YR 2 HR STORM
TWN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 4.07-10
6958-038

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SECTION 5
ALTERNATIVE EVALUATION AND RECOMMENDATIONS

The section provides an evaluation of the alternatives identified to alleviate the problem areas revealed by the hydraulic model and recommendations for addressing conveyance issues within the Twin Lakes Service Area.

5.01 DESCRIPTION OF ALTERNATIVES

Multiple alternatives to alleviate the conveyance issues identified by the conveyance models are comprehensively considered in this section. These include both I/I removal and infrastructure improvements.

A. Implement an I/I Removal Program

In all cases, the problem areas exhibit significant peaking factors that are a result of excess wet weather flow leaking into the sanitary sewer system. Generally, there are two ways to address the problems; make improvements to the sewer system to convey and treat the excess flow or make improvements to the sewer system to reduce the excess flow at the source by implementing an I/I removal program.

An I/I program starts with a study to identify the sources of I/I into the separate sewer system. There are several potential sources of I/I into the system. Historically speaking, most often infiltration is associated with aged sanitary systems. The flow metering program demonstrated that a large portion of the collection system is impacted by wet weather. Common sources of I/I include connected downspouts and foundation drains, sump pump connections, storm and sanitary cross connections, manhole defects, and pipe defects. The I/I study will identify those potential sources present in the service area. There are several methods of identifying sources of I/I; the most common being manhole inspections, smoke testing, dye testing, and sewer televising.

Once the sources of I/I are identified, sewer televising is used to plan rehabilitation to address the sources. This plan could potentially include a downspout and foundation drain disconnection program, manhole repair program, point sewer repairs, and sanitary sewer lining.

Section 3 of this report includes a recommended prioritization for addressing I/I within the collection system and can be used as a starting point for identifying and removing sources of I/I. The implementation of an I/I removal program is not anticipated to eliminate peak wet weather flows and surcharging but could reduce the impacts and lessen the extent and cost of other infrastructure improvements required to alleviate the issues.

There is much debate over the expected effectiveness of an I/I removal program. Some municipalities and private utilities have spent considerable efforts and resources trying to locate and remove sources of I/I with little success. Part of the limited success of I/I programs can be attributed to the fact that a majority of I/I within a collection system comes from private property sources that could include service laterals to buildings as well as downspouts, foundation drains, and sump pumps connected to the sanitary sewer system. Any effective I/I program must include some type of private I/I removal component, whether that is a downspout disconnection program, sump pump disconnection program, or lateral rehabilitation program.

B. Infrastructure Improvements

There are several infrastructure improvements that can address the conveyance issues within the Twin Lakes Service Area. However, there is a balance between the amount of desired protection and the amount of funding available for the improvements. With sufficient funding, all surcharging could be alleviated at any storm recurrence interval, but it comes at a high cost. Therefore, the infrastructure improvements discussed in this section are based on providing a level of protection up to the theoretical design storm of a 10-Year, 2-Hour storm event.

1. Alternative 1

Alternative 1 involves removing and replacing a number of existing sewers with larger diameter sewers. Figures 5.01-1 through 5.01-6 were created to visually show the proposed improvements associated with Alternative 1.

2. Alternative 2

Alternative 2 is similar to Alternative 1 with the main difference being construction of a new relief sewer upstream of Lift Station L, which allows for less sewer removal and replacement across the golf course. The difference between Alternative 2 and Alternative 1 is shown visually in Figure 5.01-7.

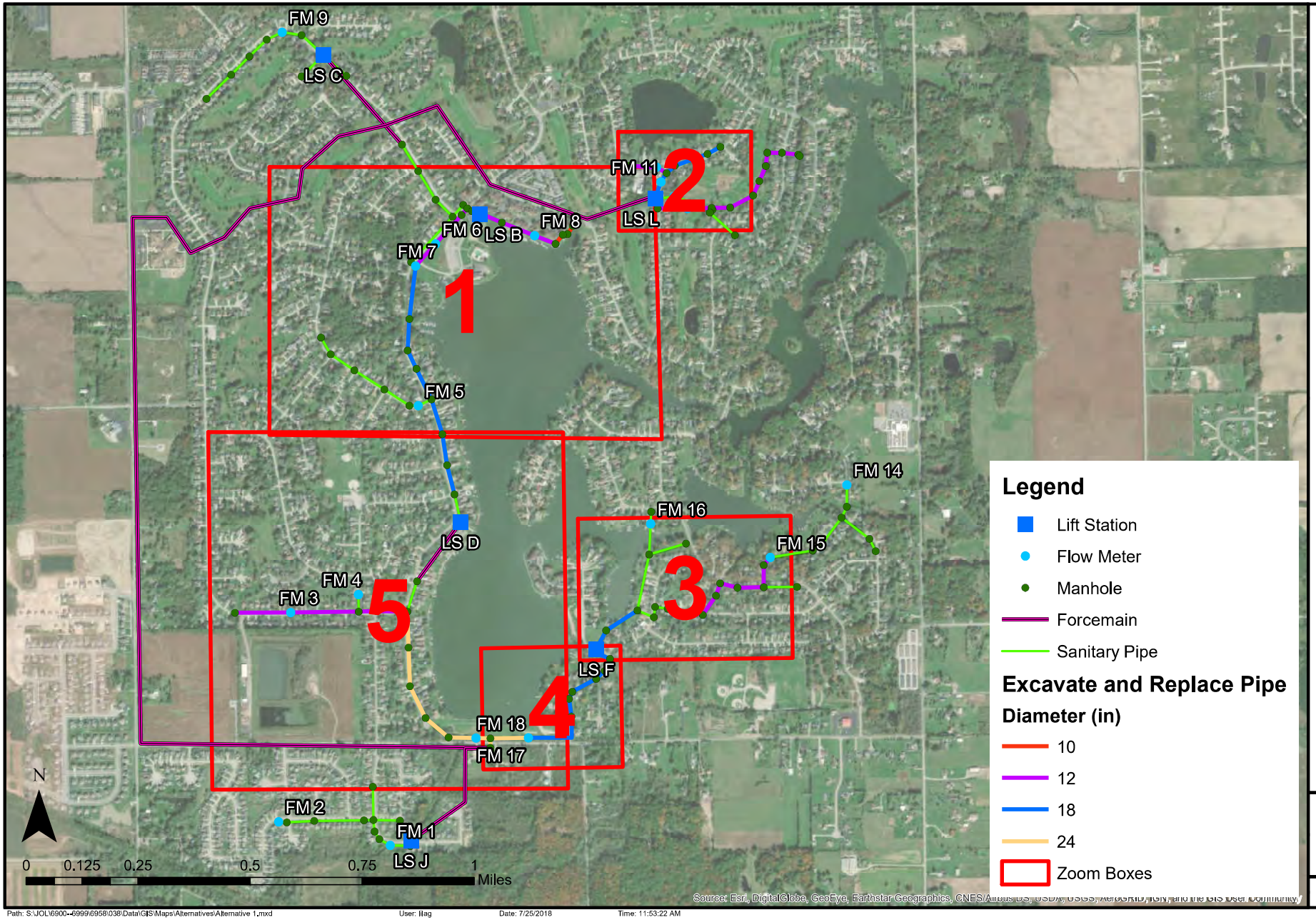
3. Alternative 3

Alternative 3 involves leaving a majority of the existing infrastructure in place and running parallel sewers directly adjacent to the existing sewers as relief sewers wherever possible. It is important to note that there are certain locations within the collection system where this is not possible because of physical constraints associated with the location of existing sewers, homes, lakes, etc. In those cases, where a parallel sewer was not possible, the existing sewer was removed and replaced with a larger diameter sewer.

It should be noted Alternative 3 results in a significant increase in the number of sewers within the collection system because of the parallel pipes and relief sewers being installed throughout the collection system. This will result in an increase in operation and maintenance for CUII that is not captured in capital costs. The impacts of operation and maintenance costs can be quantified using a 20 year total present worth analysis, however, that level of detail falls outside the scope of this particular study. Furthermore, CUII already devotes significant resources to maintaining this collection system and WWTP. As a result, this alternative is no longer being considered based on direction from CUII.

4. Various Lift Station and Force Main Improvements

A number of lift station improvements were also evaluated using the XPSWMM model. The lift station and force main improvements were identified by CUII based on previous discussions and evaluations outside the scope of this study.



ALTERNATIVE 1
PROPOSED IMPROVEMENT- FULL VIEW
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 3.01-1
6958-038

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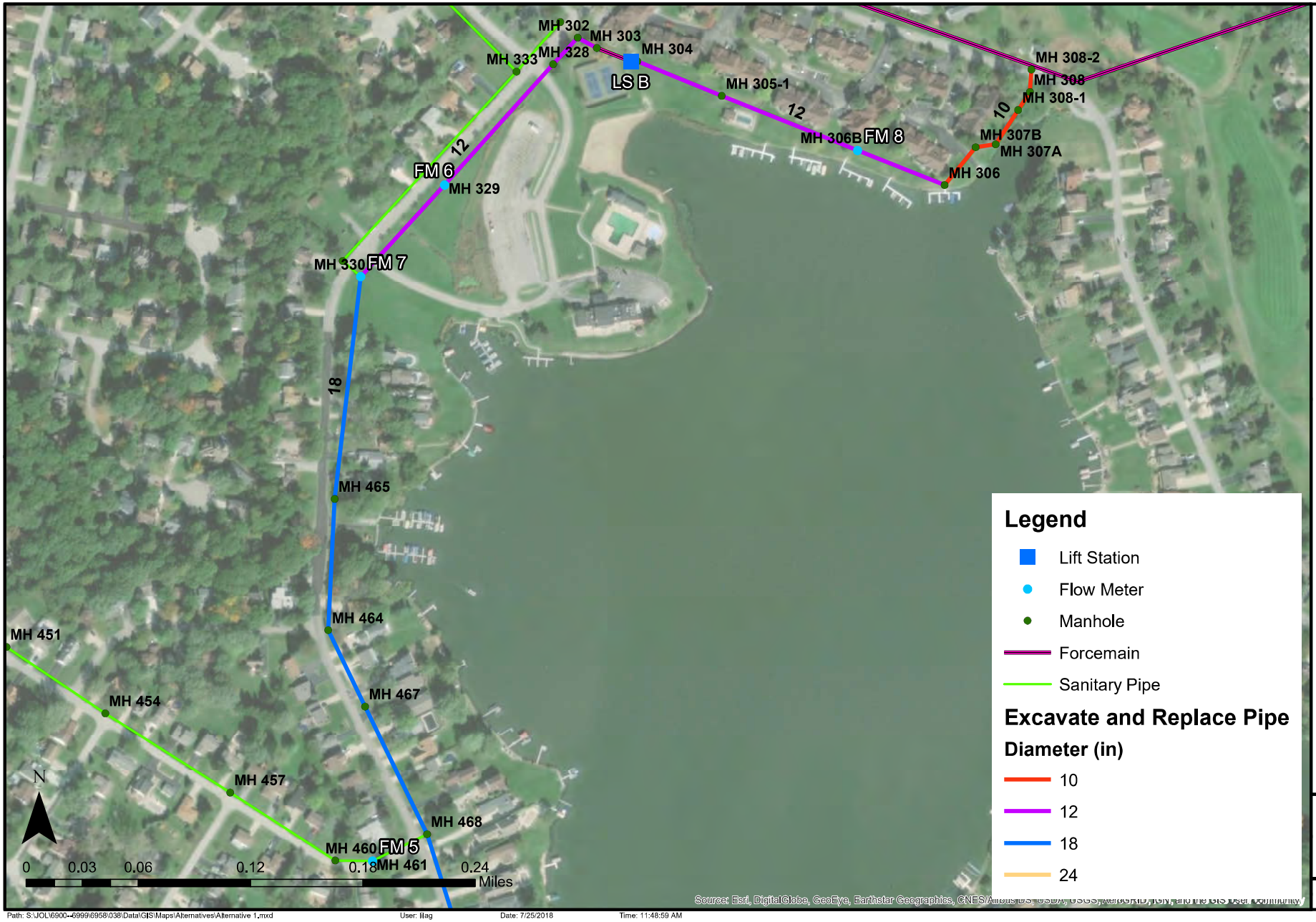

ALTERNATIVE 1
PROPOSED IMPROVEMENT- ZOOM 1
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 2.01-2
6958-038

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ALTERNATIVE 1
PROPOSED IMPROVEMENT- ZOOM 2
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 3.01-3
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment 2SCO
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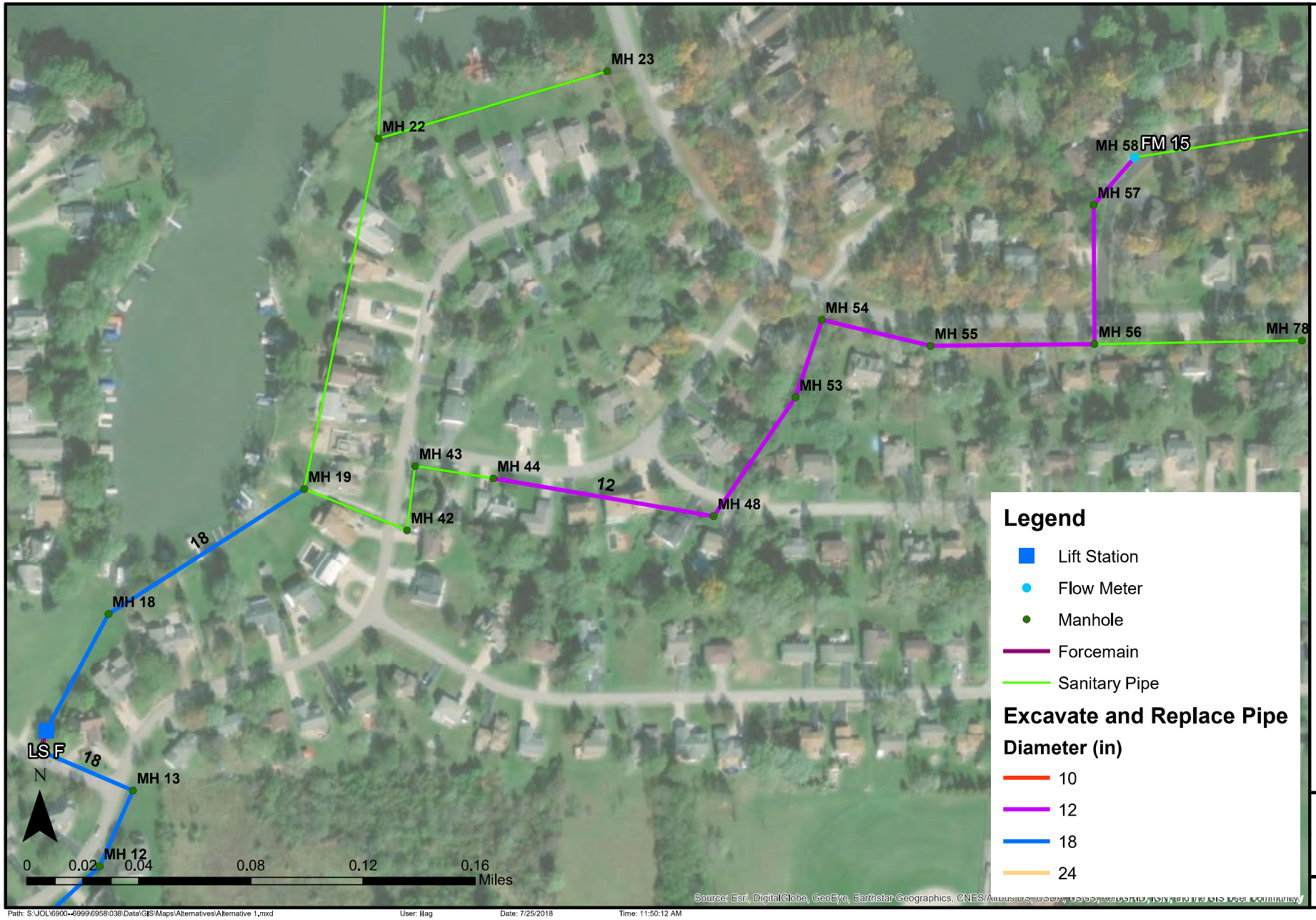

ALTERNATIVE 1
PROPOSED IMPROVEMENT- ZOOM 3
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 2.01-4
6958-038

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Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment DSD-10
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ALTERNATIVE 1
PROPOSED IMPROVEMENT- ZOOM 4
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 2.01-5
6958-038

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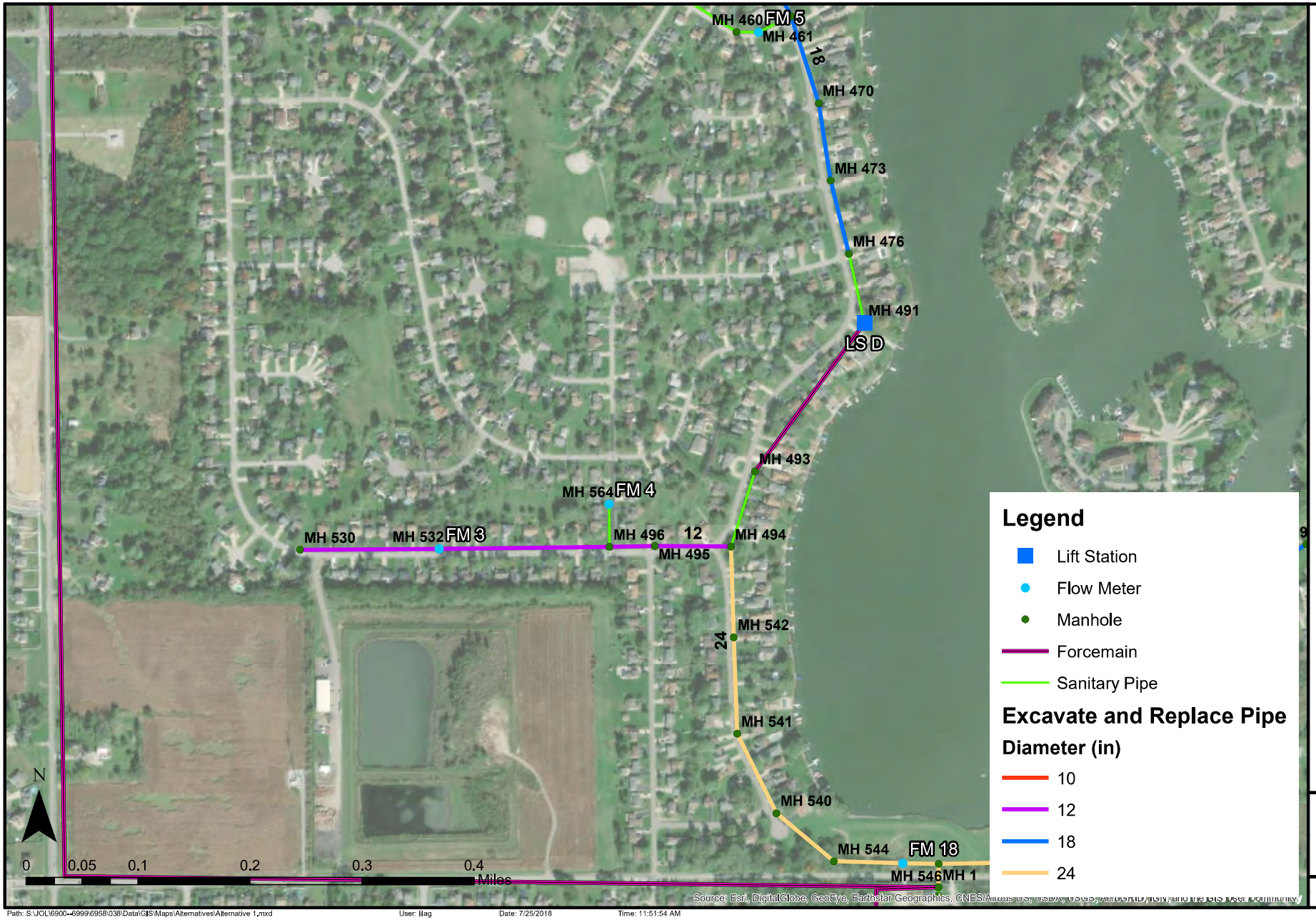
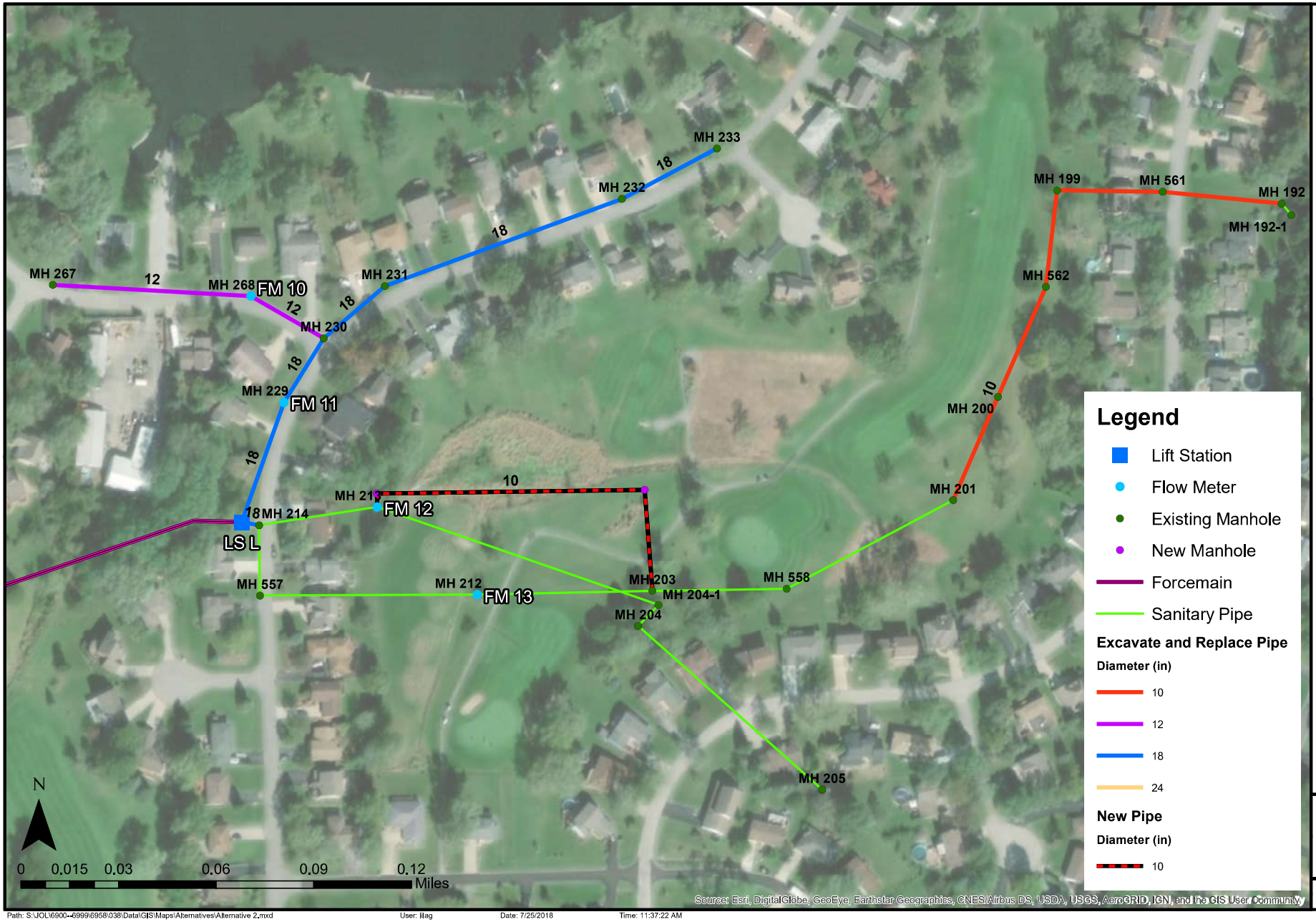


ALTERNATIVE 1
PROPOSED IMPROVEMENT- ZOOM 5
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 2.01-6
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment 2SCO
Page 80 of 2[illegible]



ALTERNATIVE 2
PROPOSED ALTERNATIVES
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 3.01-7
6958-038

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The lift station improvements evaluated include the following:

a. Rerouting the force main from LS C to connect to the force main from LS L, bypassing the downstream collection system.

b. A new force main from LS D directly to the WWTP, bypassing the collection system between LS D and the WWTP.

c. Rerouting the force main from LS B to connect to the force main from LS L, bypassing the downstream collection system.

d. The improvements associated with both LS C and D described above.

e. The improvements associated with both LS C and B described above.

f. The improvements associated with LS C, LS D, and LS B described above.

The results of these evaluations are discussed in Paragraph 5.02.E. As noted in Section 4 of this report, a limited amount of data was available at each of these lift stations. Therefore, the accuracy of the modeling results associated with the lift stations is unknown, and any alternatives associated with improving lift stations will require additional study to accurately determine the effects of the improvements on the upstream and downstream collection system.

5. A Combination of Alternatives

Some of the alternatives described above alone do not alleviate all problem areas identified by the model within the collection system, as described in the next section. As a result, a matrix of alternatives was developed to evaluate multiple combinations of the above alternatives to determine the most cost-effective combination of alternatives.

5.02 EVALUATION OF ALTERNATIVES

This subsection discusses the modeling results associated with implementation of each of the above alternatives for various theoretical storm scenarios and whether the alternatives effectively address all the conveyance issues within the collection system.

A 10-Year, 2-Hour storm, which is equivalent to 2.45 inches of rain over two hours, was selected to evaluate the effectiveness of the alternatives described above. There is no guidance available for the design of separate sanitary sewers regarding specific design storms. Rather, separate sewers are typically designed based on a theoretical ratio of peak flows to daily average flow (peaking factor). For example, in Illinois, Section 370.310 of the Illinois Administrative Code states the following: “The design peak flow for sanitary sewers shall be selected based on one of the following methods: (1) The ratio of peak to average daily flow as determined by the following equation:

$$PF = \frac{18+\sqrt{P}}{4+\sqrt{P}}$$

where P is population in thousands, or (2) values established from an infiltration/inflow study acceptable to the Agency.”

Peak flows associated with a 10-Year recurrence interval storm have been acceptable to the Illinois Environmental Protection Agency based on past experience. Furthermore, the peaking factor associated with running the 10-Year, 2-Hour storm through the model is higher than the peaking factor calculated using the theoretical peaking factor equation (8.59 vs. 3.47 at the Twin Lakes WWTP). Thus, using the 10-Year recurrence interval storm is the more conservative approach and seems appropriate.

A. Implement an I/I Removal Program

As previously discussed, the effectiveness of an I/I removal program is uncertain. However, even the most robust I/I removal program, one that would target and address I/I associated with the CUII infrastructure and private infrastructure, would likely result in a maximum I/I reduction of 30 percent.

Figures 5.02-1 through 5.02-6 were created to demonstrate how the problem areas within the collection system during a 10-Year, 2-Hour theoretical storm would be addressed if just an I/I removal program were implemented, assuming various levels of I/I removal effectiveness. The figures are described as follows:

1. Figures 5.02-1 and 5.02-2 show which problem areas remain during a 10-Year, 2-Hour storm assuming a 10 percent reduction in I/I across the entire collection system.

2. Figures 5.02-3 and 5.02-4 show which problem areas remain during a 10-Year, 2-Hour storm assuming a 20 percent reduction in I/I across the entire collection system.

3. Figures 5.02-5 and 5.02-6 show which problem areas remain during a 10-Year, 2-Hour storm assuming a 30 percent reduction in I/I across the entire collection system.

As shown in these figures, even if an effective I/I removal program was implemented and a 30 percent reduction of I/I was achieved, there are still several problem areas within the collection system. An I/I Removal Program alone will not be enough to alleviate the conveyance issues within the collection system. This alternative could and should be used in combination with additional infrastructure improvements discussed later in this section.

B. Alternative 1 with No I/I Removal

Figures 5.02-7 and 5.02-8 show the modeling results associated with running a 10-Year, 2-Hour storm with the improvements associated with Alternative 1. The figures demonstrate that all SSOs and potential basement backups have been removed during a 10-Year, 2-Hour storm.

C. Alternative 2 with No I/I Removal

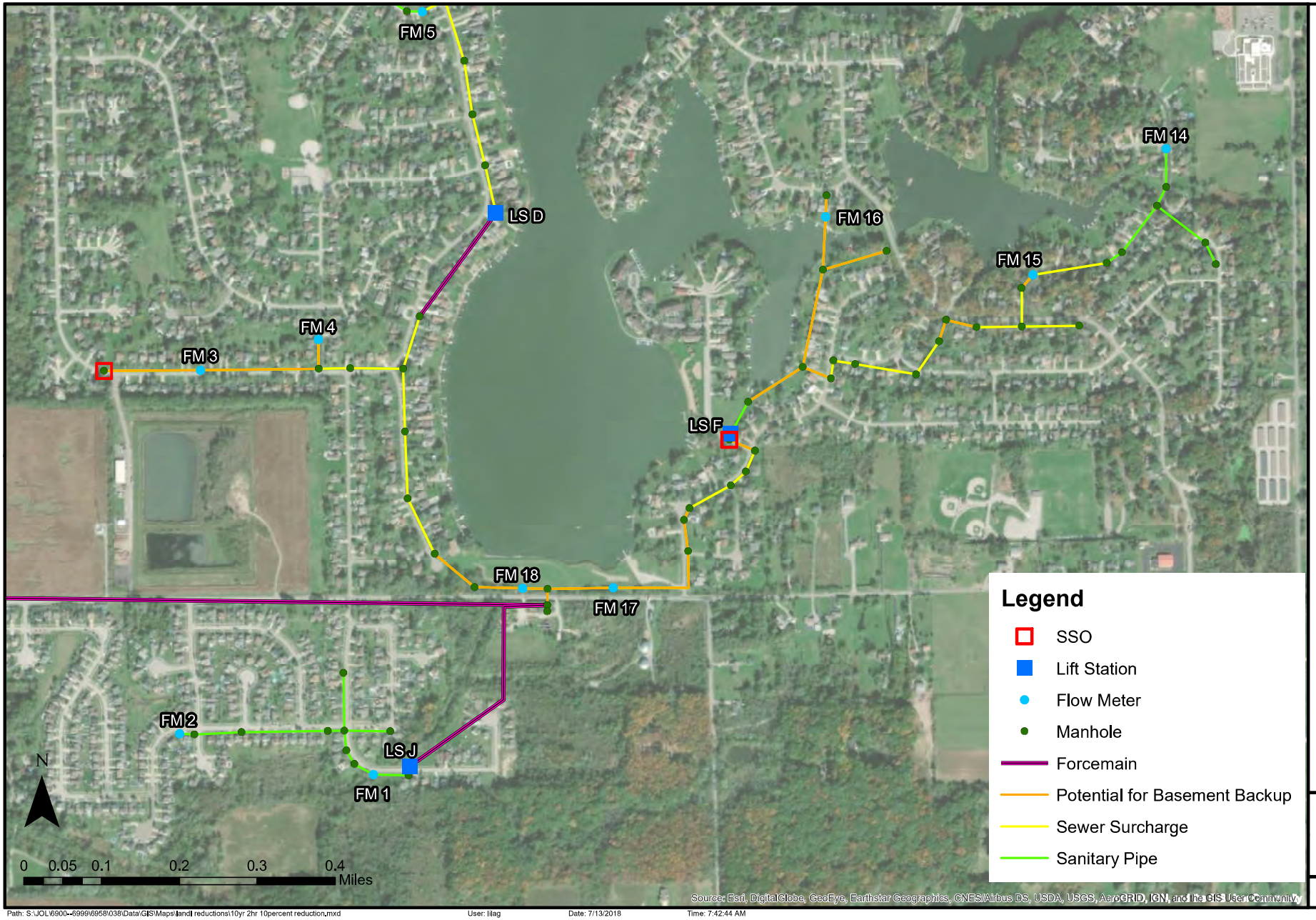
Figures 5.02-9 through 5.02-10 show the modeling results associated with running a 10-Year, 2-Hour storm with the improvements associated with Alternative 2. Again, the figures demonstrate that all SSOs and potential basement backups have been removed during a 10-Year, 2-Hour storm.

REMAINING PROBLEM AREAS AFTER IMPLEMENTATION OF I/I REMOVAL PROGRAM-10 PERCENT I/I REDUCTION-NORTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 2.0-1
6958-038

Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\land reductions\10yr 2hr 10percent reduction.mxd User: lilag Date: 7/5/2018 Time: 10:37:05 AM

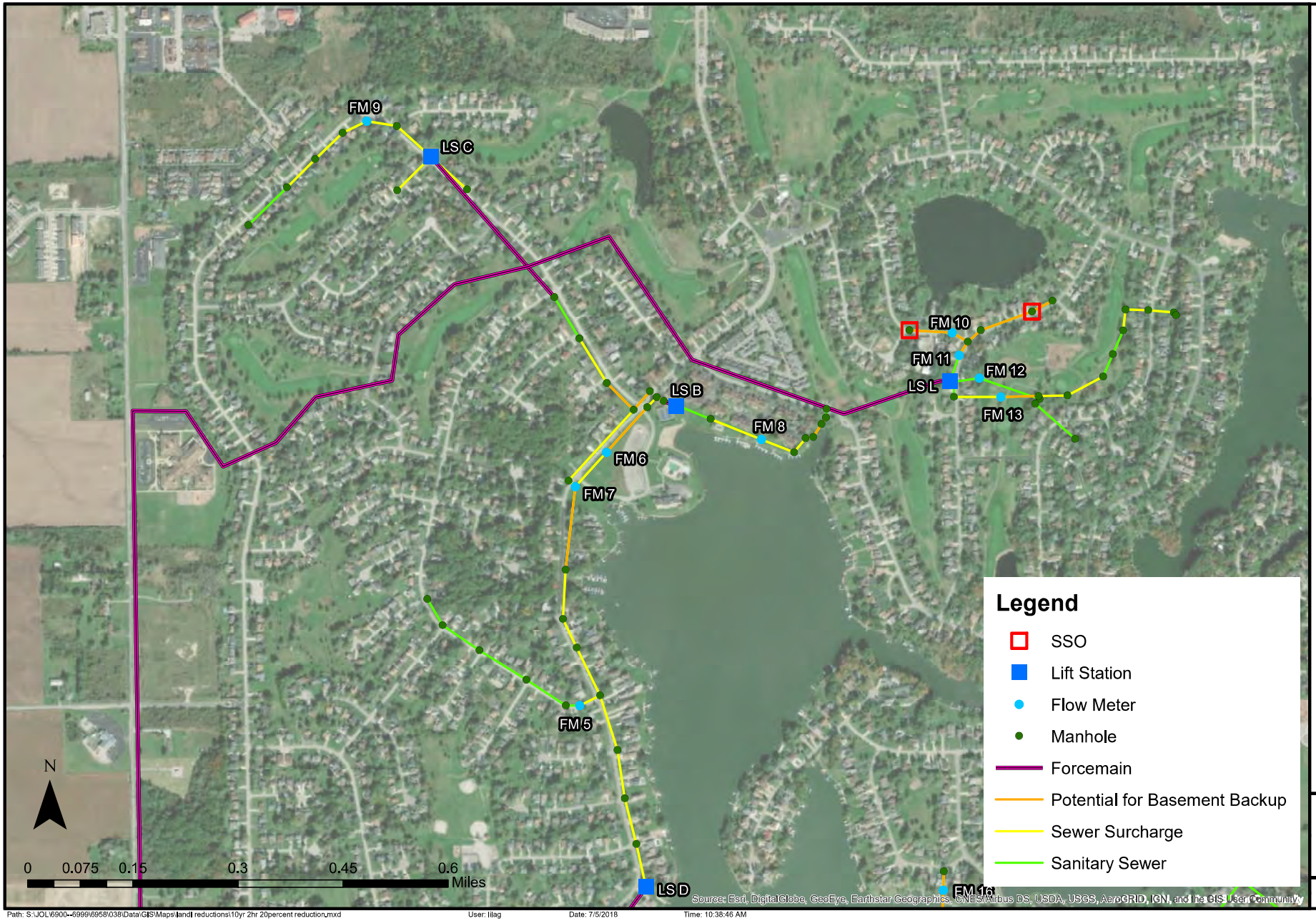


REMAINING PROBLEM AREAS AFTER IMPLEMENTATION OF I/I REMOVAL PROGRAM-10 PERCENT I/I REDUCTION-SOUTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 2-2
6958-038

Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\landl reductions\10yr 2hr 10percent reduction.mxd User: lilag Date: 7/13/2018 Time: 7:42:44 AM



REMAINING PROBLEM AREAS AFTER IMPLEMENTATION OF I/I REMOVAL PROGRAM-20 PERCENT I/I REDUCTION-NORTH

TWIN LAKES SERVICE AREA METERING AND MODELING

COMMUNITY UTILITIES OF INDIANA, INC.

LAKE AND PORTER COUNTIES, IN

FIGURE 2-3

6958-038

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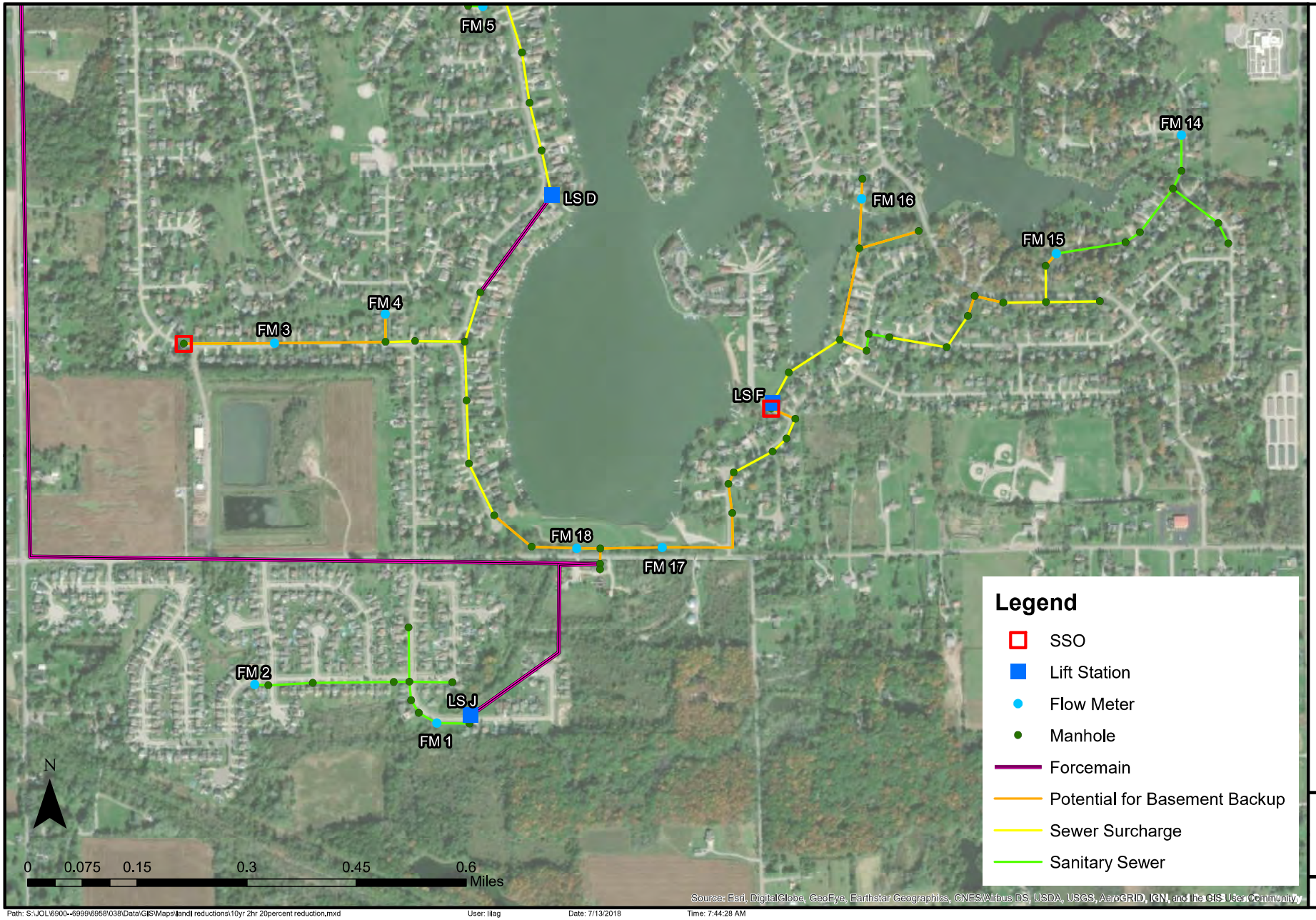
Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment DSO-10
Page 86 of 223



REMAINING PROBLEM AREAS AFTER IMPLEMENTATION OF I/I REMOVAL PROGRAM-20 PERCENT I/I REDUCTION-SOUTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 2.2-4
6958-038

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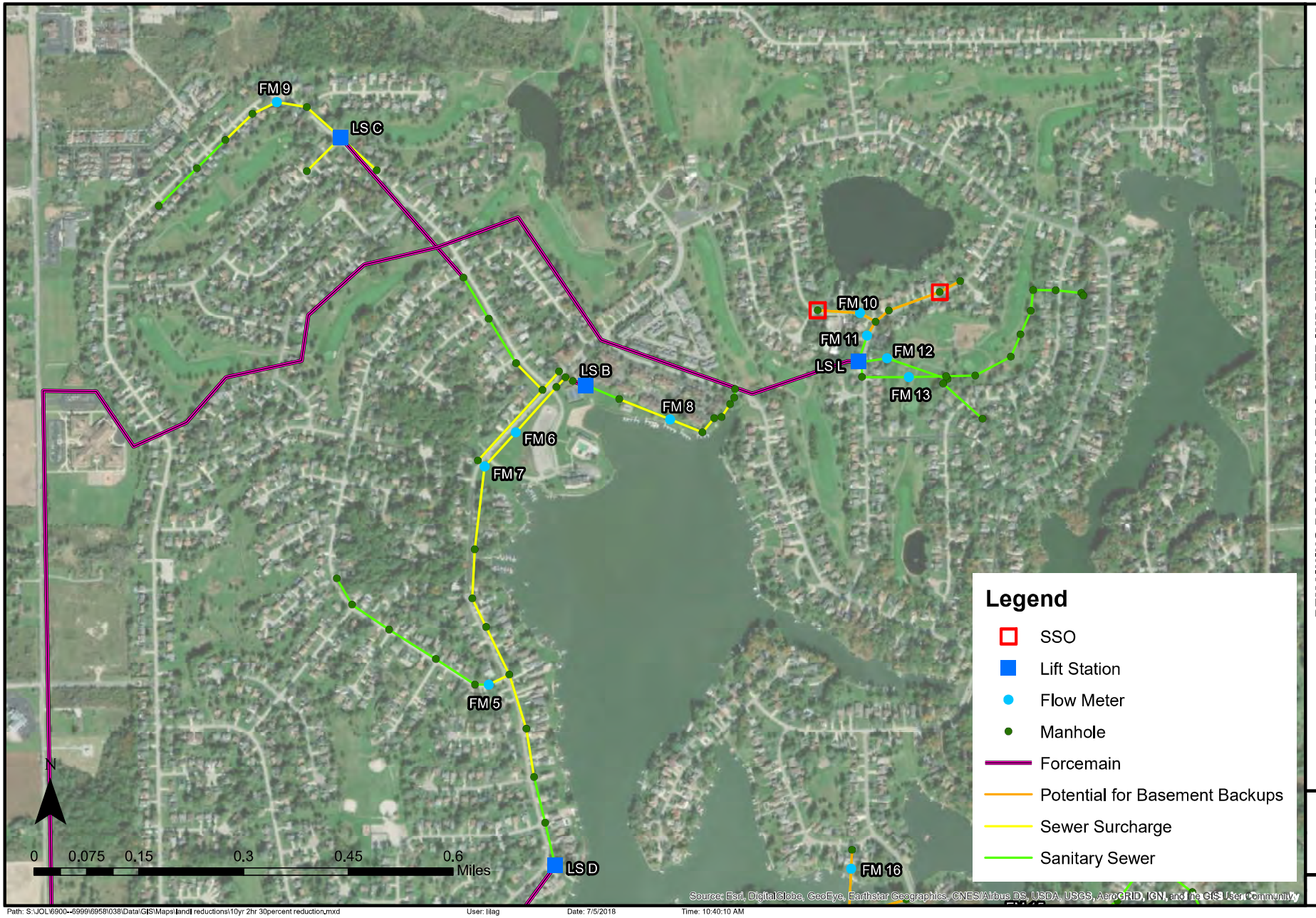


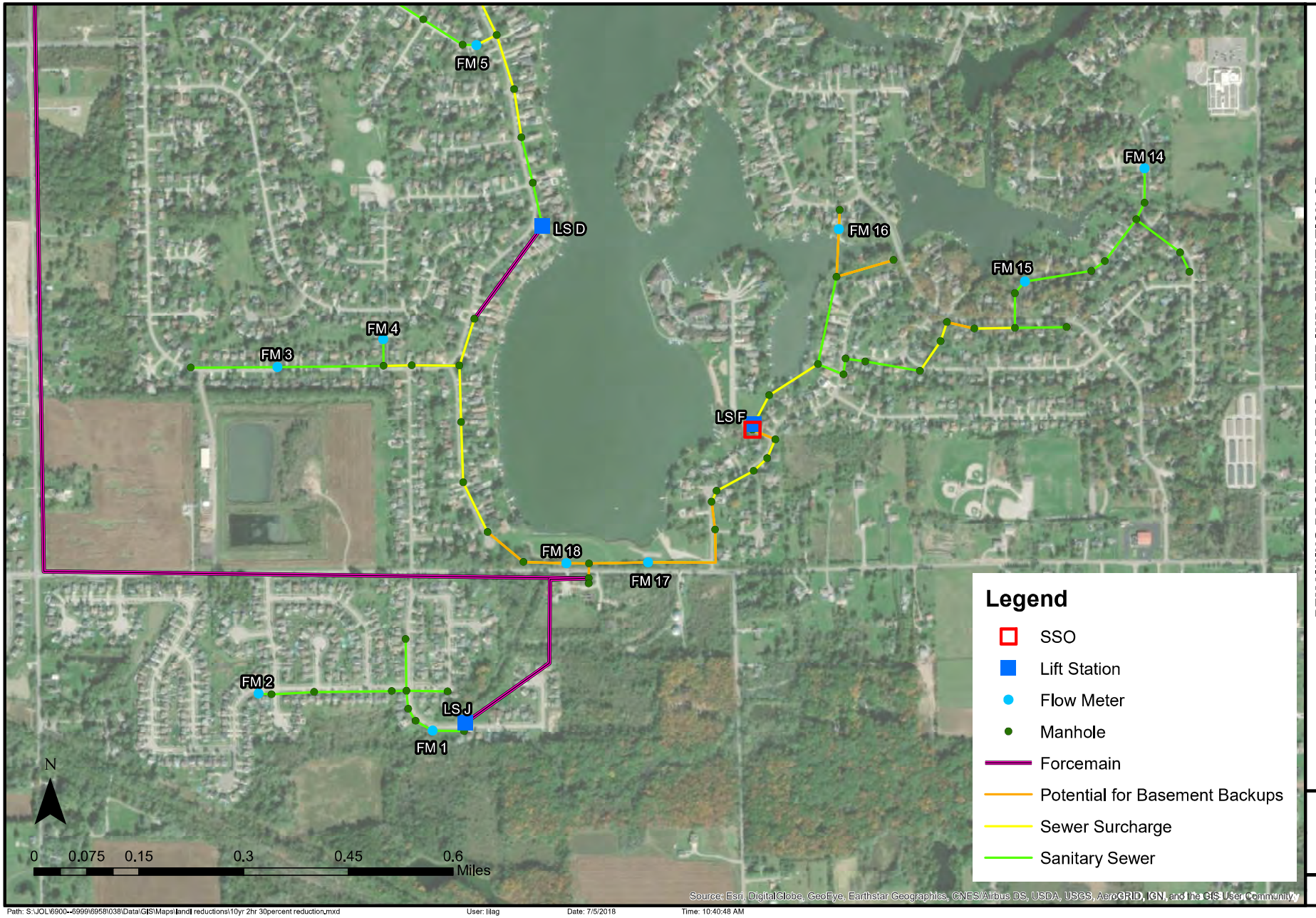
REMAINING PROBLEM AREAS AFTER IMPLEMENTATION OF I/I REMOVAL PROGRAM-30 PERCENT I/I REDUCTION-NORTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 2.02-5
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment ISO 10
Page 88 of 223

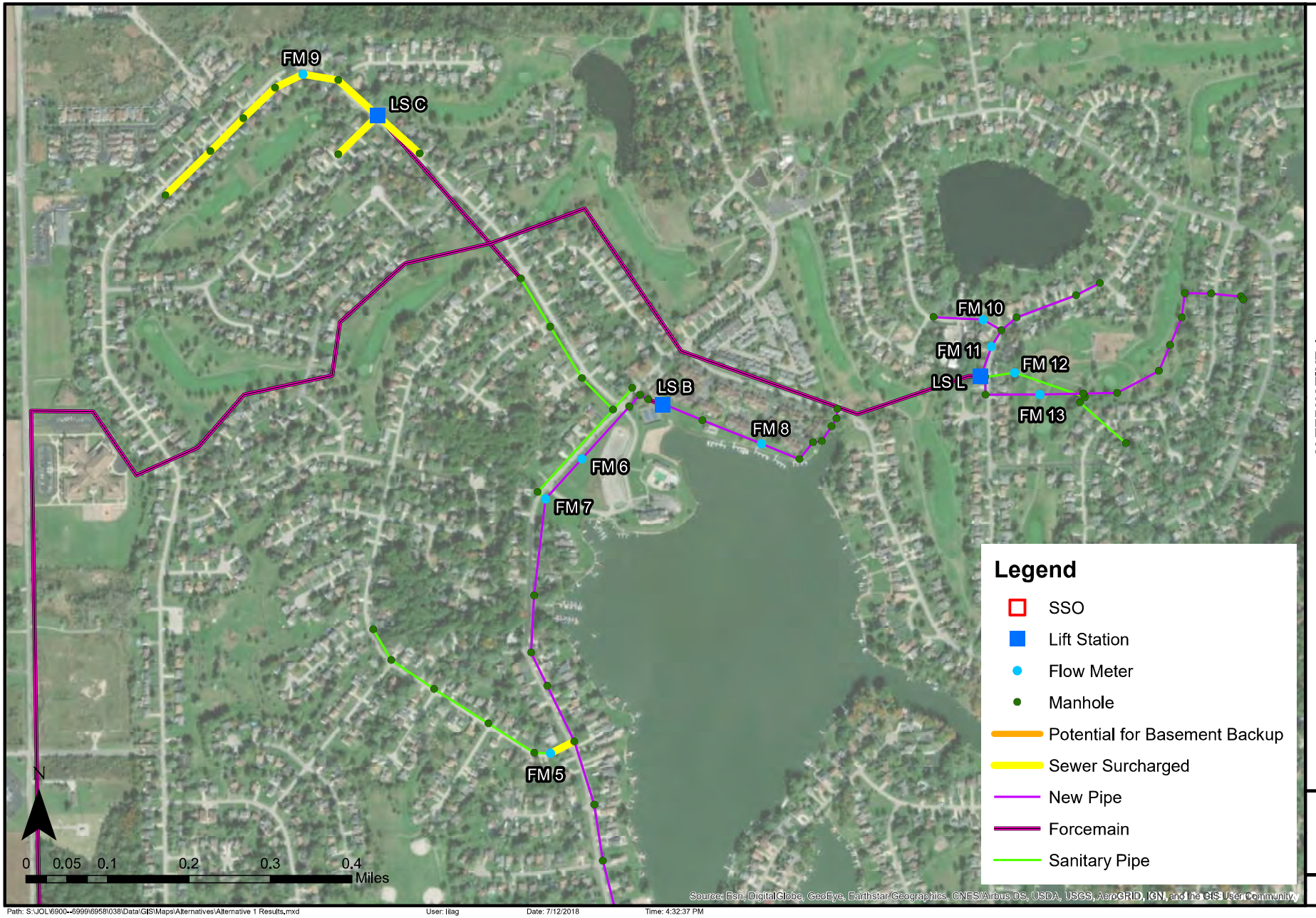


REMAINING PROBLEM AREAS AFTER IMPLEMENTATION OF I/I REMOVAL PROGRAM-30 PERCENT I/I REDUCTION-SOUTH

TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

FIGURE 2-6
6958-038

Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\landl reductions\10yr 2hr 30percent reduction.mxd User: lilag Date: 7/5/2018 Time: 10:40:48 AM

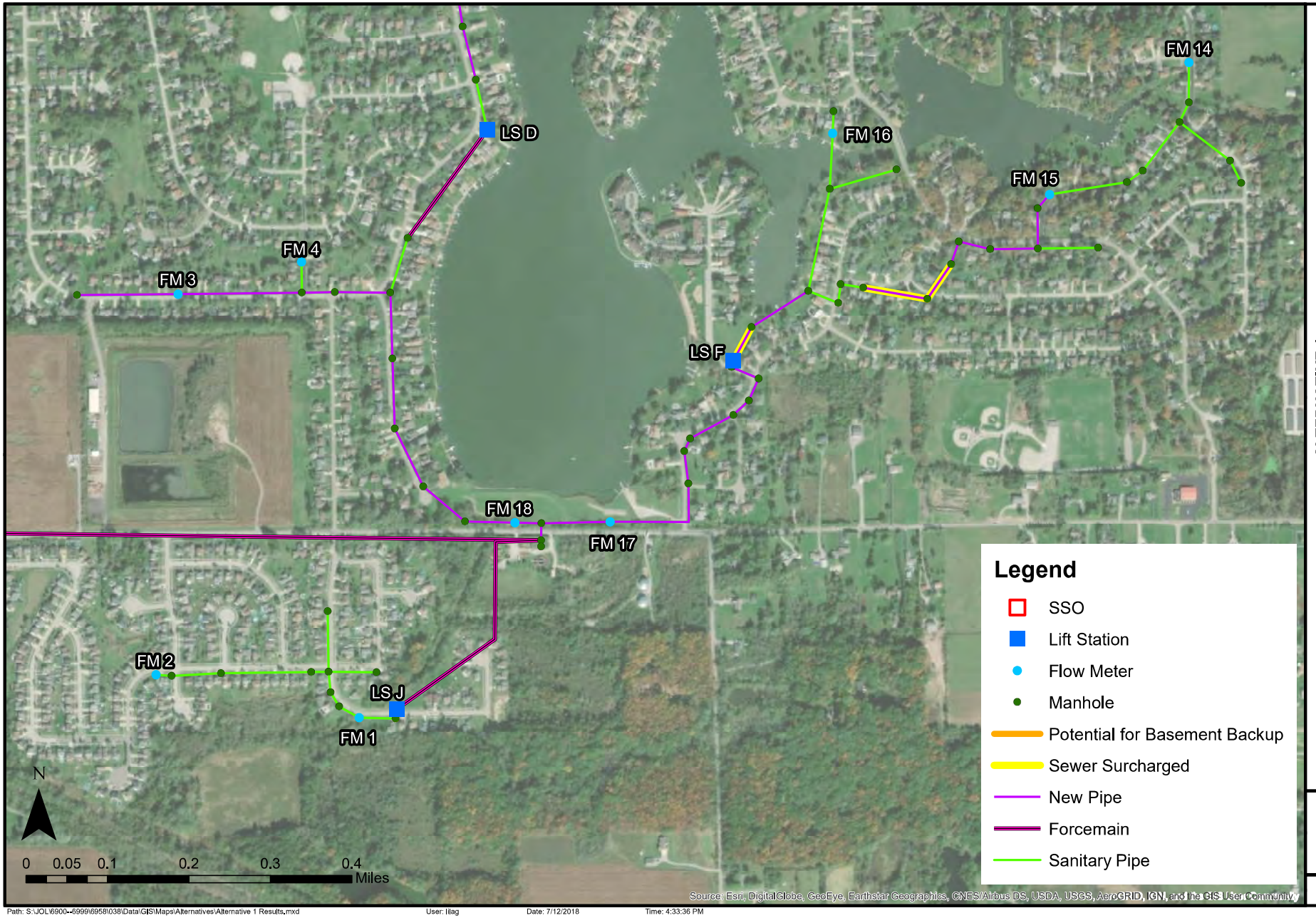


ALTERNATIVE 1
PROPOSED IMPROVEMENT MODEL RESULTS-NORTH
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 6.2-7
6958-038

Community Utilities of Indiana, Inc.
NEW CAUSE Wastewater Treatment Plant
Attachment ISC-10
Page 90 of 233



ALTERNATIVE 1
PROPOSED IMPROVEMENT MODEL RESULTS-SOUTH
TWIN LAKES SERVICE AREA MONITORING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 2-2.8
6958-038

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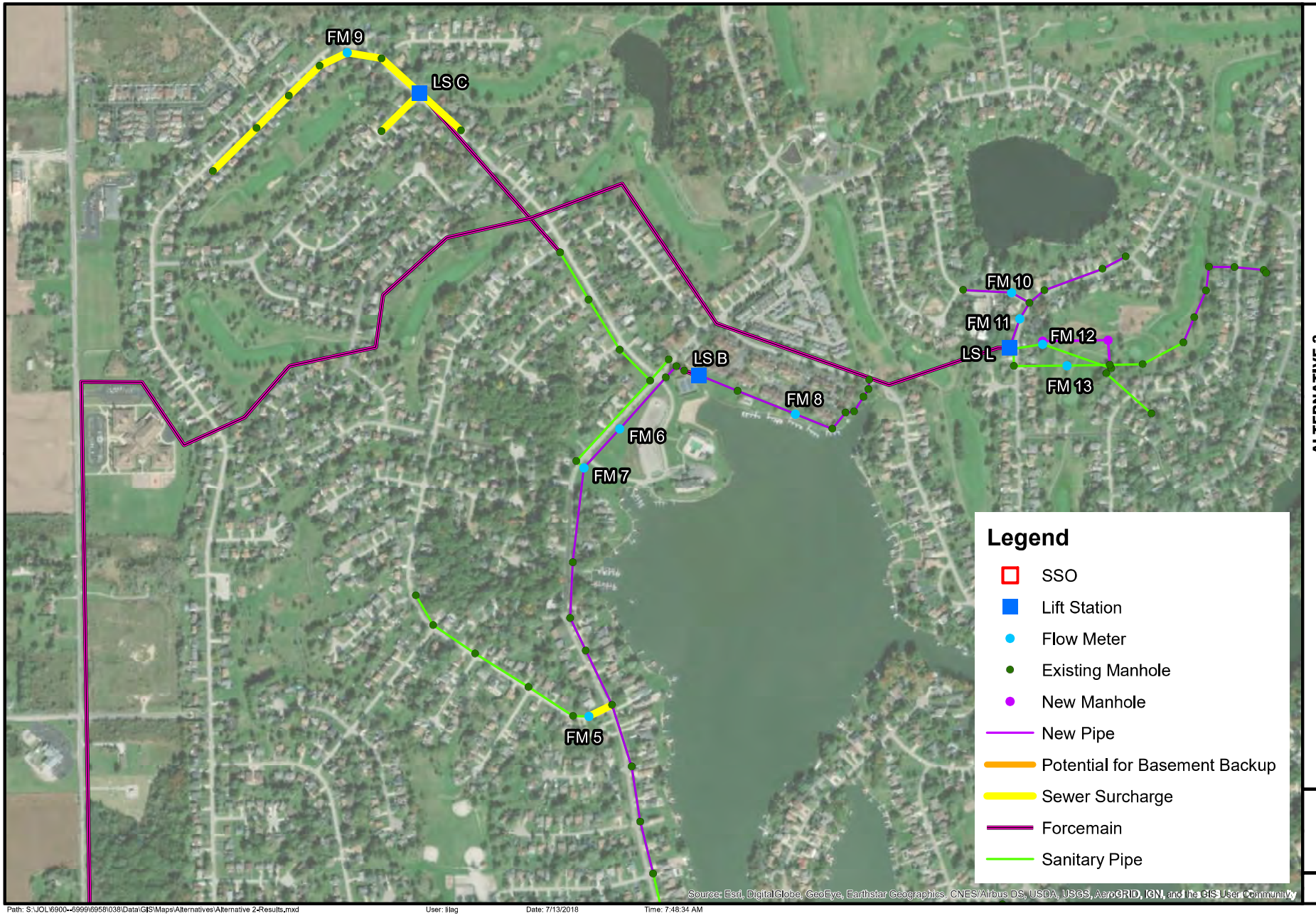

ALTERNATIVE 2
PROPOSED IMPROVEMENT MODEL RESULTS-NORTH
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 2.02-9
6958-038

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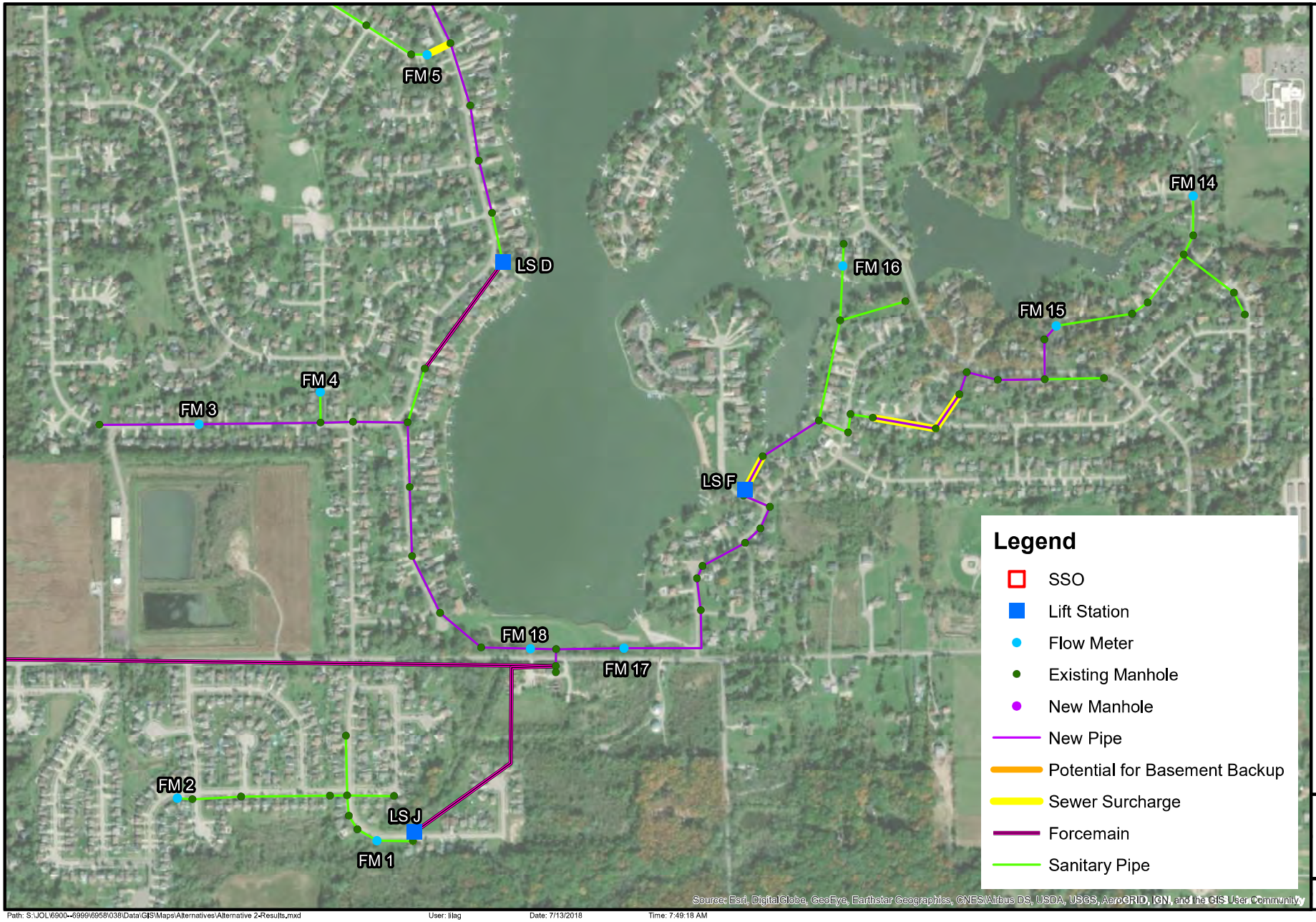


ALTERNATIVE 2
PROPOSED IMPROVEMENT MODEL RESULTS-SOUTH
TWIN LAKES SERVICE AREA METERING AND MODELING
COMMUNITY UTILITIES OF INDIANA, INC.
LAKE AND PORTER COUNTIES, IN

STRAND ASSOCIATES

FIGURE 5.02-10
6958-038

Path: S:\JOL\6900--6999\6958\038\Data\GIS\Maps\Alternatives\Alternative 2-Results.mxd User: lllag Date: 7/13/2018 Time: 7:49:18 AM

D. Various Lift Station and Force Main Improvements

CUII requested a number of lift station and force main improvements be evaluated using the model to determine how effective they would be at removing the potential for basement backups and SSOs within the collection system. Based on the modeling results, none of the evaluated lift station and force main improvements identified in section 5.01.B.4 above alleviate all the issues within the collection system for a 10-Year, 2-Hour storm scenario. These improvements would need to be implemented in combination with another alternative to alleviate all the issues in the collection system. Since these improvements alone do not result in addressing all issues and there are numerous alternatives that were evaluated, figures were not created displaying the results, as agreed in discussions with CUII.

The model was created using limited lift station data. As a result, the results may not reflect actual conditions and additional studies should be completed as part of detailed design to more accurately determine the effects of any lift station improvements on the overall collection system.

5.03 OPINION OF PROBABLE CAPITAL COSTS

A. Comparison of Alternatives 1 and 2

As described above, only Alternatives 1 and 2 are able to effectively address all the conveyance issues identified within the model without implementing other improvements. As such, a comparison of the opinion of probable capital costs (OPCC) associated with only those two alternatives is presented in Table 5.03-1.

Item	Alternative 1	Alternative 2
New Manhole Installation	-	$20,000
New Sewer Installation		
10-inch Sewer	-	$60,000
Excavate and Replace Existing Sewer[1]		
10-inch Sewer	$96,000	$295,000
12-inch Sewer	$1,920,000	$1,420,000
18-inch Sewer	$1,650,000	$1,650,000
24-inch Sewer	$780,000	$785,000
Subtotal	$2,312,000	$2,239,000
Bypass Pumping	$1,190,000	$1,100,000
Subtotal	$5,645,000	$5,325,000
Contractor's General Conditions (10 percent)	$564,000	$533,000
Subtotal	$6,209,000	$5,858,000
Contingencies (10 percent)	$621,000	$586,000
Subtotal	$6,830,000	$6,444,000
Technical Services 15 percent)	$1,025,000	$967,000
Total	**$7,855,000**	**$7,410,000**

[1] Pipe sizes reflect the new pipe sizes.

Table 5.03-1 OPCC Comparison Between Alternatives 1 and 2

Based on the cost evaluation above, Alternative 2 has lower capital costs than Alternative 1. It is important to note that this only represents the costs associated with implementing only Alternatives 1 or 2, and not for implementing any other alternative (no I/I reduction program and no lift station improvements). These costs change if other improvements are included with Alternatives 1 and 2 as described in the next section.

B. Comparison of Combination of Alternatives

As discussed, CUII has been working on implementing a number of lift station and force main improvements within the Twin Lakes collection system, which have been developed and evaluated by CUII outside the scope of this report. Additionally, CUII wanted to know how reductions of I/I in the collection system could further improve conditions in the system. A matrix of improvements was developed to run several scenarios through the model. The results of this modeling were then combined with Alternative 1 and Alternative 2, respectively, to determine what components of Alternatives 1 and 2 would still need to be implemented to alleviate all wet weather-related issues within the collection system. Table 5.03-2 provides the matrix of scenarios run through the model. Each “X” represents a scenario that was evaluated using the model.

	Percent Reduction in I/I				
	0%	20%	40%	60%	100%
No Lift Station Improvements	X	X	X	X	X
Rerouting Lift Station C Only	X	X	X	X	X
Rerouting Lift Station D Only	X	X	X	X	X
Rerouting both Lift Stations C and D	X	X	X	X	X
Rerouting Lift Station B Only	X	X	X	X	X
Rerouting both Lift Stations B and C	X	X	X	X	X
Rerouting Lift Stations B, C,and D	X	X	X	X	X

Table 5.03-2 Modeled Scenarios

OPCCs for the collection system improvements for each scenario were then developed and are summarized in Table 5.03-3 (Alternative 1) and Table 5.03-4 (Alternative 2). Figure 5.03-1 and 5.03-2 show the costs associated with each scenario.

It is important to note that the costs summarized in Tables 5.03-3 and 5.03-4 are only for the improvements associated with gravity sewers within the collection system. All costs associated with lift station and force main improvements are not included because they were developed by CUII outside the scope of this study. Additionally, any lift station improvements implemented should be further studied as part of detailed design.

Detailed breakdowns of the OPCC for each scenario are summarized in Appendix E.

	Percent Reduction in I/I				
	0%	20%	40%	60%	100%
No Lift Station Improvements	$7,855,000	$7,590,000	$3,351,000	$2,128,000	$0
Rerouting Lift Station C Only	$6,534,000	$5,907,000	$3,285,000	$1,719,000	$0
Rerouting Lift Station D Only	$7,024,000	$6,120,000	$3,351,000	$2,128,000	$0
Rerouting both Lift Stations C and D	$5,748,000	$4,692,000	$3,285,000	$1,719,000	$0
Rerouting Lift Station B Only	$6,139,000	$5,498,000	$2,956,000	$1,719,000	$0
Rerouting both Lift Stations B and C	$5,517,000	$4,528,000	$2,956,000	$1,719,000	$0
Rerouting Lift Stations B, C, and D	$5,122,000	$4,297,000	$2,956,000	$1,719,000	$0

Table 5.03-3 Alternative 1 Collection System Improvement Costs

	Percent Reduction in I/I				
	0%	20%	40%	60%	100%
No Lift Station Improvements	$7,410,000	$6,957,000	$3,417,000	$2,128,000	$0
Rerouting Lift Station C Only	$6,103,000	$5,259,000	$3,337,000	$1,719,000	$0
Rerouting Lift Station D Only	$6,572,000	$5,486,000	$3,417,000	$2,128,000	$0
Rerouting both Lift Stations C and D	$5,320,000	$4,060,000	$3,337,000	$1,719,000	$0
Rerouting Lift Station B Only	$5,697,000	$4,866,000	$3,009,000	$1,719,000	$0
Rerouting both Lift Stations B and C	$5,088,000	$3,896,000	$3,009,000	$1,719,000	$0
Rerouting Lift Stations B, C, and D	$4,680,000	$3,665,000	$3,009,000	$1,719,000	$0

Table 5.03-4 Alternative 2 Collection System Improvement Costs

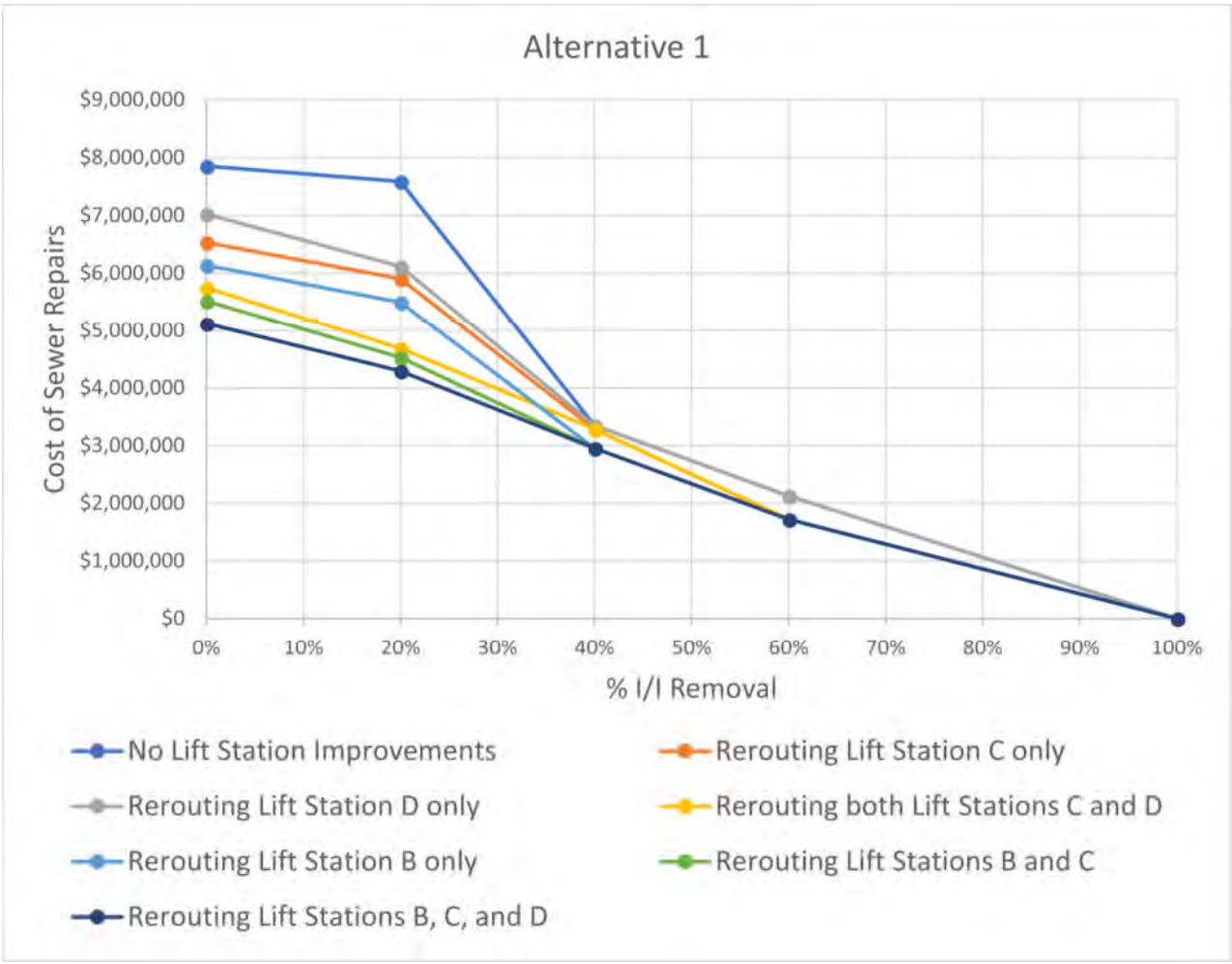


Figure 5.03-1 Alternative 1 Collection System Improvement Costs Graph

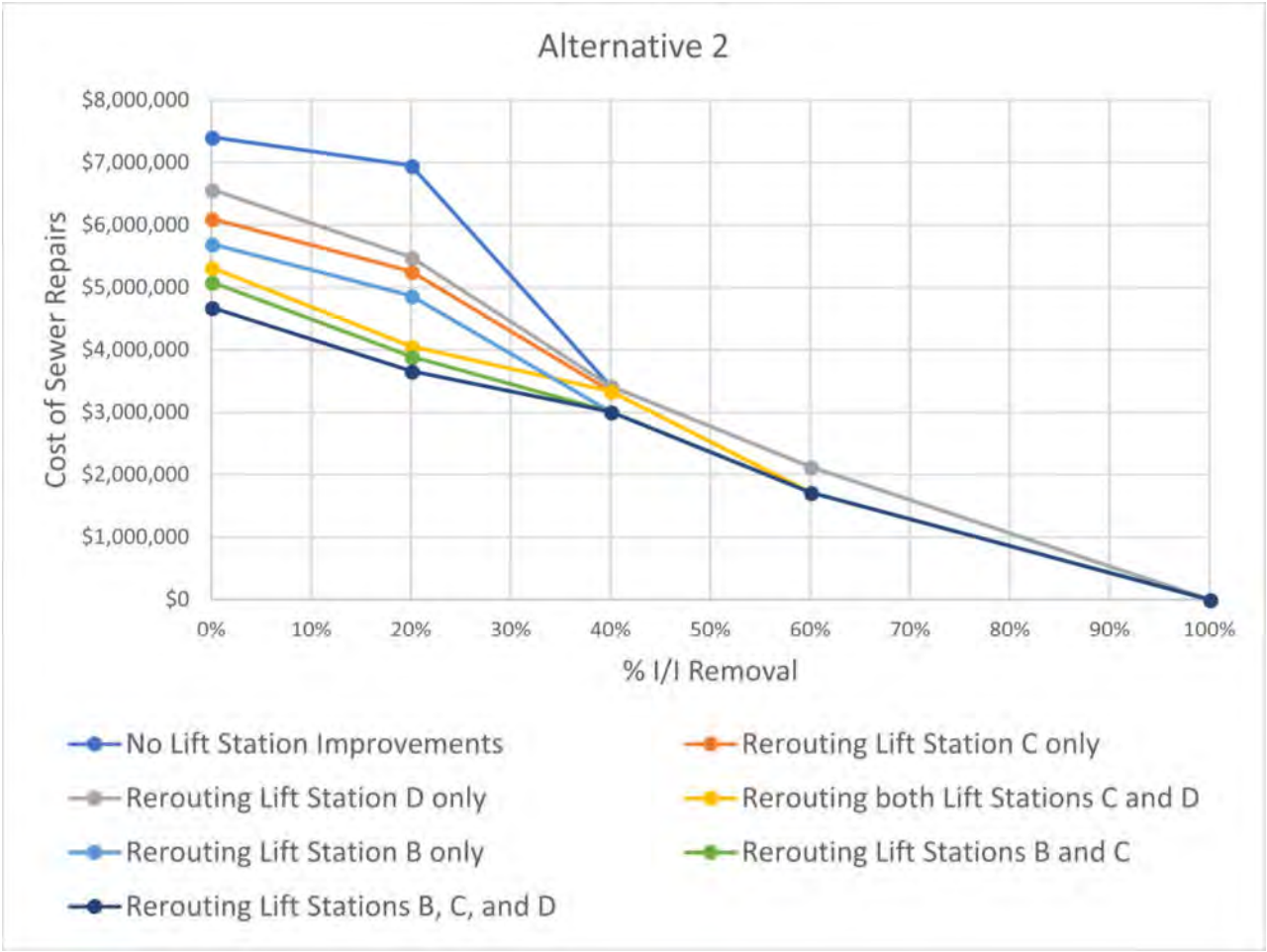


Figure 5.03-2 Alternative 2 Collection System Improvement Costs Graph

5.04 RECOMMENDATIONS

This section provides recommendations to alleviate collection system conveyance issues moving forward.

A. Implement a Comprehensive I/I Removal Program

It is recommended CUII implement a comprehensive I/I removal program. A comprehensive I/I removal program will benefit CUII in a number of ways. It will give CUII a better idea of the condition of its collection system. The rehabilitation performed based on the I/I investigations could not only reduce the amount of I/I entering the system, but more importantly, it would also prevent a costly sewer infrastructure failure in the future.

It could also reduce the amount of I/I entering the system enough to reduce the size of the necessary infrastructure improvements discussed. Figures 5.03-1 and 5.03-2 show how costs change based on how much I/I is removed from the collection system.

The prioritization provided in Section 3 ranked FM basins for further investigation to identify and remove sources of I/I. A copy of Table 3.05-4 is shown in Table 5.04-1. Traditionally, sources of inflow are easier and less expensive to locate and repair than sources of infiltration. Thus, basins with higher inflow potential were given priority over basins with primarily infiltration. FM basins 10, 7, 14, 3, 6, and 18 ranked in the top six, respectively. An I/I removal plan should focus on these six FM basins first to provide the most cost-effective benefit to the overall performance of the collection system.

Priority FM Basin	Peaking Factor Rank	I/I Rate Rank	Overall Rank
10	1	1	1
7	6	3	4
14	3	6	3
3	4	10	5
6	5	7	6
18	2	2	2

Table 5.04-1 Basin Prioritization

B. Collect Data Associated with Collection System

There is limited available information associated with the Twin Lakes Service Area, as discussed throughout this report. Available mapping is either old or does not contain vital information such as pipe diameter, pipe material, pipe invert elevations, etc. It is recommended that CUII complete a detailed survey of the entire collection system to develop a GIS database.

A GIS database would be a central location where all information associated with the Twin Lakes Service Area would be located. The database can be used to develop multiple types of maps, but can also be used as an asset management system to more efficiently operate and maintain the collection system.

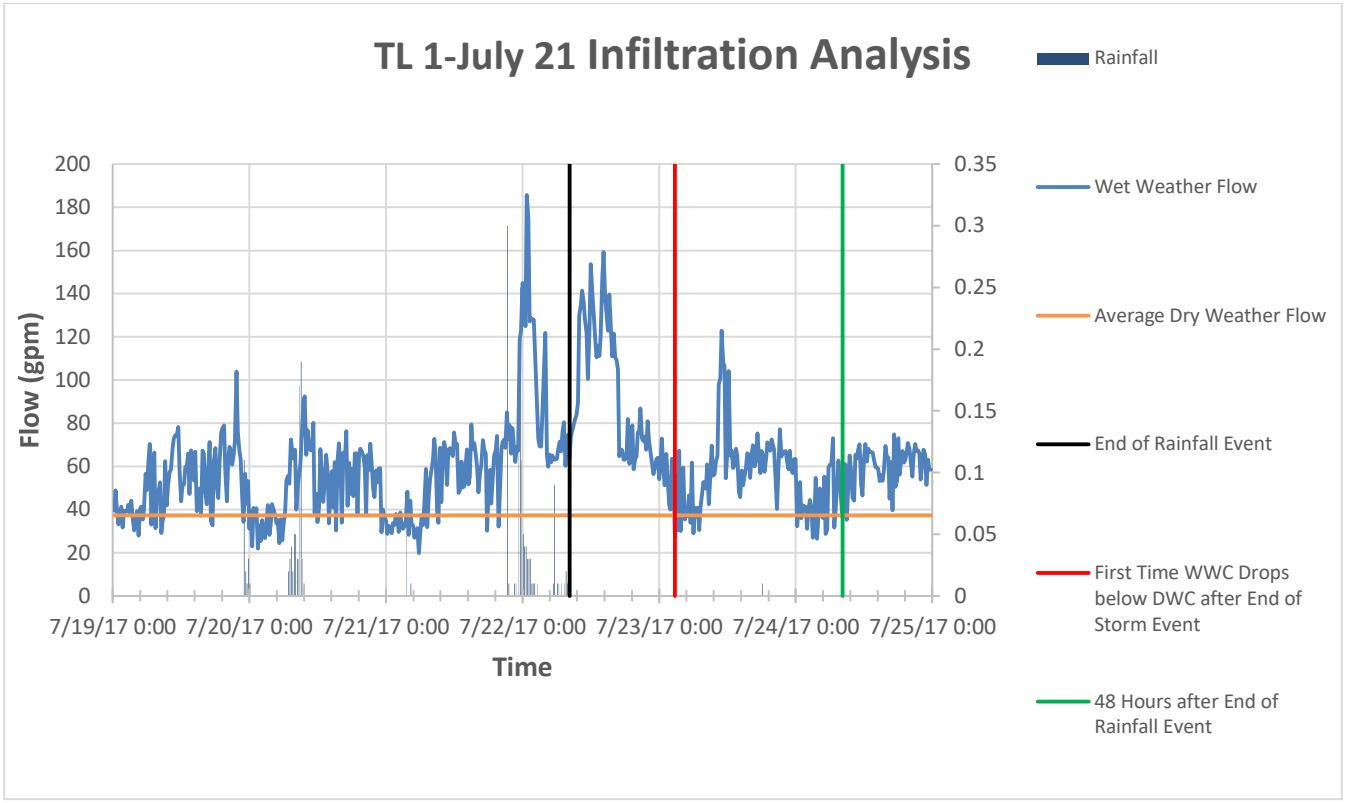
Additionally, it is recommended that CUII perform a detailed study on each of its lift stations. This detailed study should include a detailed survey to create accurate as-built drawings showing the dimensions and elevations of the wet well, incoming sewers, and outgoing force main. Additionally, the detailed study can accurately determine the current operating setpoints for each lift station. This would allow CUII to adjust pumping station control parameters to optimize its operations moving forward. The detailed study should also include documenting detailed pump information including the serial number. Serial numbers can be used to find accurate pump curves and rated capacities.

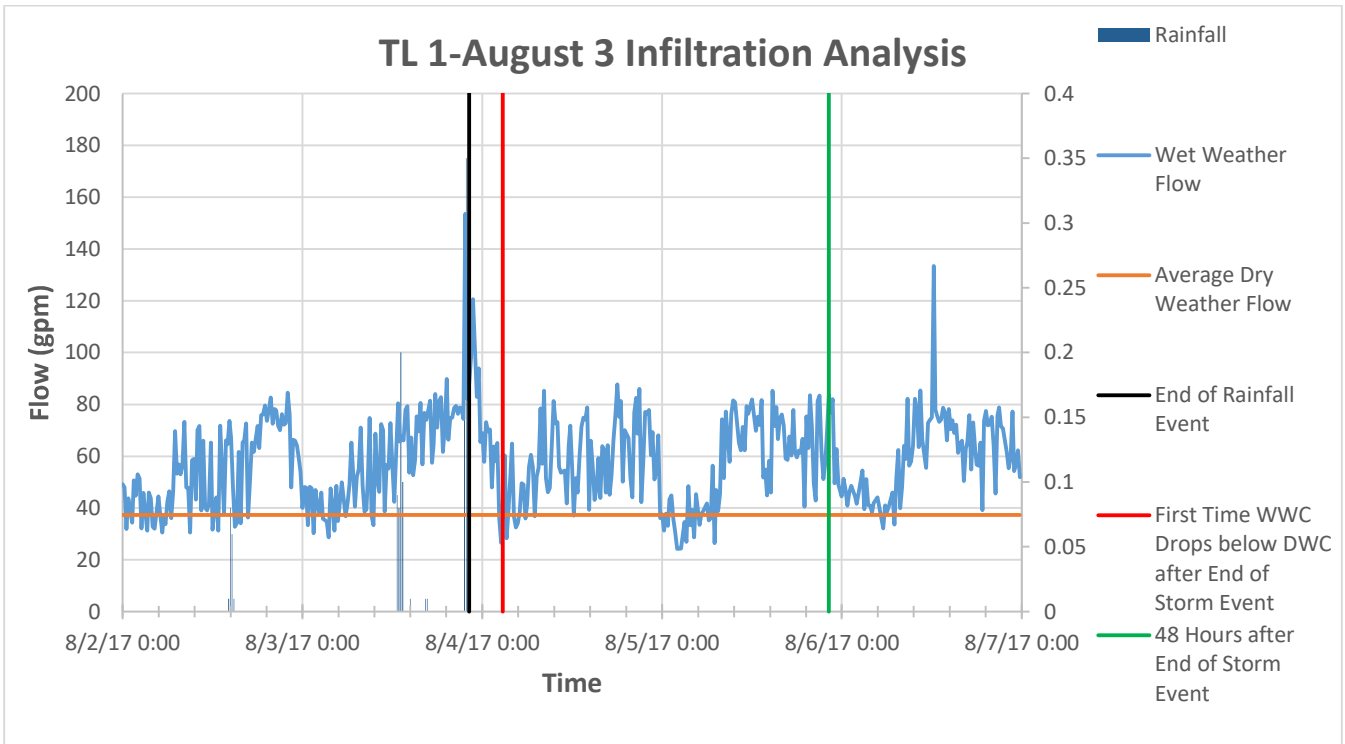
Finally, the detailed study should include a lift station calibration to better understand the current pumping capacities of each lift station. A lift station calibration consists of timing how fast the wet well drops at a lift station over a fixed vertical distance. The diameter of the wet well is then used to calculate a total volume pumped during the timed pumping activity. Once the volume pumped and the time of pumping is known, a flow rate can be calculated. This process should be repeated numerous times, using single and multiple pumps, and under various conditions, such as during both dry and wet weather. CUII should also install pressure gauge taps on the force main discharge pipes at each lift station. This will allow for regular verification of head conditions on the pump, which is necessary to determine whether pumps need to be replaced. The head pressure is also an indication of the force main condition and whether potential blockages have developed that need to be located and removed.

C. Develop and Implement a System Improvement Plan

An I/I removal program is not sufficient to alleviate all issues within the collection system, as discussed throughout this report section. As such, additional capital improvements to the collection system are required. The collection system modeled, developed as part of the scope of this report, is meant to be used as a planning tool and not for detailed design for CUII. As such, the information provided within this report, contained within the model, and any other information available to CUII and its consultants should be used to develop and implement an overall System Improvement Plan to alleviate wet weather issues within the Twin Lakes collection system. However, any individual projects identified within the System Improvement Plan should be further evaluated using a detailed design approach to determine the specific design elements associated with those improvements.

APPENDIX A
WET WEATHER RESPONSES


TL 1-July 21 Infiltration Analysis
Flow (gpm)
Time
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Rainfall Event


TL 1-August 3 Infiltration Analysis
Flow (gpm)
Time
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8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
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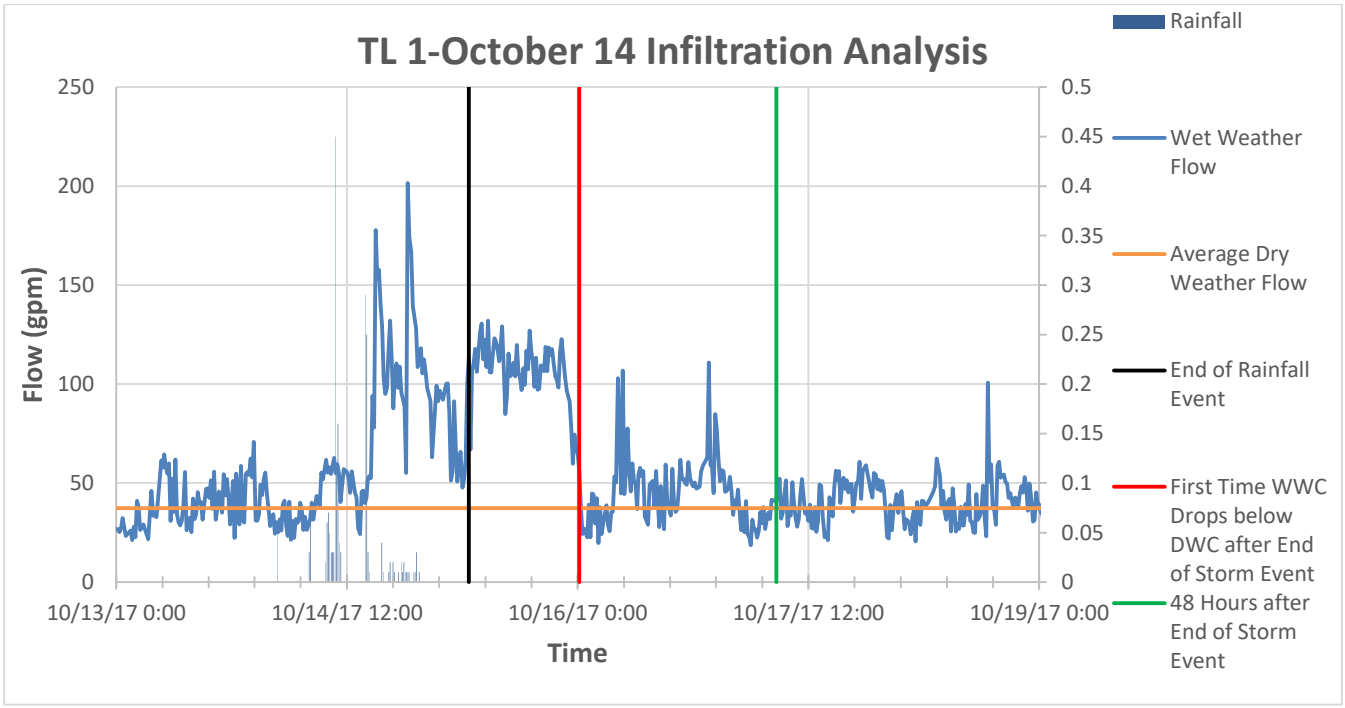
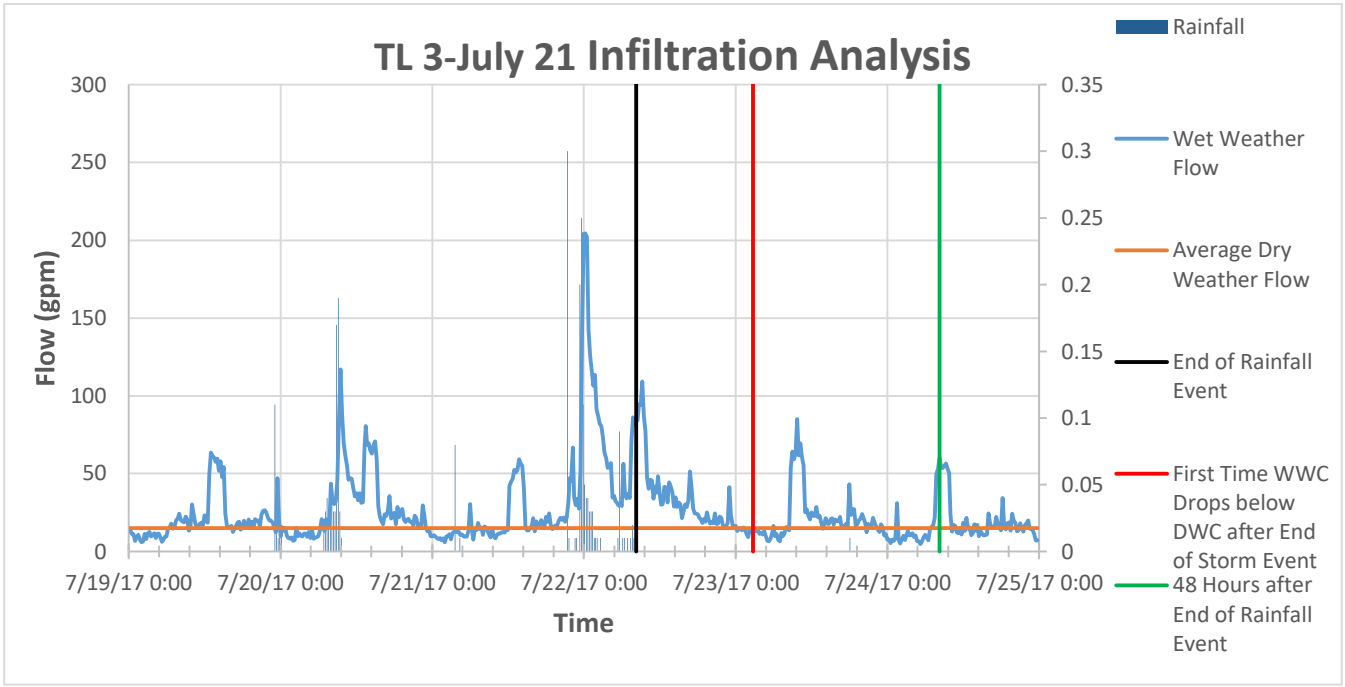
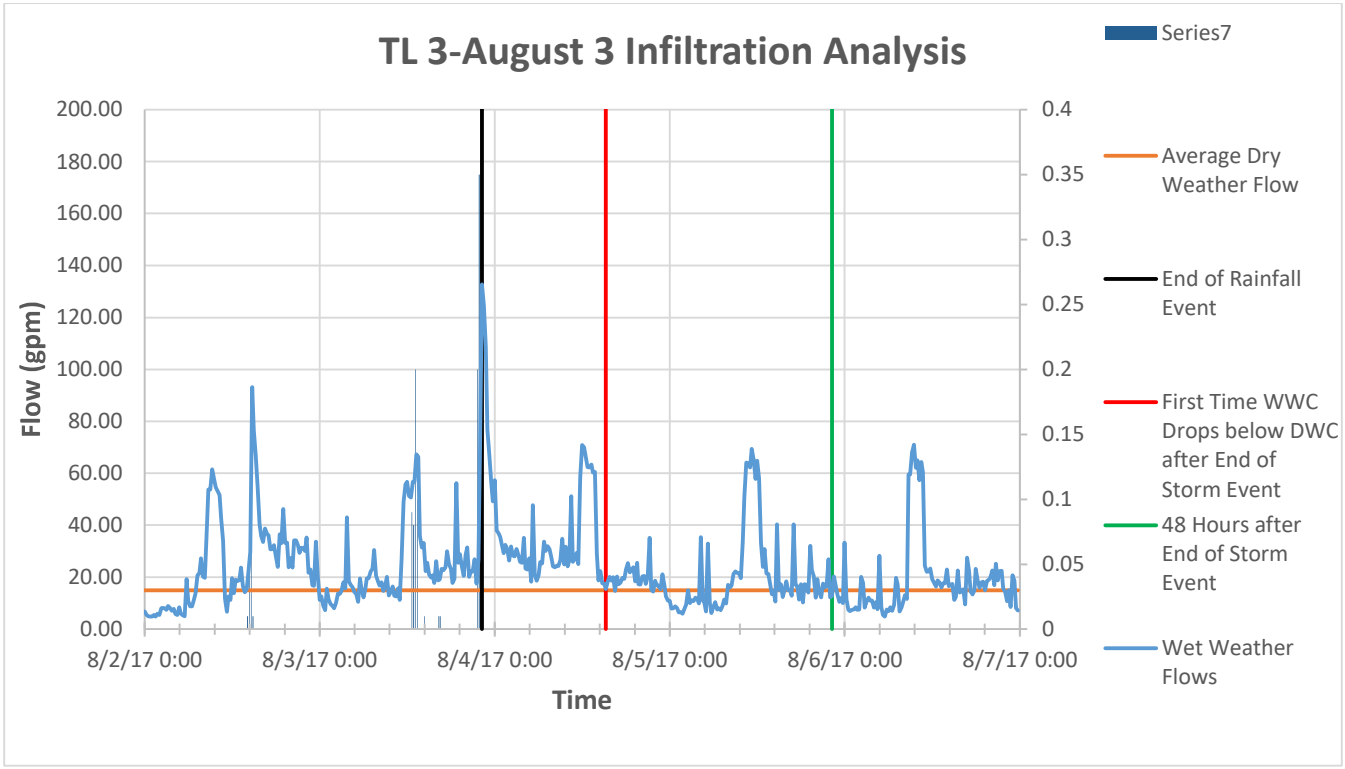
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event


TL 1-October 14 Infiltration Analysis
Flow (gpm)
250
200
150
100
50
0
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event


TL 3-July 21 Infiltration Analysis
Flow (gpm)
300
250
200
150
100
50
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Rainfall Event


TL 3-August 3 Infiltration Analysis
Series7
Flow (gpm)
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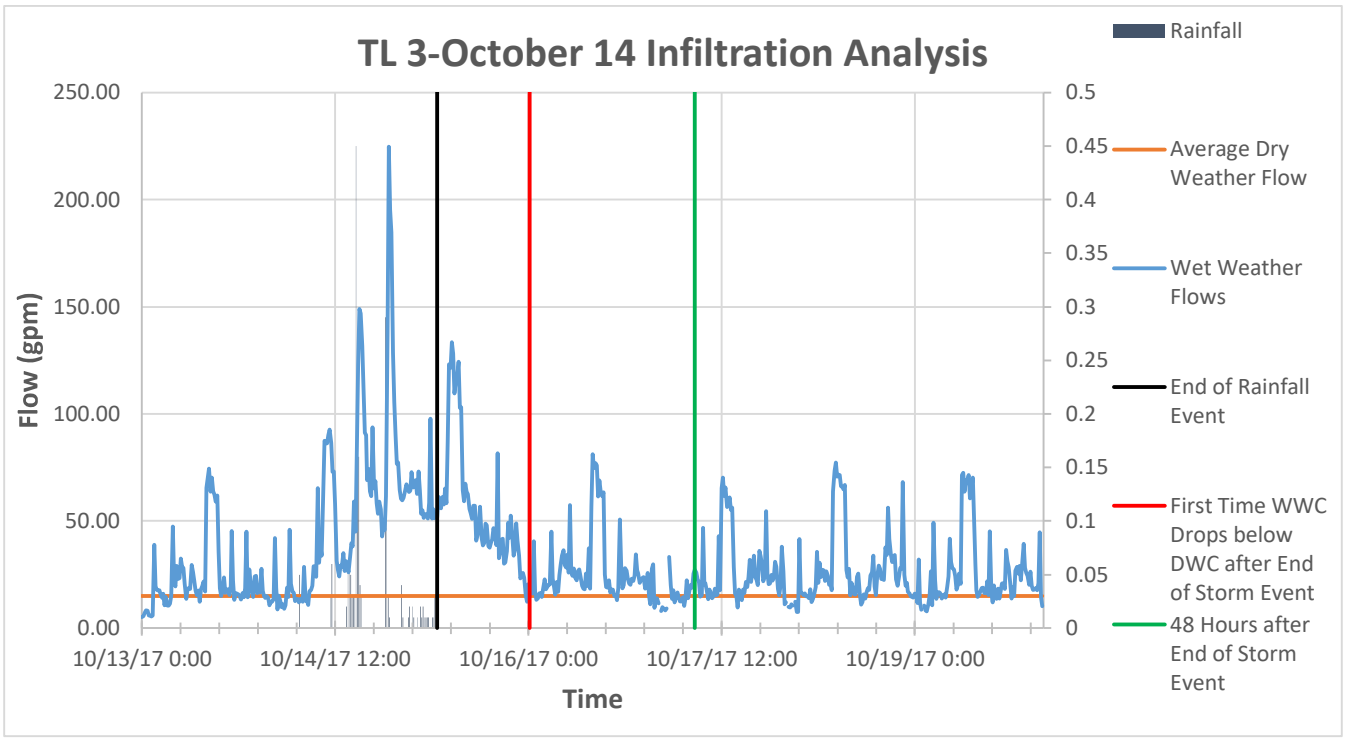
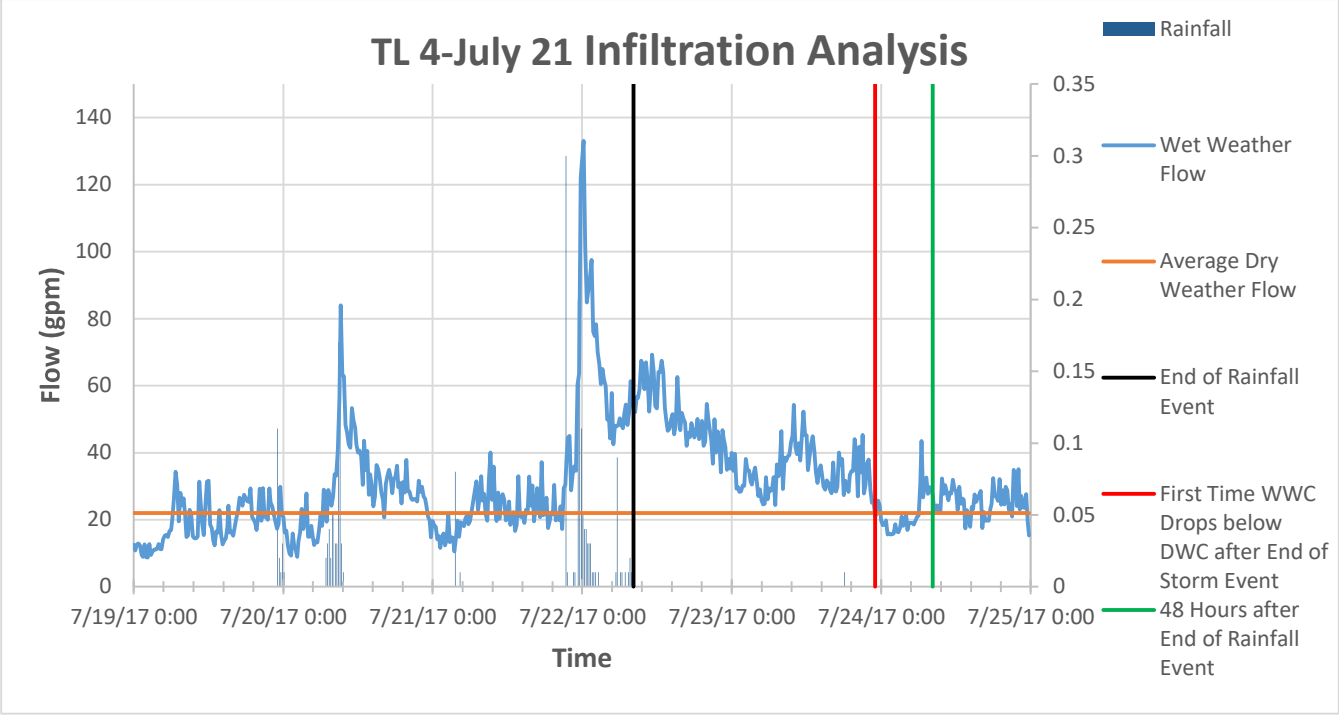
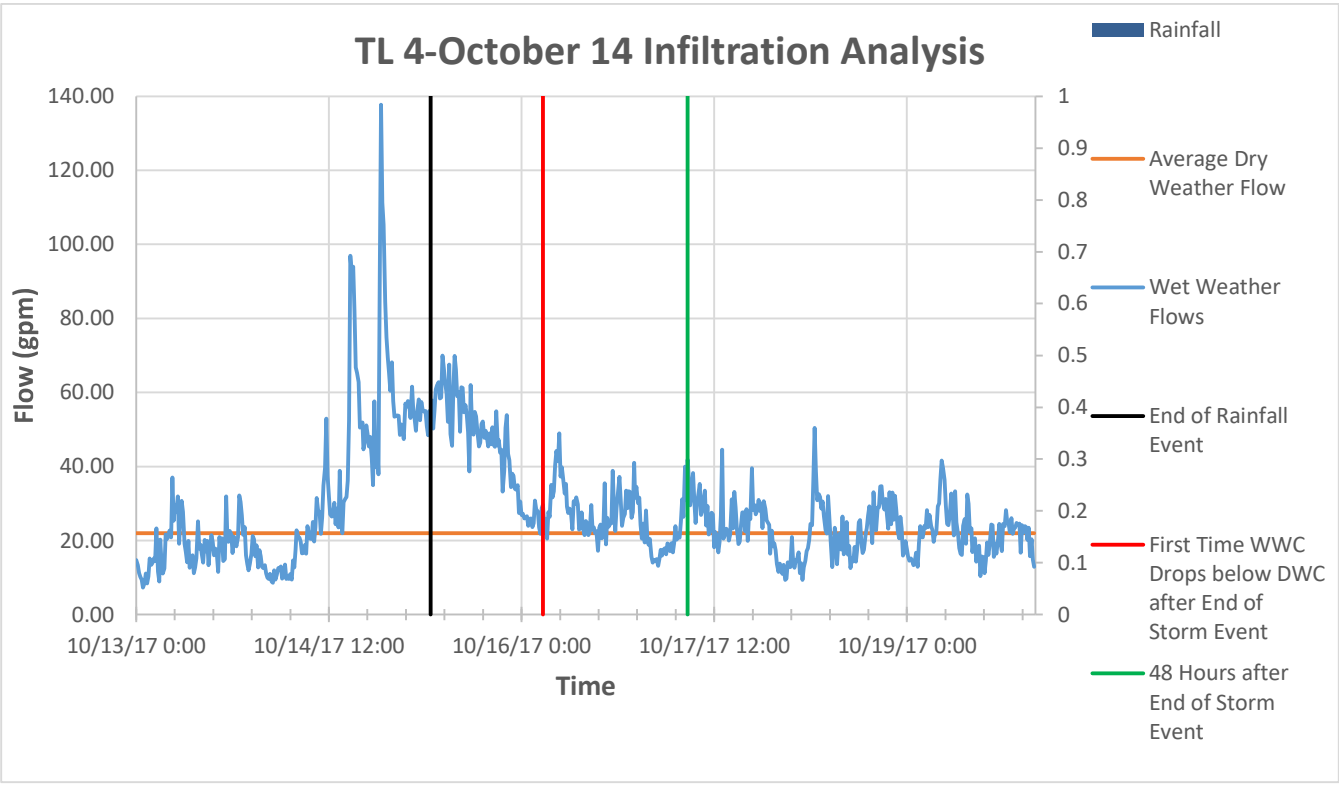
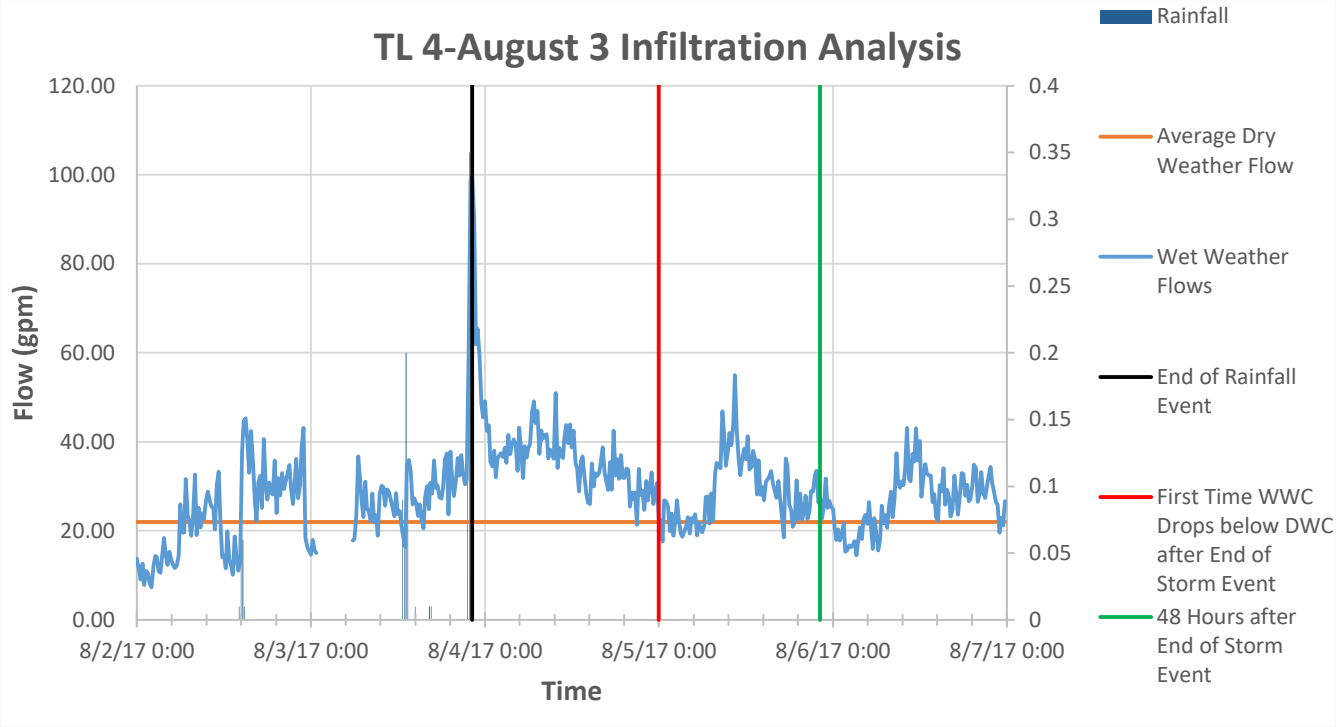
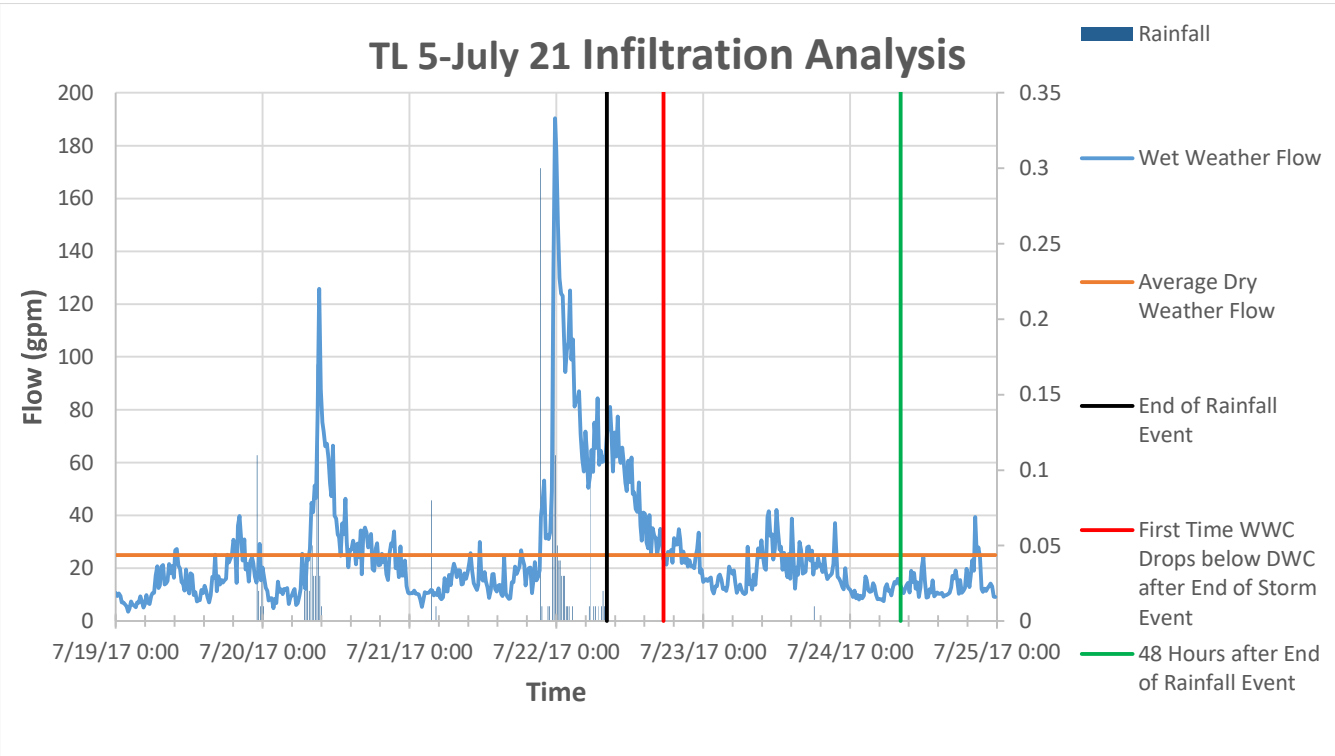
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event
Wet Weather Flows

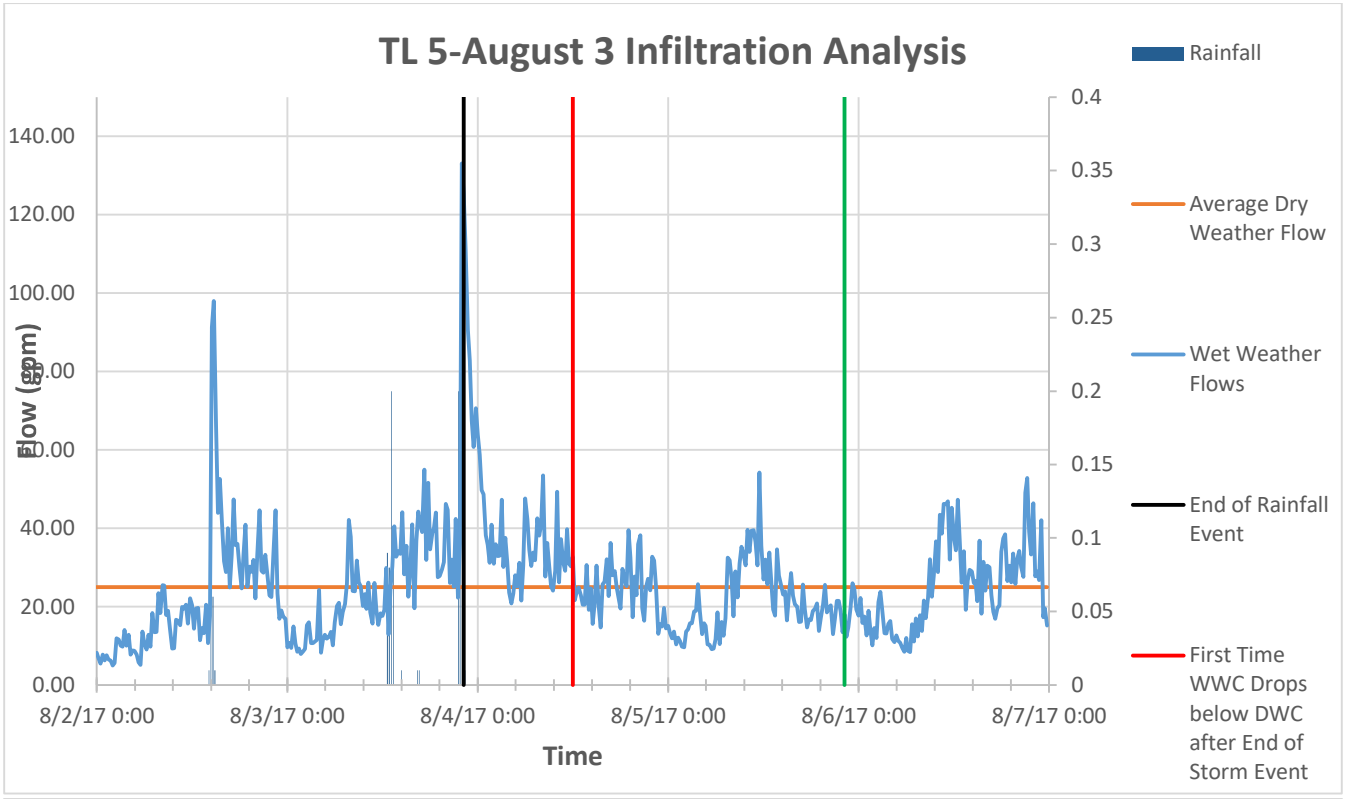

TL 3-October 14 Infiltration Analysis
Rainfall
Flow (gpm)
250.00
200.00
150.00
100.00
50.00
0.00
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Average Dry Weather Flow
Wet Weather Flows
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

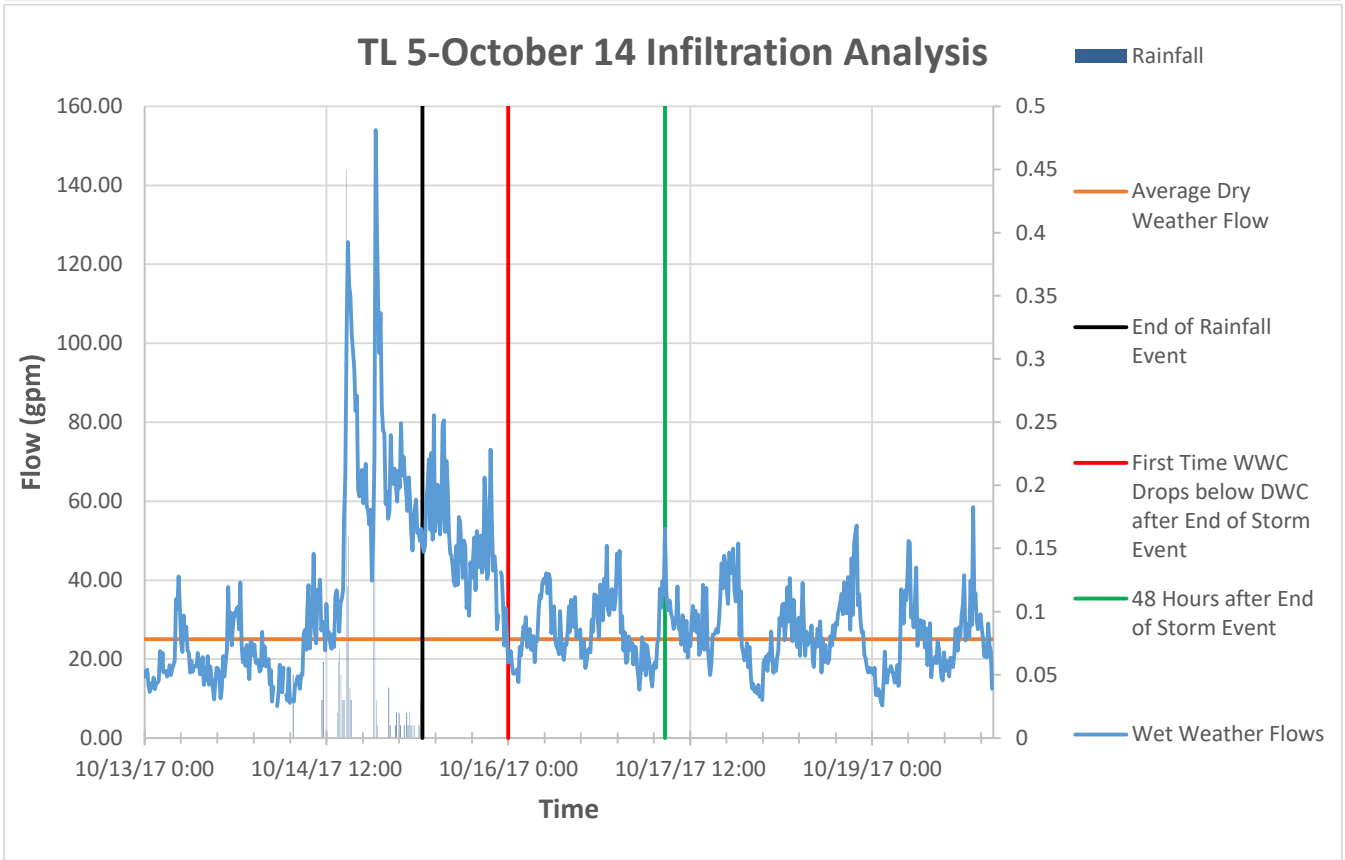

TL 4-July 21 Infiltration Analysis
Flow (gpm)
Time
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Rainfall Event

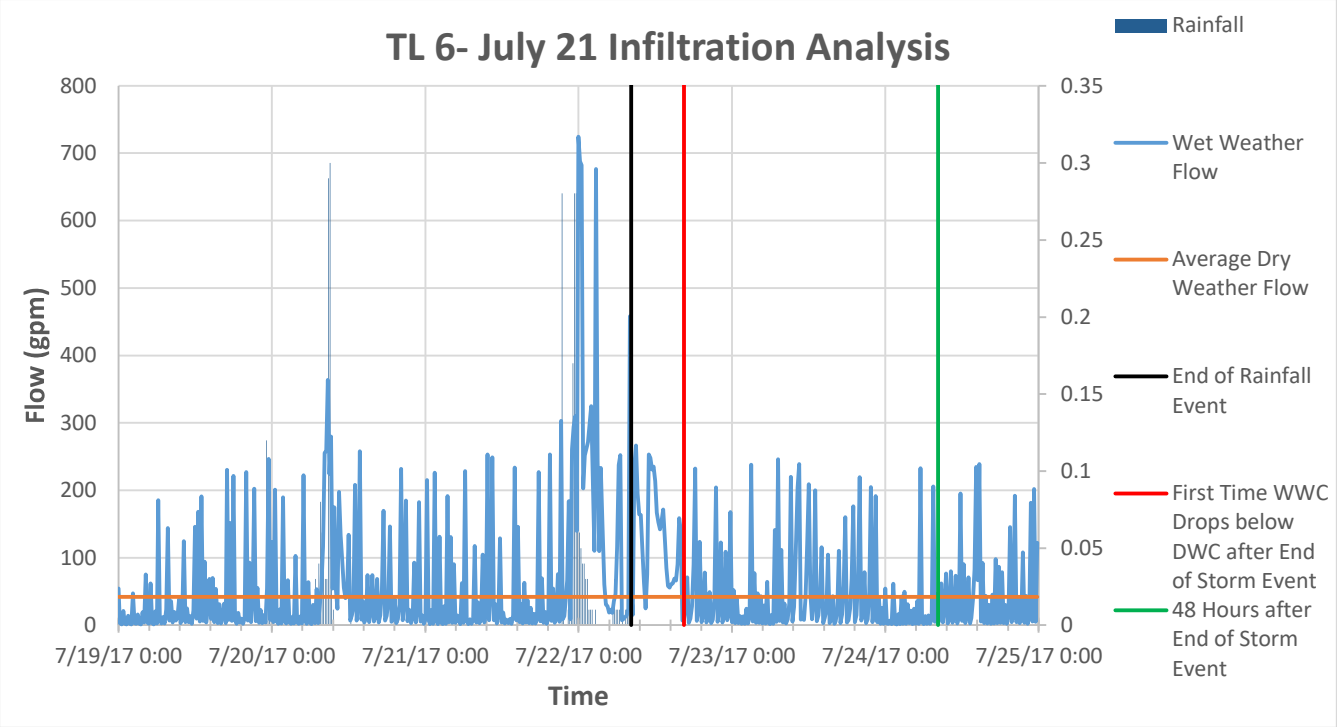

TL 4-October 14 Infiltration Analysis
Flow (gpm)
Time
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Rainfall
Average Dry Weather Flow
Wet Weather Flows
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

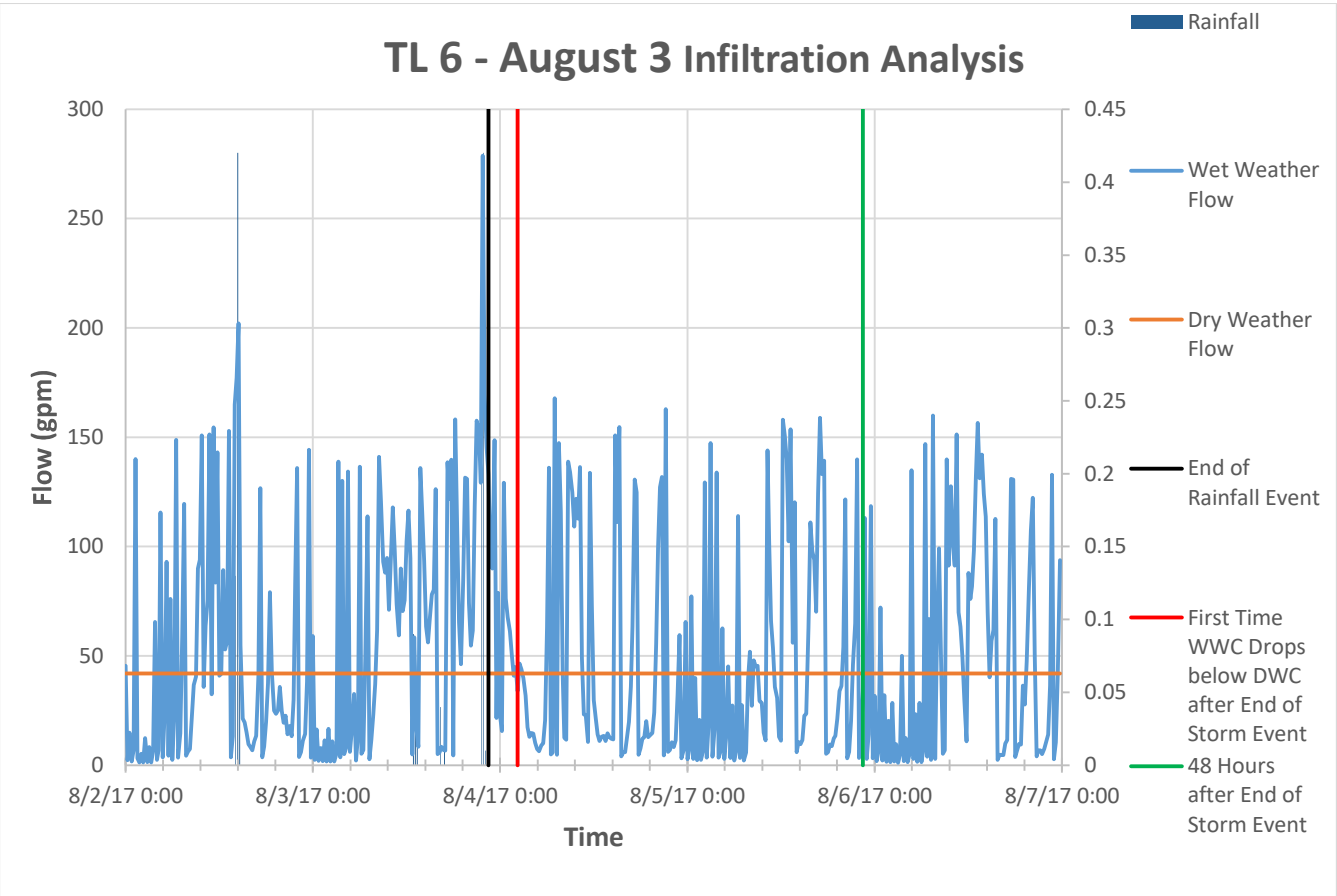

TL 4-August 3 Infiltration Analysis
Flow (gpm)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Rainfall
Average Dry Weather Flow
Wet Weather Flows
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

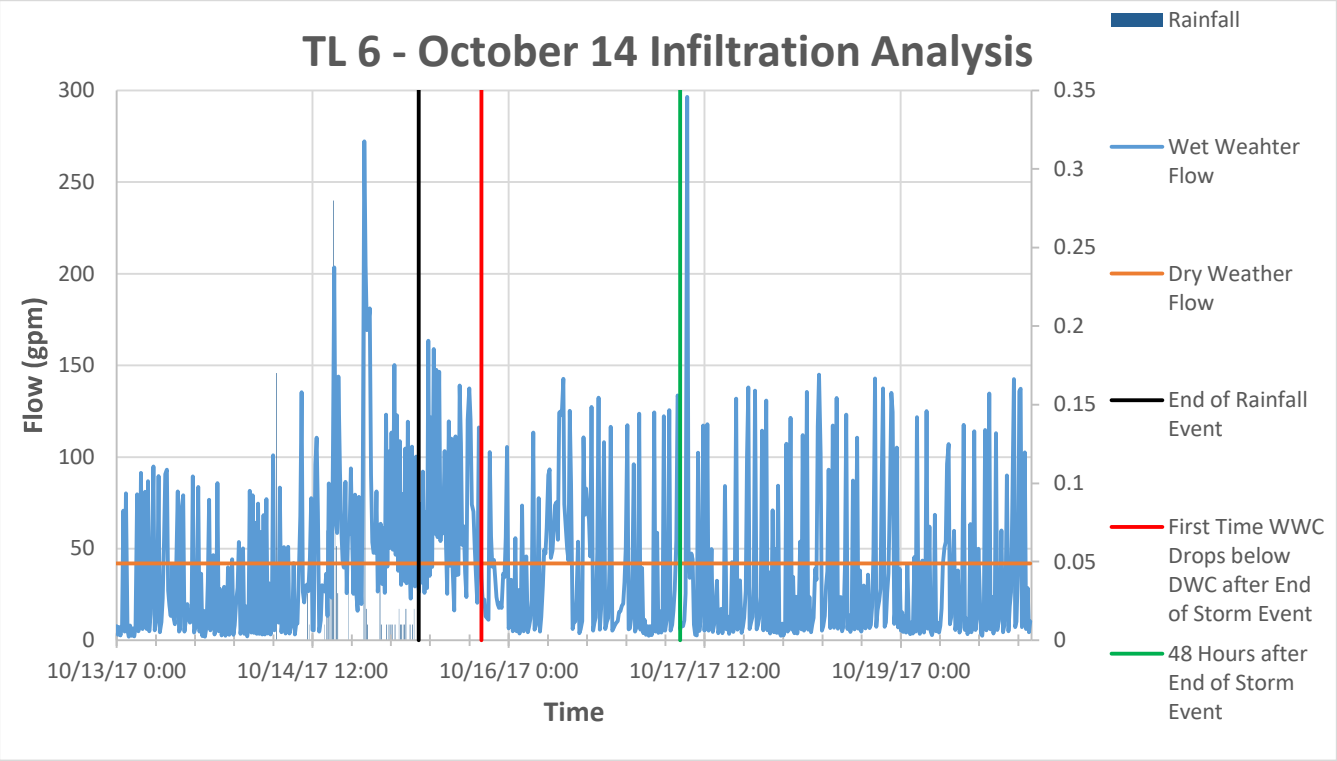

TL 5-July 21 Infiltration Analysis
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Rainfall Event

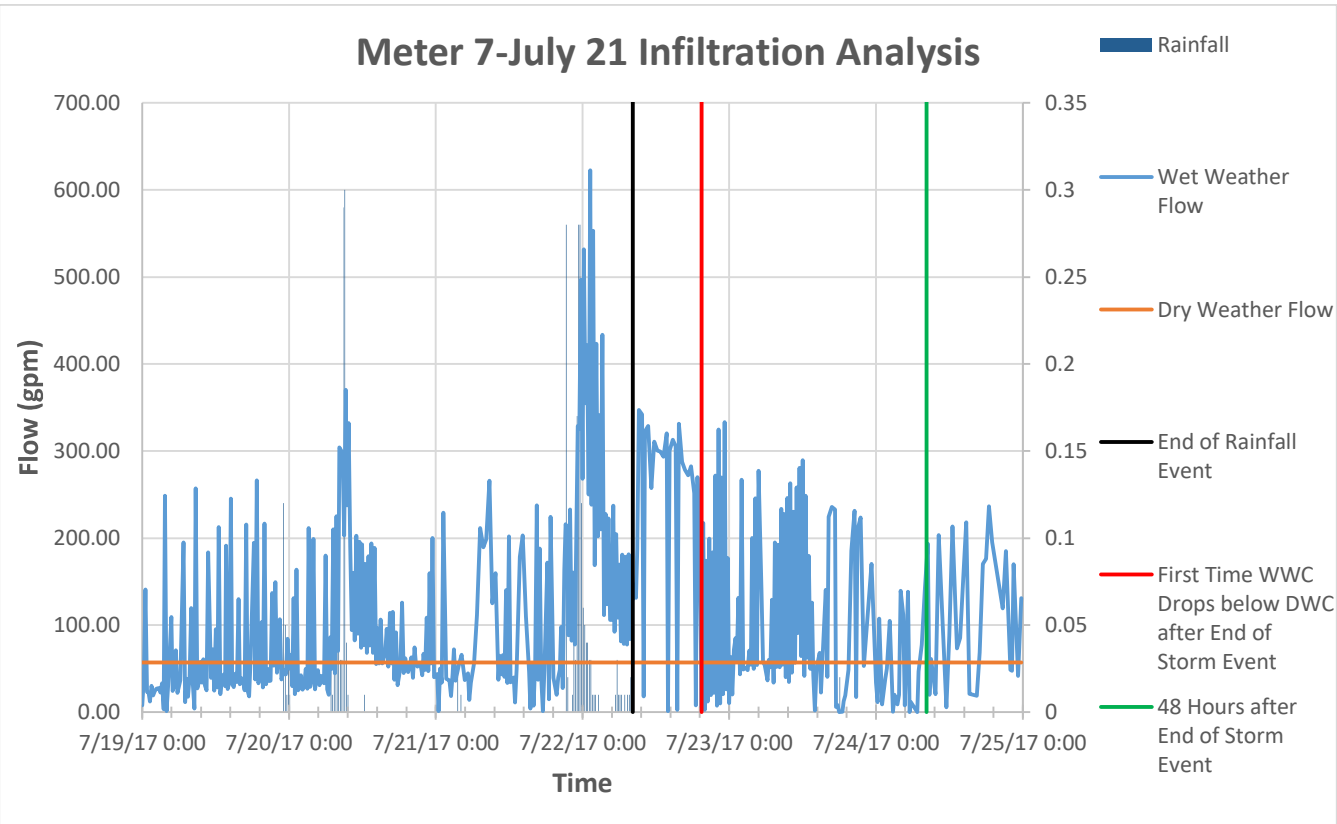

TL 5-August 3 Infiltration Analysis
Rainfall
Average Dry Weather Flow
Wet Weather Flows
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
Flow (gpm)
Time
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00

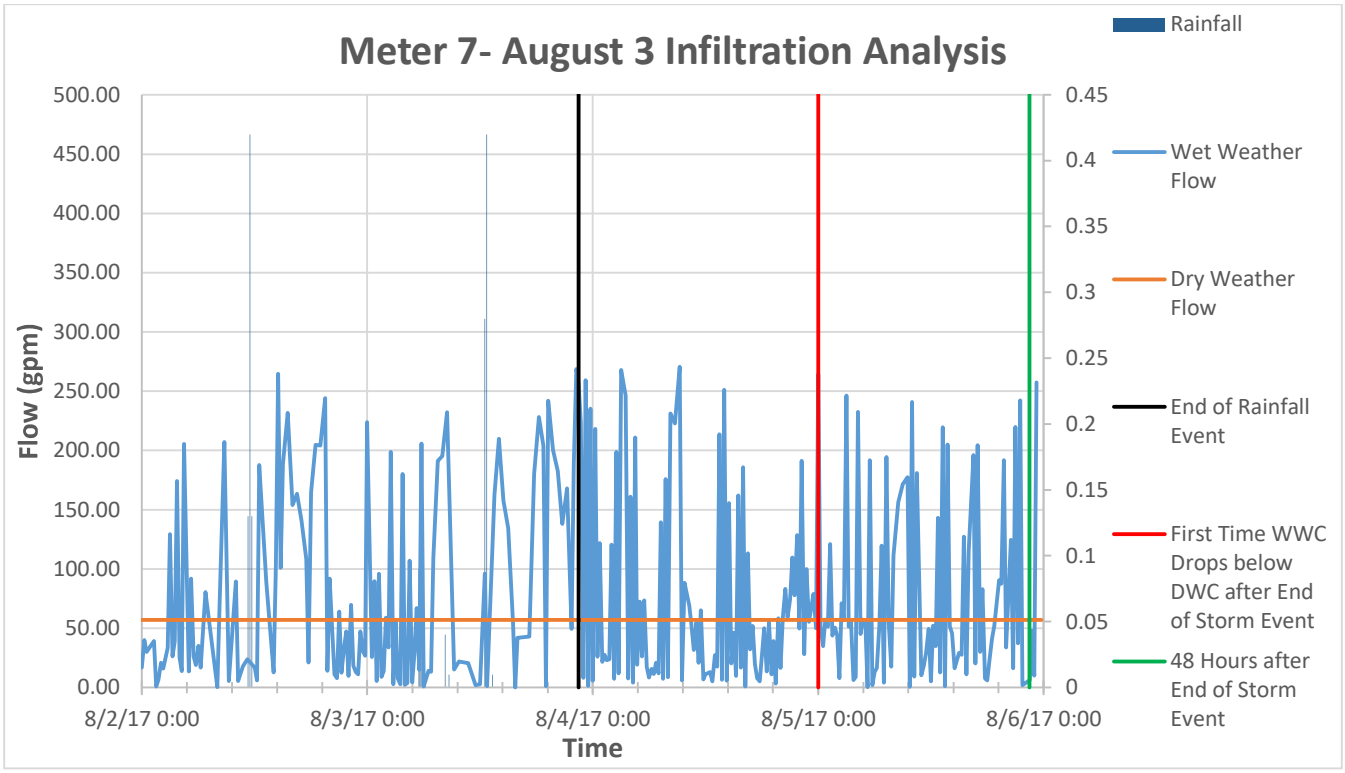

TL 5-October 14 Infiltration Analysis
Rainfall
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event
Wet Weather Flows
Flow (gpm)
Time
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00

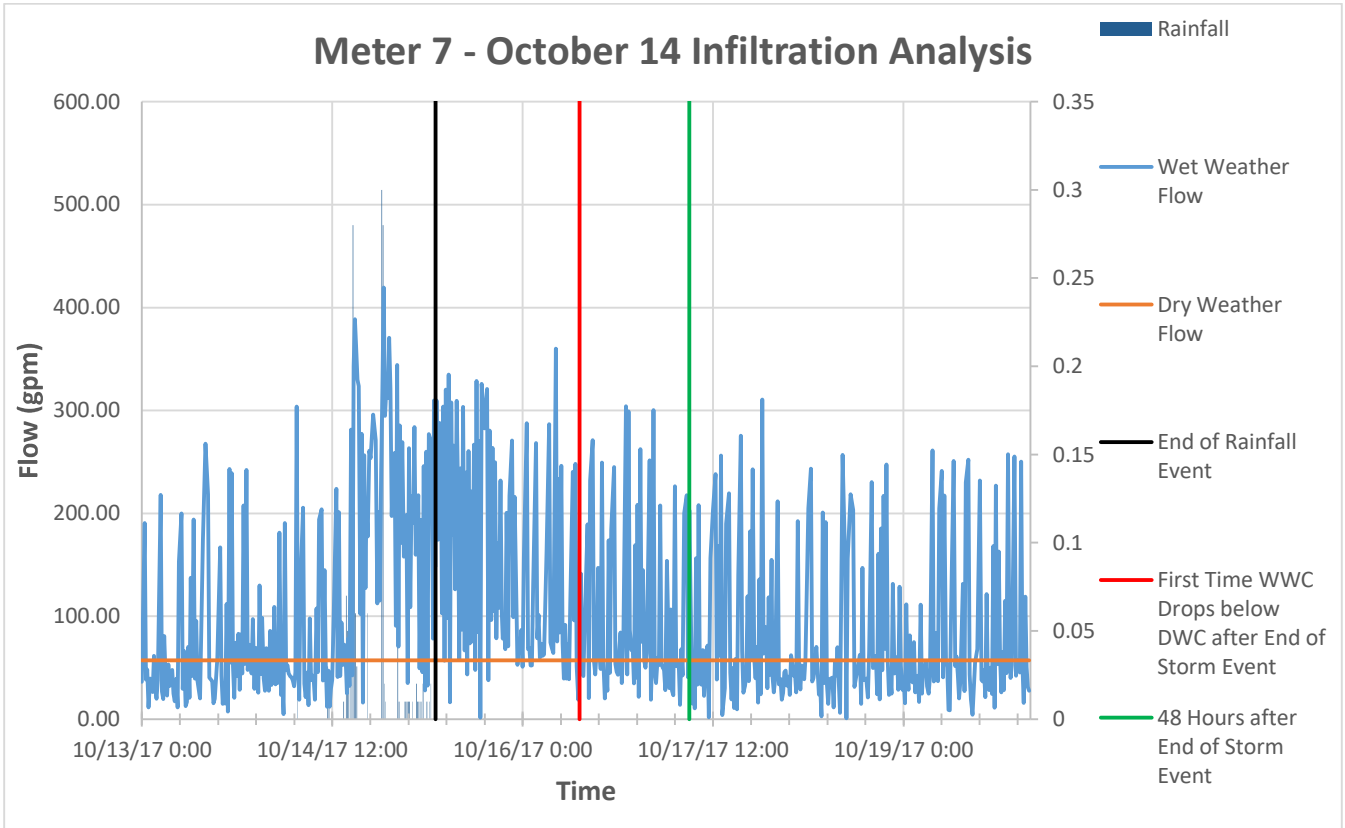

TL 6- July 21 Infiltration Analysis
Rainfall
Flow (gpm)
800
700
600
500
400
300
200
100
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

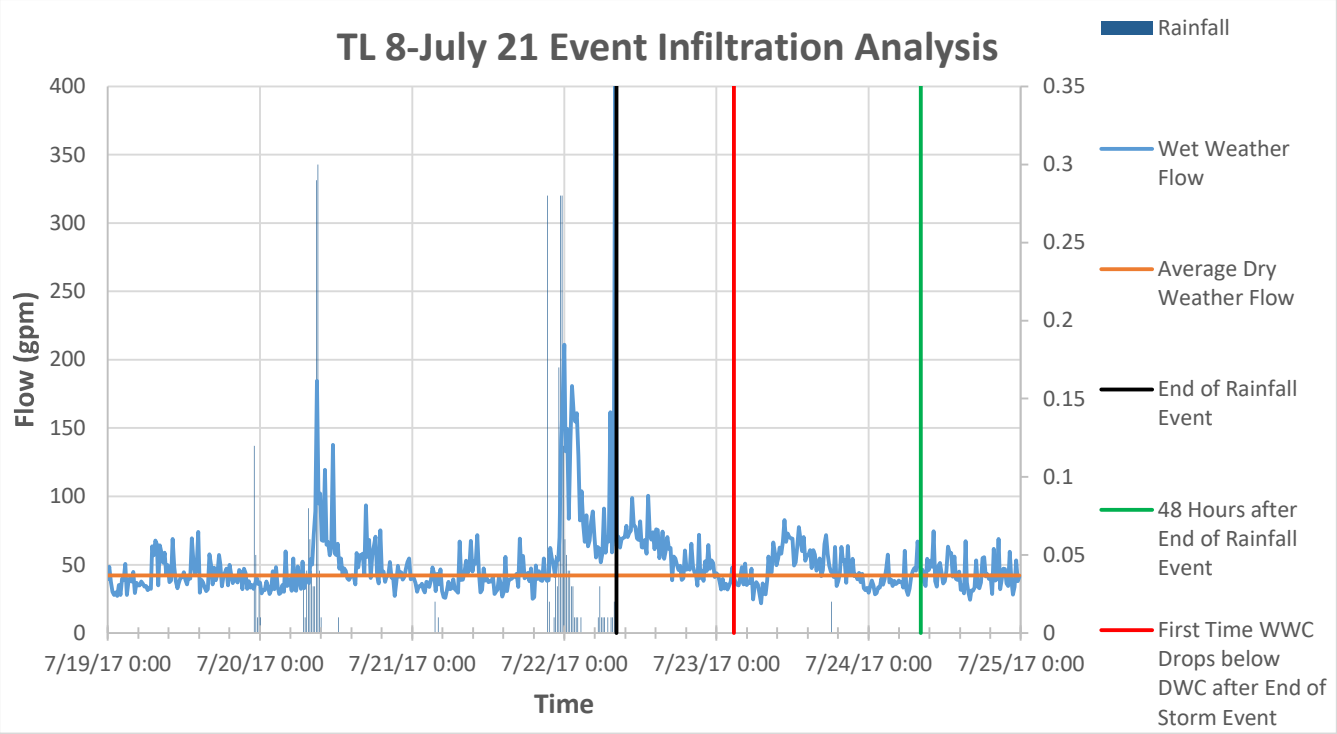

TL 6 - August 3 Infiltration Analysis
Rainfall
Flow (gpm)
300
250
200
150
100
50
0
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

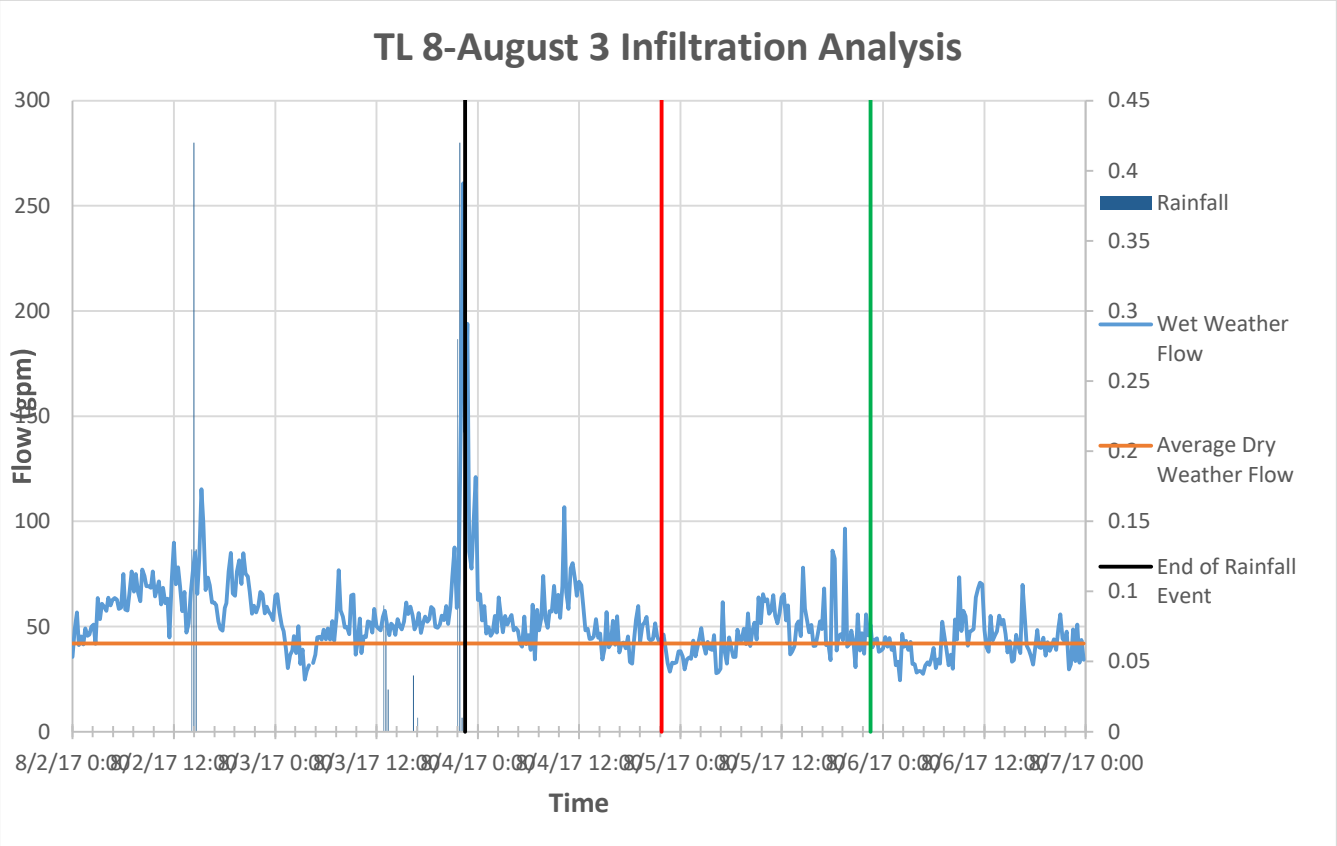

TL 6 - October 14 Infiltration Analysis
Flow (gpm)
300
250
200
150
100
50
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Rainfall
Wet Weahter Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

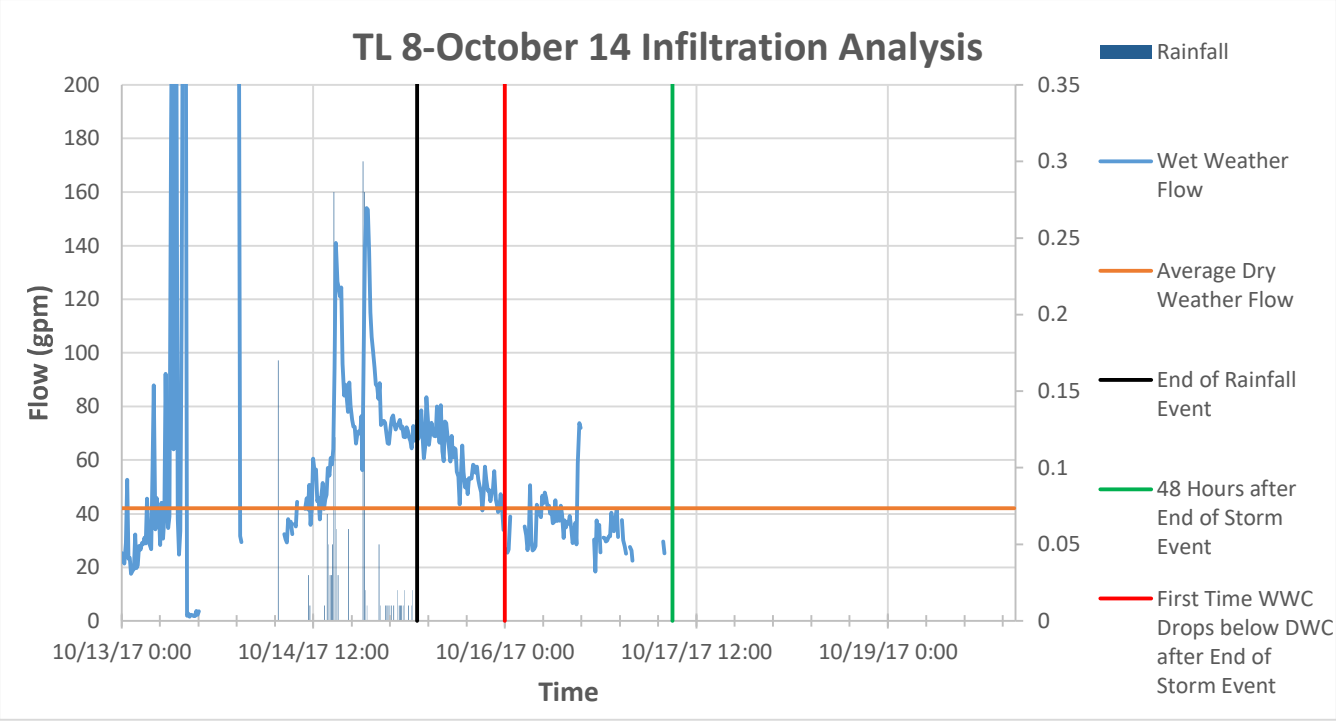

Meter 7-July 21 Infiltration Analysis
Flow (gpm)
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

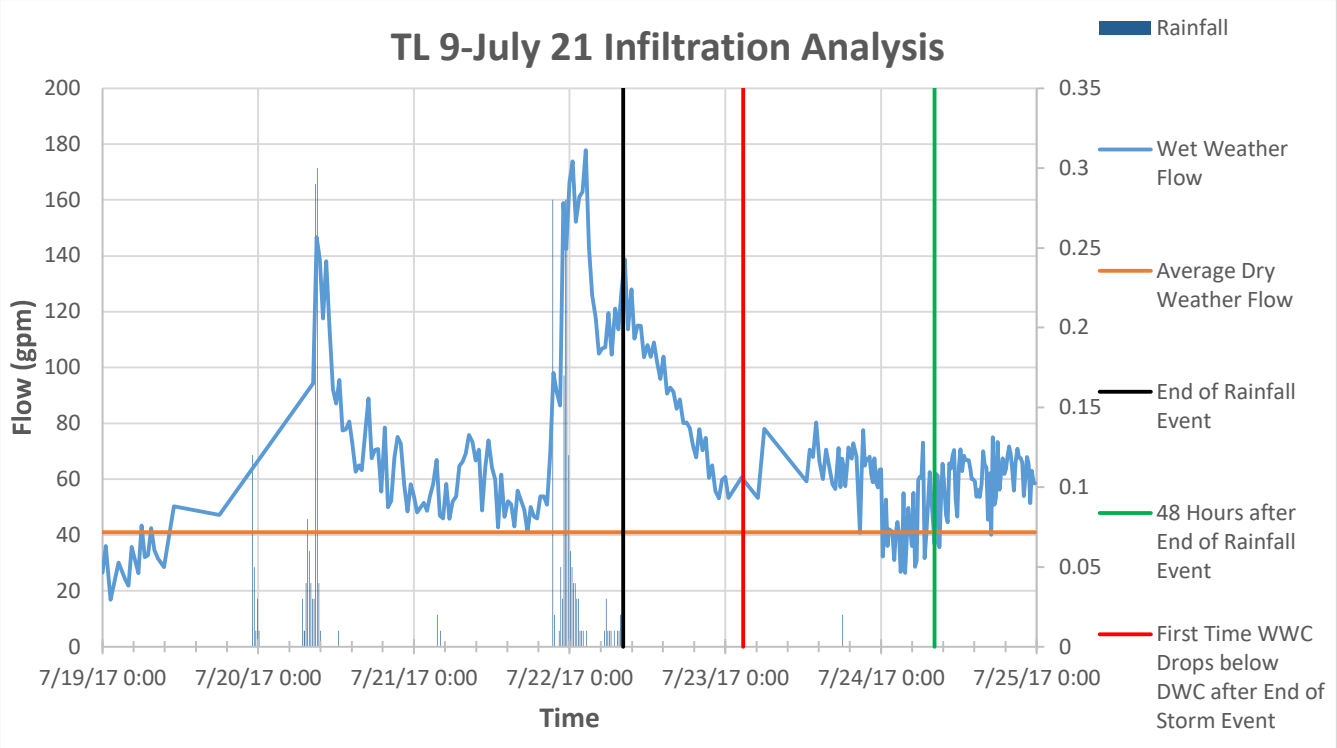

Meter 7- August 3 Infiltration Analysis
Rainfall
Flow (gpm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
Time
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

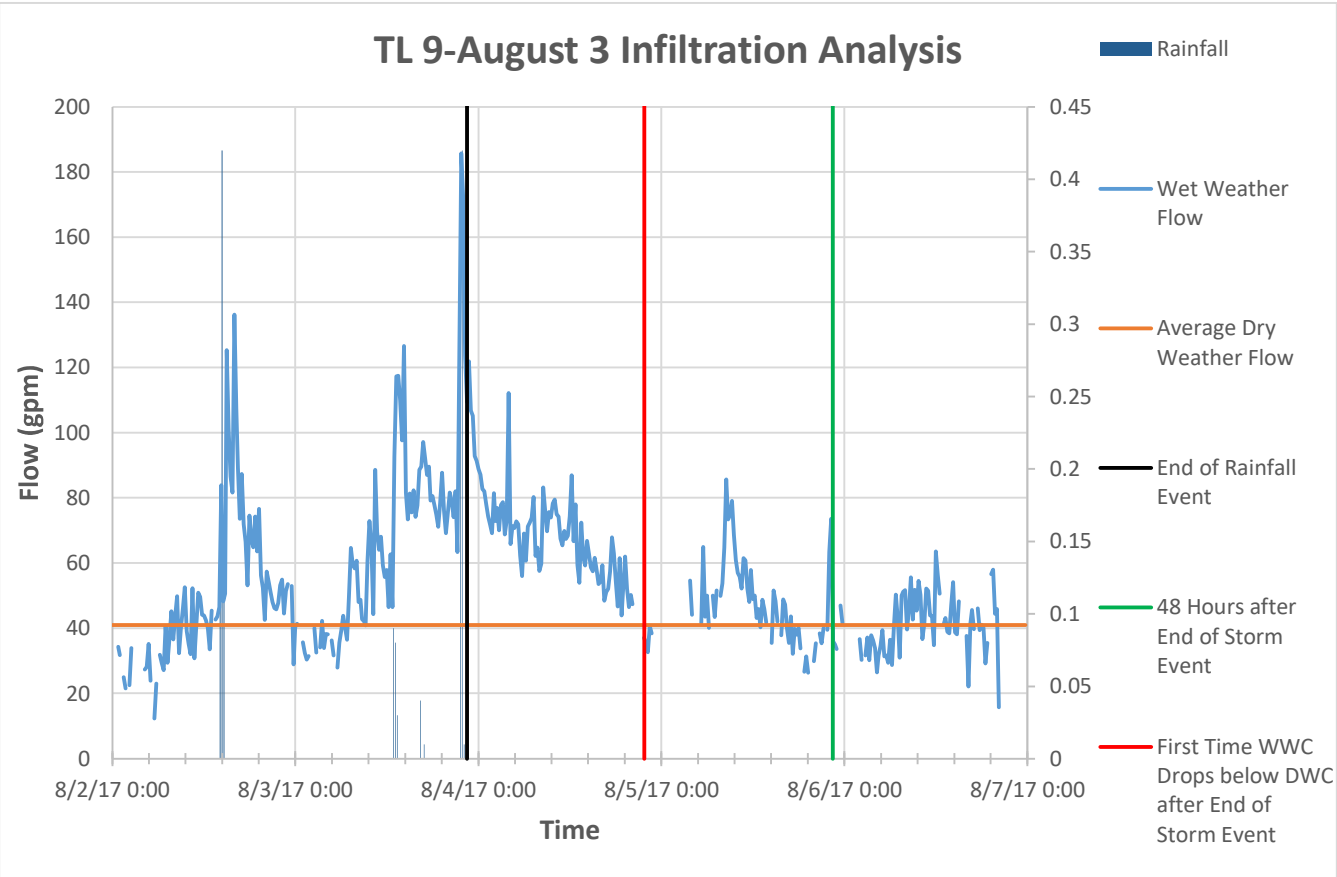

Meter 7 - October 14 Infiltration Analysis
Rainfall
Flow (gpm)
600.00
500.00
400.00
300.00
200.00
100.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

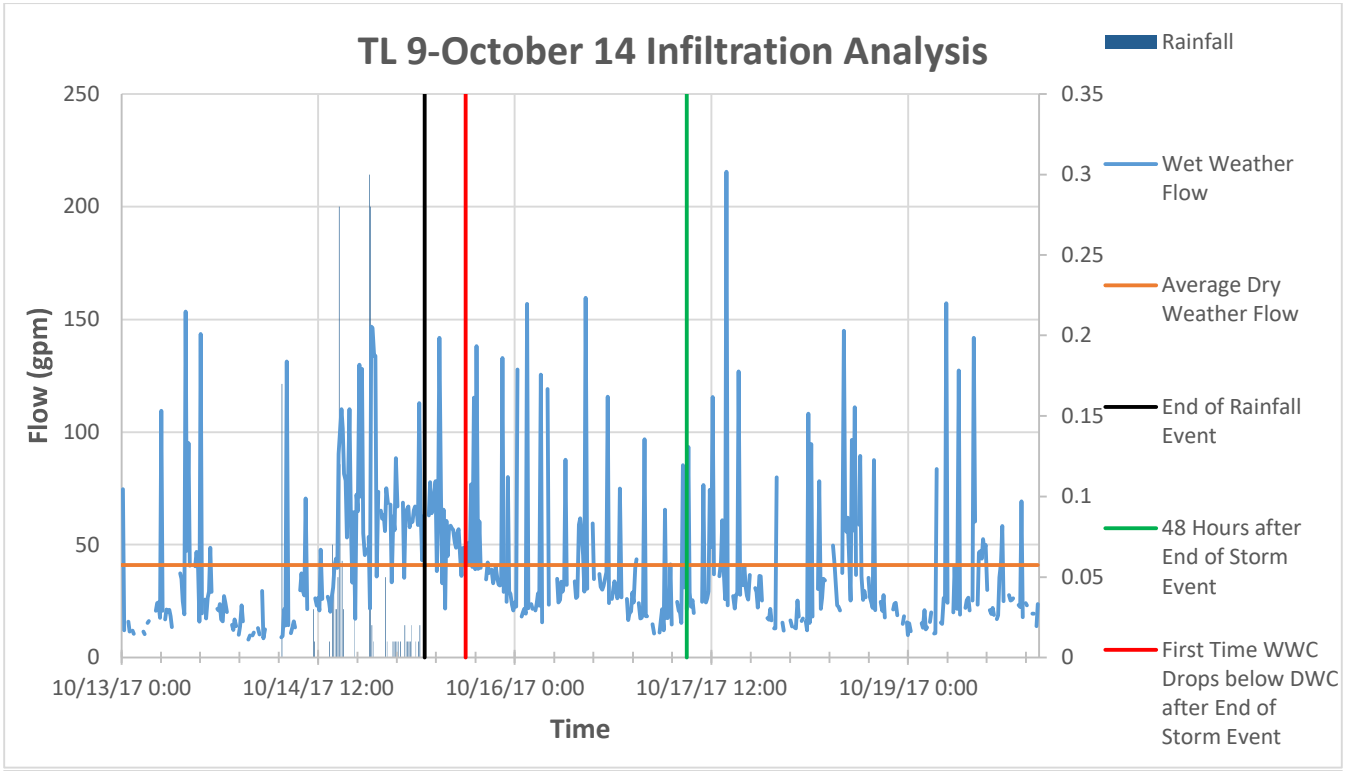

TL 8-July 21 Event Infiltration Analysis
Flow (gpm)
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event

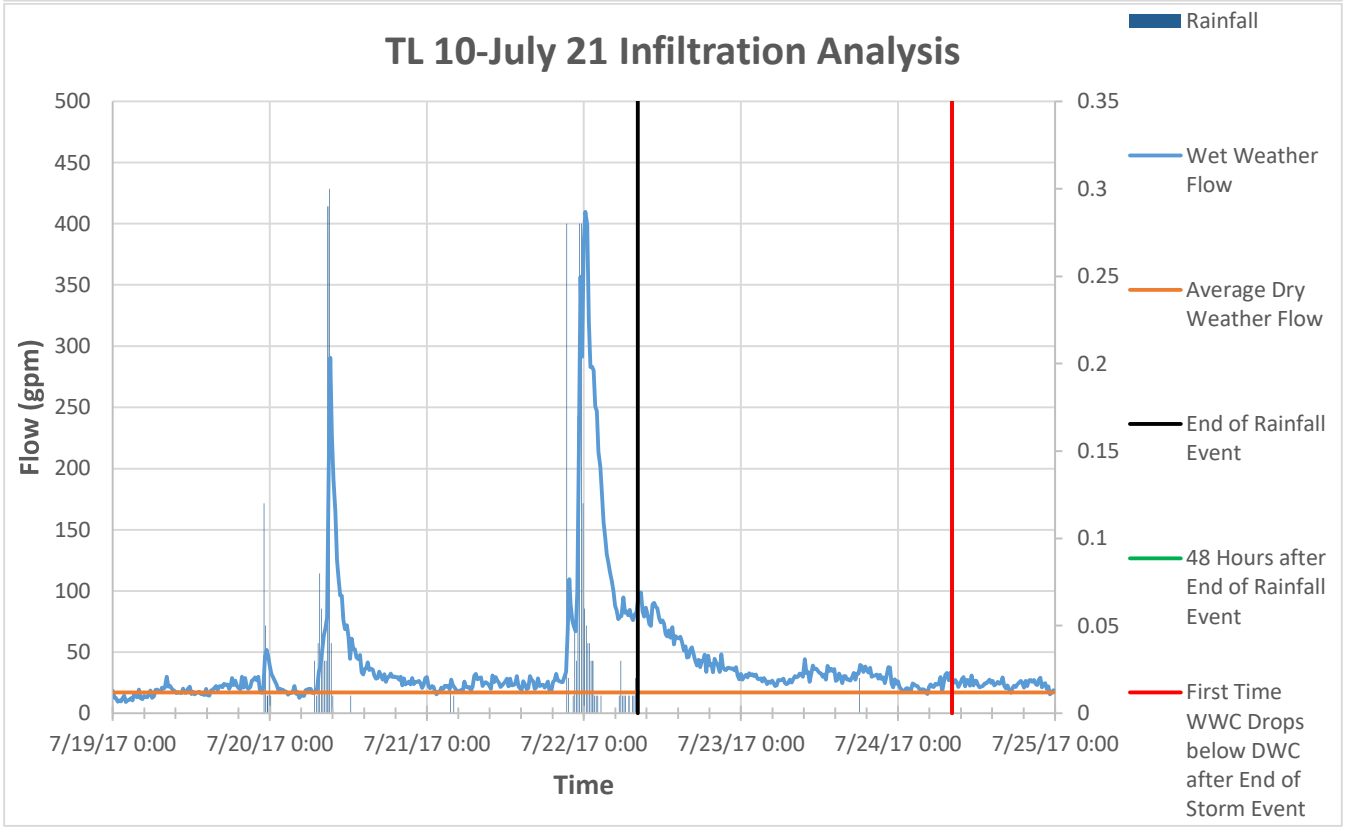

TL 8-August 3 Infiltration Analysis
Flow (gpm)
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event

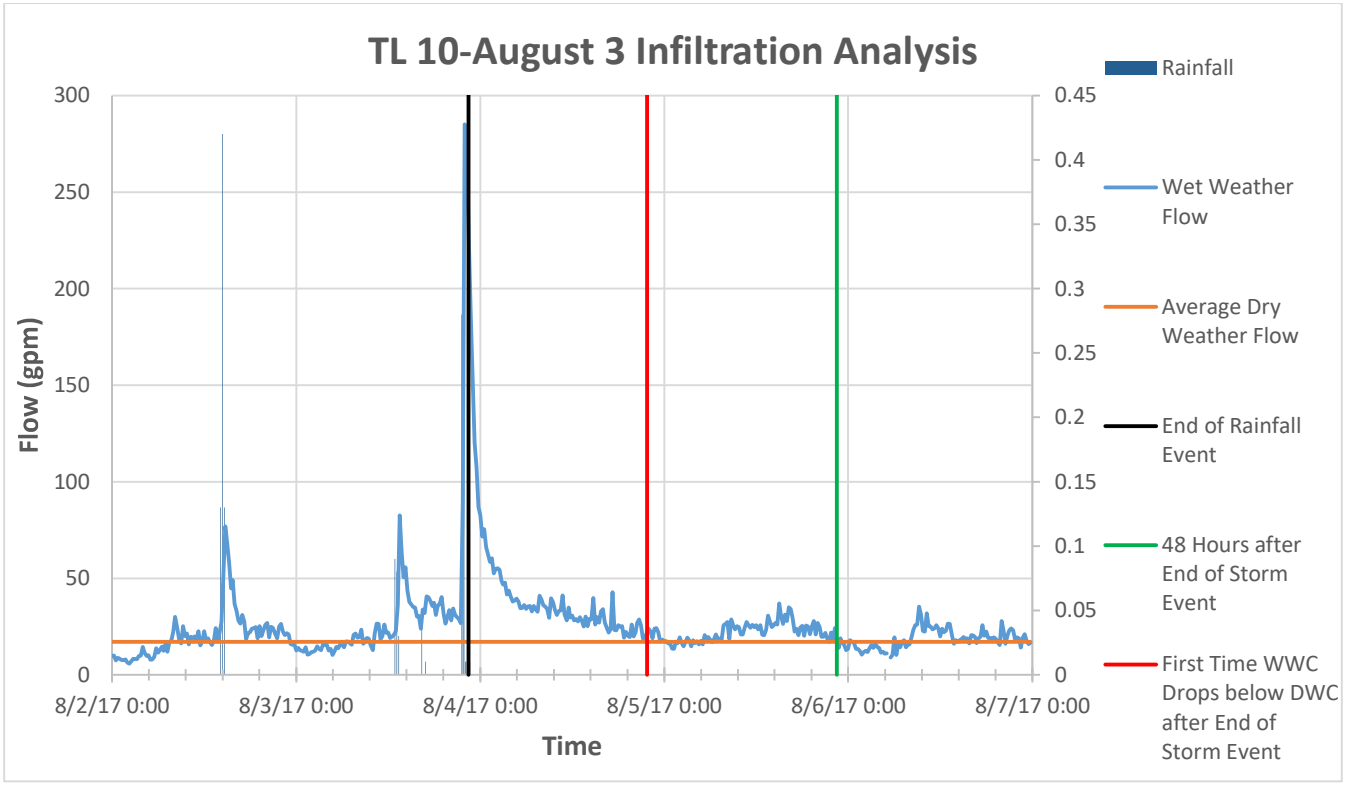

TL 8-October 14 Infiltration Analysis
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

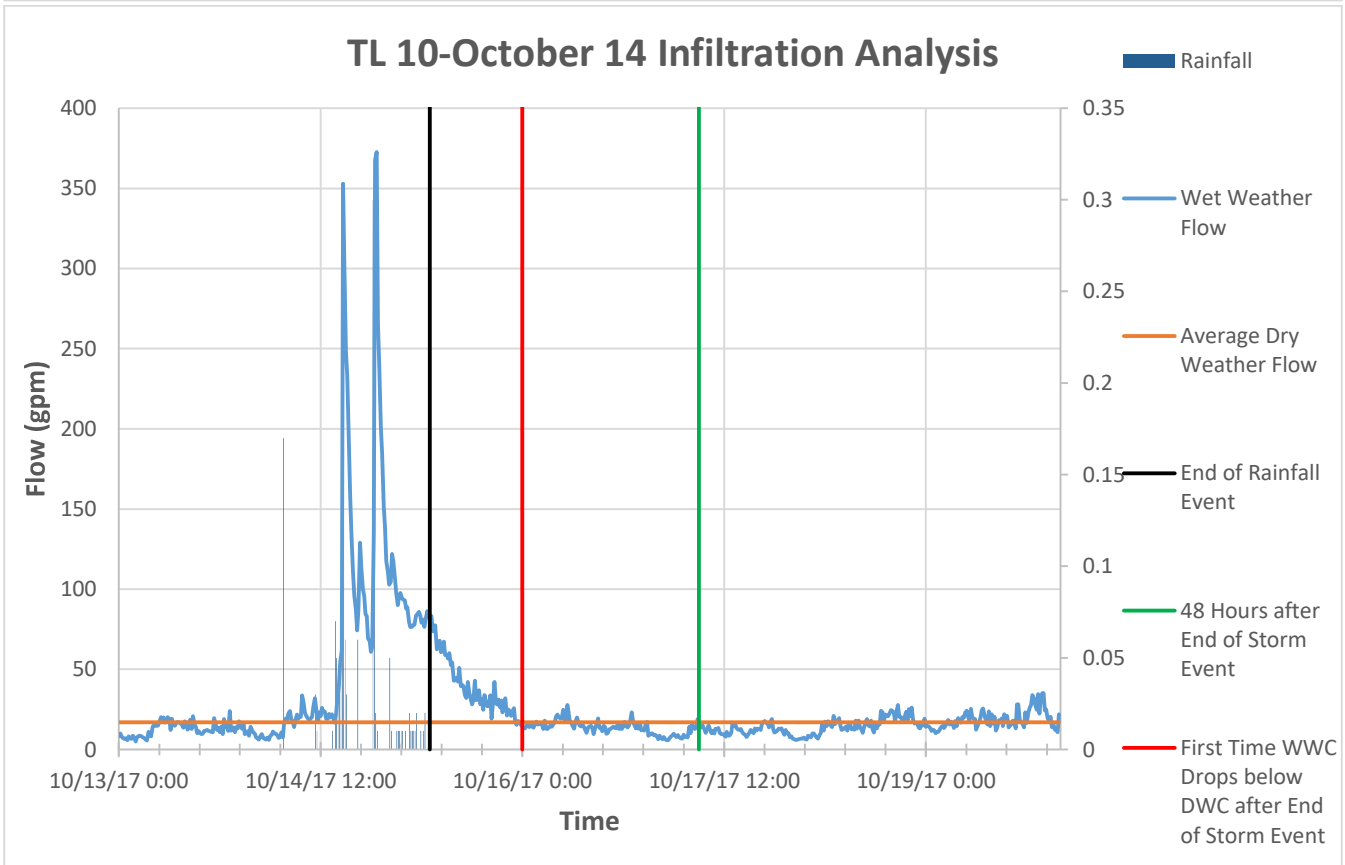

TL 9-July 21 Infiltration Analysis
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
Flow (gpm)
Time
200
180
160
140
120
100
80
60
40
20
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00

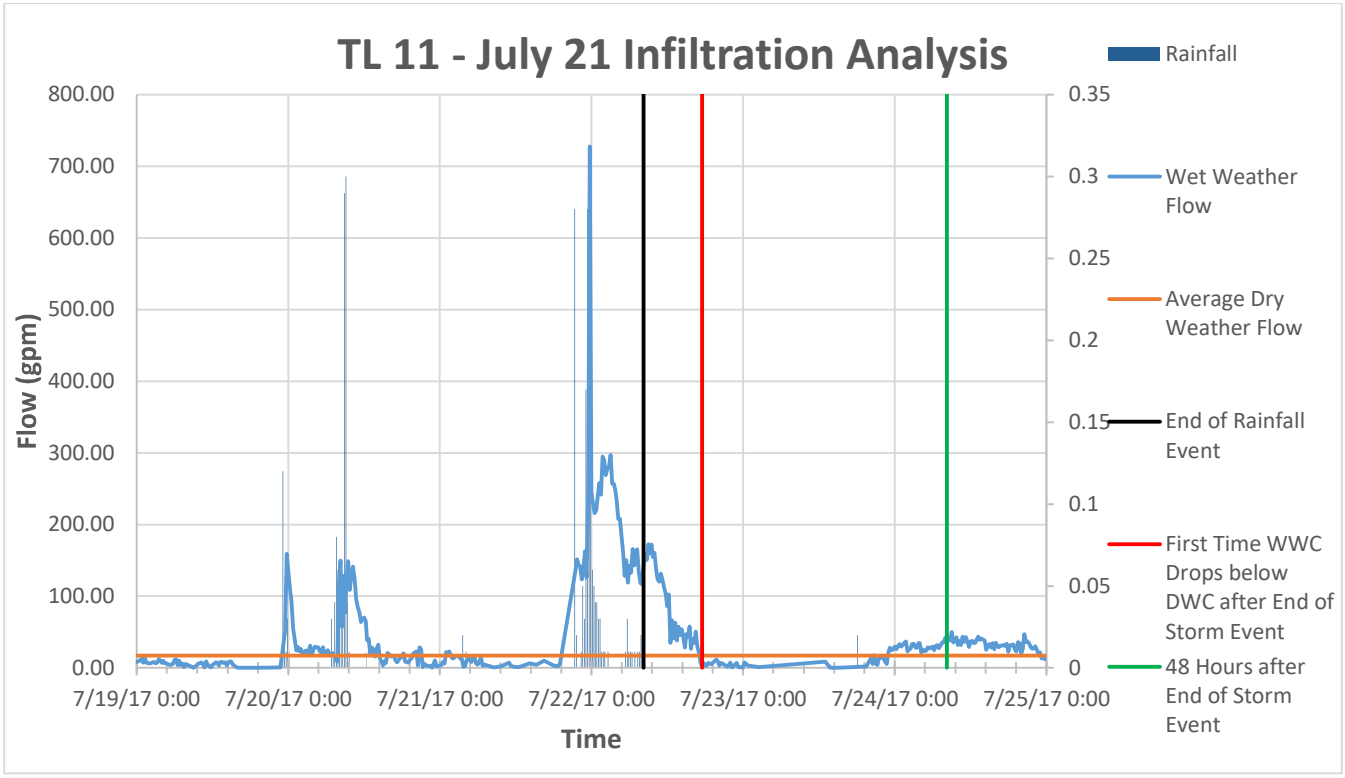

TL 9-August 3 Infiltration Analysis
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event
Flow (gpm)
Time
200
180
160
140
120
100
80
60
40
20
0
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00

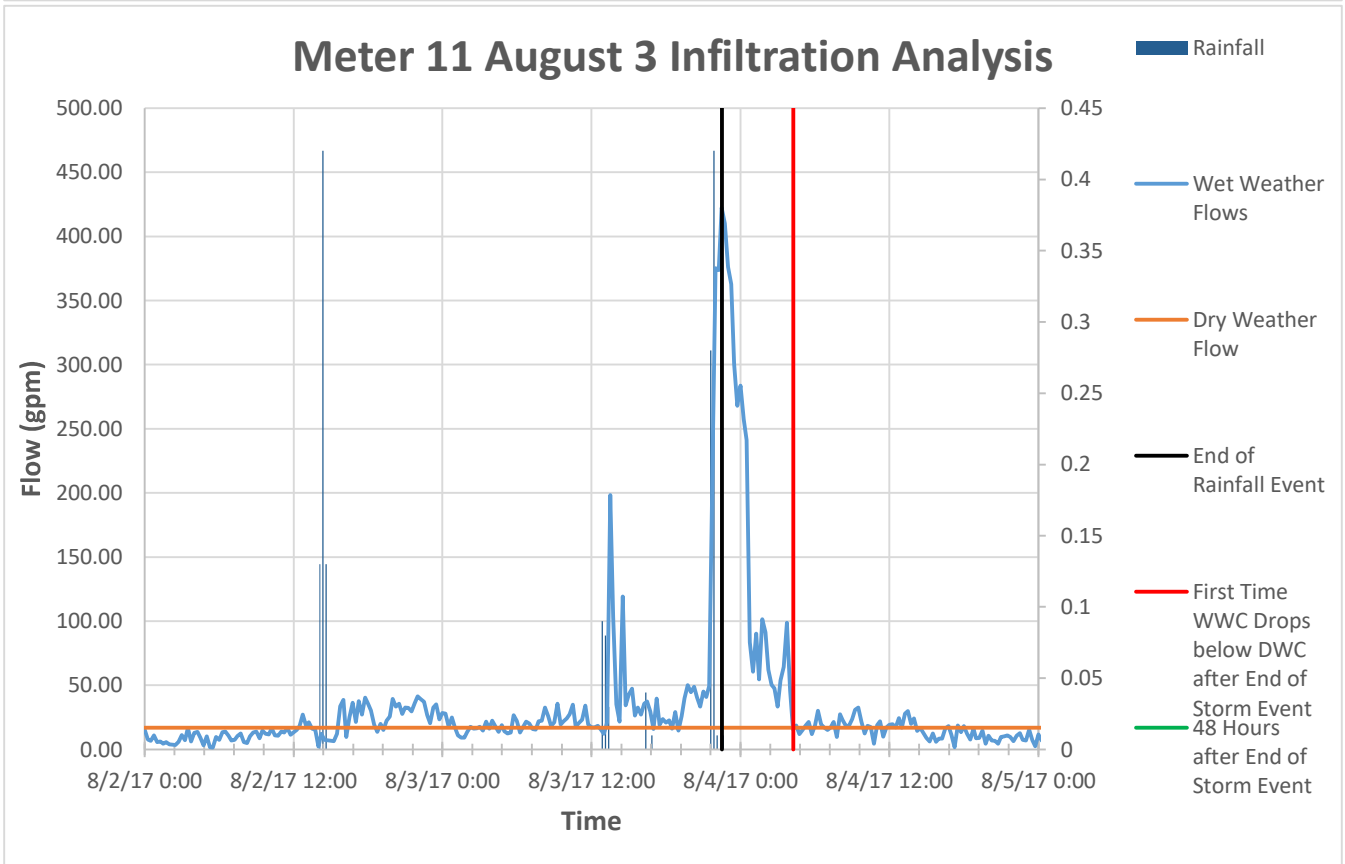

TL 9-October 14 Infiltration Analysis
Rainfall
Flow (gpm)
250
200
150
100
50
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

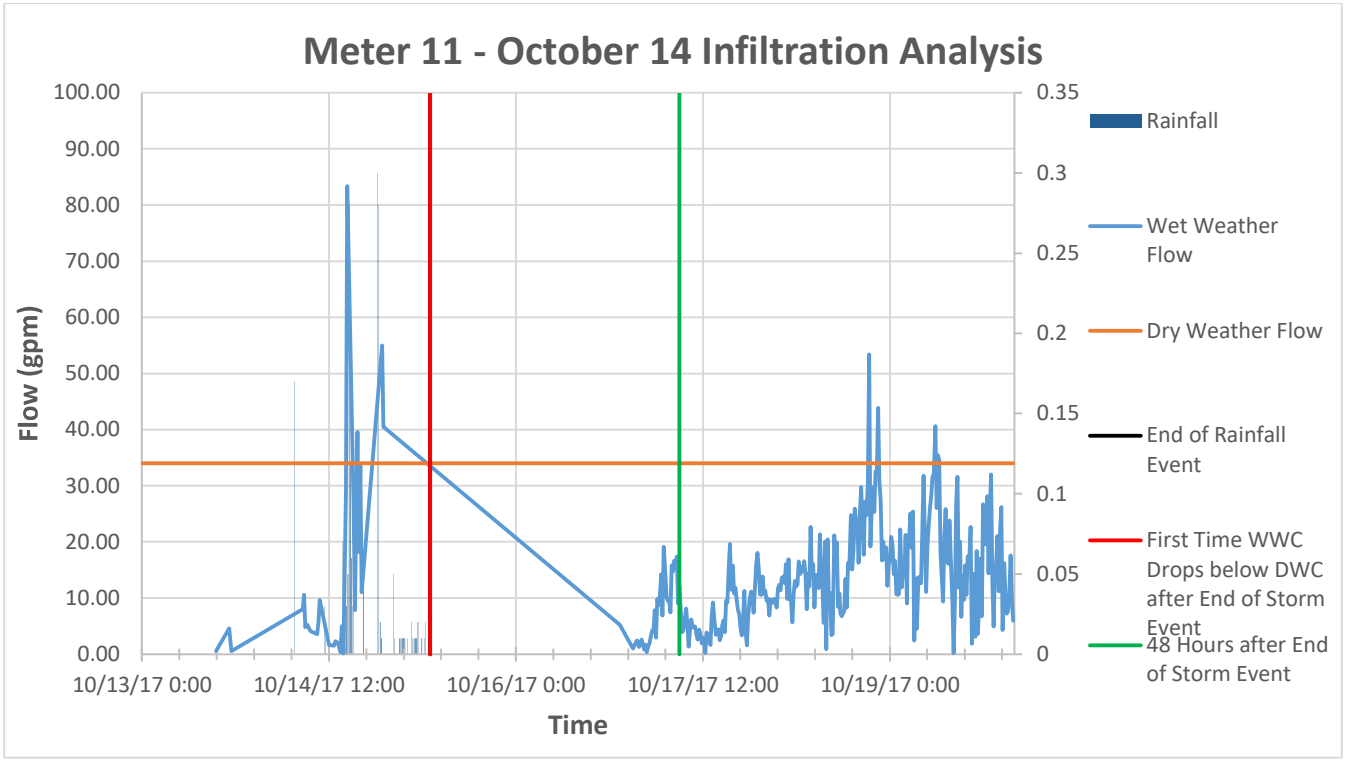

TL 10-July 21 Infiltration Analysis
Rainfall
Flow (gpm)
500
450
400
350
300
250
200
150
100
50
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event

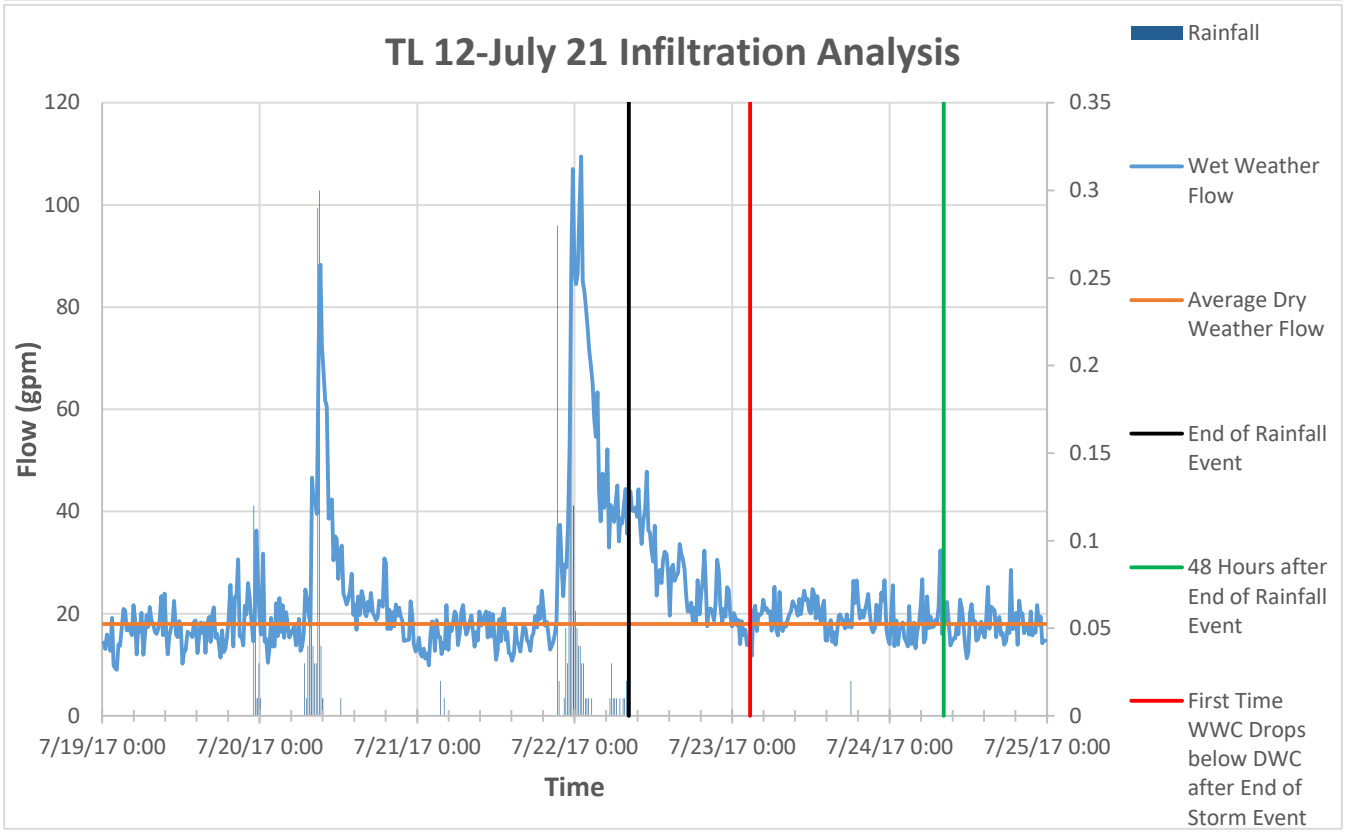

TL 10-August 3 Infiltration Analysis
Flow (gpm)
300
250
200
150
100
50
0
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

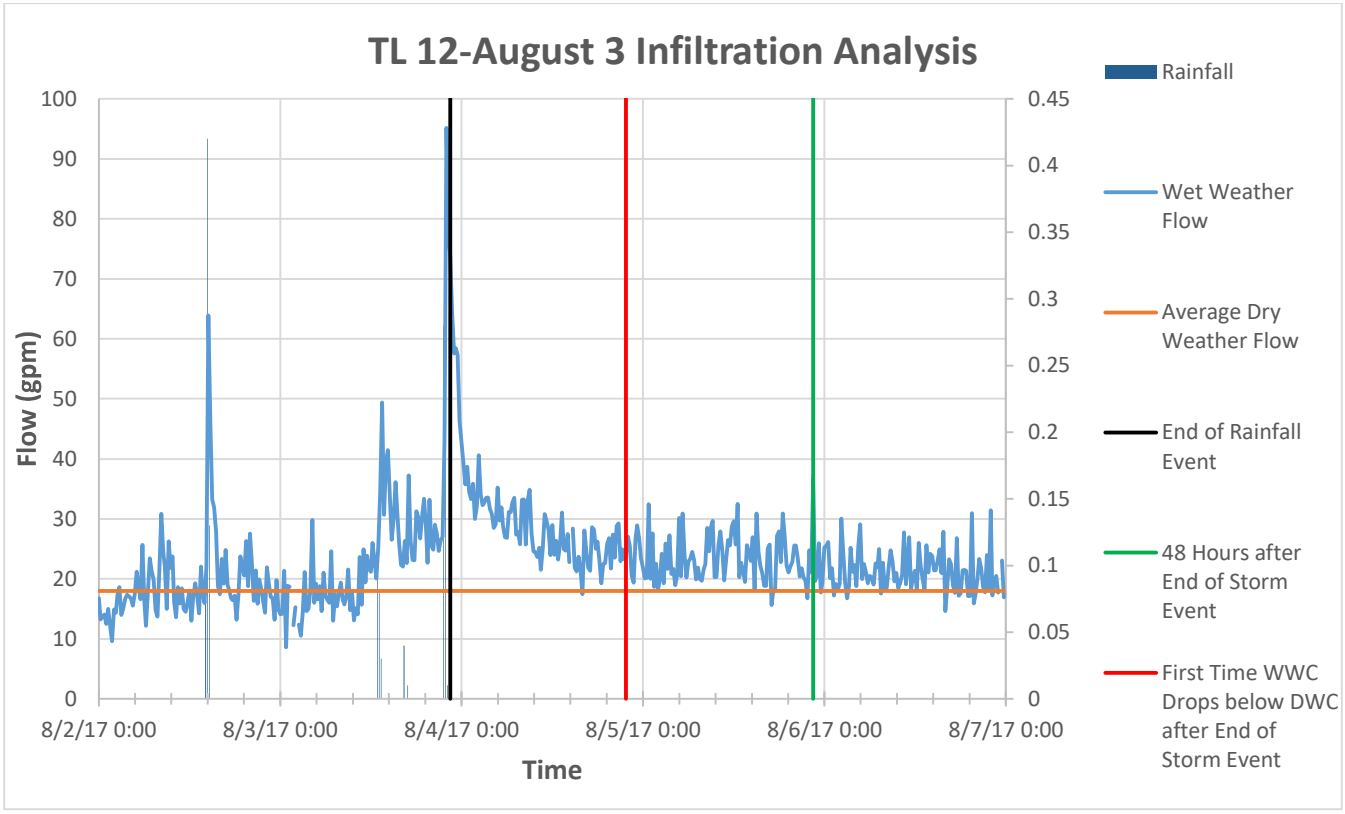

TL 10-October 14 Infiltration Analysis
Flow (gpm)
400
350
300
250
200
150
100
50
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

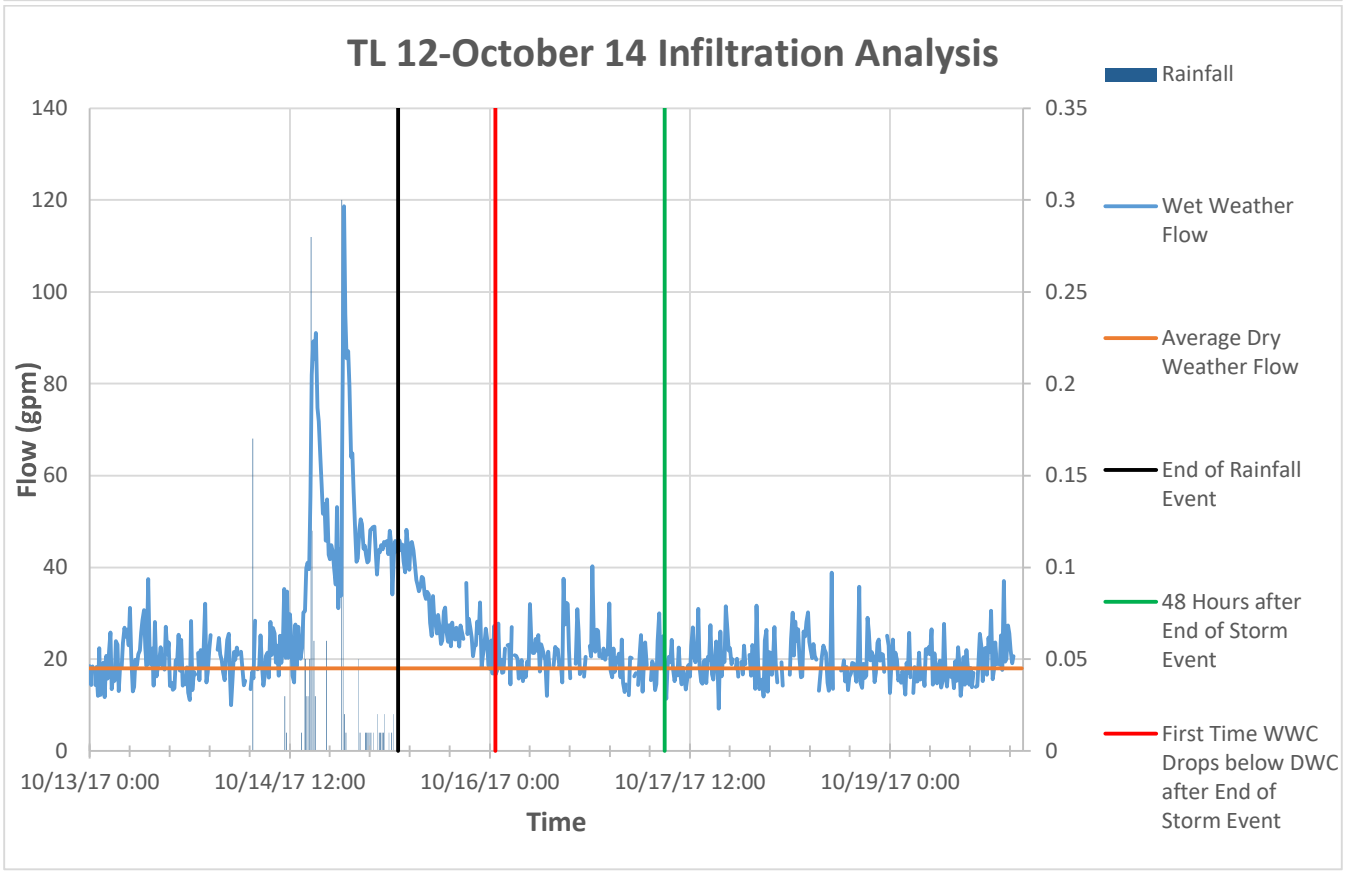

TL 11 - July 21 Infiltration Analysis
Flow (gpm)
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

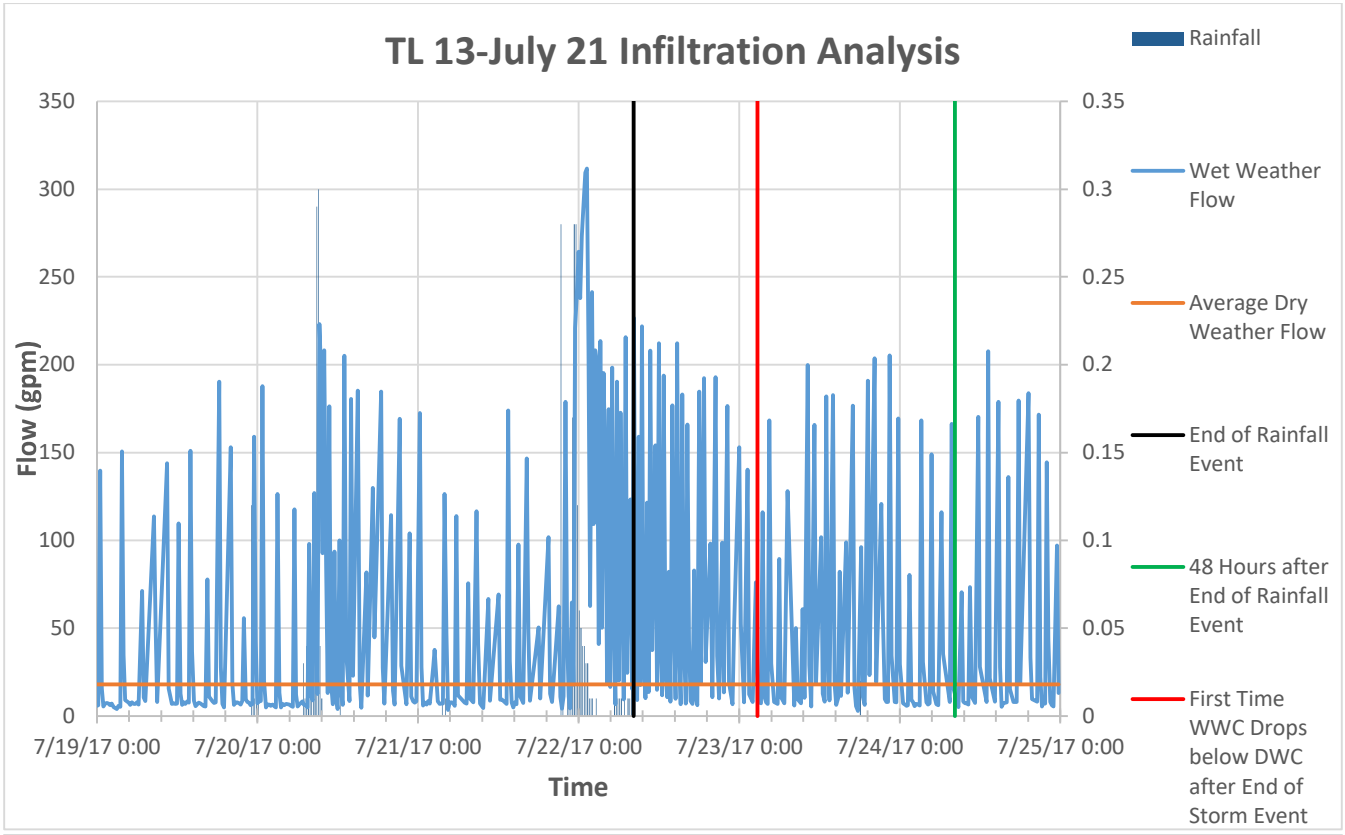

Meter 11 August 3 Infiltration Analysis
Flow (gpm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/2/17 12:00
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
Time
Rainfall
Wet Weather Flows
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

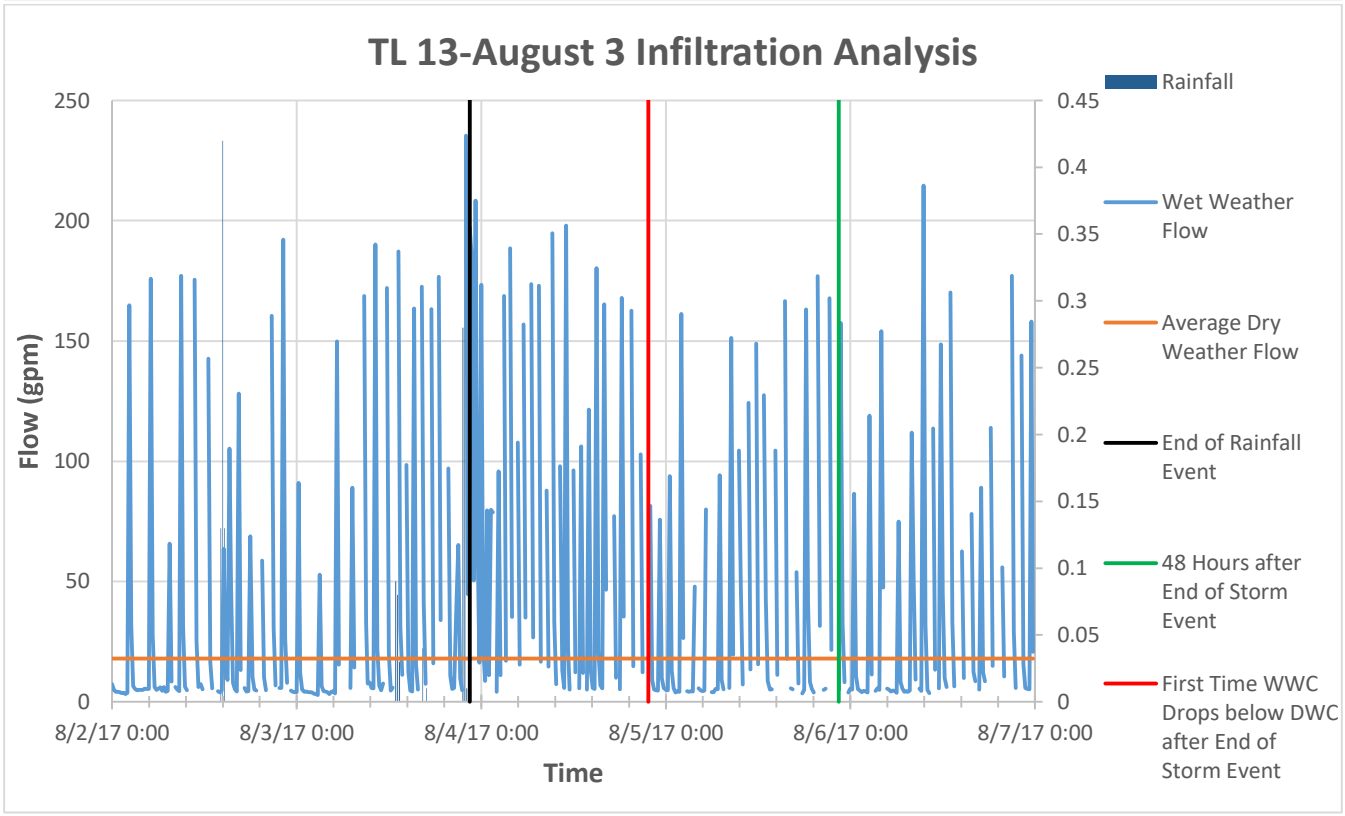

Meter 11 - October 14 Infiltration Analysis
Flow (gpm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Rainfall
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

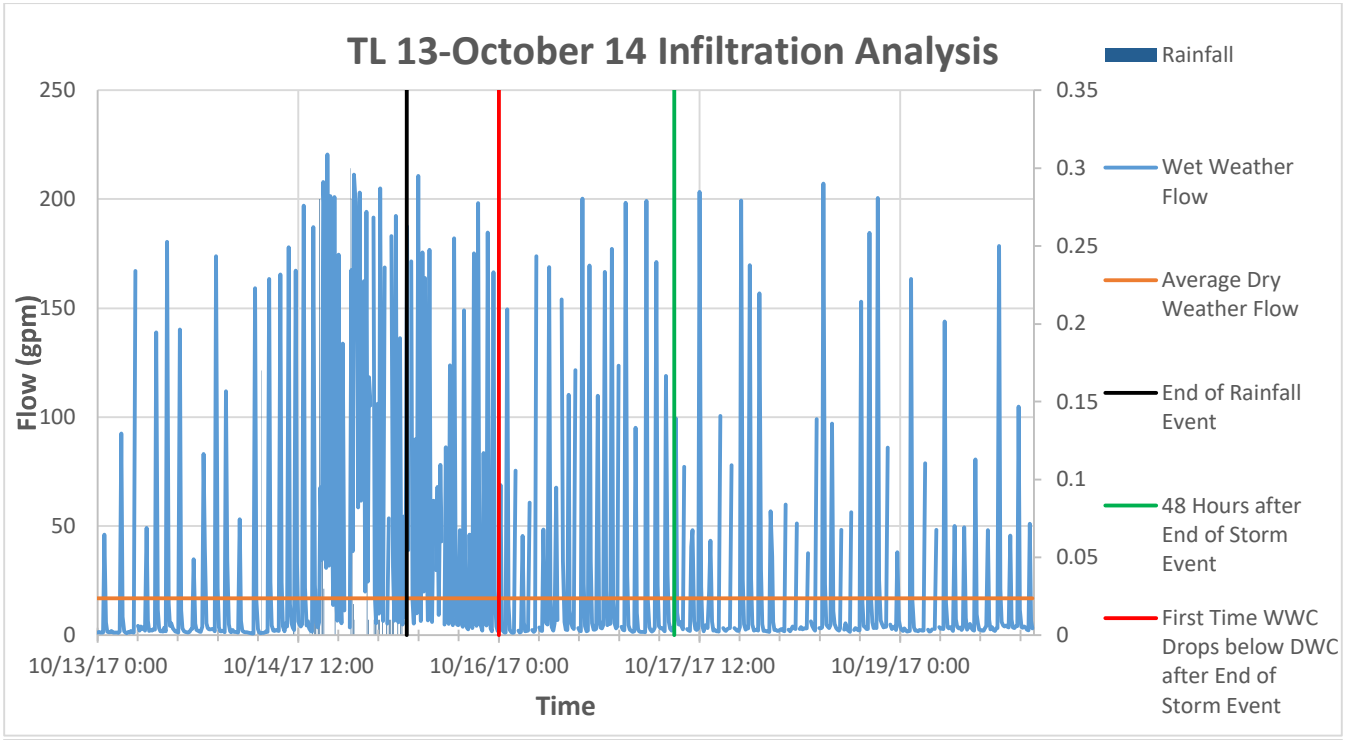

TL 12-July 21 Infiltration Analysis
Flow (gpm)
120
100
80
60
40
20
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event

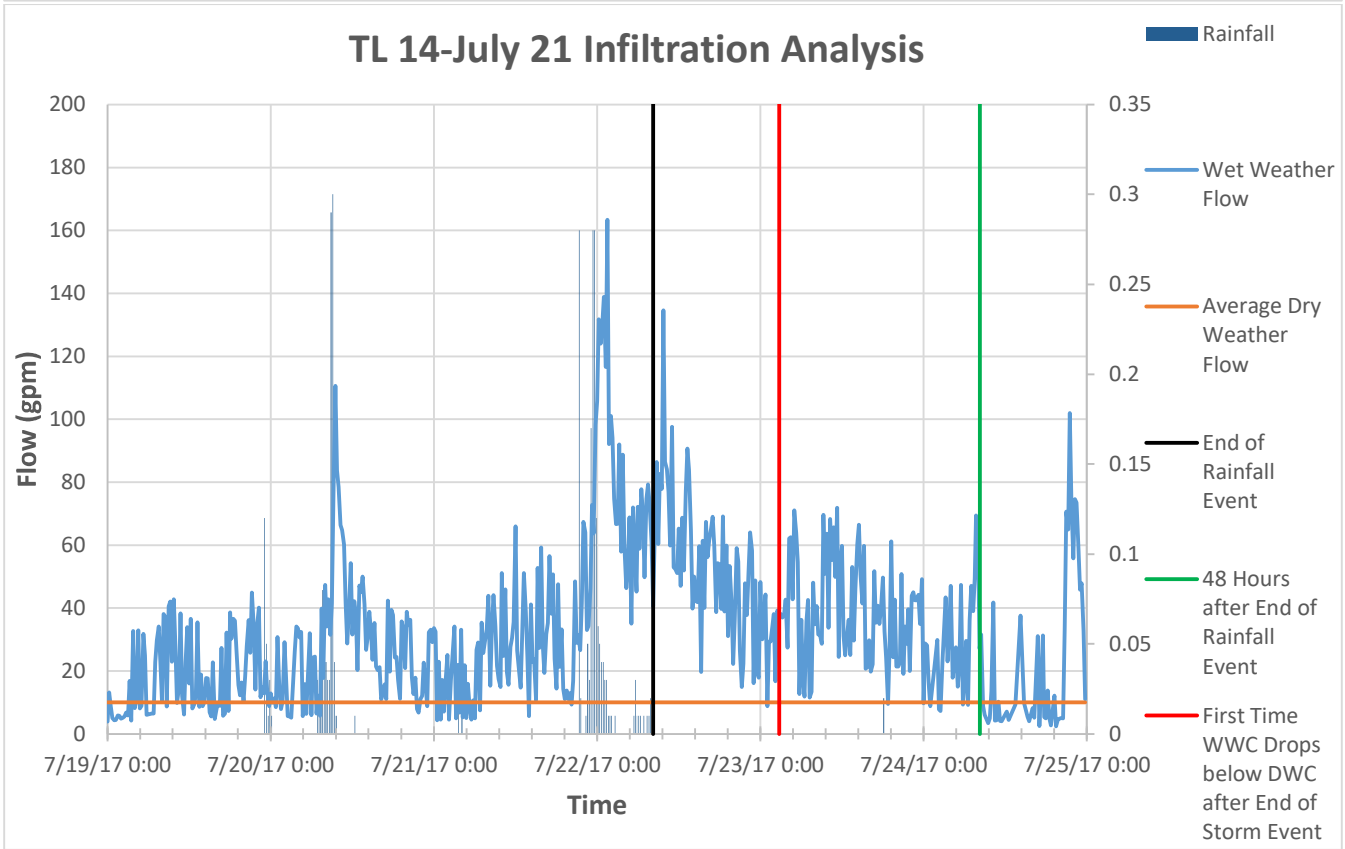

TL 12-August 3 Infiltration Analysis
Flow (gpm)
Time
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

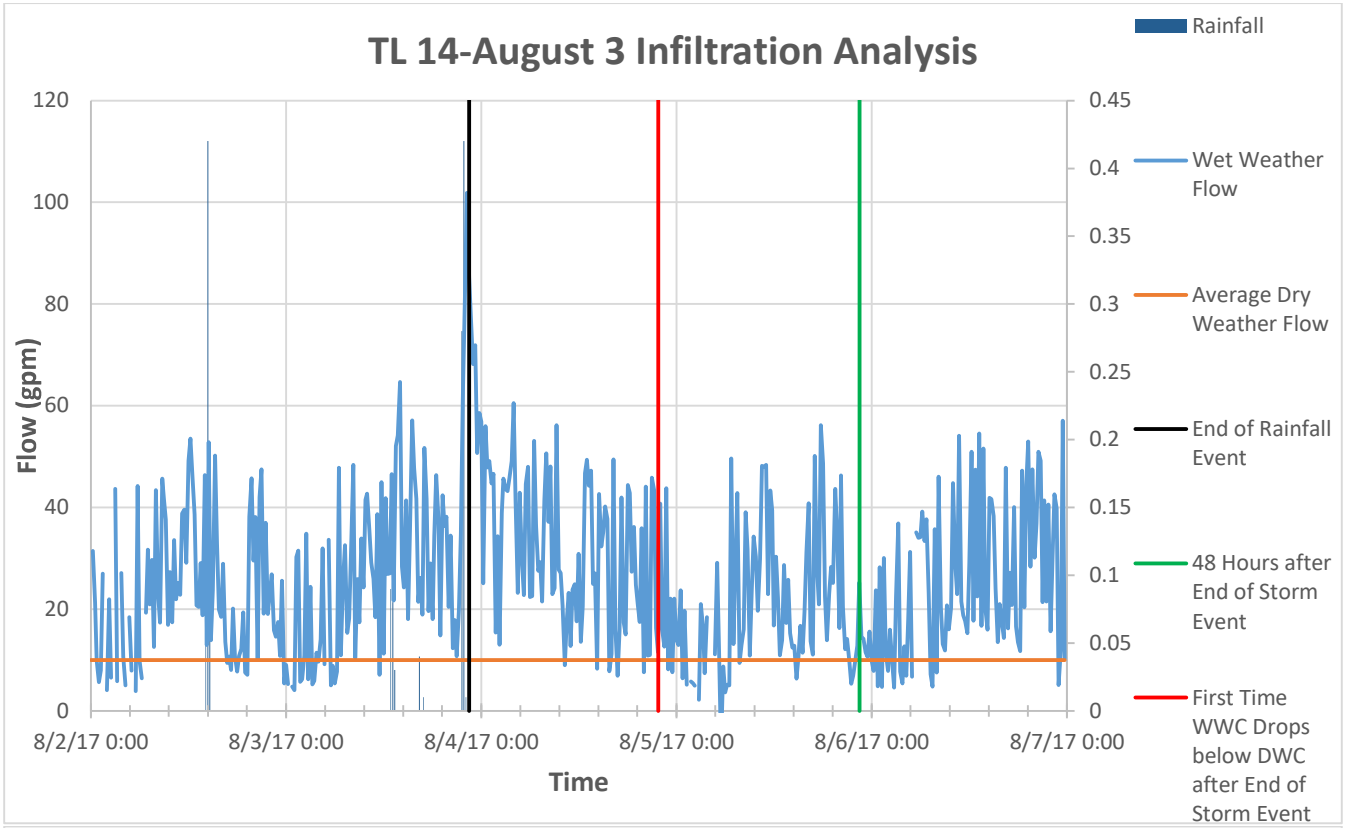

TL 12-October 14 Infiltration Analysis
Flow (gpm)
Time
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

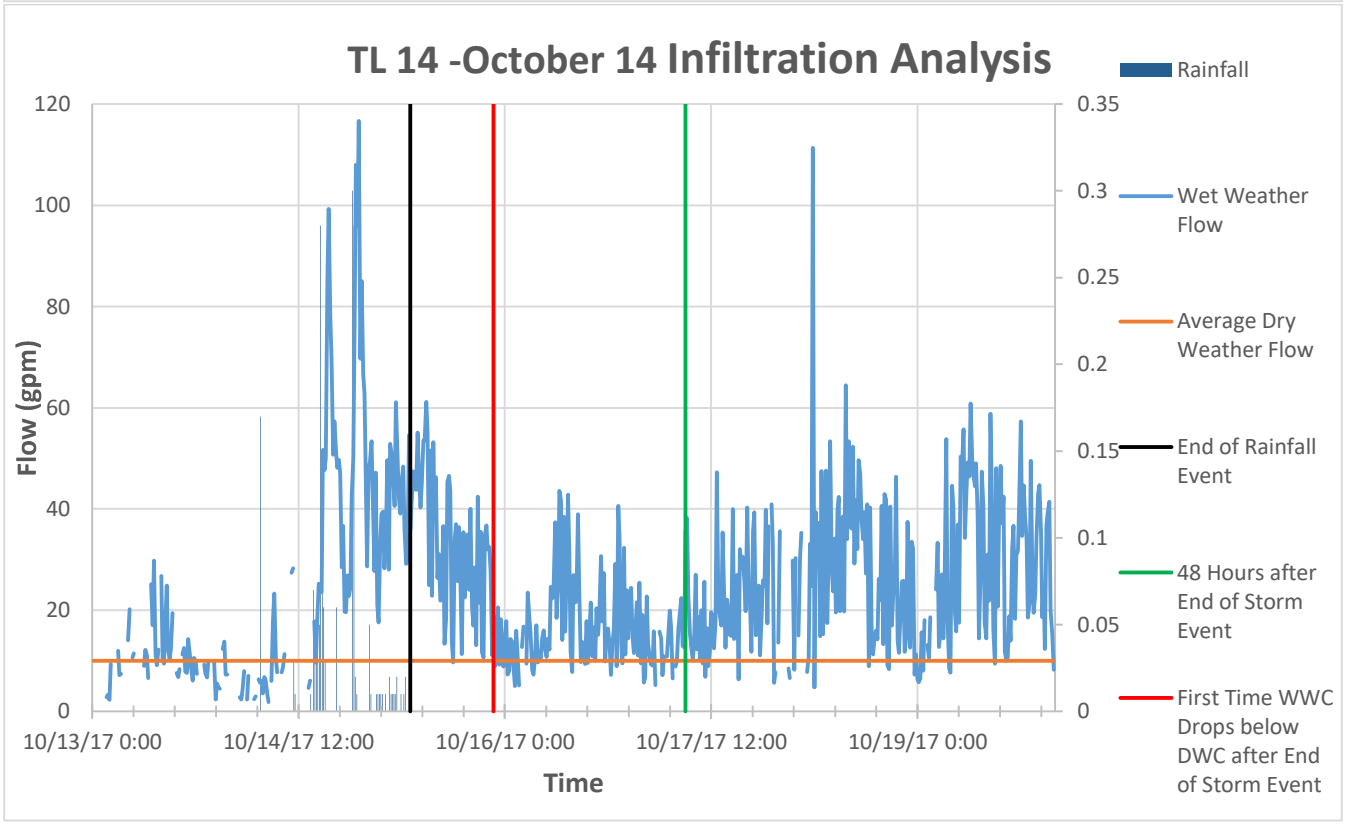

TL 13-July 21 Infiltration Analysis
Flow (gpm)
350
300
250
200
150
100
50
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event

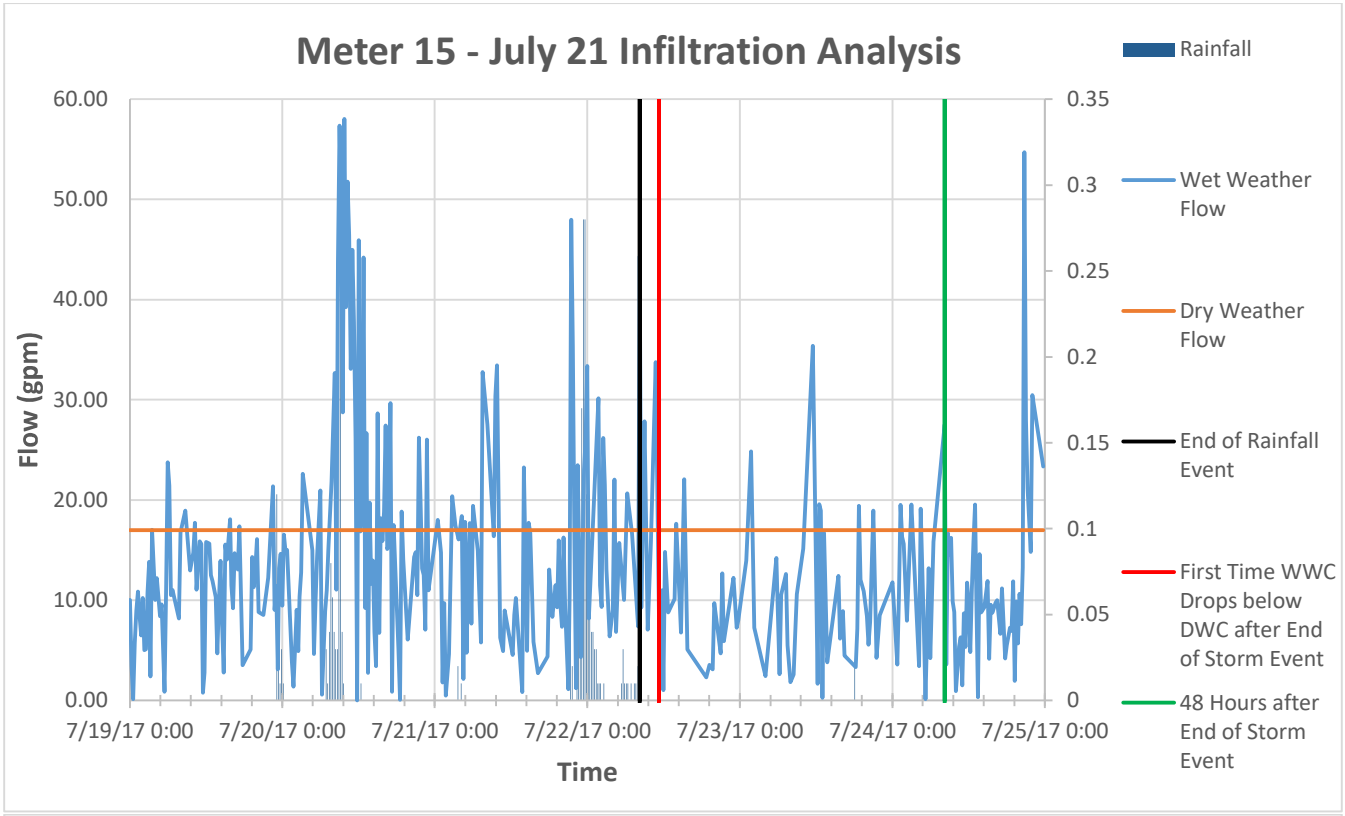

TL 13-August 3 Infiltration Analysis
Flow (gpm)
250
200
150
100
50
0
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

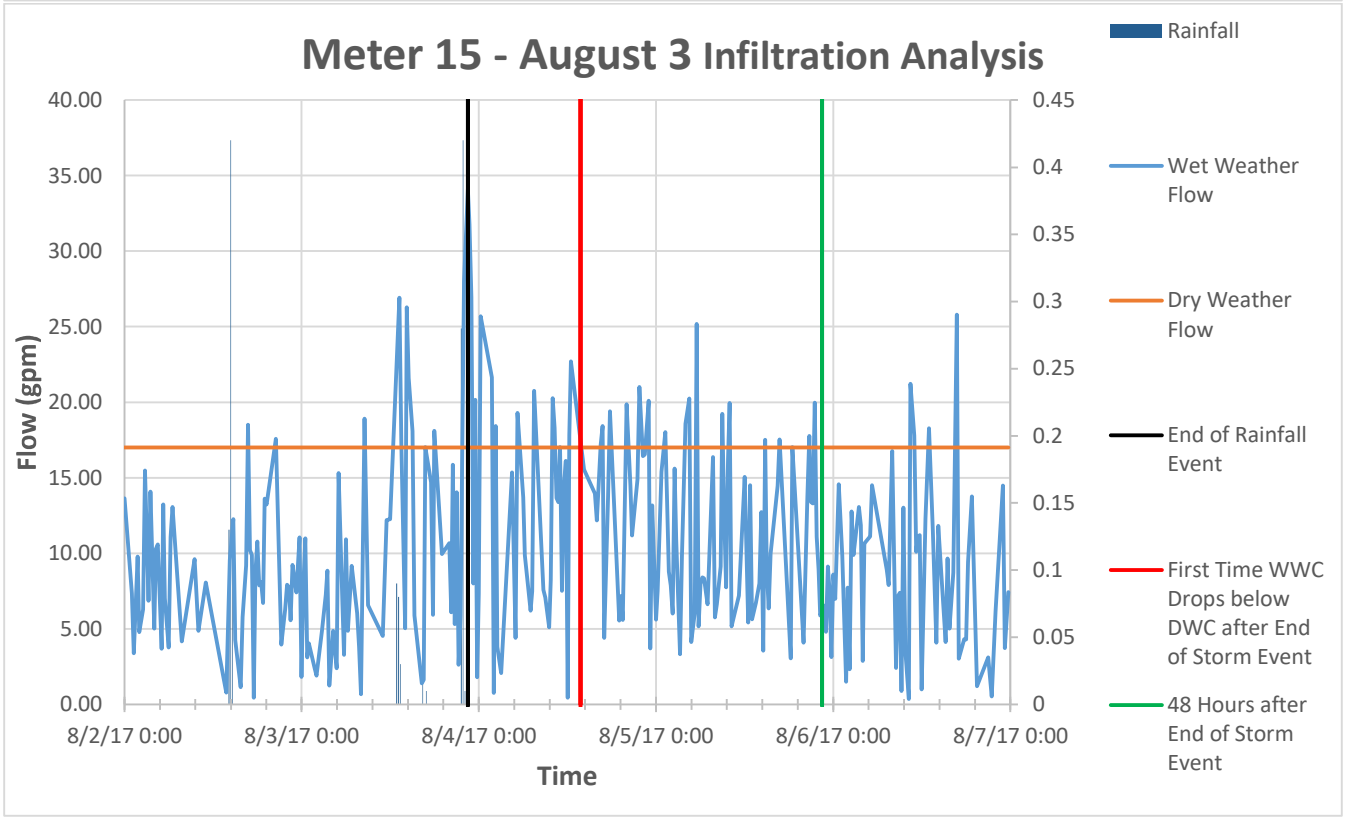

TL 13-October 14 Infiltration Analysis
Flow (gpm)
250
200
150
100
50
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

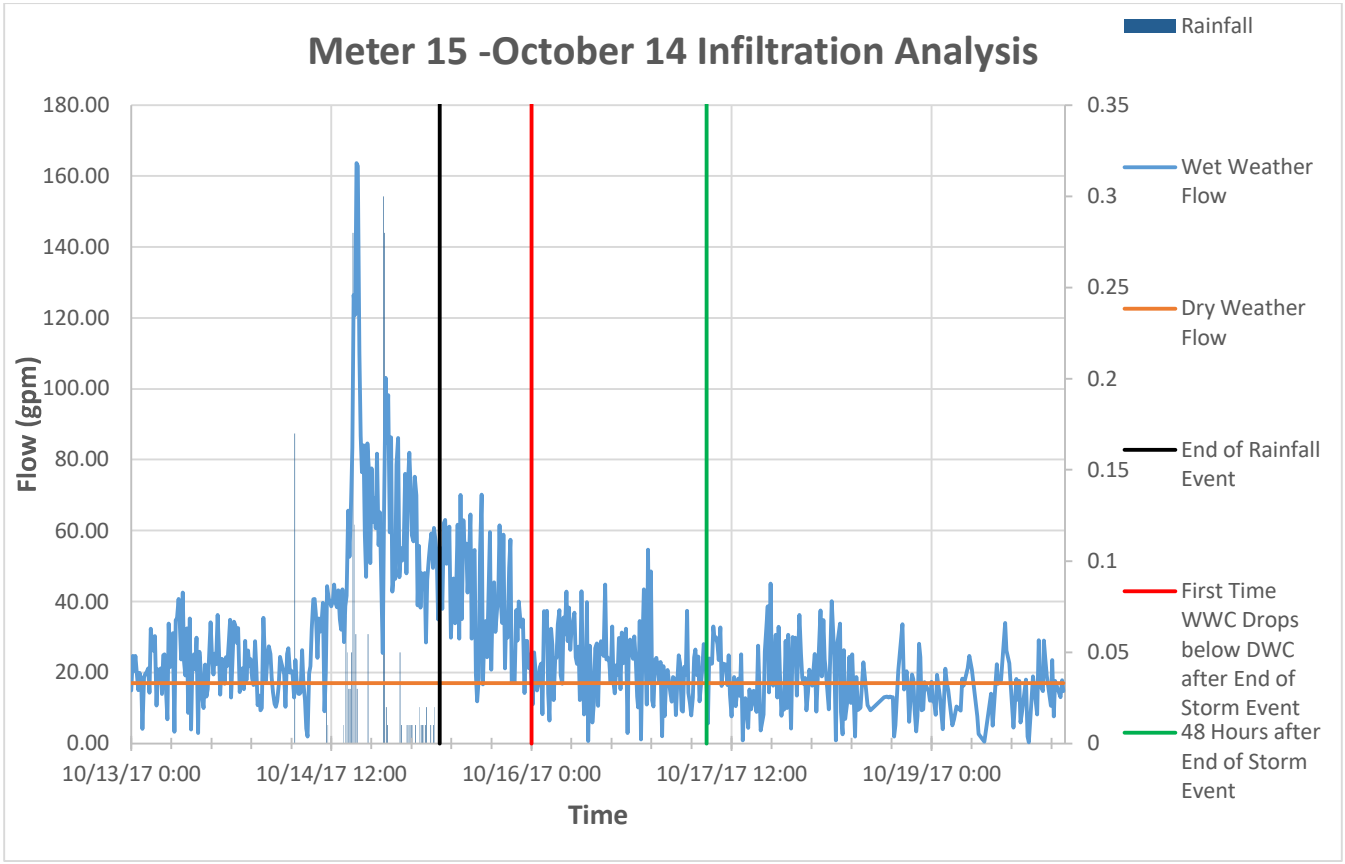

TL 14-July 21 Infiltration Analysis
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event

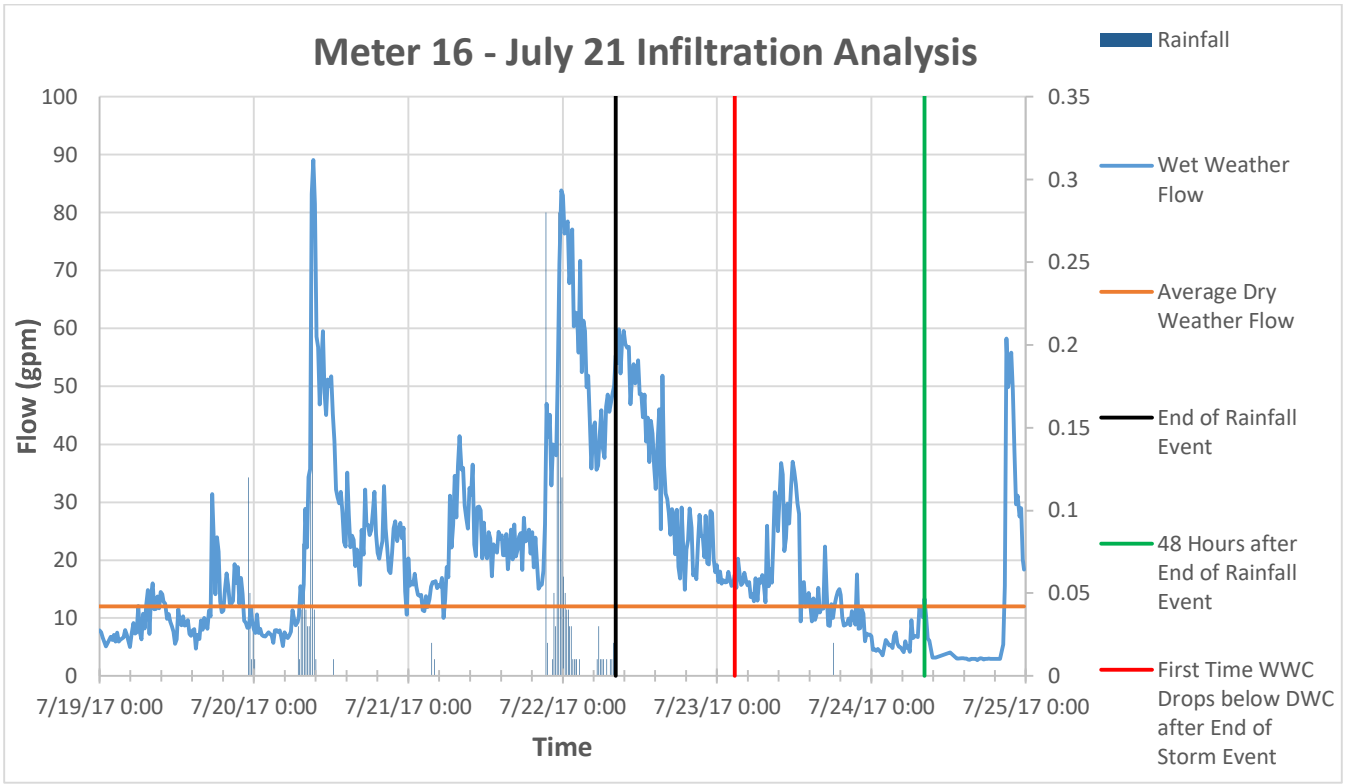

TL 14-August 3 Infiltration Analysis
Rainfall
Flow (gpm)
120
100
80
60
40
20
0
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

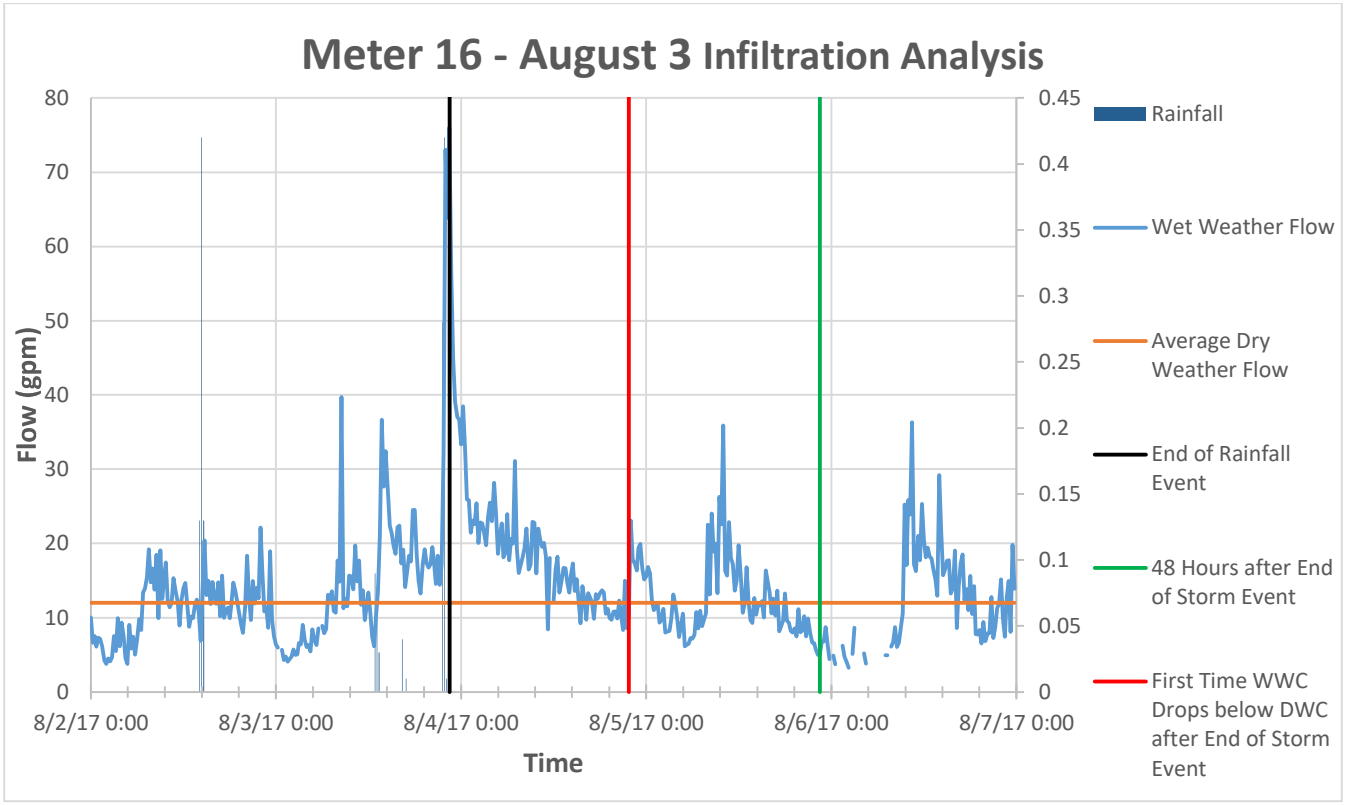

TL 14 -October 14 Infiltration Analysis
Rainfall
Flow (gpm)
120
100
80
60
40
20
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

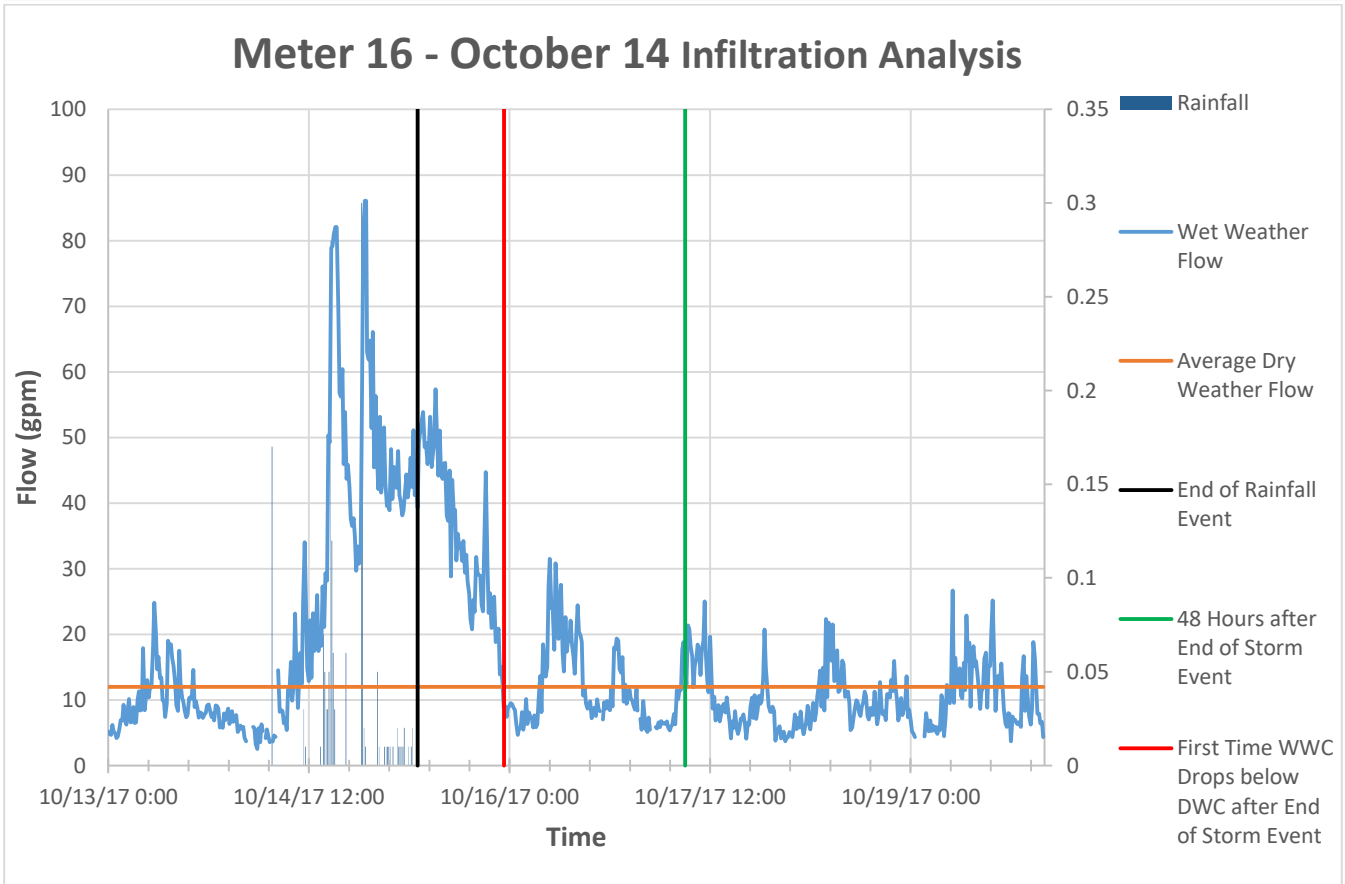

Meter 15 - July 21 Infiltration Analysis
Flow (gpm)
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

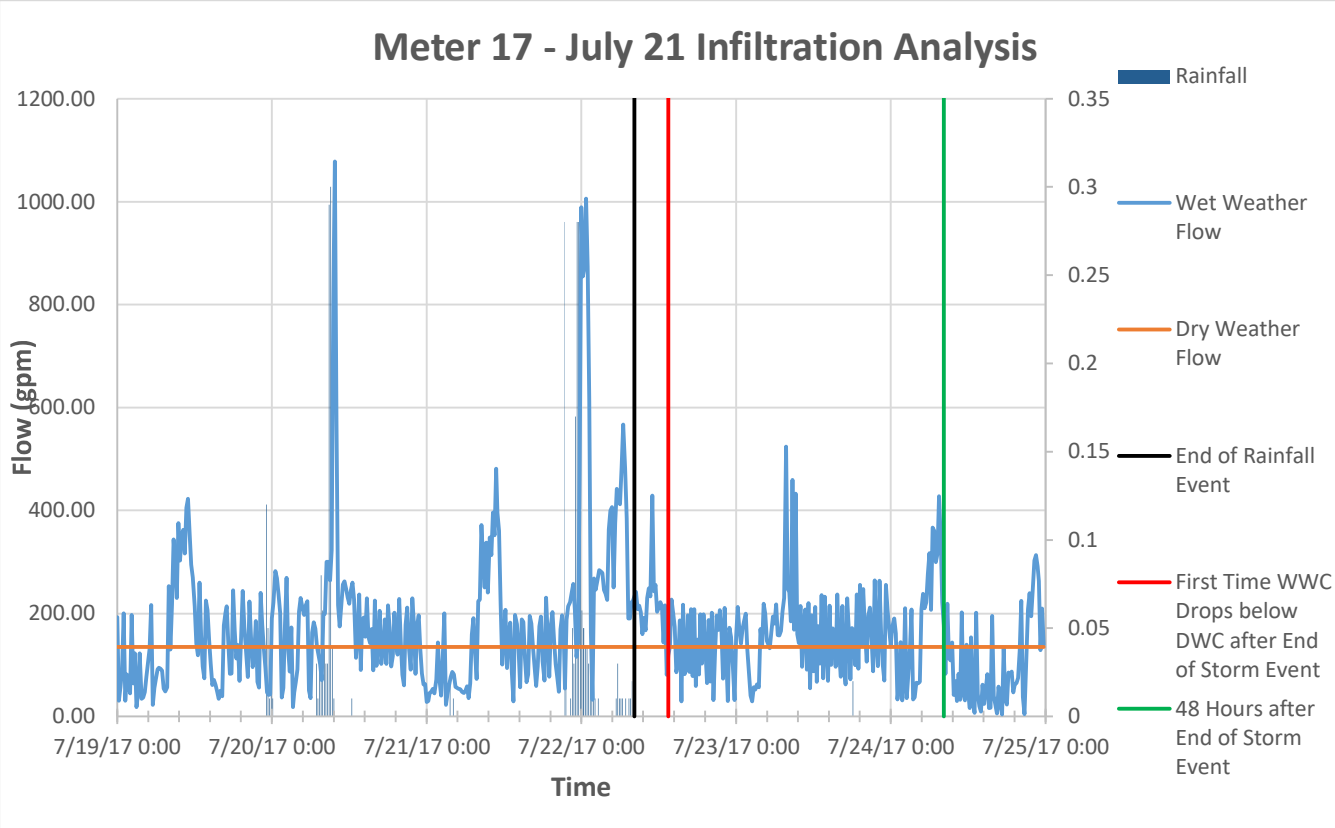

Meter 15 - August 3 Infiltration Analysis
Flow (gpm)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Rainfall
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

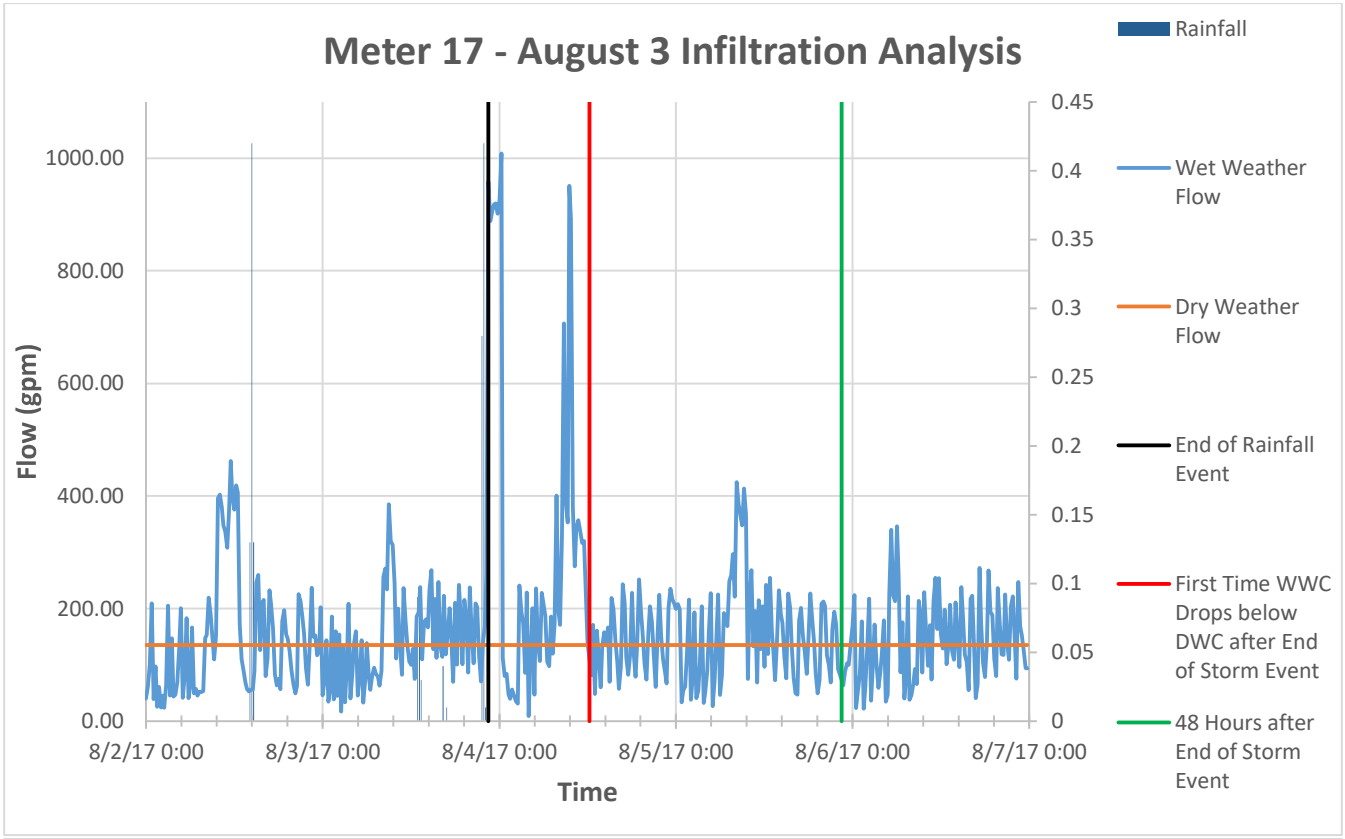

Meter 15 -October 14 Infiltration Analysis
Rainfall
Flow (gpm)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

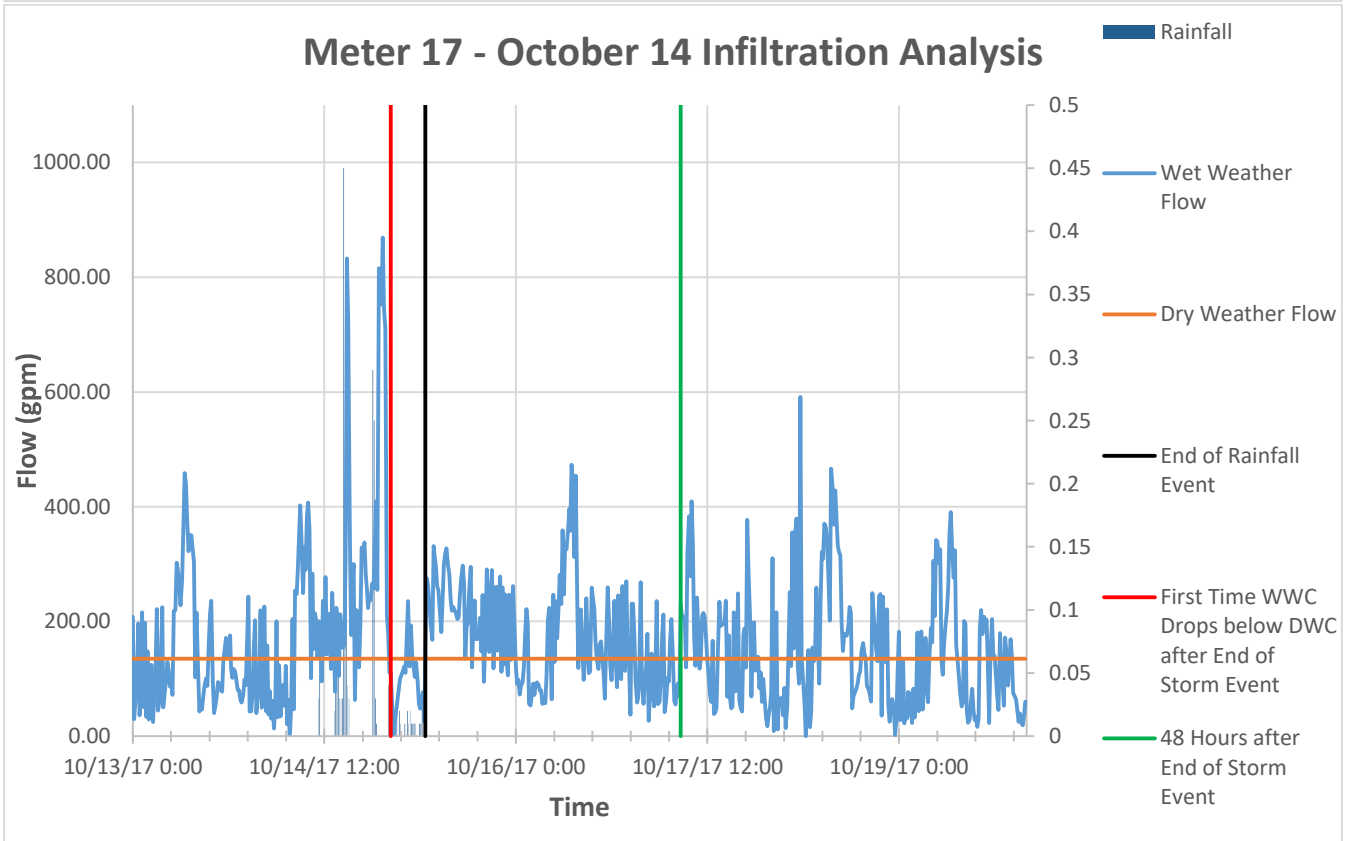

Meter 16 - July 21 Infiltration Analysis
Rainfall
Flow (gpm)
100
90
80
70
60
50
40
30
20
10
0
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event

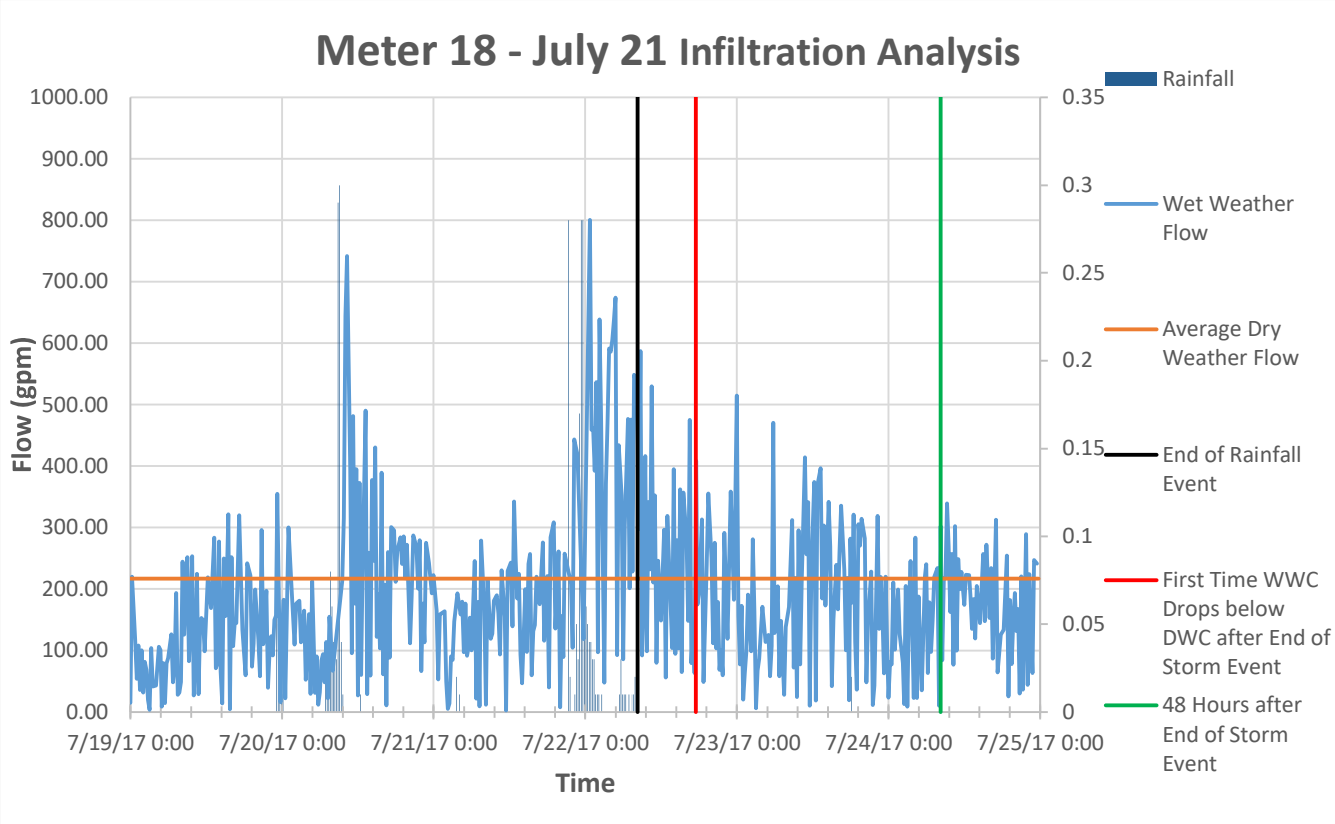

Meter 16 - August 3 Infiltration Analysis
Flow (gpm)
Time
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

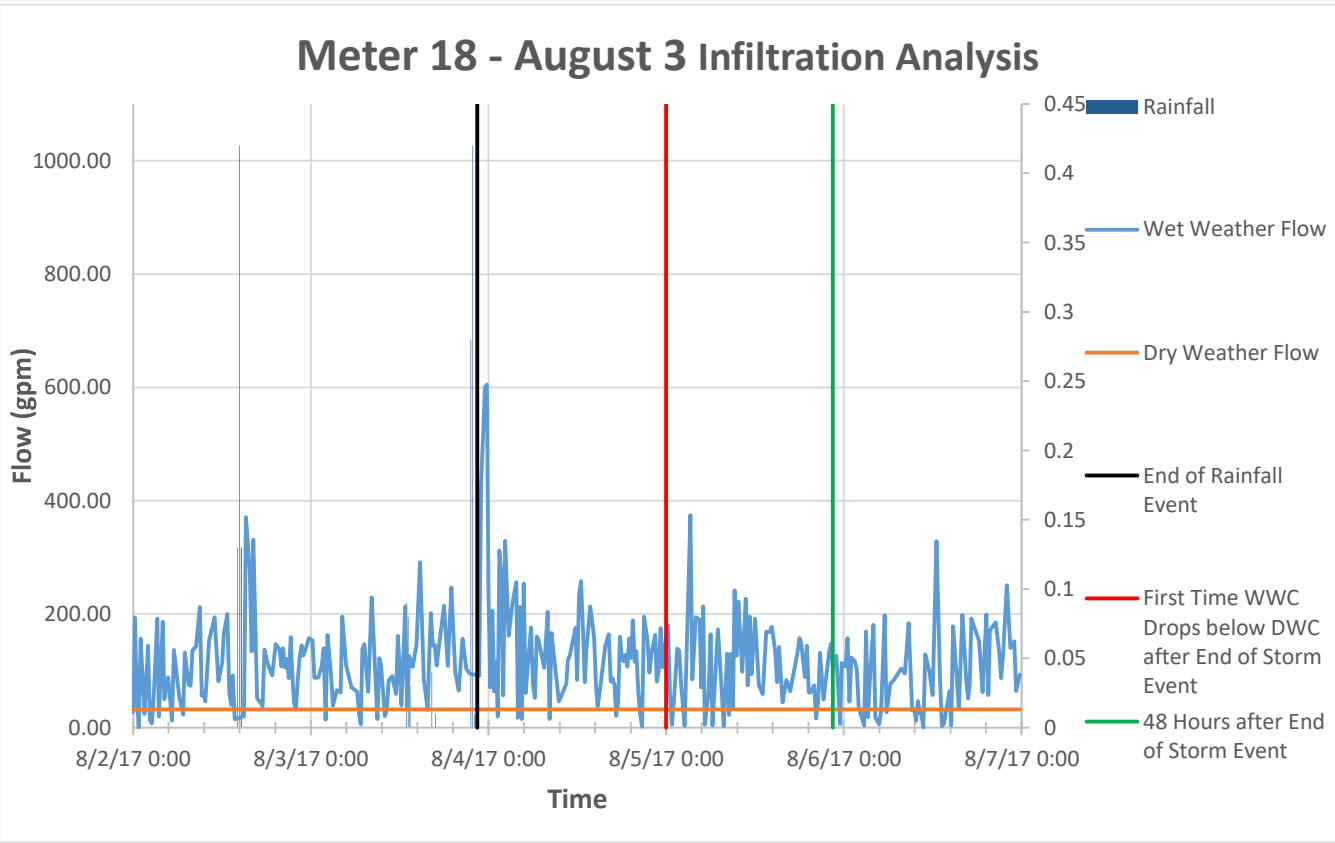

Meter 16 - October 14 Infiltration Analysis
Flow (gpm)
Time
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
48 Hours after End of Storm Event
First Time WWC Drops below DWC after End of Storm Event

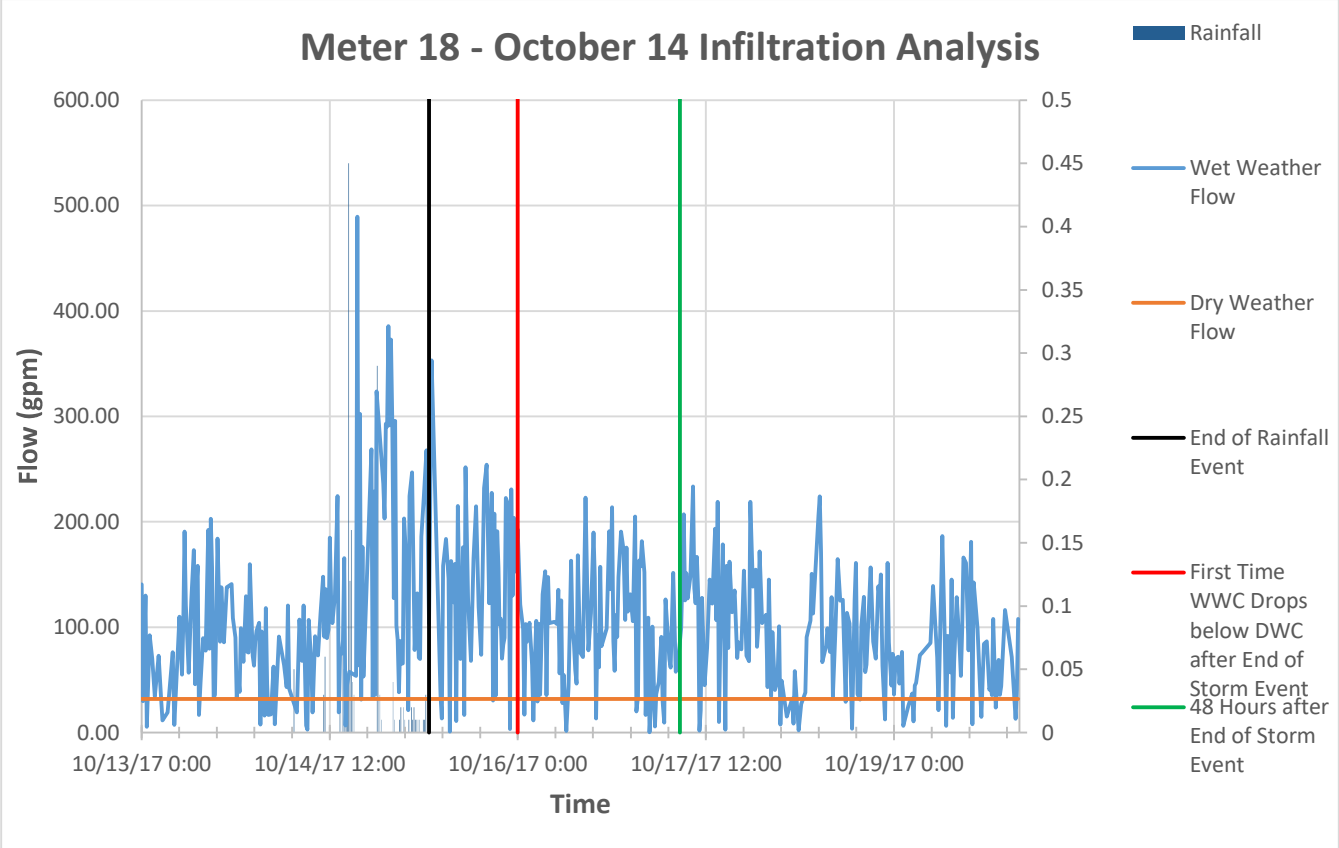

Meter 17 - July 21 Infiltration Analysis
Flow (gpm)
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event


Meter 17 - August 3 Infiltration Analysis
Rainfall
Flow (gpm)
1000.00
800.00
600.00
400.00
200.00
0.00
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

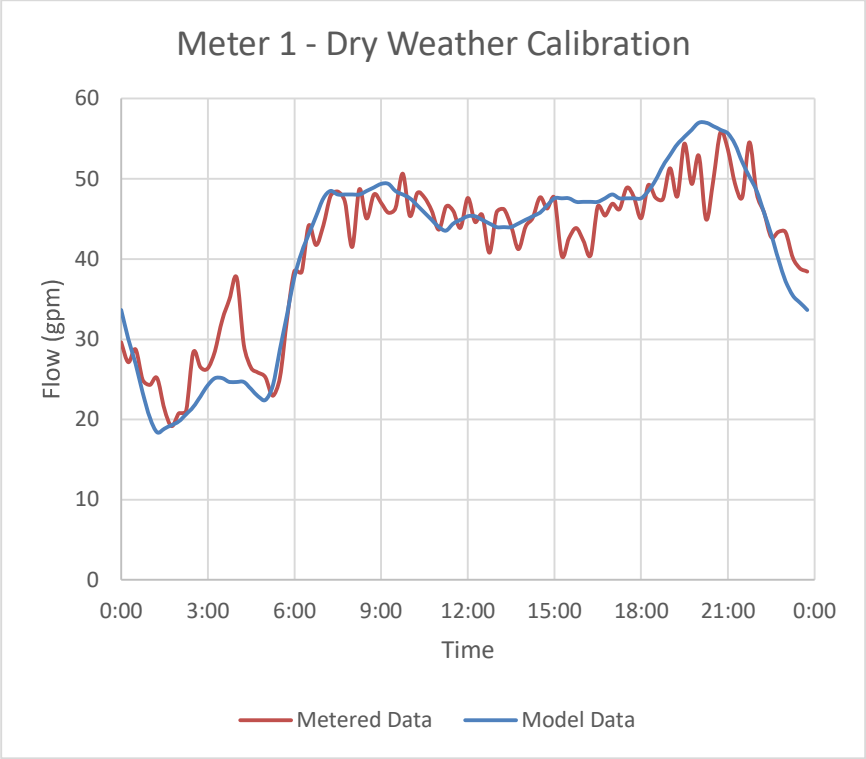

Meter 17 - October 14 Infiltration Analysis
Rainfall
Flow (gpm)
1000.00
800.00
600.00
400.00
200.00
0.00
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

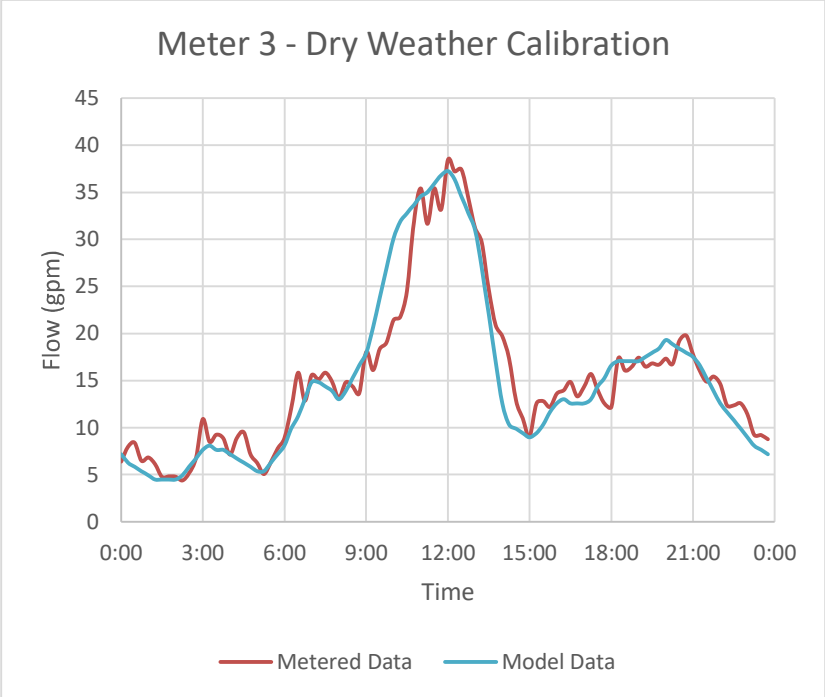

Meter 18 - July 21 Infiltration Analysis
Flow (gpm)
1000.00
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
7/19/17 0:00
7/20/17 0:00
7/21/17 0:00
7/22/17 0:00
7/23/17 0:00
7/24/17 0:00
7/25/17 0:00
Time
Rainfall
Wet Weather Flow
Average Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

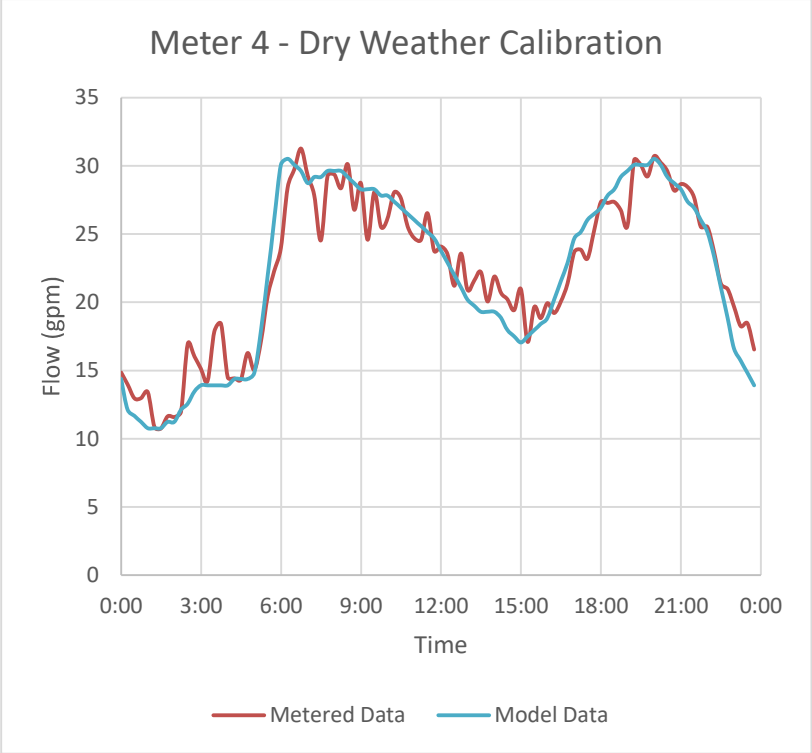

Meter 18 - August 3 Infiltration Analysis
Flow (gpm)
1000.00
800.00
600.00
400.00
200.00
0.00
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
8/2/17 0:00
8/3/17 0:00
8/4/17 0:00
8/5/17 0:00
8/6/17 0:00
8/7/17 0:00
Time
Rainfall
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

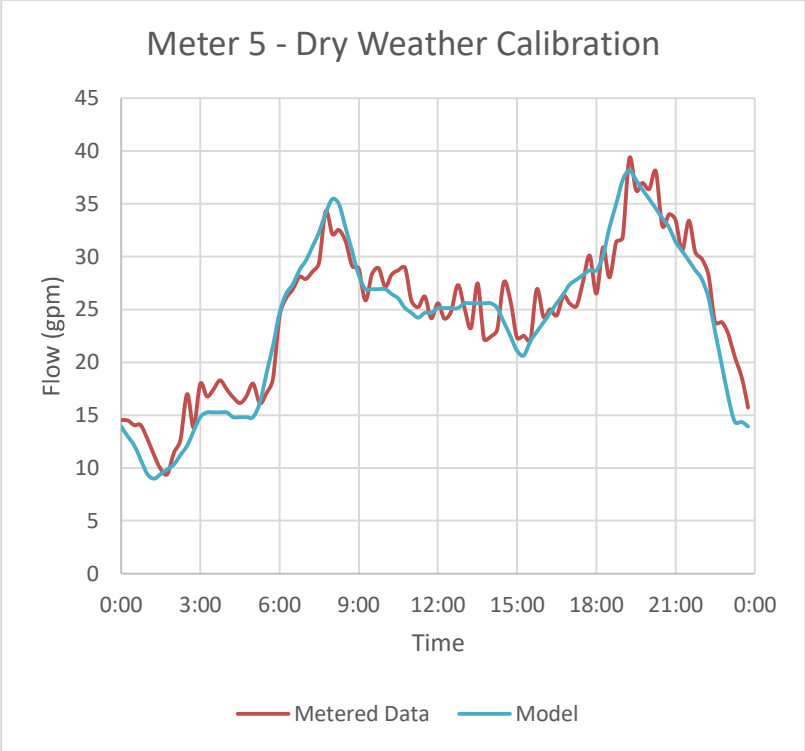

Meter 18 - October 14 Infiltration Analysis
Flow (gpm)
600.00
500.00
400.00
300.00
200.00
100.00
0.00
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/13/17 0:00
10/14/17 12:00
10/16/17 0:00
10/17/17 12:00
10/19/17 0:00
Time
Rainfall
Wet Weather Flow
Dry Weather Flow
End of Rainfall Event
First Time WWC Drops below DWC after End of Storm Event
48 Hours after End of Storm Event

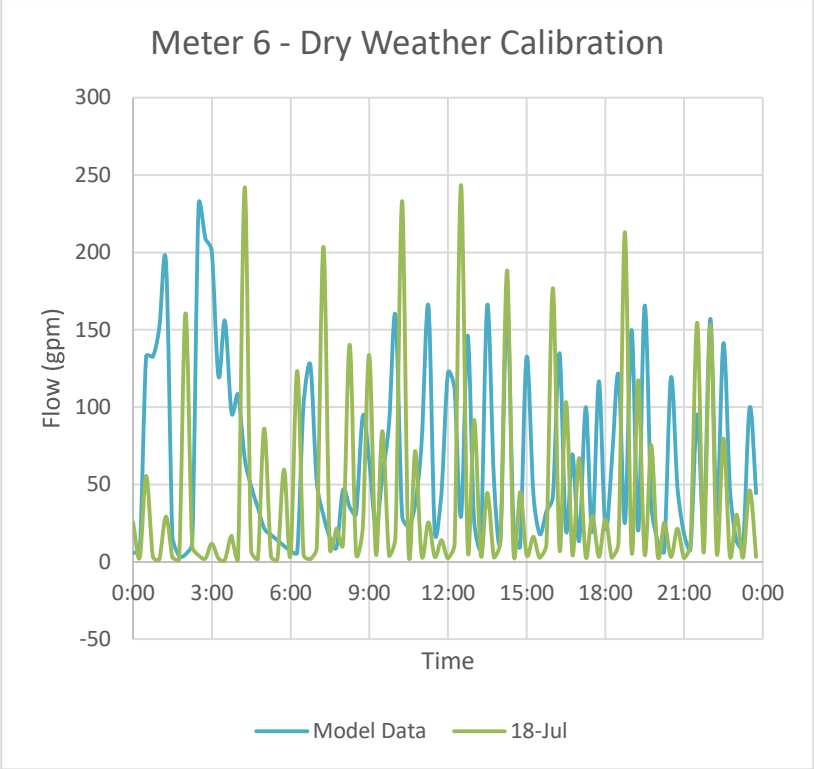
APPENDIX B
DRY WEATHER CALIBRATION GRAPHS

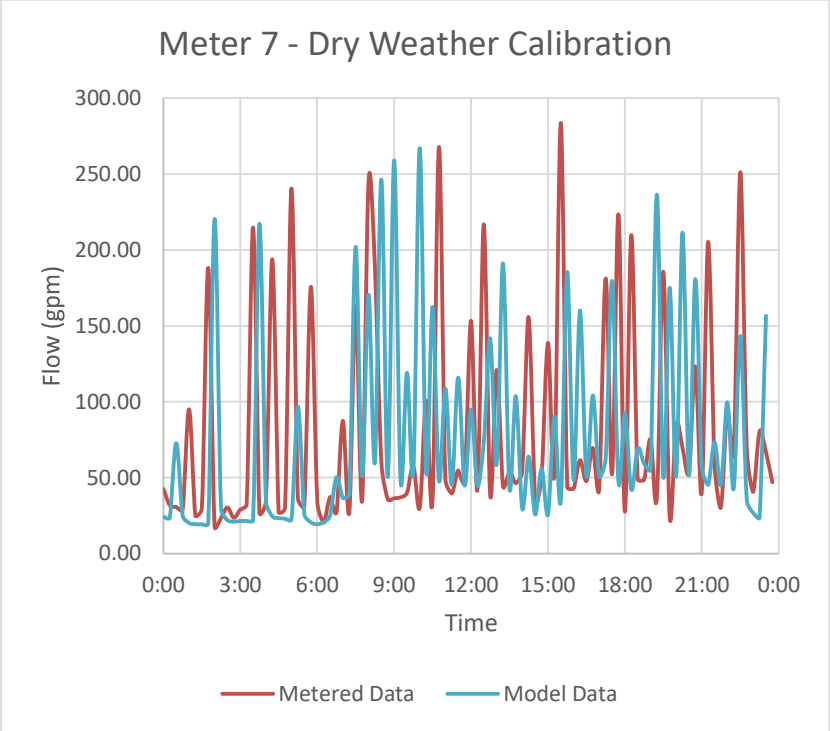

Meter 1 - Dry Weather Calibration
Flow (gpm)
60
50
40
30
20
10
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

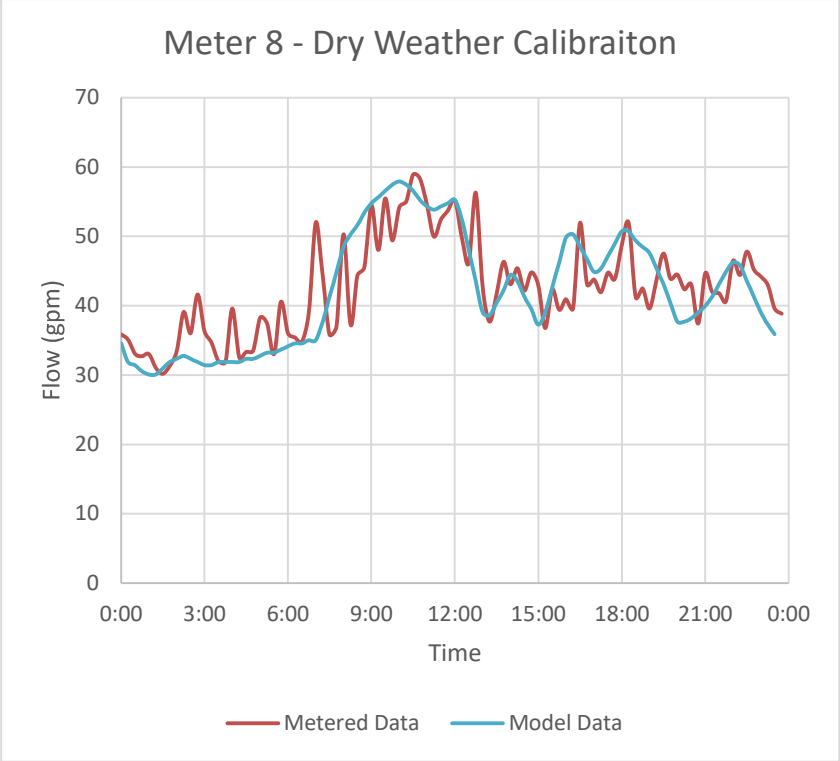

Meter 3 - Dry Weather Calibration
Flow (gpm)
45
40
35
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

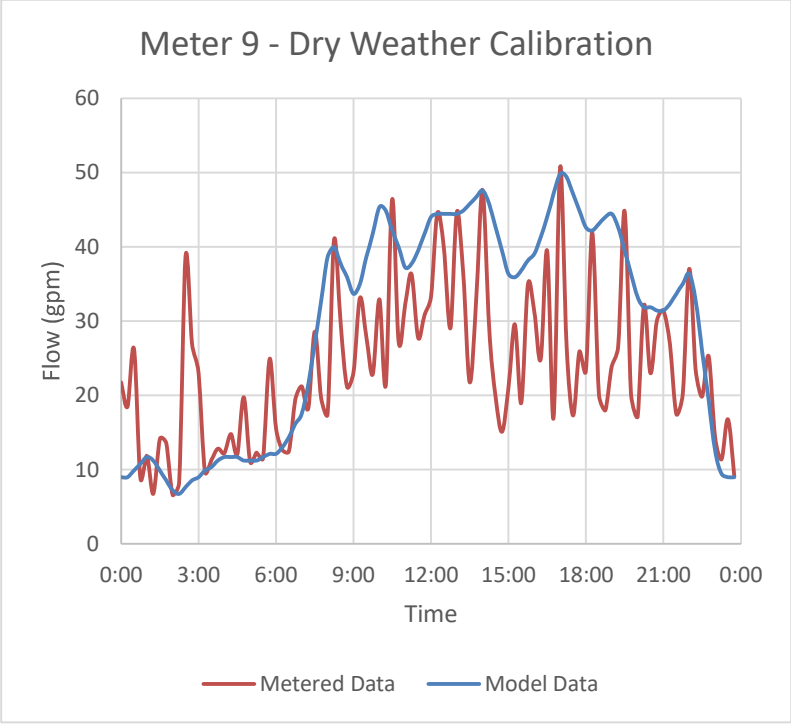

Meter 4 - Dry Weather Calibration
Flow (gpm)
35
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

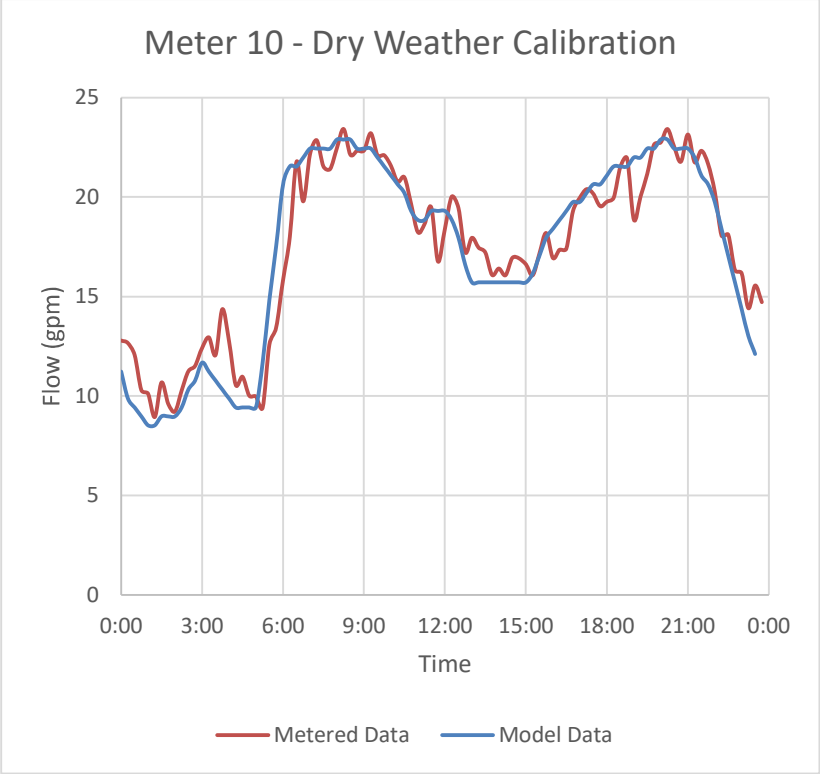

Meter 5 - Dry Weather Calibration
Flow (gpm)
45
40
35
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model

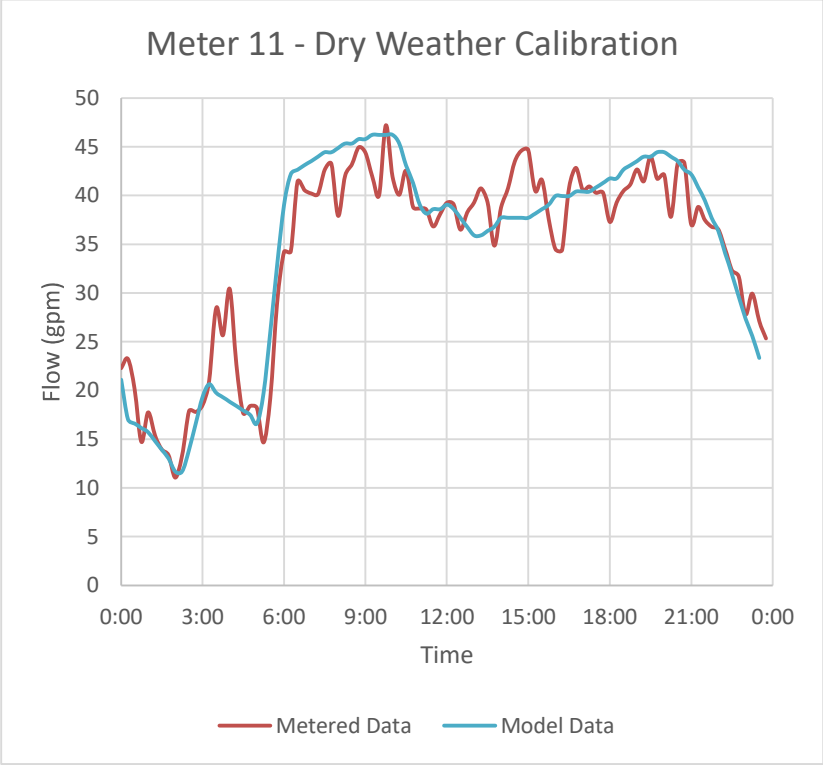

Meter 6 - Dry Weather Calibration
300
250
200
150
100
50
0
-50
Flow (gpm)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Model Data
18-Jul

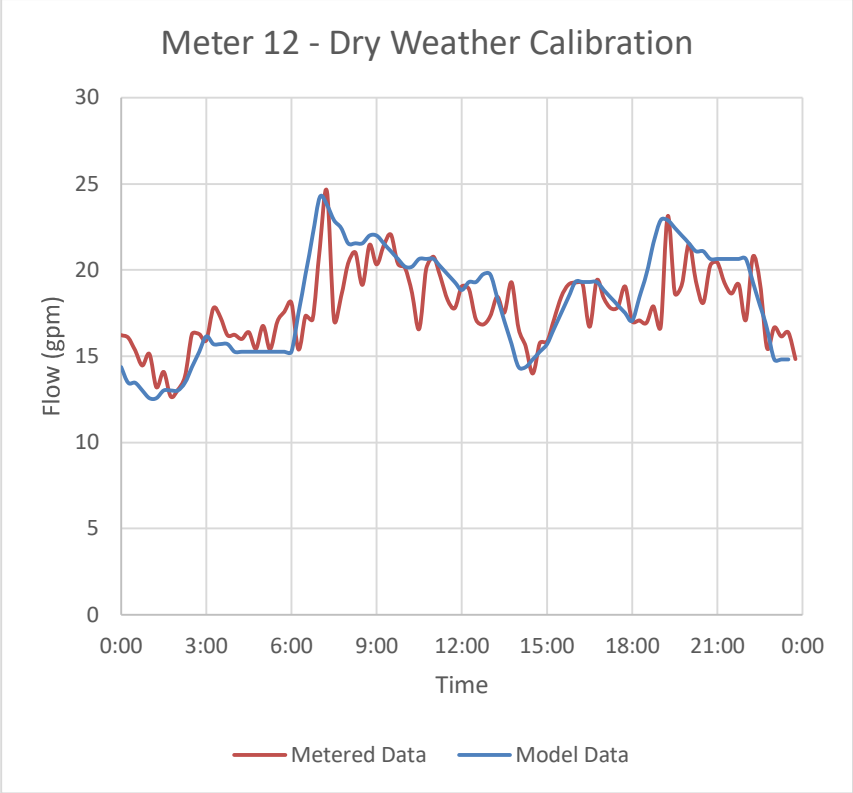

Meter 7 - Dry Weather Calibration
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Flow (gpm)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

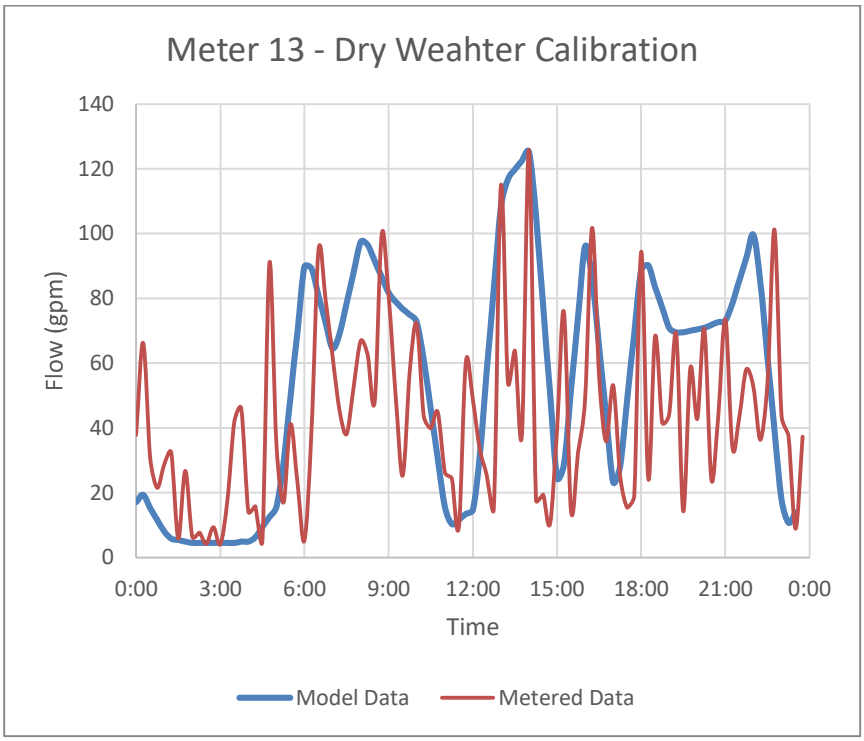

Meter 8 - Dry Weather Calibraiton
Flow (gpm)
70
60
50
40
30
20
10
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

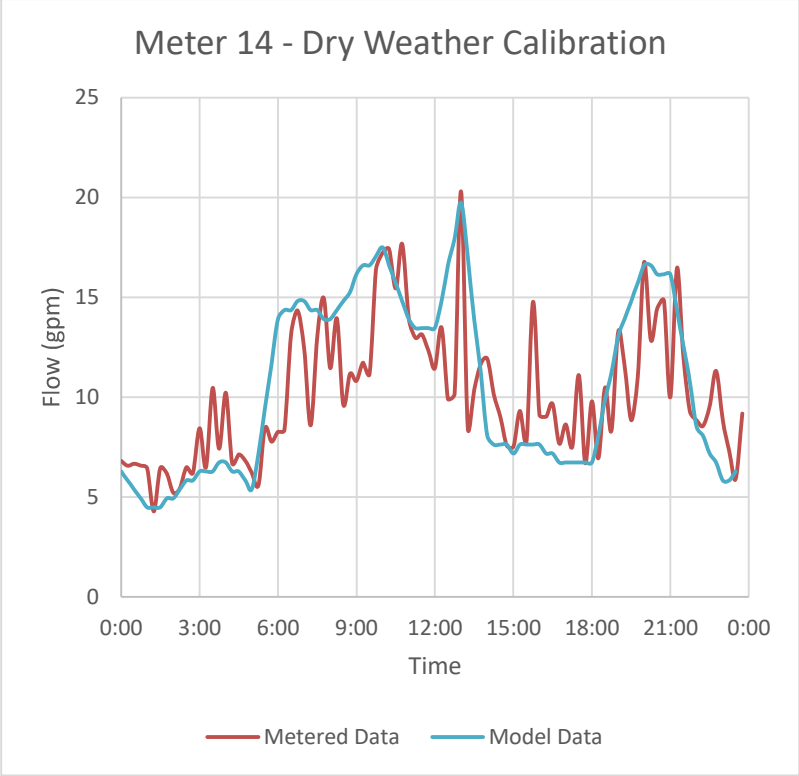

Meter 9 - Dry Weather Calibration
Flow (gpm)
60
50
40
30
20
10
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

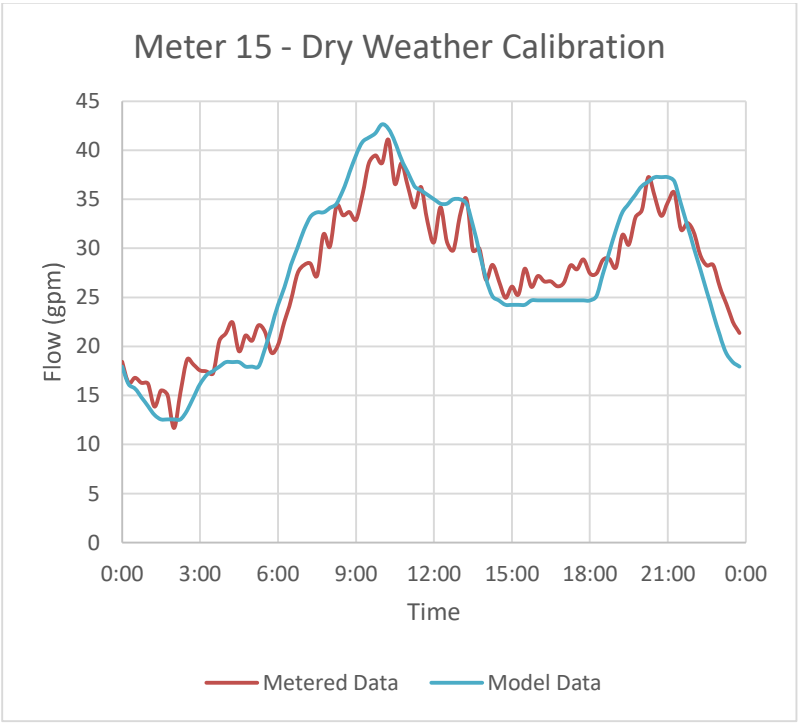

Meter 10 - Dry Weather Calibration
Flow (gpm)
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

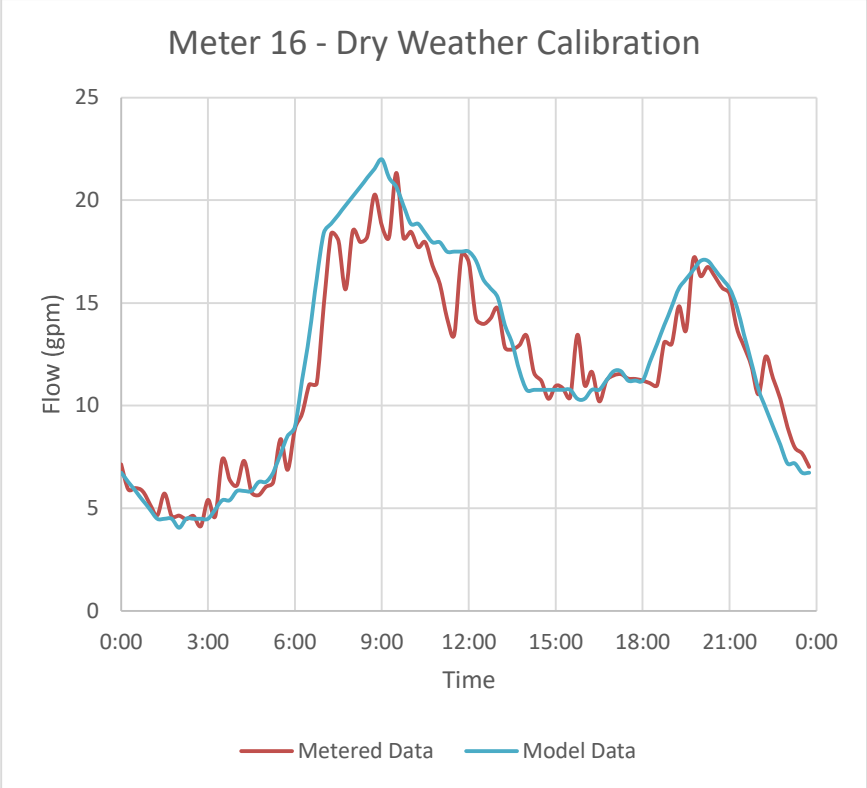

Meter 11 - Dry Weather Calibration
Flow (gpm)
50
45
40
35
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

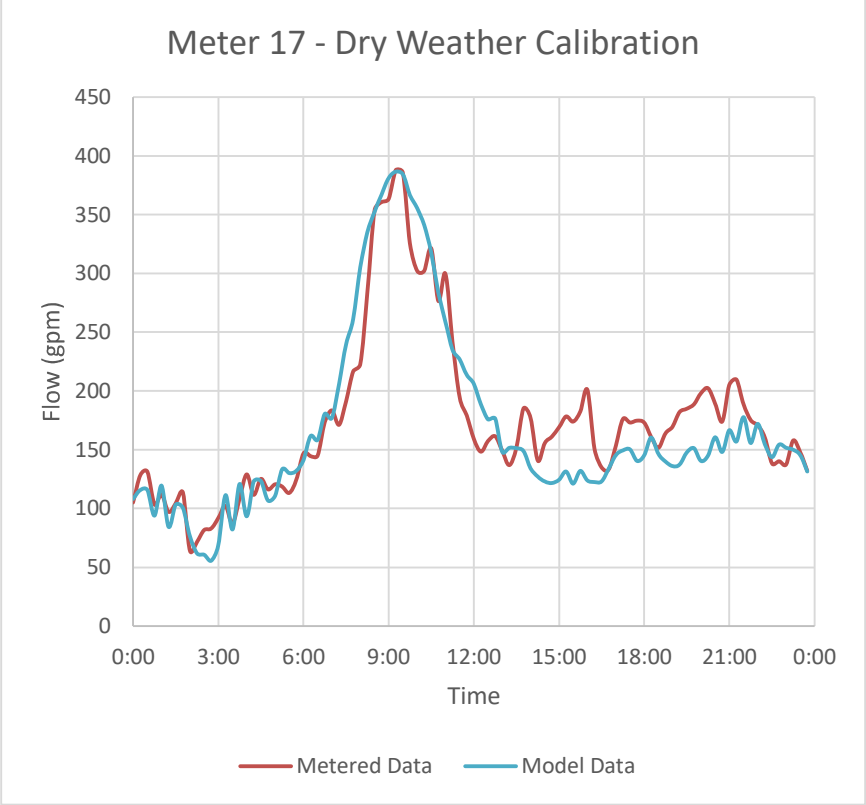

Meter 12 - Dry Weather Calibration
Flow (gpm)
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

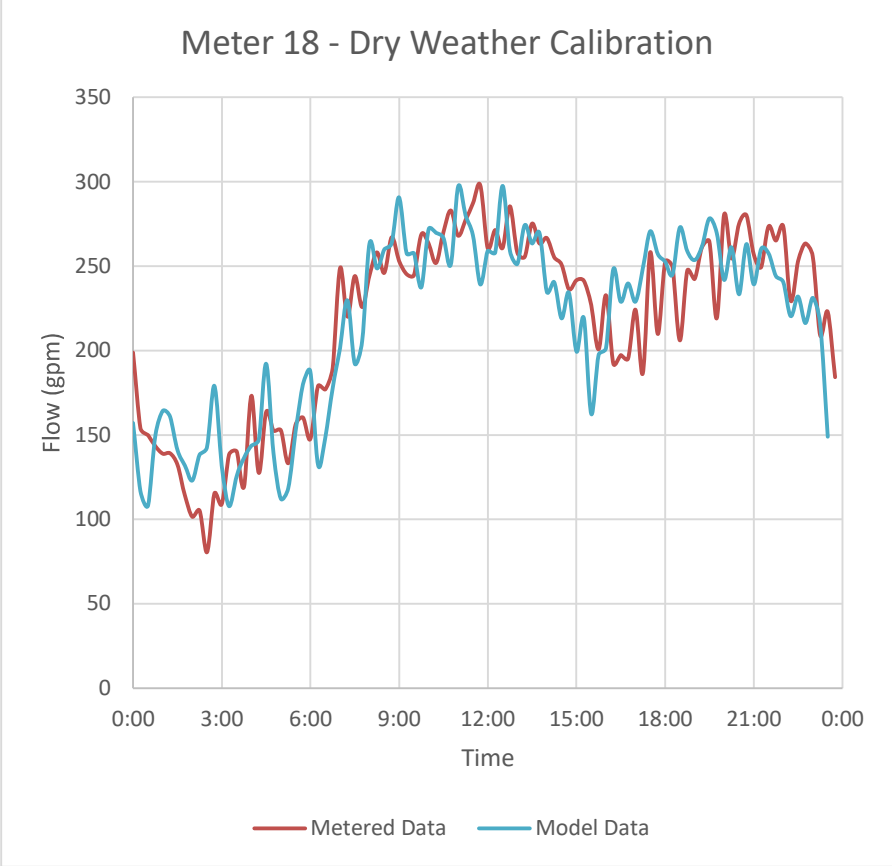

Meter 13 - Dry Weahter Calibration
Flow (gpm)
140
120
100
80
60
40
20
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Model Data
Metered Data


Meter 14 - Dry Weather Calibration
Flow (gpm)
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

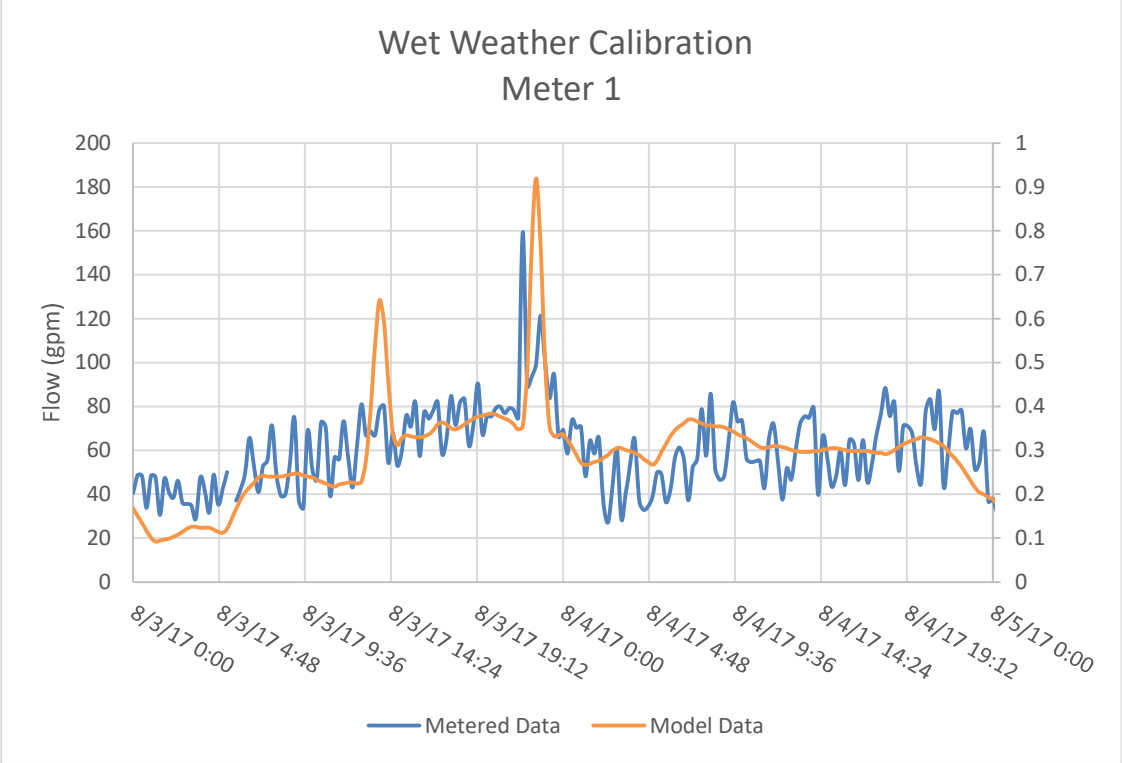

Meter 15 - Dry Weather Calibration
Flow (gpm)
45
40
35
30
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

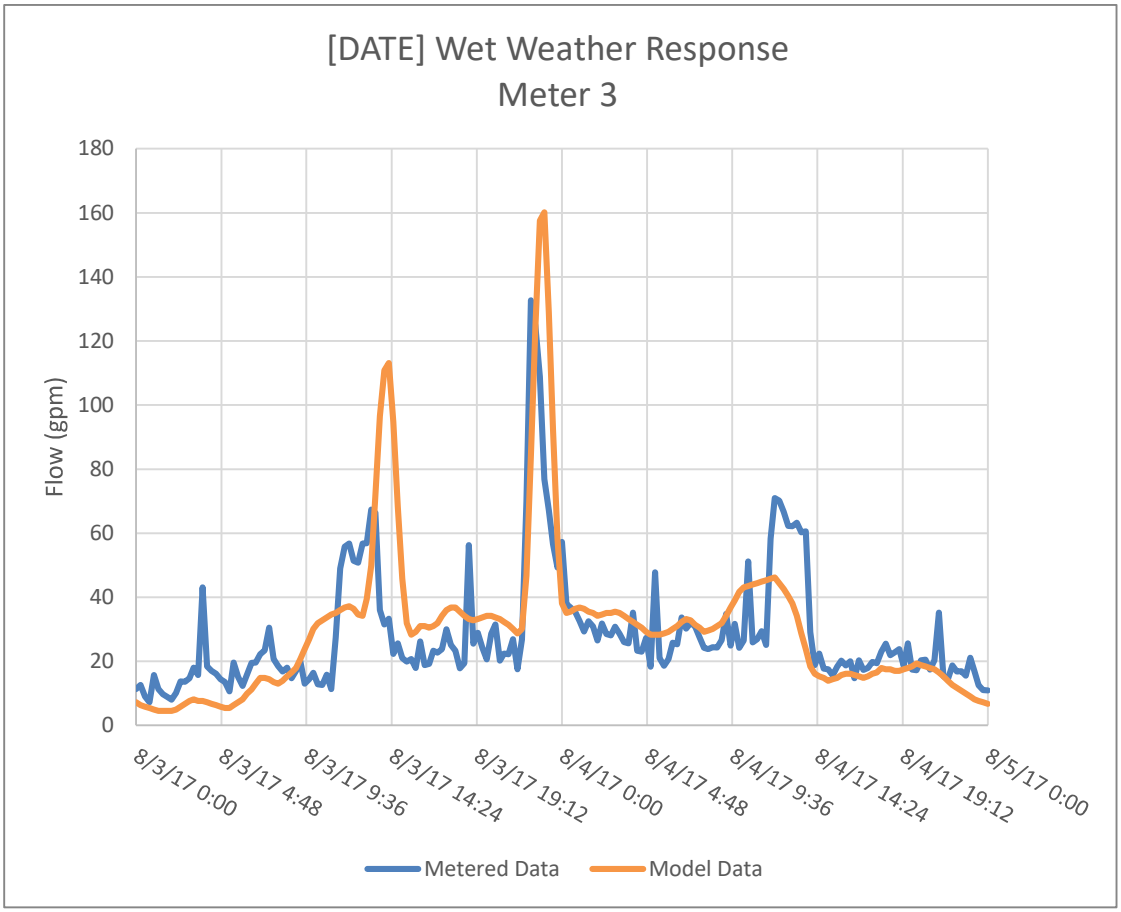

Meter 16 - Dry Weather Calibration
Flow (gpm)
25
20
15
10
5
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

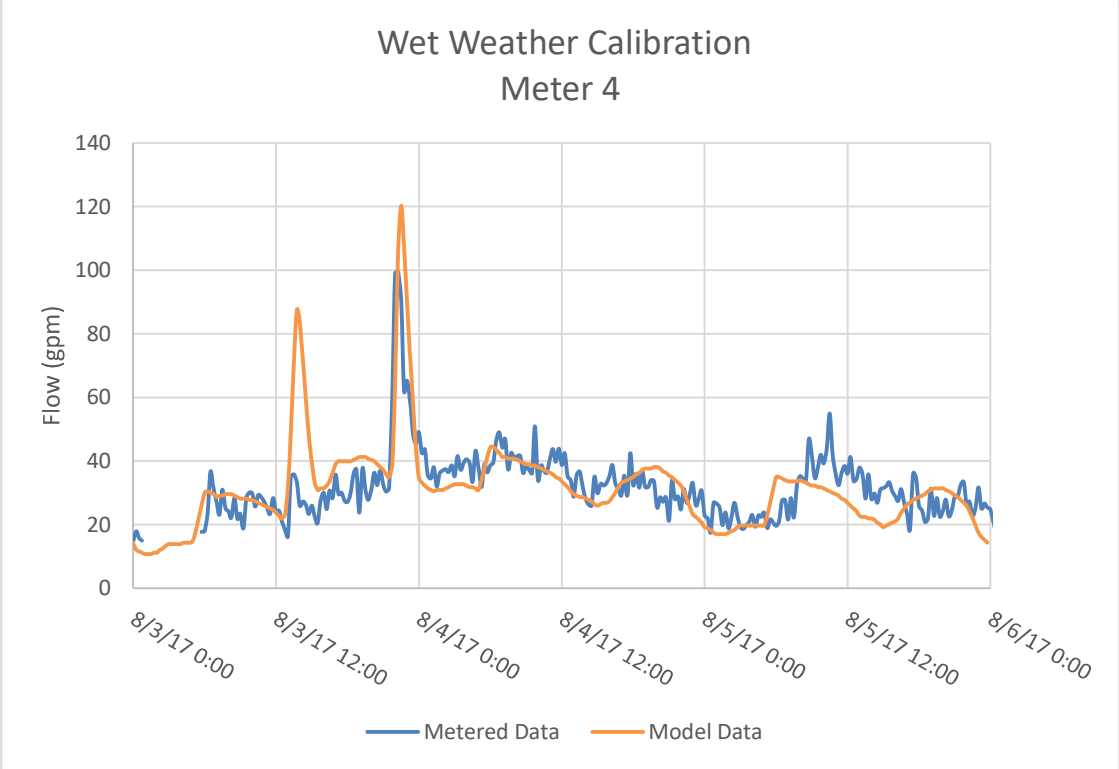

Meter 17 - Dry Weather Calibration
Flow (gpm)
450
400
350
300
250
200
150
100
50
0
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

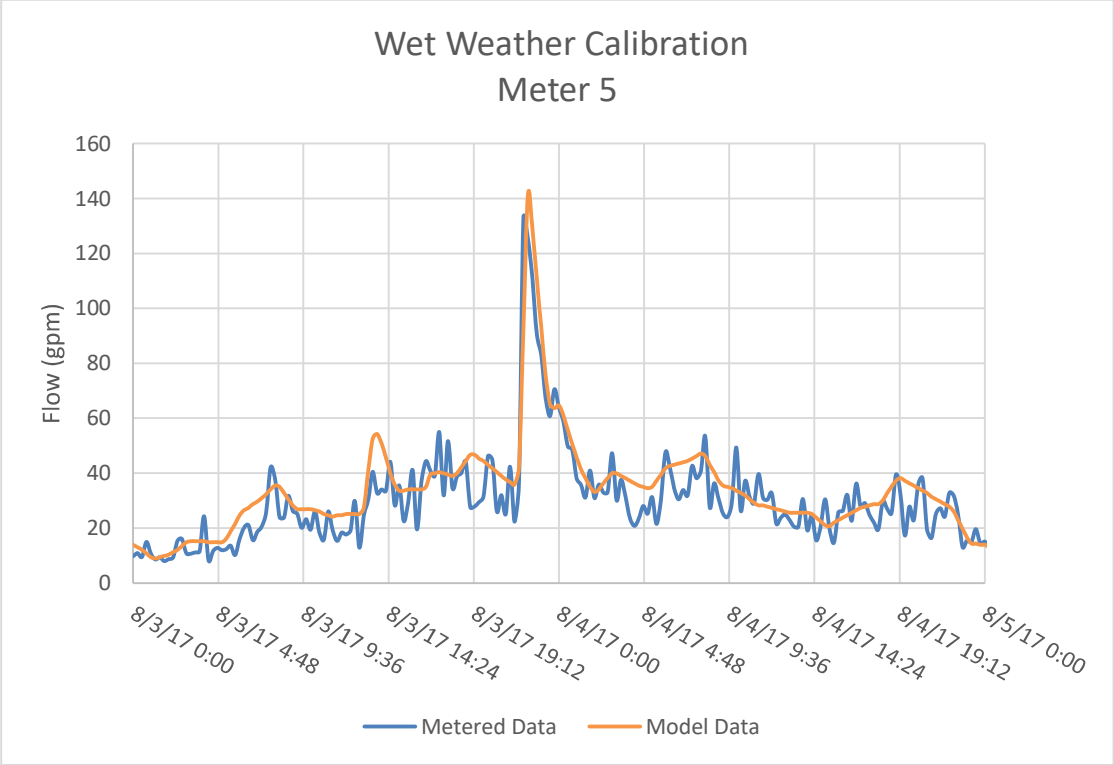

Meter 18 - Dry Weather Calibration
350
300
250
200
150
100
50
0
Flow (gpm)
0:00
3:00
6:00
9:00
12:00
15:00
18:00
21:00
0:00
Time
Metered Data
Model Data

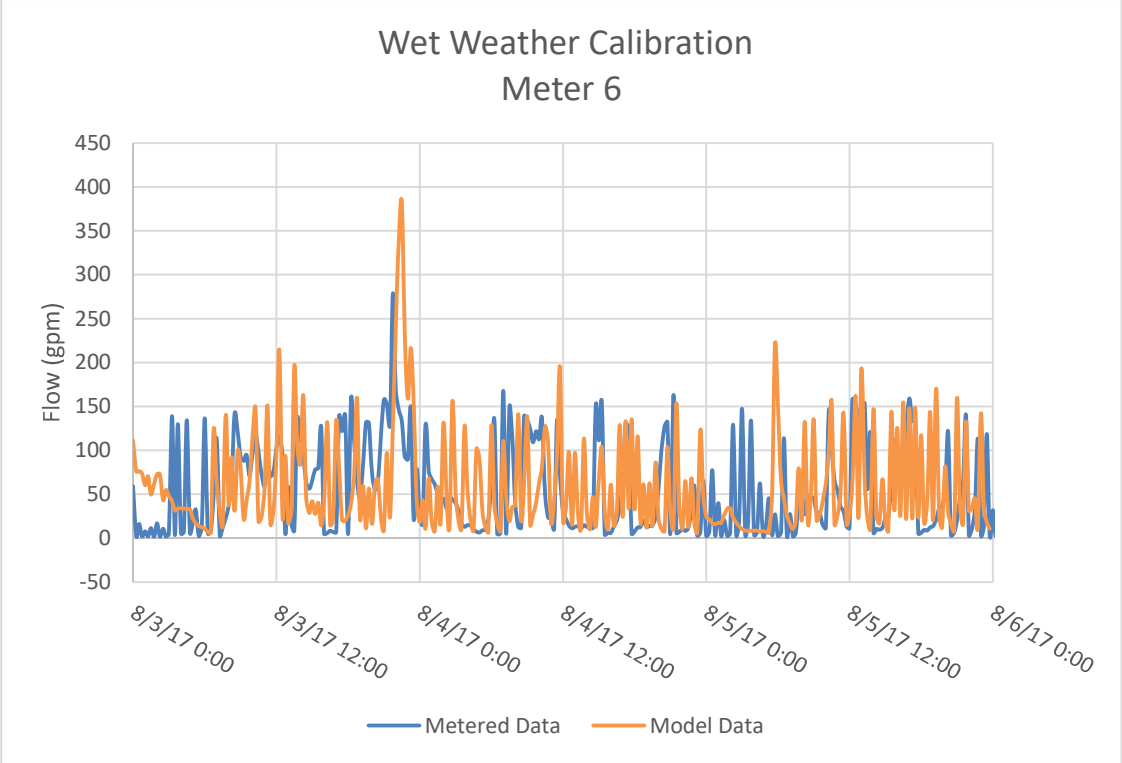
APPENDIX C
WET WEATHER CALIBRATION GRAPHS

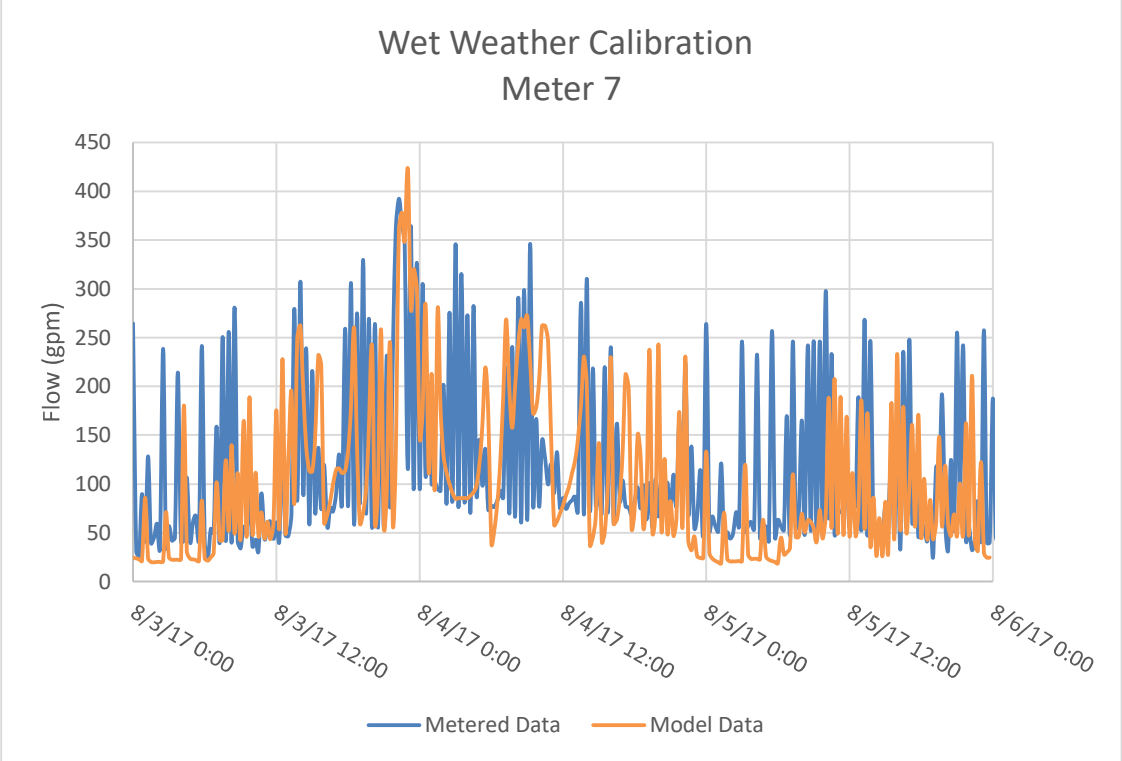

Wet Weather Calibration
Meter 1
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
8/3/17 0:00
8/3/17 4:48
8/3/17 9:36
8/3/17 14:24
8/3/17 19:12
8/4/17 0:00
8/4/17 4:48
8/4/17 9:36
8/4/17 14:24
8/4/17 19:12
8/5/17 0:00
Metered Data
Model Data

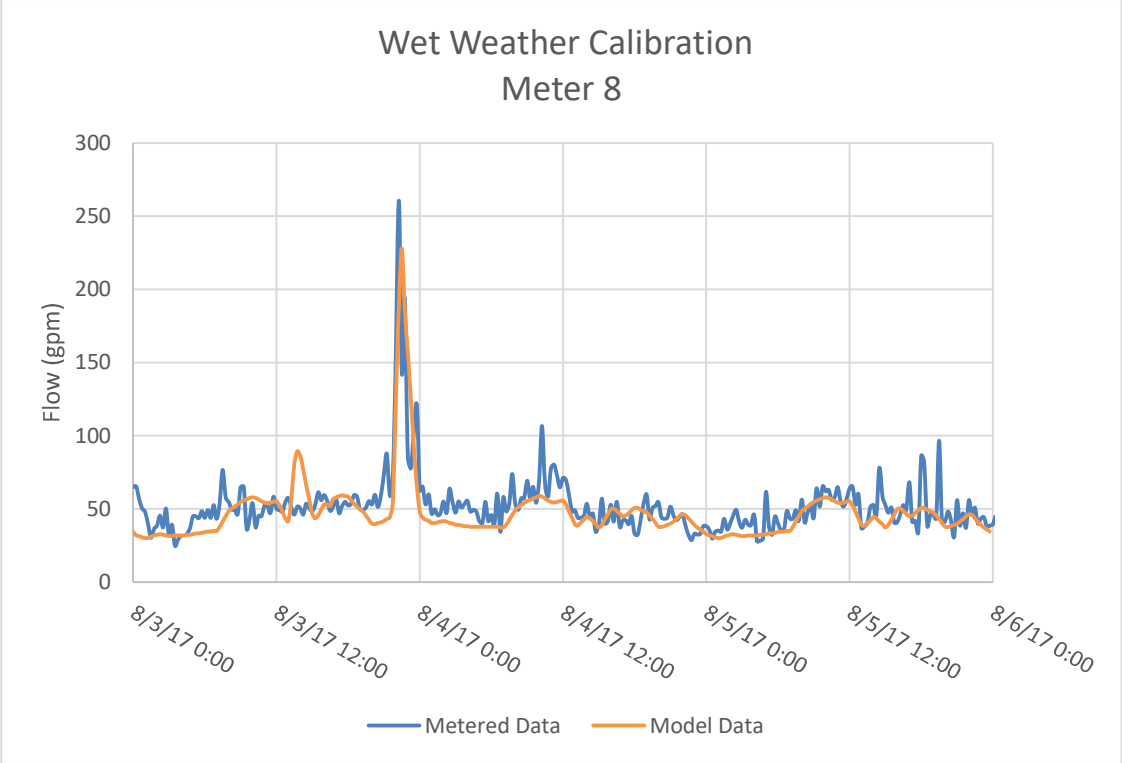

[DATE] Wet Weather Response
Meter 3
Flow (gpm)
180
160
140
120
100
80
60
40
20
0
8/3/17 0:00
8/3/17 4:48
8/3/17 9:36
8/3/17 14:24
8/3/17 19:12
8/4/17 0:00
8/4/17 4:48
8/4/17 9:36
8/4/17 14:24
8/4/17 19:12
8/5/17 0:00
Metered Data
Model Data

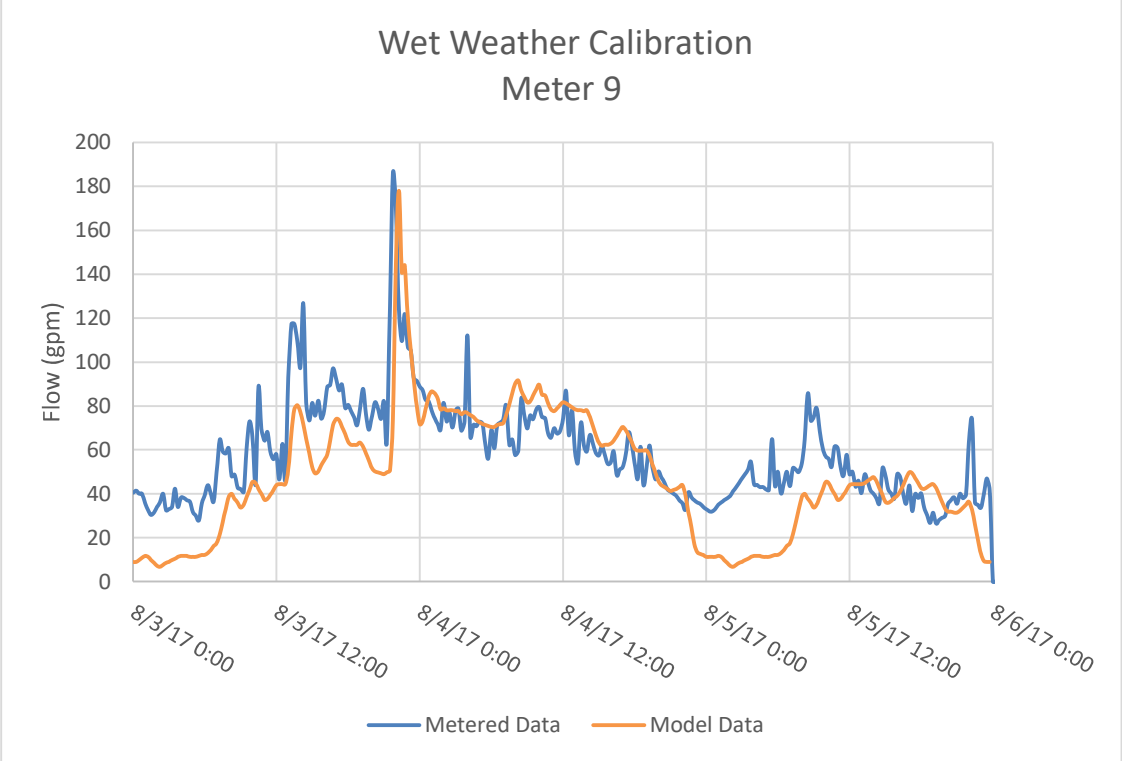

Wet Weather Calibration
Meter 4
Flow (gpm)
140
120
100
80
60
40
20
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

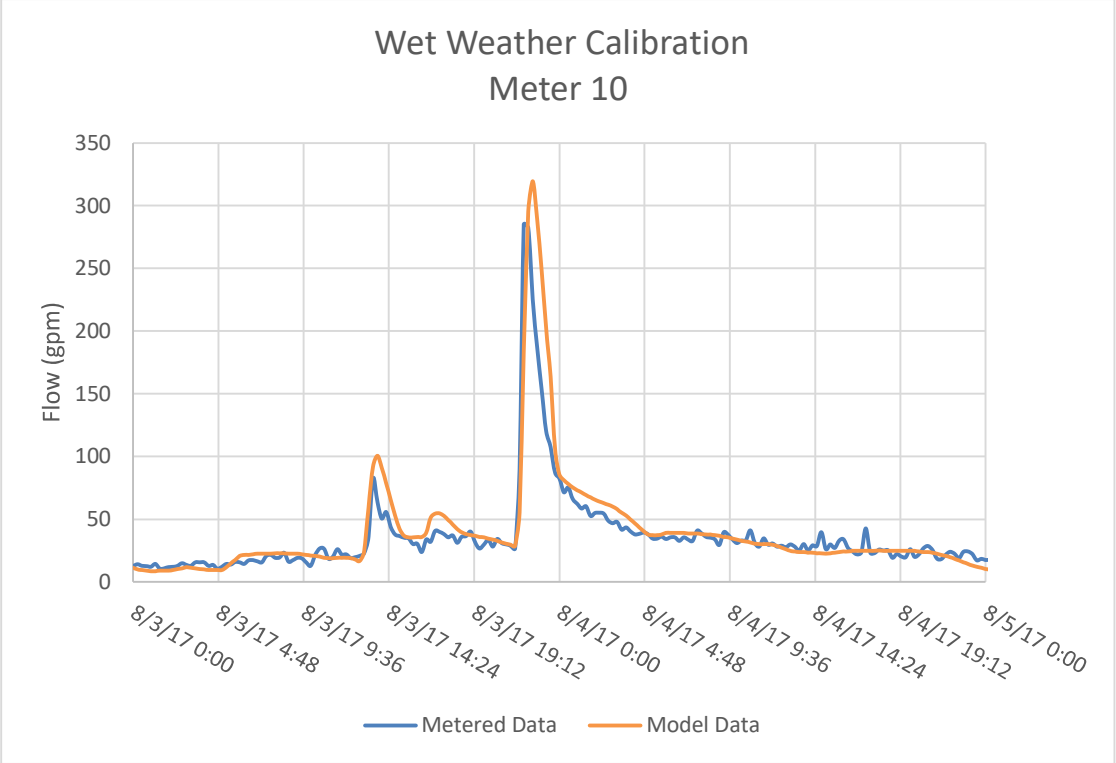

Wet Weather Calibration
Meter 5
Flow (gpm)
160
140
120
100
80
60
40
20
0
8/3/17 0:00
8/3/17 4:48
8/3/17 9:36
8/3/17 14:24
8/3/17 19:12
8/4/17 0:00
8/4/17 4:48
8/4/17 9:36
8/4/17 14:24
8/4/17 19:12
8/5/17 0:00
Metered Data
Model Data

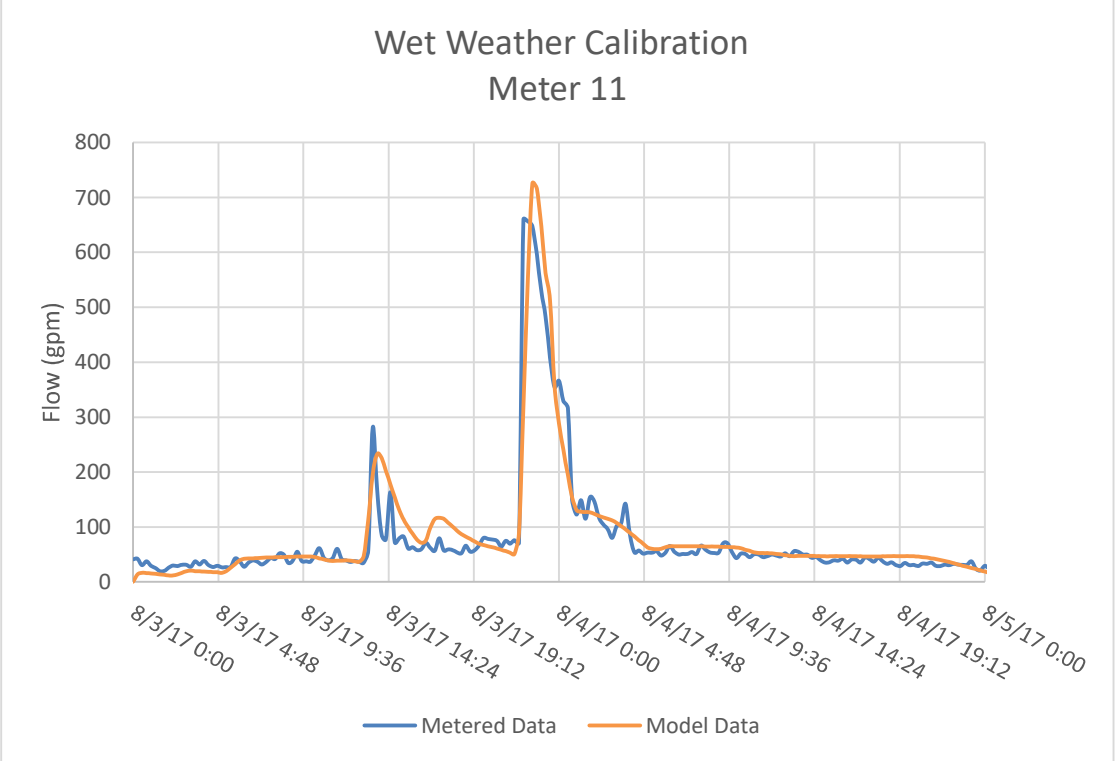

Wet Weather Calibration
Meter 6
Flow (gpm)
450
400
350
300
250
200
150
100
50
0
-50
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

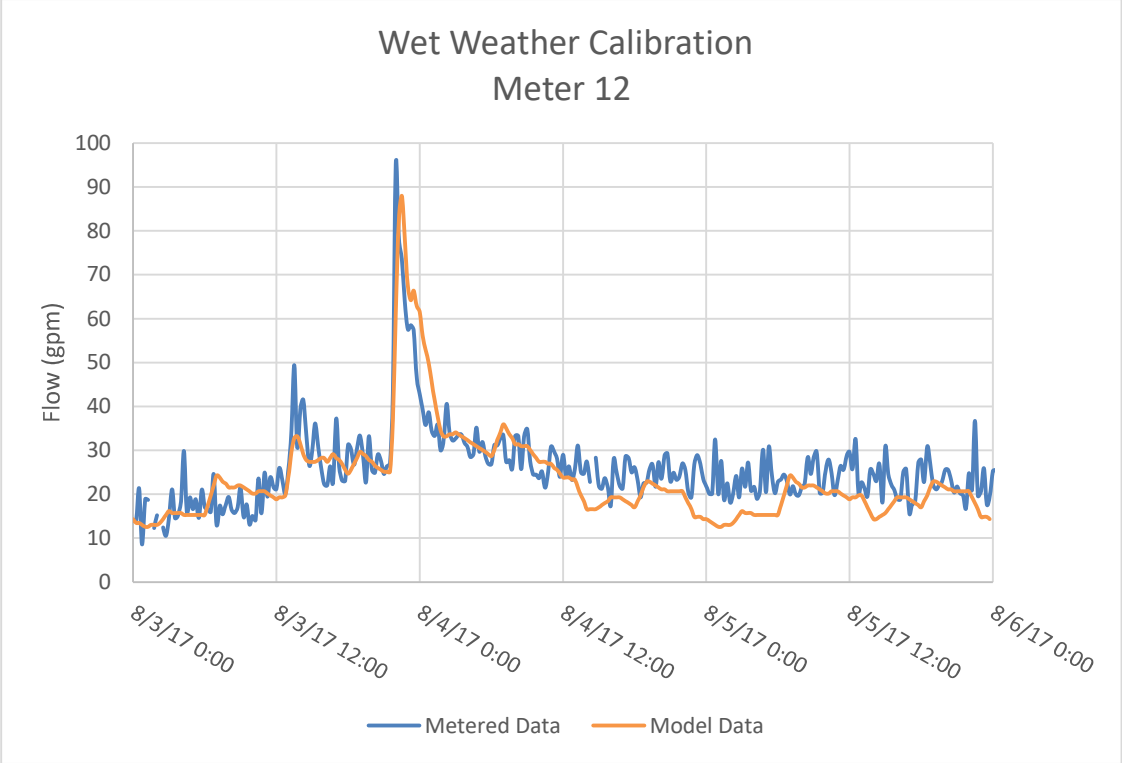

Wet Weather Calibration
Meter 7
Flow (gpm)
450
400
350
300
250
200
150
100
50
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

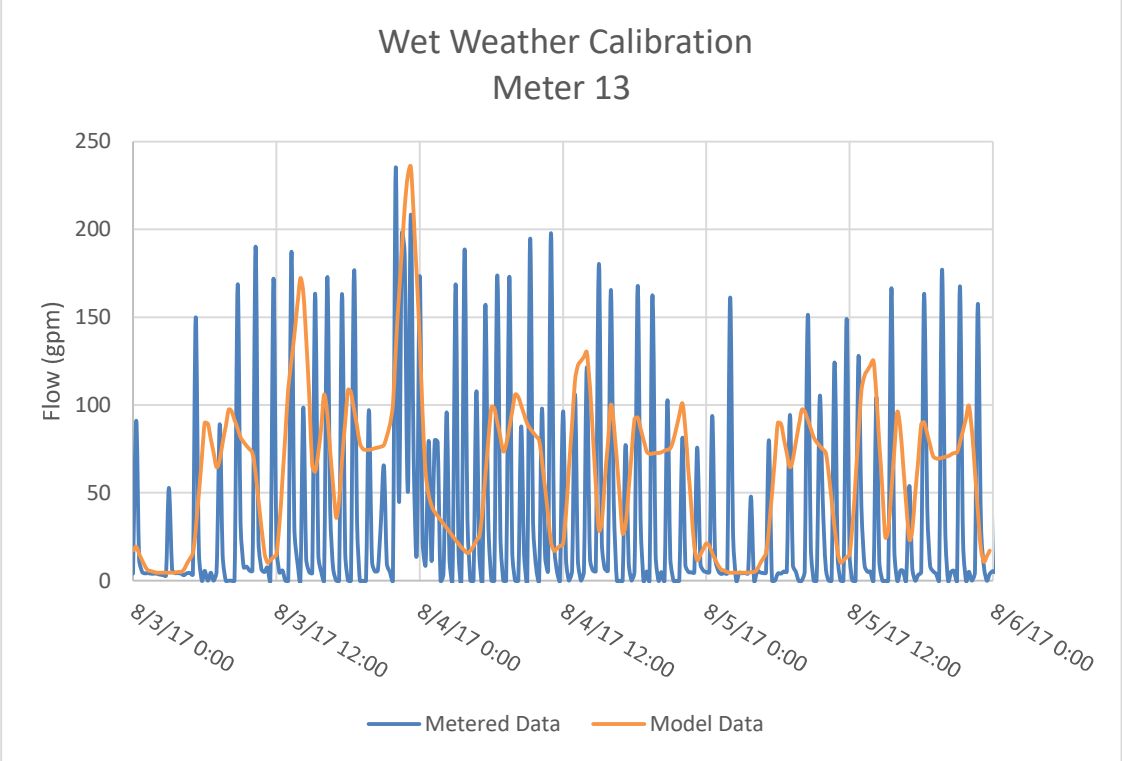

Wet Weather Calibration
Meter 8
Flow (gpm)
300
250
200
150
100
50
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

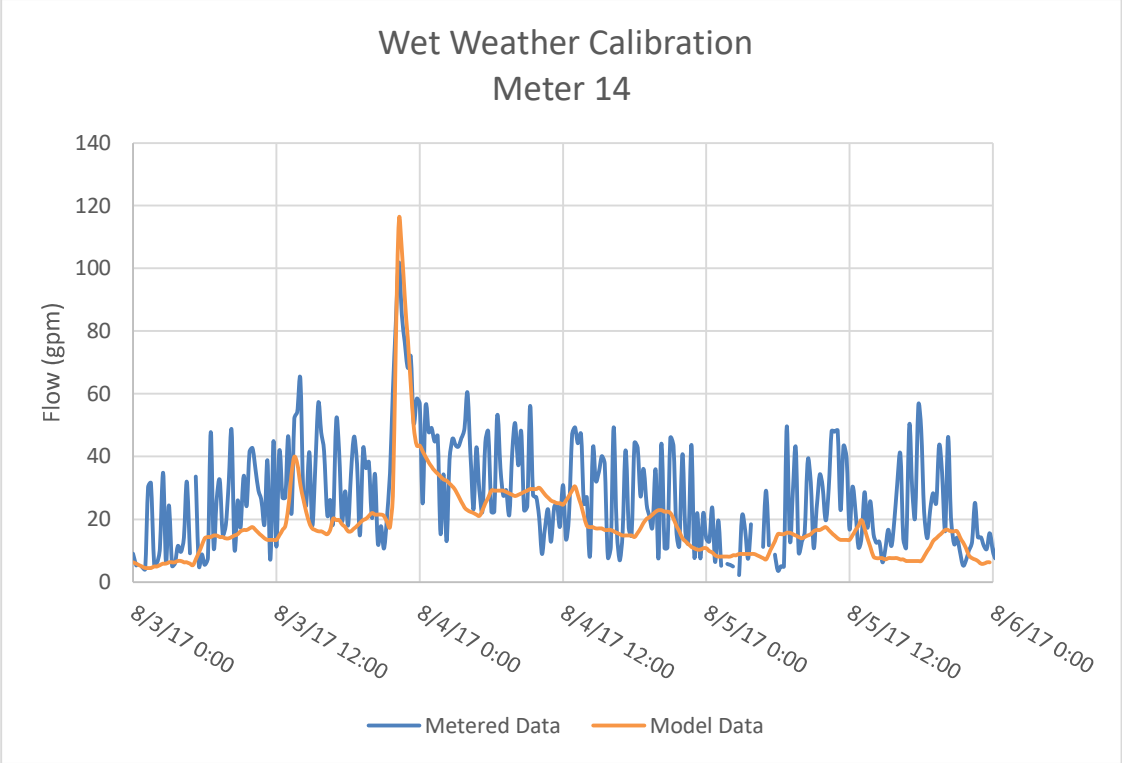

Wet Weather Calibration
Meter 9
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

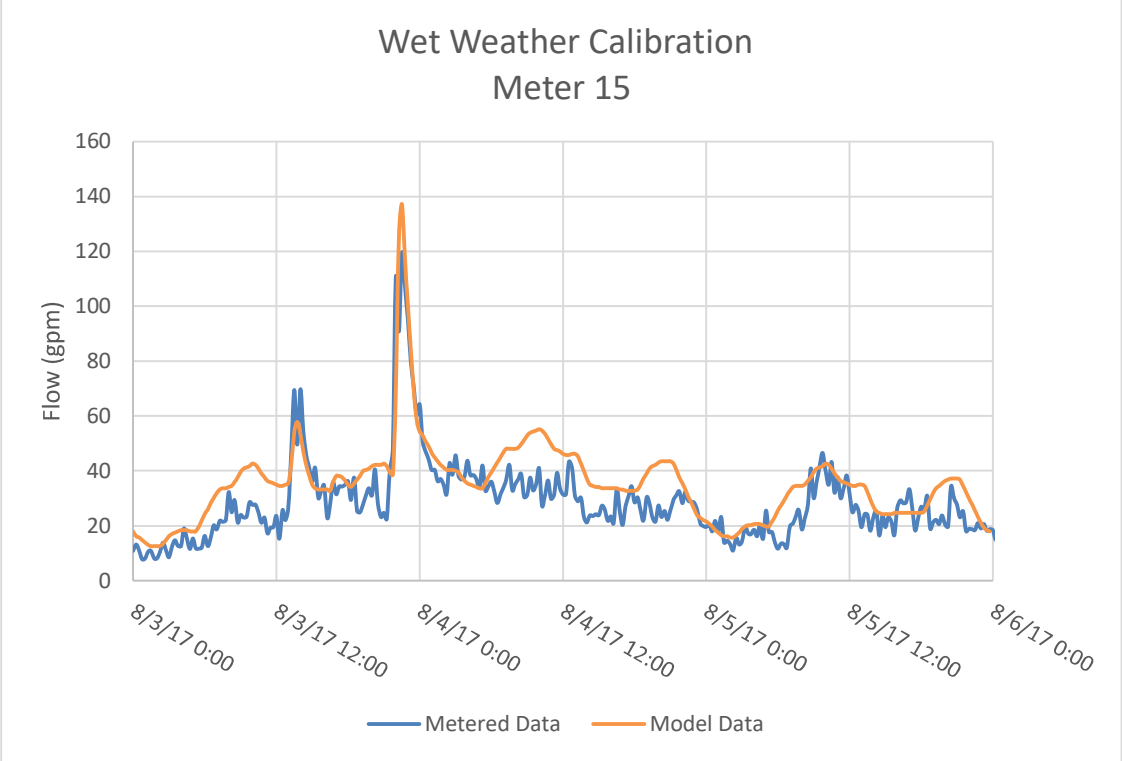

Wet Weather Calibration
Meter 10
Flow (gpm)
350
300
250
200
150
100
50
0
8/3/17 0:00
8/3/17 4:48
8/3/17 9:36
8/3/17 14:24
8/3/17 19:12
8/4/17 0:00
8/4/17 4:48
8/4/17 9:36
8/4/17 14:24
8/4/17 19:12
8/5/17 0:00
Metered Data
Model Data

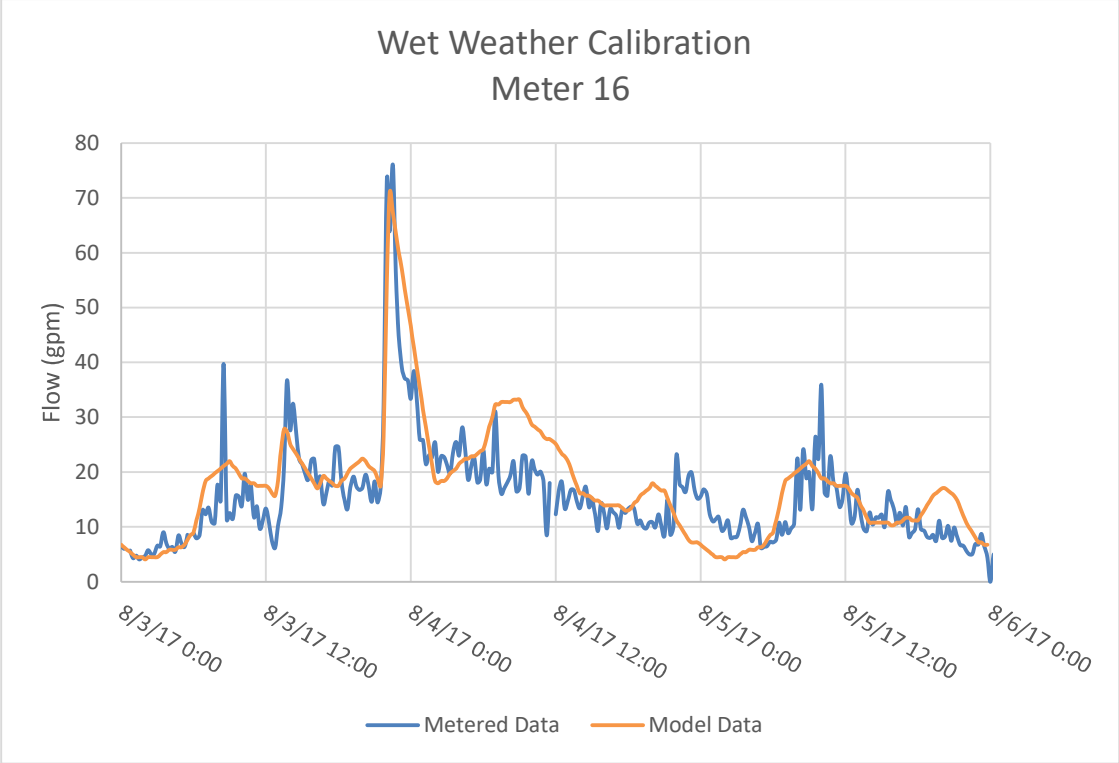

Wet Weather Calibration
Meter 11
Flow (gpm)
800
700
600
500
400
300
200
100
0
8/3/17 0:00
8/3/17 4:48
8/3/17 9:36
8/3/17 14:24
8/3/17 19:12
8/4/17 0:00
8/4/17 4:48
8/4/17 9:36
8/4/17 14:24
8/4/17 19:12
8/5/17 0:00
Metered Data
Model Data

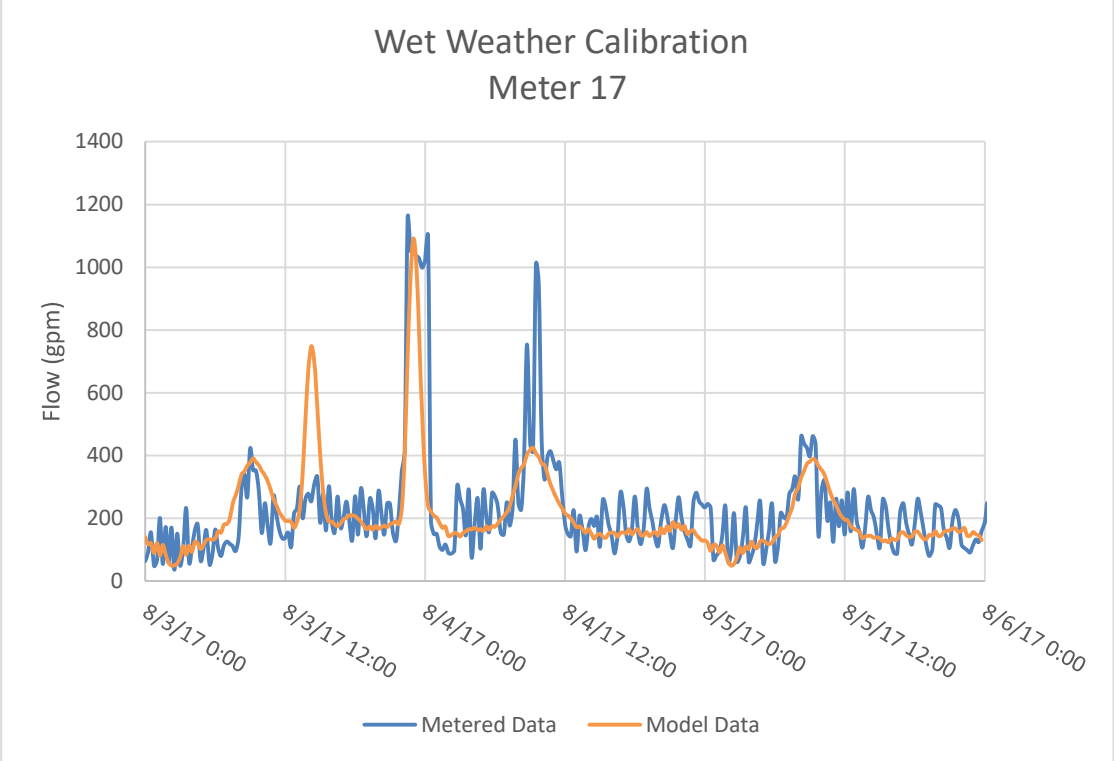

Wet Weather Calibration
Meter 12
Flow (gpm)
100
90
80
70
60
50
40
30
20
10
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

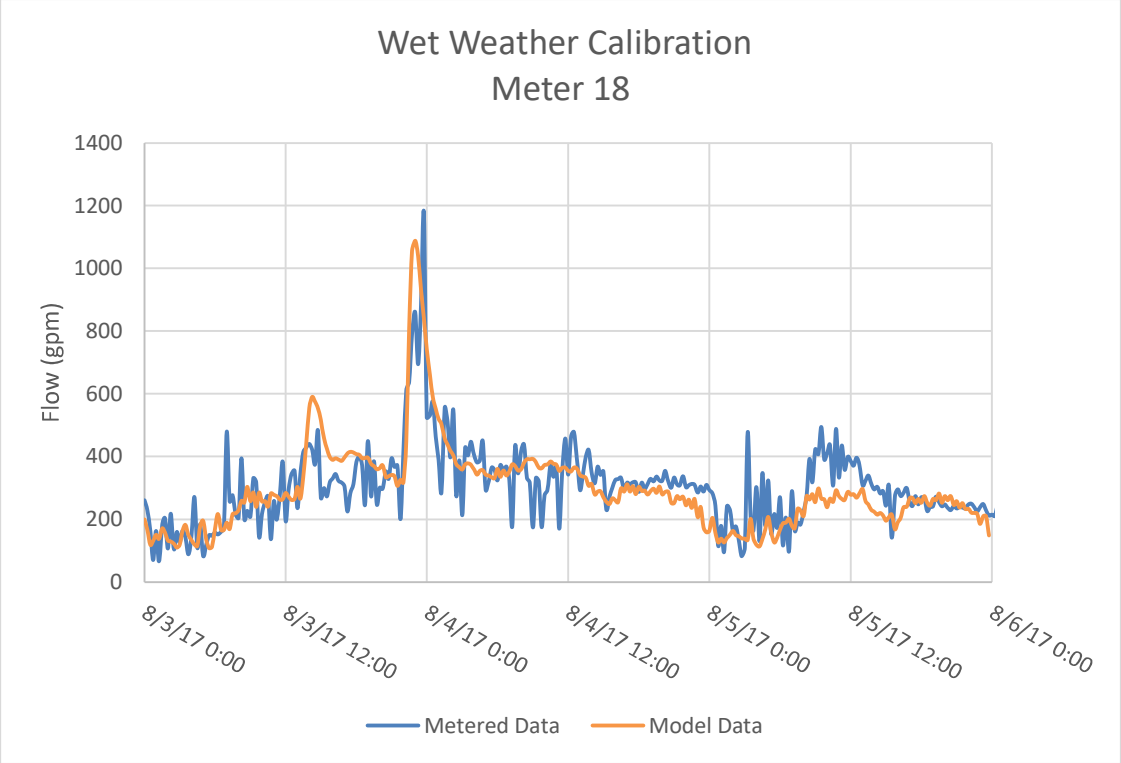

Wet Weather Calibration
Meter 13
Flow (gpm)
250
200
150
100
50
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data


Wet Weather Calibration
Meter 14
Flow (gpm)
140
120
100
80
60
40
20
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

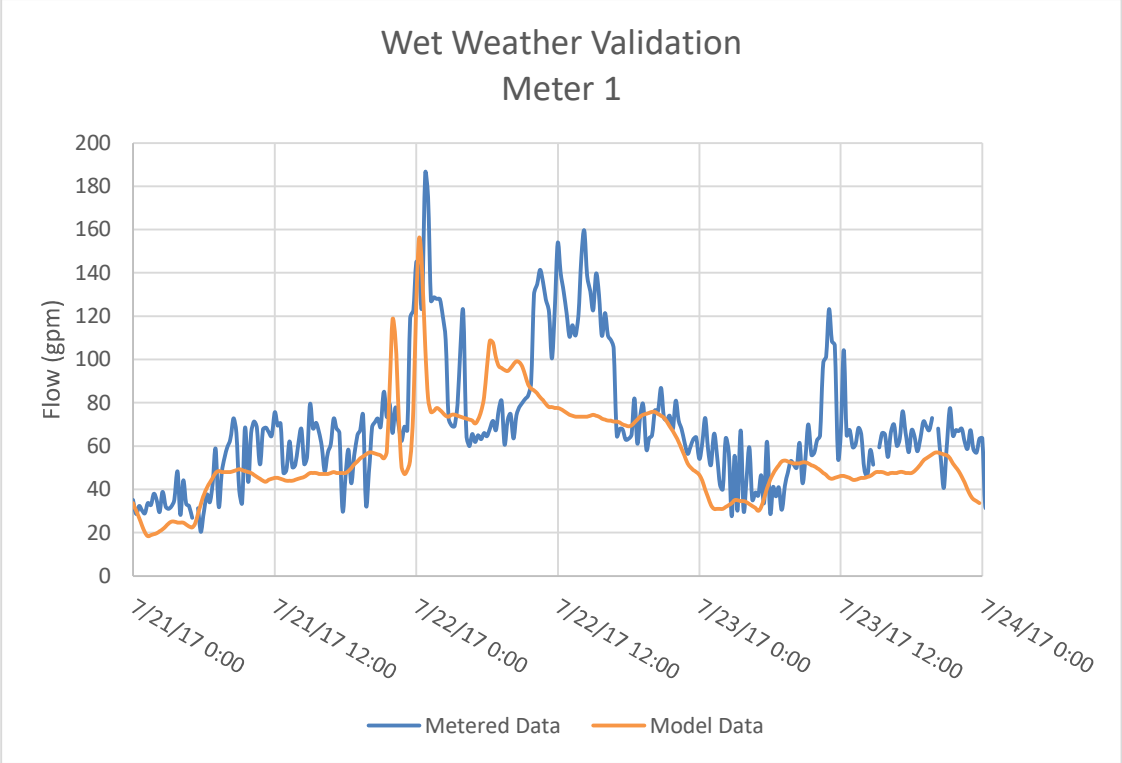

Wet Weather Calibration
Meter 15
Flow (gpm)
160
140
120
100
80
60
40
20
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

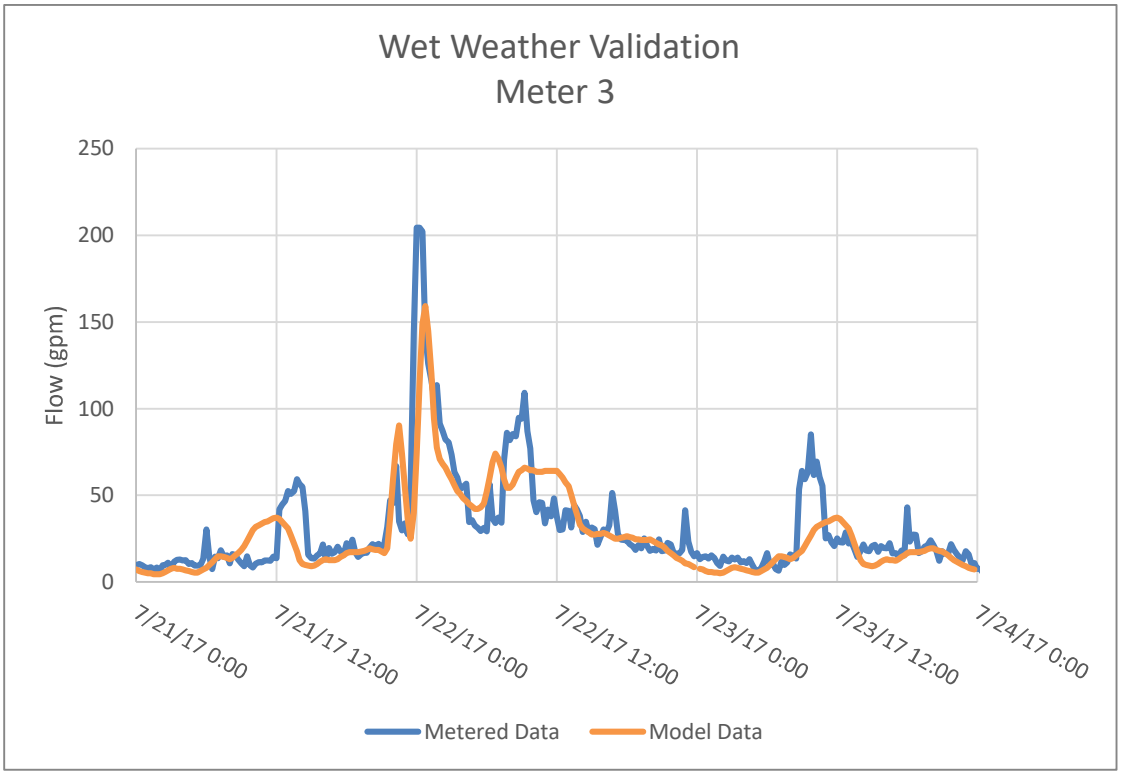

Wet Weather Calibration
Meter 16
Flow (gpm)
80
70
60
50
40
30
20
10
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

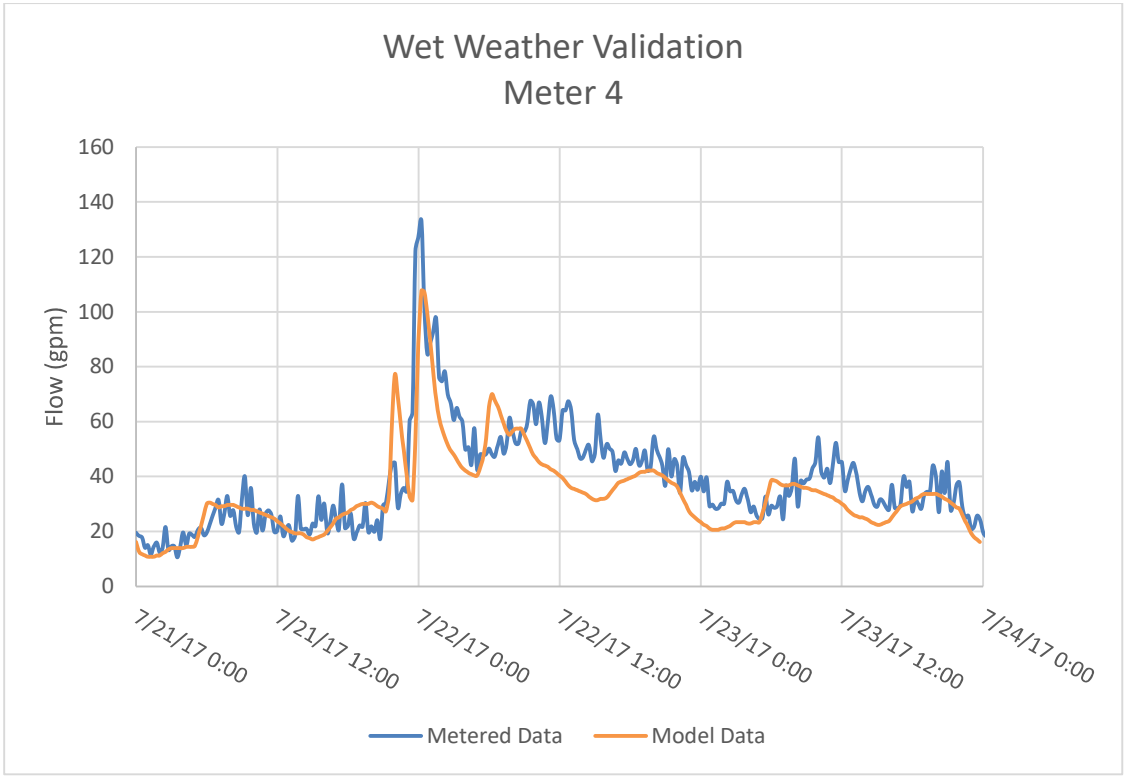

Wet Weather Calibration
Meter 17
Flow (gpm)
1400
1200
1000
800
600
400
200
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

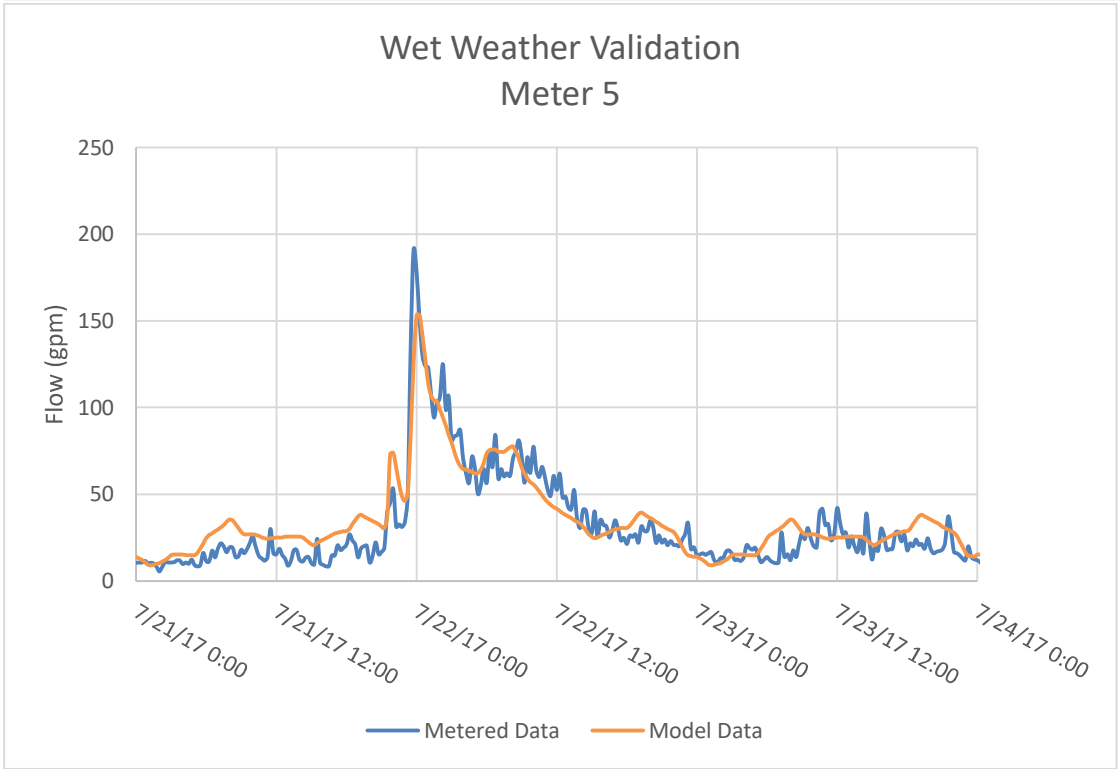

Wet Weather Calibration
Meter 18
Flow (gpm)
1400
1200
1000
800
600
400
200
0
8/3/17 0:00
8/3/17 12:00
8/4/17 0:00
8/4/17 12:00
8/5/17 0:00
8/5/17 12:00
8/6/17 0:00
Metered Data
Model Data

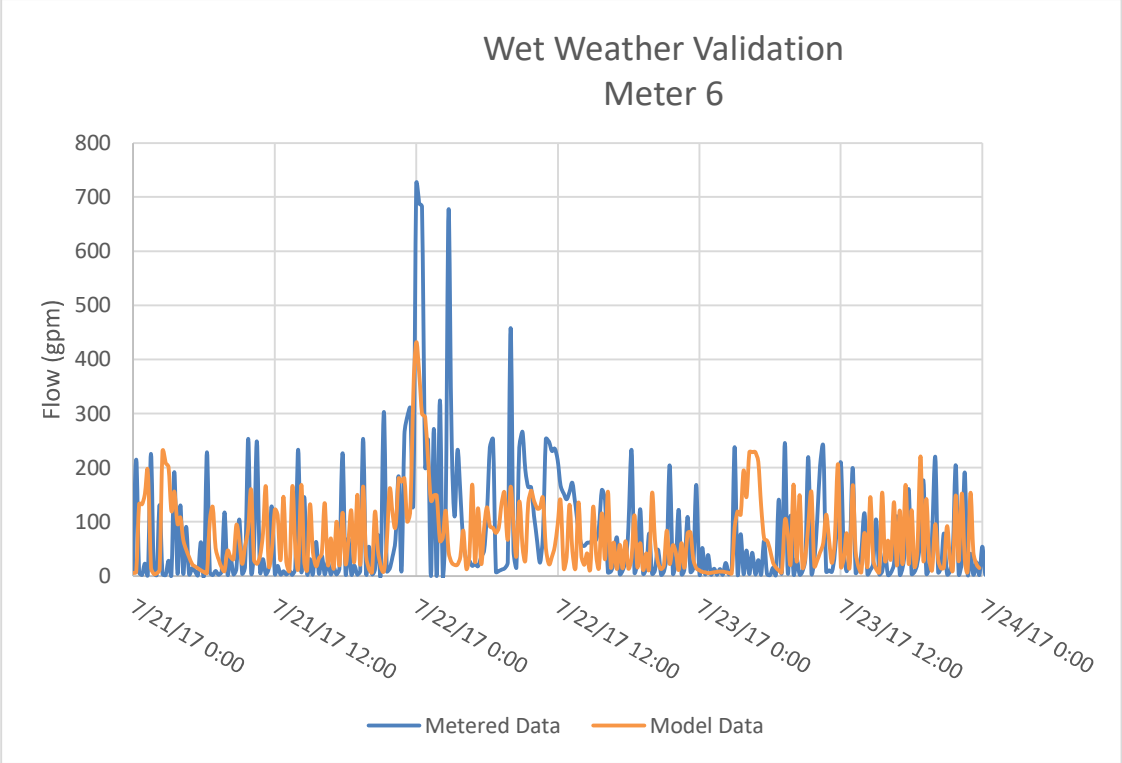
APPENDIX D
WET WEATHER VALIDATION GRAPHS

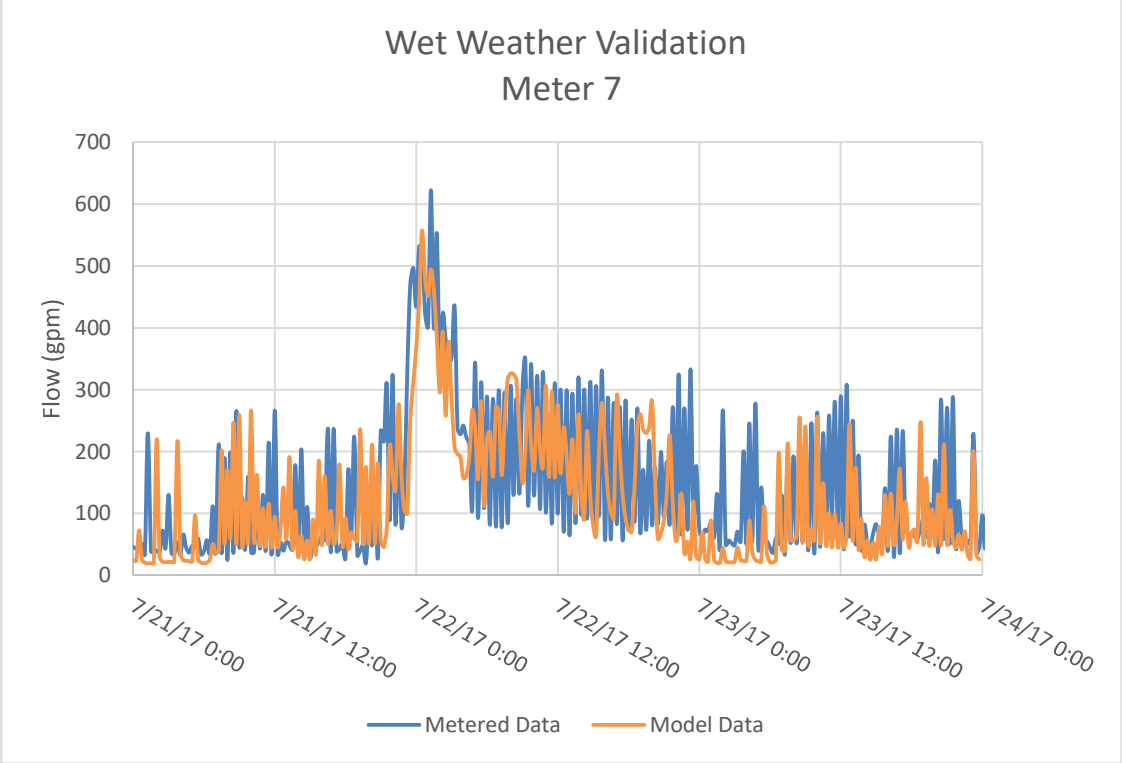

Wet Weather Validation
Meter 1
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

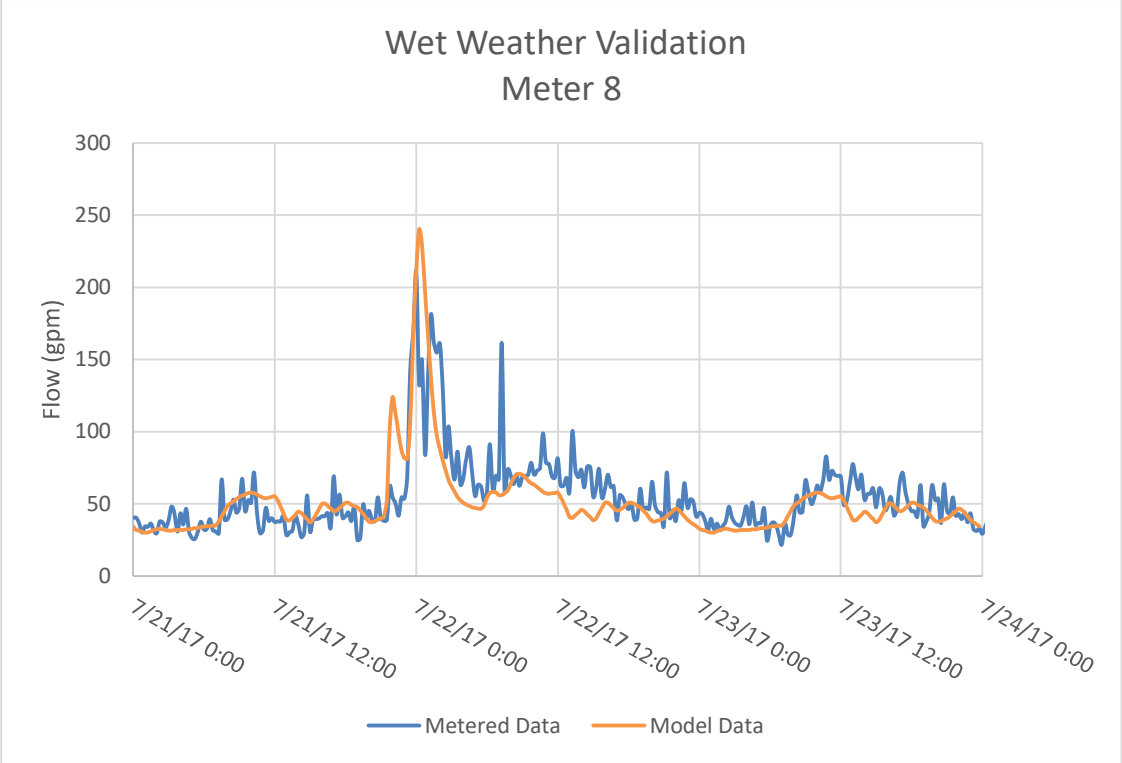

Wet Weather Validation
Meter 3
Flow (gpm)
250
200
150
100
50
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

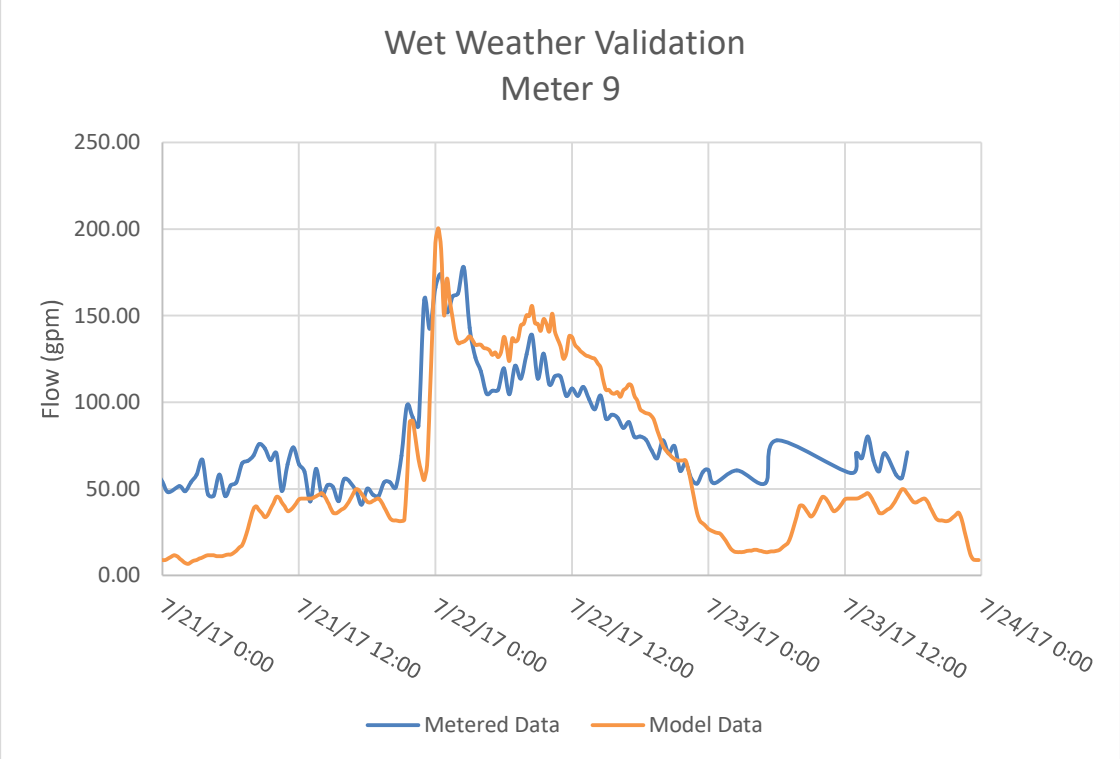

Wet Weather Validation
Meter 4
Flow (gpm)
160
140
120
100
80
60
40
20
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

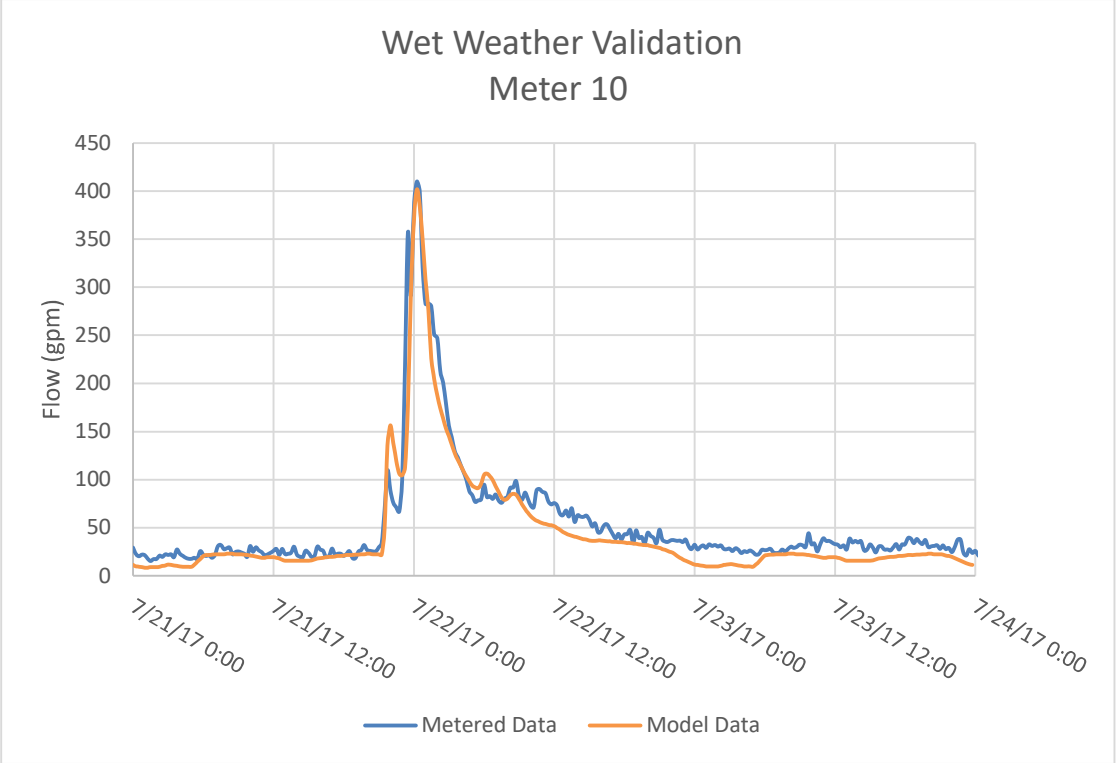

Wet Weather Validation
Meter 5
Flow (gpm)
250
200
150
100
50
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

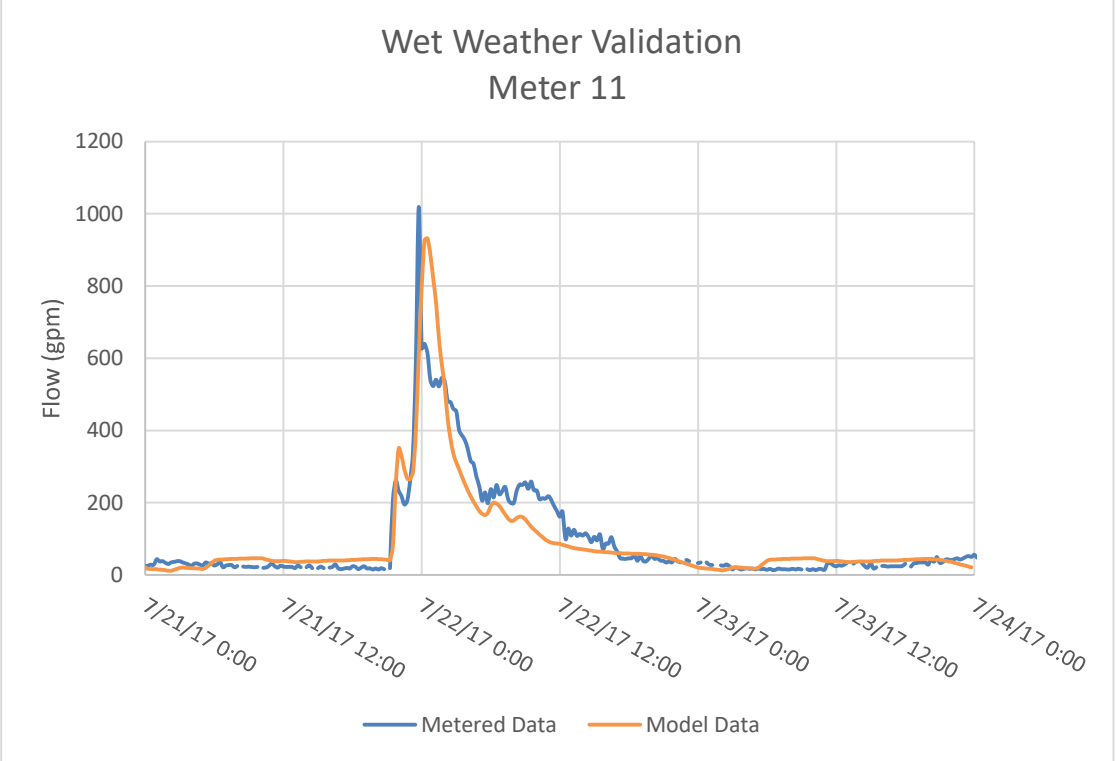

Wet Weather Validation
Meter 6
Flow (gpm)
800
700
600
500
400
300
200
100
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

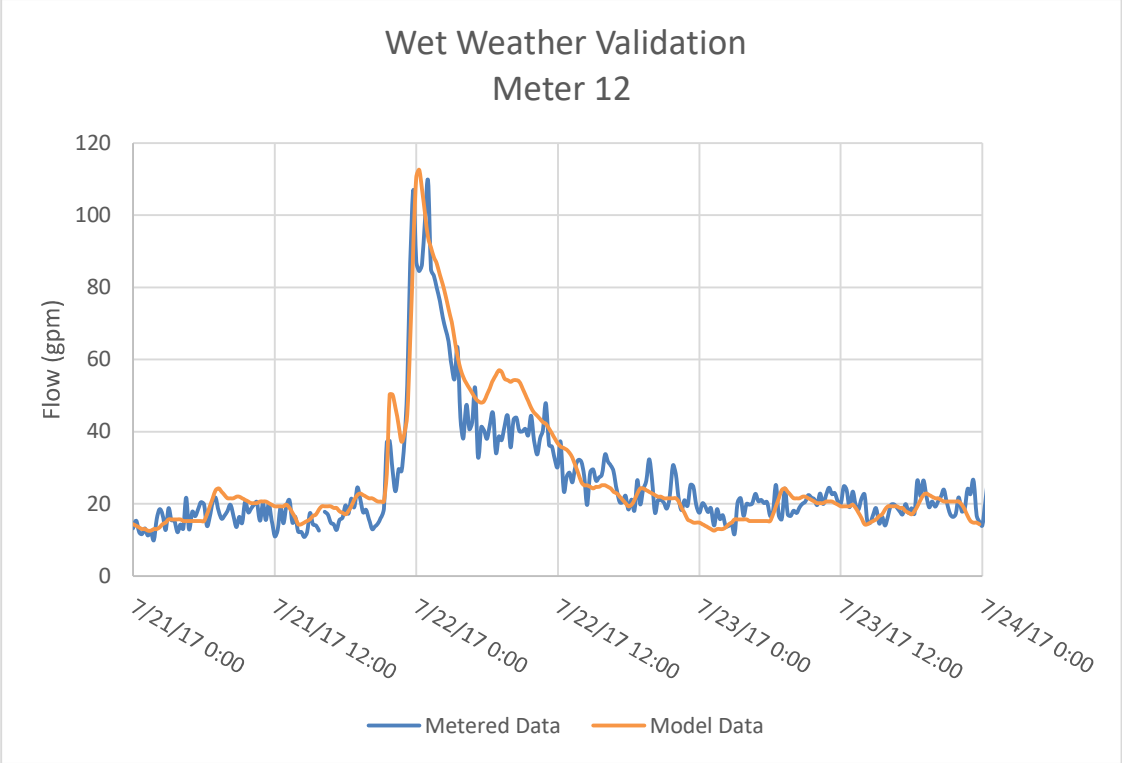

Wet Weather Validation
Meter 7
Flow (gpm)
700
600
500
400
300
200
100
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

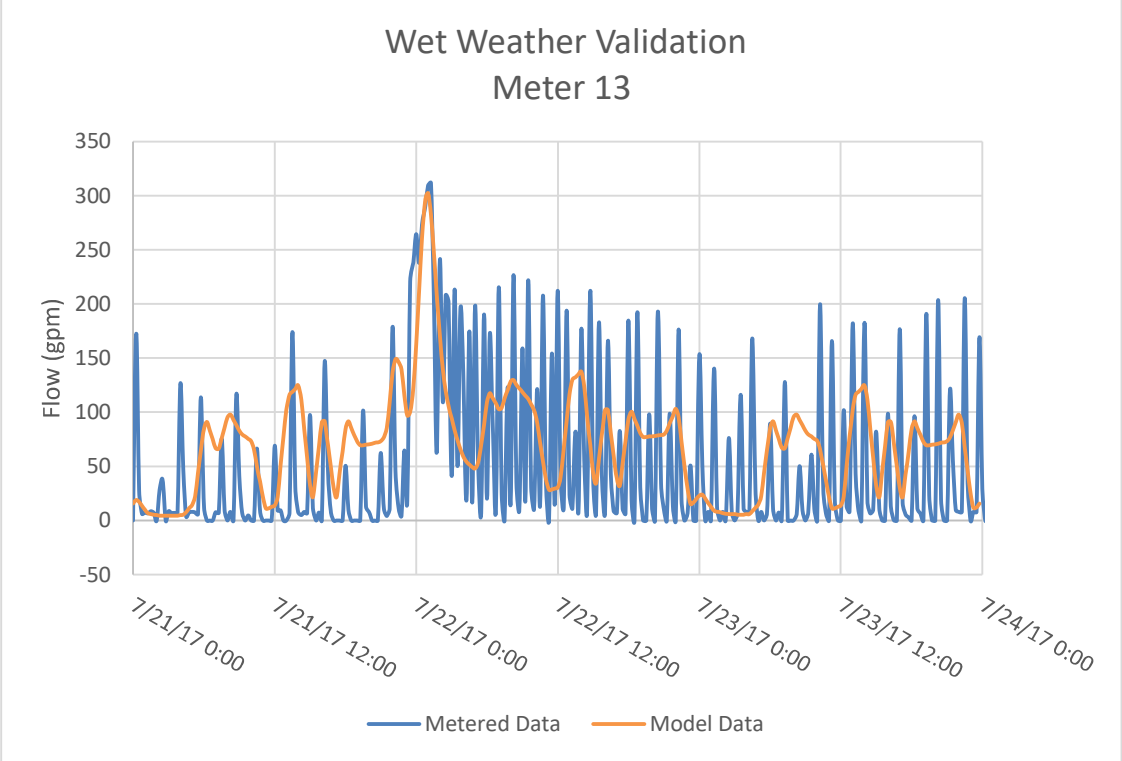

Wet Weather Validation
Meter 8
Flow (gpm)
300
250
200
150
100
50
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

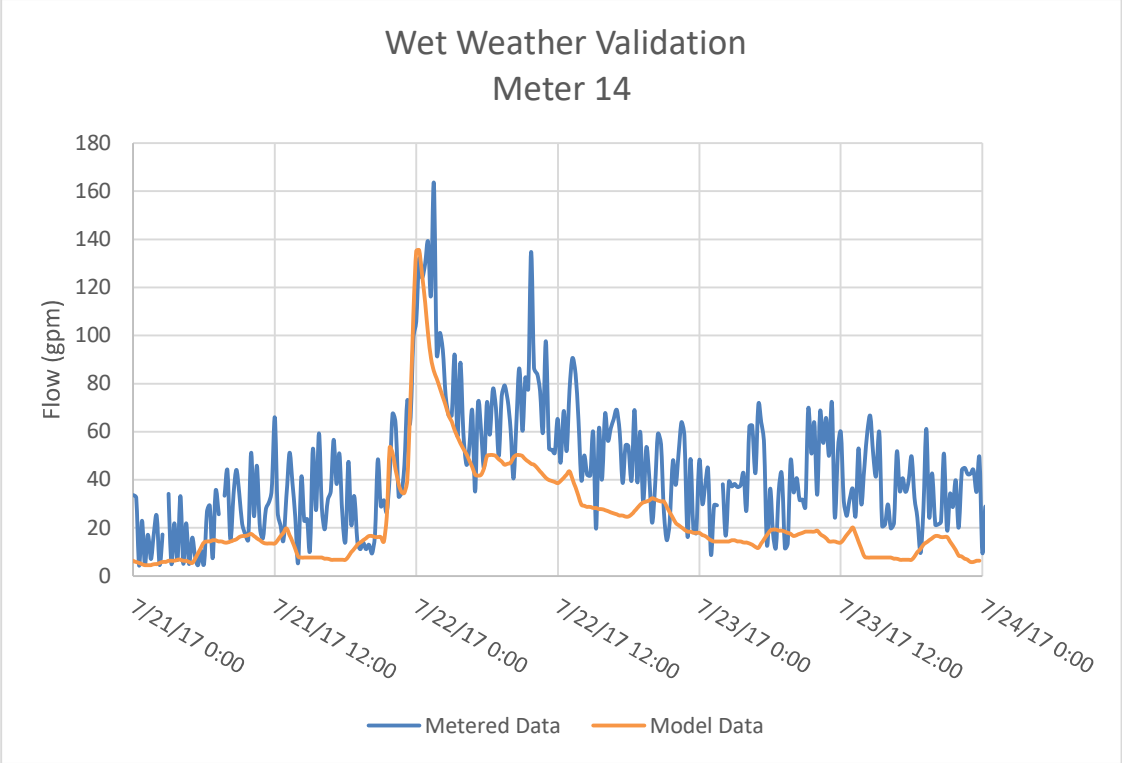

Wet Weather Validation
Meter 9
Flow (gpm)
250.00
200.00
150.00
100.00
50.00
0.00
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

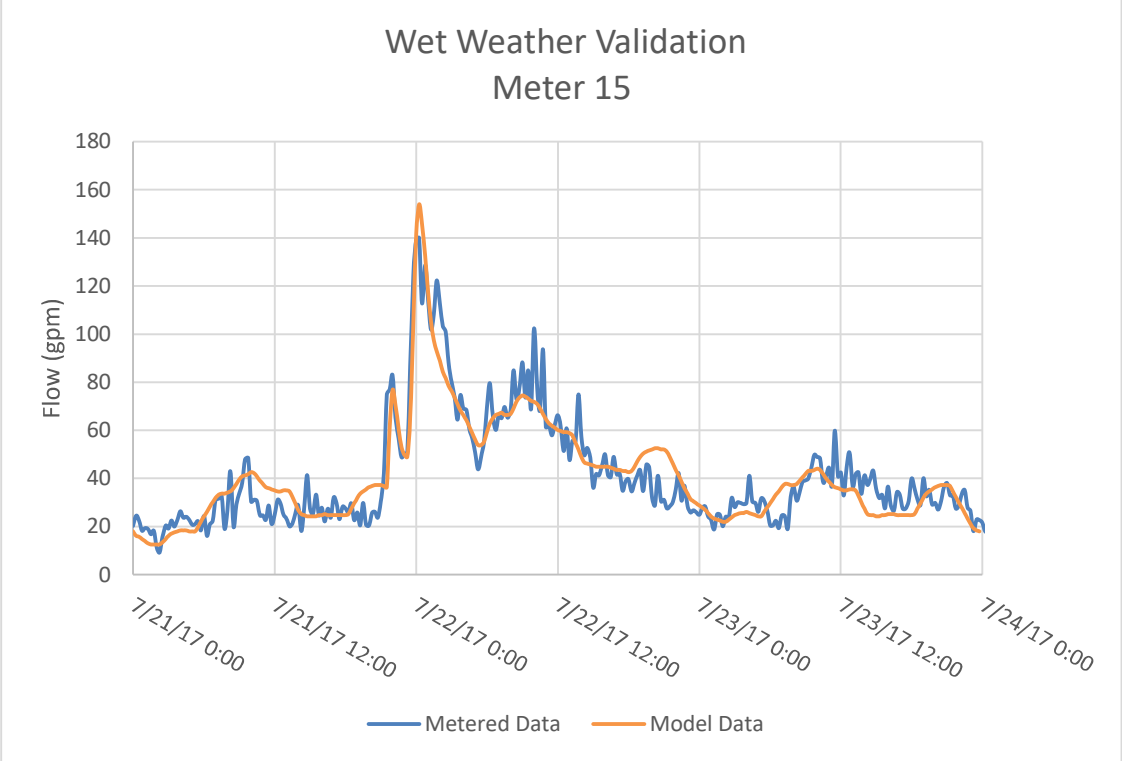

Wet Weather Validation
Meter 10
Flow (gpm)
450
400
350
300
250
200
150
100
50
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

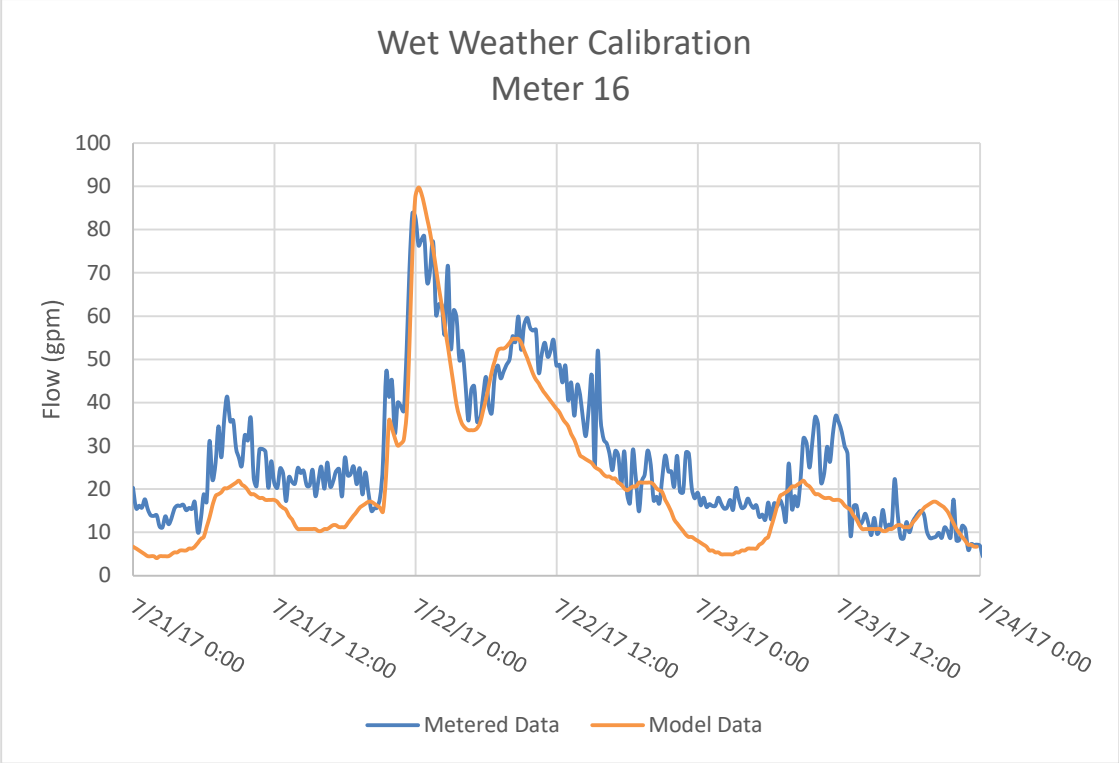

Wet Weather Validation
Meter 11
Flow (gpm)
1200
1000
800
600
400
200
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

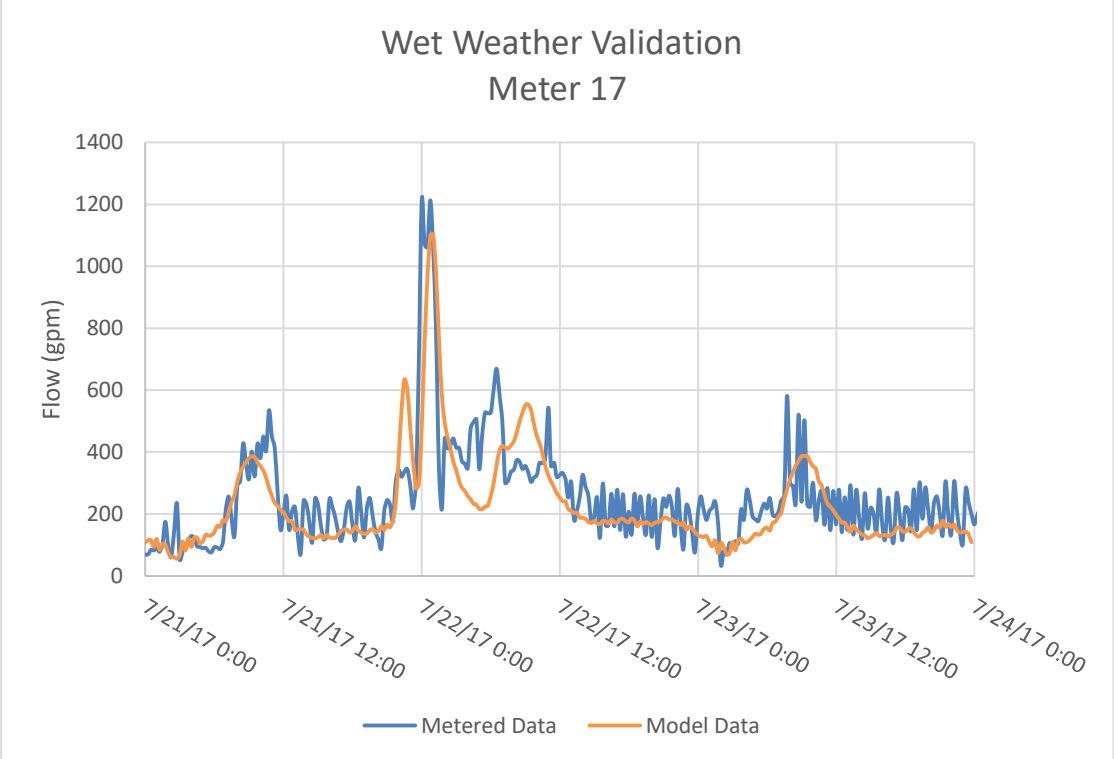

Wet Weather Validation
Meter 12
Flow (gpm)
120
100
80
60
40
20
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

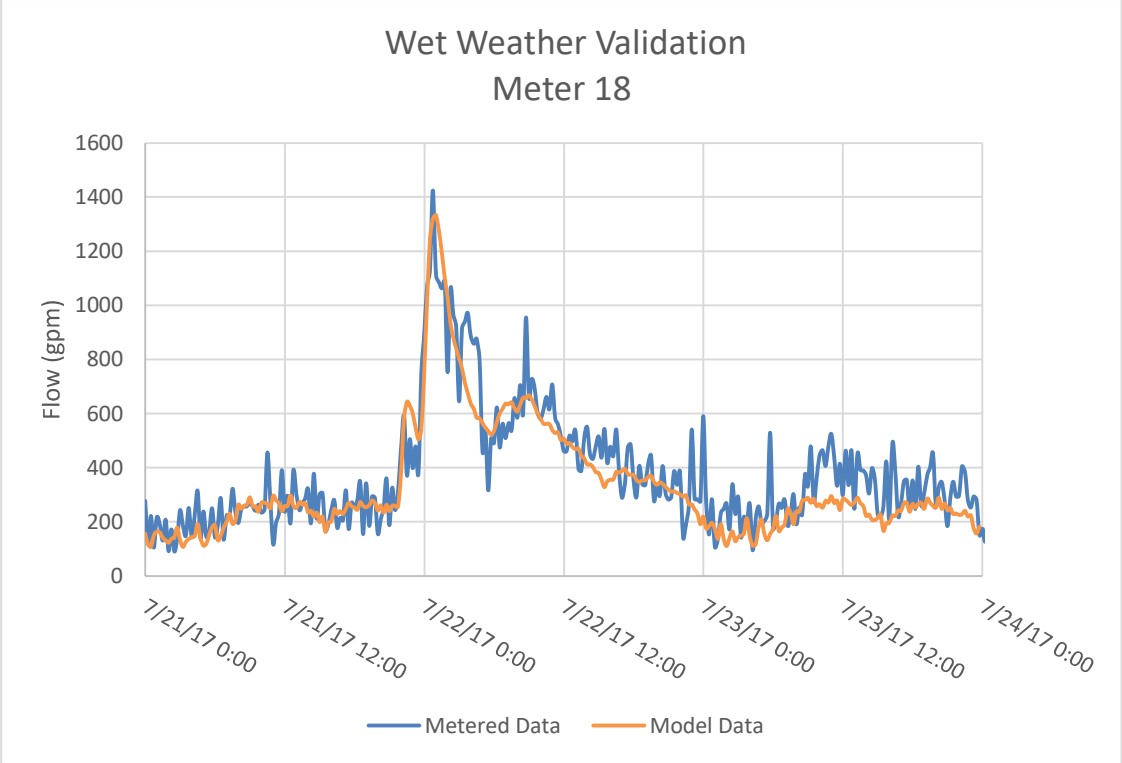

Wet Weather Validation
Meter 13
Flow (gpm)
350
300
250
200
150
100
50
0
-50
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data


Wet Weather Validation
Meter 14
Flow (gpm)
180
160
140
120
100
80
60
40
20
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data


Wet Weather Validation
Meter 15
Flow (gpm)
180
160
140
120
100
80
60
40
20
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data


Wet Weather Calibration
Meter 16
Flow (gpm)
100
90
80
70
60
50
40
30
20
10
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data


Wet Weather Validation
Meter 17
Flow (gpm)
1400
1200
1000
800
600
400
200
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data


Wet Weather Validation
Meter 18
Flow (gpm)
1600
1400
1200
1000
800
600
400
200
0
7/21/17 0:00
7/21/17 12:00
7/22/17 0:00
7/22/17 12:00
7/23/17 0:00
7/23/17 12:00
7/24/17 0:00
Metered Data
Model Data

APPENDIX E
DETAILED COST EVALUATIONS

Alternative 1: No Lift Station Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 494	MH 542	24	427	LF	$290	$124,000	WWTP	18
	MH 542	MH 541	24	455	LF	$290	$132,000	WWTP	18
	MH 541	MH 540	24	417	LF	$290	$121,000	WWTP	18
	MH 540	MH 544	24	353	LF	$290	$102,000	WWTP	18
	MH 545	MH 546	24	171	LF	$290	$49,000	WWTP	WWTP
	MH 544	MH 545	24	325	LF	$290	$94,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	12	183	LF	$230	$42,000	L	13
	MH 562	MH 200	12	194	LF	$230	$45,000	L	13
	MH 199	MH 562	12	158	LF	$230	$36,000	L	13
	MH 561	MH 199	12	171	LF	$230	$39,000	L	13
	MH 192	MH 561	12	194	LF	$230	$45,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		

Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				119	DAYS	$10,000	$1,190,000		
Subtotal							$5,645,000		
General Conditions							$564,000		
Subtotal							$6,209,000		
Contenginces							$621,000		
Subtotal							$6,830,000		
Technical Services							$1,025,000		
Total							**$7,855,000**		

Alternative 1: No Lift Station Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 494	MH 542	21	427	LF	$275	$117,000	WWTP	18
	MH 542	MH 541	21	455	LF	$275	$125,000	WWTP	18
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation							$0		
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				116	DAYS	$10,000	$1,160,000		

Subtotal							$5,455,000		
General Conditions							$545,000		
Subtotal							$6,000,000		
Contenginces							$600,000		
Subtotal							$6,600,000		
Technical Services							$990,000		
Total							**$7,590,000**		

Alternative 1: No Lift Station Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$245	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$220	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$230	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$220	$47,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 16	MH 13	18	189	LF	$230	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$260	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$230	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$230	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$230	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$230	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$230	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$230	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$260	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation							$0		
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				52	DAYS	$10,000	$520,000		
Subtotal							$2,408,000		
General Conditions							$241,000		
Subtotal							$2,649,000		
Contenginces							$265,000		
Subtotal							$2,914,000		
Technical Services							$437,000		
Total							**$3,351,000**		

Alternative 1: No Lift Station Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				34	DAYS	$10,000	$340,000		
Subtotal							$1,529,000		
General Conditions							$153,000		
Subtotal							$1,682,000		
Contenginces							$168,000		
Subtotal							$1,850,000		
Technical Services							$278,000		
Total							**$2,128,000**		

Alternative 1: Lift Station C Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 494	MH 542	21	427	LF	$275	$117,000	WWTP	18
	MH 542	MH 541	21	455	LF	$275	$125,000	WWTP	18
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	12	183	LF	$230	$42,000	L	13
	MH 562	MH 200	12	194	LF	$230	$45,000	L	13
	MH 199	MH 562	12	158	LF	$230	$36,000	L	13
	MH 561	MH 199	12	171	LF	$230	$39,000	L	13
	MH 192	MH 561	12	194	LF	$230	$45,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				100	DAYS	$10,000	$1,000,000		
Subtotal							$4,696,000		

General Conditions							$470,000		
Subtotal							$5,165,000		
Contenginces							$517,000		
Subtotal							$5,682,000		
Technical Services							$852,000		
Total							**$6,534,000**		

Alternative 1: Lift Station C Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				92	DAYS	$10,000	$920,000		
Subtotal							$4,245,000		
General Conditions							$425,000		
Subtotal							$4,670,000		
Contenginces							$467,000		
Subtotal							$5,136,000		
Technical Services							$770,000		
Total							**$5,907,000**		

Alternative 1: Lift Station C Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$245	$65,000	F	17
	MH 19	MH 18	18	438	LF	$245	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				51	DAYS	$10,000	$510,000		
Subtotal							$2,361,000		
General Conditions							$236,000		
Subtotal							$2,597,000		
Contenginces							$260,000		
Subtotal							$2,856,000		
Technical Services							$428,000		
Total							**$3,285,000**		

Alternative 1: Lift Station C Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$230	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$230	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$230	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$230	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$230	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$230	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$230	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 1: Lift Station D Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	12	183	LF	$230	$42,000	L	13
	MH 562	MH 200	12	194	LF	$230	$45,000	L	13
	MH 199	MH 562	12	158	LF	$230	$36,000	L	13
	MH 561	MH 199	12	171	LF	$230	$39,000	L	13
	MH 192	MH 561	12	194	LF	$230	$45,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				0	EA	$10,000	$0		

New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				108	DAYS	$10,000	$1,080,000		
Subtotal							$5,048,000		
General Conditions							$505,000		
Subtotal							$5,553,000		
Contenginces							$555,000		
Subtotal							$6,108,000		
Technical Services							$916,000		
Total							**$7,024,000**		

Alternative 1: Lift Station D Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				94	DAYS	$10,000	$940,000		
Subtotal							$4,398,000		
General Conditions							$440,000		
subtotal							$4,838,000		

Contenginces							$484,000		
Subtotal							$5,322,000		
Technical Services							$798,000		
Total							**$6,120,000**		

Alternative 1: Lift Station D Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				52	DAYS	$10,000	$520,000		
Subtotal							$2,408,000		
General Conditions							$241,000		
Subtotal							$2,649,000		
Contenginces							$265,000		
Subtotal							$2,914,000		
Technical Services							$437,000		
Total							**$3,351,000**		

Alternative 1: Lift Station D Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	F	17
	MH 12	MH 11	15	138	LF	$245	$34,000	F	17
	MH 11	MH 10	15	319	LF	$245	$78,000	F	17
	MH 10	MH 9	15	90	LF	$245	$22,000	F	17
	MH 9	MH 5	15	212	LF	$245	$52,000	F	17
	MH 3	MH 546	15	447	LF	$245	$110,000	F	17
	MH 546	MH 1	24	110	LF	$290	$32,000	F	17
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				34	DAYS	$10,000	$340,000		
Subtotal							$1,529,000		
General Conditions							$153,000		
Subtotal							$1,682,000		
Contenginces							$168,000		
Subtotal							$1,850,000		
Technical Services							$278,000		
Total							**$2,128,000**		

Alternative 1: Lift Station C and D Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	12	183	LF	$230	$42,000	L	13
	MH 562	MH 200	12	194	LF	$230	$45,000	L	13
	MH 199	MH 562	12	158	LF	$230	$36,000	L	13
	MH 561	MH 199	12	171	LF	$230	$39,000	L	13
	MH 192	MH 561	12	194	LF	$230	$45,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				89	DAYS	$10,000	$890,000		
Subtotal							$4,131,000		
General Conditions							$413,000		
Subtotal							$4,544,000		

Contenginces							$454,000		
Subtotal							$4,999,000		
Technical Services							$750,000		
Total							**$5,748,000**		

Alternative 1: Lift Station C and D Improvements with 20% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				73	DAYS	$10,000	$730,000		
Subtotal							$3,372,000		
General Conditions							$337,000		
Subtotal							$3,709,000		
Contenginces							$371,000		
Subtotal							$4,080,000		
Technical Services							$612,000		
Total							**$4,692,000**		

Alternative 1: Lift Station C and D Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				51	DAYS	$10,000	$510,000		
Subtotal							$2,361,000		
General Conditions							$236,000		
Subtotal							$2,597,000		
Contenginces							$260,000		
Subtotal							$2,856,000		
Technical Services							$428,000		
Total							**$3,285,000**		

Alternative 1: Lift Station C and D Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 1: Lift Station B Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 494	MH 542	21	427	LF	$275	$117,000	WWTP	18
	MH 542	MH 541	21	455	LF	$275	$125,000	WWTP	18
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	12	183	LF	$230	$42,000	L	13
	MH 562	MH 200	12	194	LF	$230	$45,000	L	13
	MH 199	MH 562	12	158	LF	$230	$36,000	L	13
	MH 561	MH 199	12	171	LF	$230	$39,000	L	13
	MH 192	MH 561	12	194	LF	$230	$45,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				94	DAYS	$10,000	$940,000		
Subtotal							$4,412,000		
General Conditions							$441,000		

Subtotal							$4,853,000		
Contenginces							$485,000		
Subtotal							$5,338,000		
Technical Services							$801,000		
Total							**$6,139,000**		

Alternative 1: Lift Station B Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				85	DAYS	$10,000	$850,000		
Subtotal							$3,951,000		
General Conditions							$395,000		
Subtotal							$4,347,000		
Contenginces							$435,000		
Subtotal							$4,781,000		
Technical Services							$717,000		
Total							**$5,498,000**		

Alternative 1: Lift Station B Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				46	DAYS	$10,000	$460,000		
Subtotal							$2,125,000		
General Conditions							$212,000		
Subtotal							$2,337,000		
Contenginces							$234,000		
Subtotal							$2,571,000		
Technical Services							$386,000		
Total							**$2,956,000**		

Alternative 1: Lift Station B Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 1: Lift Station B and C Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	12	183	LF	$230	$42,000	L	13
	MH 562	MH 200	12	194	LF	$230	$45,000	L	13
	MH 199	MH 562	12	158	LF	$230	$36,000	L	13
	MH 561	MH 199	12	171	LF	$230	$39,000	L	13
	MH 192	MH 561	12	194	LF	$230	$45,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				85	DAYS	$10,000	$850,000		
Subtotal							$3,965,000		

General Conditions							$396,000		
Subtotal							$4,361,000		
Contenginces							$436,000		
Subtotal							$4,797,000		
Technical Services							$720,000		
Total							**$5,517,000**		

Alternative 1: Lift Station B and C Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0		$90	$0		
Sewer 10"				0		$100	$0		
Sewer 12"				0		$110	$0		
Sewer 18"				0		$140	$0		
Sewer 24"				0		$170	$0		
Restoration									
Sewer Bypass Pumping				70	DAYS	$10,000	$700,000		
Subtotal							$3,254,000		
General Conditions							$325,000		
Subtotal							$3,580,000		
Contenginces							$358,000		
Subtotal							$3,938,000		
Technical Services							$591,000		
Total							**$4,528,000**		

Alternative 1: Lift Station B and C Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				46	DAYS	$10,000	$460,000		
Subtotal							$2,125,000		
General Conditions							$212,000		
Subtotal							$2,337,000		
Contenginces							$234,000		
Subtotal							$2,571,000		
Technical Services							$386,000		
Total							**$2,956,000**		

Alternative 1: Lift Station B and C Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 1: Lift Station B, C, and D Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	12	183	LF	$230	$42,000	L	13
	MH 562	MH 200	12	194	LF	$230	$45,000	L	13
	MH 199	MH 562	12	158	LF	$230	$36,000	L	13
	MH 561	MH 199	12	171	LF	$230	$39,000	L	13
	MH 192	MH 561	12	194	LF	$230	$45,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				80	DAYS	$10,000	$800,000		
Subtotal							$3,681,000		
General Conditions							$368,000		
Subtotal							$4,049,000		
Contenginces							$405,000		
Subtotal							$4,454,000		
Technical Services							$668,000		
Total							**$5,122,000**		

Alternative 1: Lift Station B, C, and D Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 212	MH 557	12	352	LF	$230	$81,000	L	WWTP
	MH 203	MH 212	12	284	LF	$230	$65,000	L	13
	MH 558	MH 203	12	218	LF	$230	$50,000	L	13
	MH 201	MH 558	12	306	LF	$230	$70,000	L	13
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 192-1	MH 192	12	25	LF	$230	$6,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				67	DAYS	$10,000	$670,000		
Subtotal							$3,088,000		
General Conditions							$309,000		
Subtotal							$3,397,000		
Contenginces							$340,000		
Subtotal							$3,736,000		
Technical Services							$560,000		
Total							**$4,297,000**		

Alternative 1: Lift Station B, C, and D Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 557	MH 214	12	114	LF	$230	$26,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				46	DAYS	$10,000	$460,000		
Subtotal							$2,125,000		
General Conditions							$212,000		
Subtotal							$2,337,000		
Contenginces							$234,000		
Subtotal							$2,571,000		
Technical Services							$386,000		
Total							**$2,956,000**		

Alternative 1: Lift Station B, C, and D Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0		$90	$0		
Sewer 10"				0		$100	$0		
Sewer 12"				0		$110	$0		
Sewer 18"				0		$140	$0		
Sewer 24"				0		$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 2: No Lift Station Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 494	MH 542	24	427	LF	$290	$124,000	WWTP	18
	MH 542	MH 541	24	455	LF	$290	$132,000	WWTP	18
	MH 541	MH 540	24	417	LF	$290	$121,000	WWTP	18
	MH 540	MH 544	24	353	LF	$290	$102,000	WWTP	18
	MH 545	MH 546	24	171	LF	$290	$49,000	WWTP	WWTP
	MH 544	MH 545	24	325	LF	$290	$94,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$6,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									

Sewer Bypass Pumping				110	DAYS	$10,000	$1,100,000		
Subtotal							$5,325,000		
General Conditions							$533,000		
Subtotal							$5,858,000		
Contenginces							$586,000		
Subtotal							$6,444,000		
Technical Services							$967,000		
Total							**$7,410,000**		

Alternative 2: No Lift Station Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 494	MH 542	21	427	LF	$275	$117,000	WWTP	18
	MH 542	MH 541	21	455	LF	$275	$125,000	WWTP	18
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$42,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$6,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212		$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				104	DAYS	$10,000	$1,040,000		
Subtotal							$4,999,000		

General Conditions							$500,000		
Subtotal							$5,499,000		
Contenginces							$550,000		
Subtotal							$6,049,000		
Technical Services							$907,000		
Total							**$6,957,000**		

Alternative 2: No Lift Station Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				52	DAYS	$10,000	$520,000		
Subtotal							$2,456,000		
General Conditions							$246,000		
Subtotal							$2,701,000		
Contenginces							$270,000		
Subtotal							$2,971,000		
Technical Services							$446,000		
Total							**$3,417,000**		

Alternative 2: No Lift Station Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	61	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	173	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	132	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				34	DAYS	$10,000	$340,000		
Subtotal							$1,529,000		
General Conditions							$153,000		
Subtotal							$1,682,000		
Contenginces							$168,000		
Subtotal							$1,850,000		
Technical Services							$278,000		
Total							**$2,128,000**		

Alternative 2: Lift Station C Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 494	MH 542	21	427	LF	$275	$117,000	WWTP	18
	MH 542	MH 541	21	455	LF	$275	$125,000	WWTP	18
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$6,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				92	DAYS	$10,000	$920,000		
Subtotal							$4,386,000		
General Conditions							$439,000		
Subtotal							$4,825,000		

Contenginces							$482,000		
Subtotal							$5,307,000		
Technical Services							$796,000		
Total							**$6,103,000**		

Alternative 2: Lift Station C Improvements with 20% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$42,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$6,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				79	DAYS	$10,000	$790,000		
Subtotal							$3,780,000		
General Conditions							$378,000		
Subtotal							$4,158,000		
Contenginces							$416,000		
Subtotal							$4,573,000		
Technical Services							$686,000		
Total							**$5,259,000**		

Alternative 2: Lift Station C Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	173	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	132	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				50	DAYS	$10,000	$500,000		
Subtotal							$2,398,000		
General Conditions							$240,000		
Subtotal							$2,638,000		
Contenginces							$264,000		
Subtotal							$2,902,000		
Technical Services							$435,000		
Total							**$3,337,000**		

Alternative 2: Lift Station C Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	173	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	132	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 2: Lift Station D Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$6,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				99	DAYS	$10,000	$990,000		
Subtotal							$4,723,000		

General Conditions							$472,000		
Subtotal							$5,195,000		
Contenginces							$520,000		
Subtotal							$5,715,000		
Technical Services							$857,000		
Total							**$6,572,000**		

Alternative 2: Lift Station D Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 330	MH 465	18	631	LF	$260	$164,000	D	18
	MH 465	MH 464	18	371	LF	$260	$96,000	D	18
	MH 464	MH 467	18	239	LF	$260	$62,000	D	18
	MH 467	MH 468	18	400	LF	$260	$104,000	D	18
	MH 468	MH 470	18	430	LF	$260	$112,000	D	18
	MH 470	MH 473	18	369	LF	$260	$96,000	D	18
	MH 473	MH 476	18	356	LF	$260	$92,000	D	18
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$42,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$6,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				82	DAYS	$10,000	$820,000		
Subtotal							$3,943,000		
General Conditions							$394,000		
Subtotal							$4,337,000		
Contenginces							$434,000		
Subtotal							$4,771,000		
Technical Services							$716,000		
Total							**$5,486,000**		

Alternative 2: Lift Station D Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				52	DAYS	$10,000	$520,000		
Subtotal							$2,456,000		
General Conditions							$246,000		
Subtotal							$2,701,000		
Contenginces							$270,000		
Subtotal							$2,971,000		
Technical Services							$446,000		
Total							**$3,417,000**		

Alternative 2: Lift Station D Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	F	17
	MH 12	MH 11	15	138	LF	$245	$34,000	F	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	17
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	17
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				34	DAYS	$10,000	$340,000		
Subtotal							$1,529,000		
General Conditions							$153,000		
Subtotal							$1,682,000		
Contenginces							$168,000		
Subtotal							$1,850,000		
Technical Services							$278,000		
Total							**$2,128,000**		

Alternative 2: Lift Station C and D Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				81	DAYS	$10,000	$810,000		
Subtotal							$3,823,000		
General Conditions							$382,000		
Subtotal							$4,205,000		
Contenginces							$421,000		
Subtotal							$4,626,000		
Technical Services							$694,000		
Total							**$5,320,000**		

Alternative 2: Lift Station C and D Improvements with 20% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 302	MH 328	12	102	LF	$230	$23,000	D	6
	MH 303	MH 302	12	62	LF	$230	$14,000	D	6
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				61	DAYS	$10,000	$610,000		
Subtotal							$2,917,000		
General Conditions							$292,000		
Subtotal							$3,209,000		
Contenginces							$321,000		
Subtotal							$3,530,000		
Technical Services							$530,000		
Total							**$4,060,000**		

Alternative 2: Lift Station C and D Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 329	MH 330	12	351	LF	$230	$81,000	D	7
	MH 328	MH 329	12	458	LF	$230	$105,000	D	6
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				50	DAYS	$10,000	$500,000		
Subtotal							$2,398,000		
General Conditions							$240,000		
Subtotal							$2,638,000		
Contenginces							$264,000		
Subtotal							$2,902,000		
Technical Services							$435,000		
Total							**$3,337,000**		

Alternative 2: Lift Station C and D Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	F	17
	MH 12	MH 11	15	138	LF	$245	$34,000	F	17
	MH 11	MH 10	15	319	LF	$245	$78,000	F	17
	MH 10	MH 9	15	90	LF	$245	$22,000	F	17
	MH 9	MH 5	15	212	LF	$245	$52,000	F	17
	MH 3	MH 546	15	447	LF	$245	$110,000	F	17
	MH 546	MH 1	24	110	LF	$290	$32,000	F	17
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 2: Lift Station B Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 494	MH 542	21	427	LF	$275	$117,000	WWTP	18
	MH 542	MH 541	21	455	LF	$275	$125,000	WWTP	18
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				85	DAYS	$10,000	$850,000		
Subtotal							$4,094,000		
General Conditions							$409,000		
Subtotal							$4,503,000		

Contenginces							$450,000		
Subtotal							$4,954,000		
Technical Services							$743,000		
Total							**$5,697,000**		

Alternative 2: Lift Station B Improvements with 20% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 541	MH 540	21	417	LF	$275	$115,000	WWTP	18
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				73	DAYS	$10,000	$730,000		
Subtotal							$3,497,000		
General Conditions							$350,000		
Subtotal							$3,847,000		
Contenginces							$385,000		
Subtotal							$4,232,000		
							$0		
Technical Services							$635,000		
Total							**$4,866,000**		

Alternative 2: Lift Station B Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				45	DAYS	$10,000	$450,000		
Subtotal							$2,162,000		
General Conditions							$216,000		
Subtotal							$2,378,000		
Contenginces							$238,000		
Subtotal							$2,616,000		
Technical Services							$392,000		
Total							**$3,009,000**		

Alternative 2: Lift Station B Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 2: Lift Station B and C Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 540	MH 544	21	353	LF	$275	$97,000	WWTP	18
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				77	DAYS	$10,000	$770,000		
Subtotal							$3,656,000		
General Conditions							$366,000		
Subtotal							$4,022,000		
Contenginces							$402,000		
Subtotal							$4,424,000		
Technical Services							$664,000		
Total							**$5,088,000**		

Alternative 2: Lift Station B and C Improvements with 20% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 545	MH 546	21	171	LF	$275	$47,000	WWTP	WWTP
	MH 544	MH 545	21	325	LF	$275	$89,000	WWTP	18
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				58	DAYS	$10,000	$580,000		
Subtotal							$2,800,000		
General Conditions							$280,000		
Subtotal							$3,080,000		
Contenginces							$308,000		
Subtotal							$3,388,000		
Technical Services							$508,000		
Total							**$3,896,000**		

Alternative 2: Lift Station B and C Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				45	DAYS	$10,000	$450,000		
Subtotal							$2,162,000		
General Conditions							$216,000		
Subtotal							$2,378,000		
Contenginces							$238,000		
Subtotal							$2,616,000		
Technical Services							$392,000		
Total							**$3,009,000**		

Alternative 2: Lift Station B and C Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

Alternative 2: Lift Station C, B, and D Improvements with 0% Reduction in I/I									
Excavate and Replace	Upstream Manhole	Downstream Manhole	New Diameter (in)	Length	Unit	Unit Cost	Total Cost	Downstream Lift Station	Downstream Flow Meter
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 532	MH 496	12	802	LF	$230	$185,000	WWTP	18
	MH 530	MH 532	12	656	LF	$230	$151,000	WWTP	3
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	12	264	LF	$230	$61,000	B	8
	MH 307A	MH 307B	10	40	LF	$220	$9,000	B	8
	MH 308-1	MH 307A	10	116	LF	$220	$26,000	B	8
	MH 308	MH 308-1	10	60	LF	$220	$13,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	18	175	LF	$260	$45,000	L	11
	MH 232	MH 231	18	410	LF	$260	$107,000	L	11
	MH 231	MH 230	18	130	LF	$260	$34,000	L	11
	MH 230	MH 229	18	122	LF	$260	$32,000	L	11
	MH 268	MH 230	12	137	LF	$230	$31,000	L	11
	MH 267	MH 268	12	322	LF	$230	$74,000	L	10
	MH 229	Lift Station L	18	206	LF	$260	$54,000	L	WWTP
	MH 214	Lift Station L	18	28	LF	$260	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 199	MH 562	10	158	LF	$220	$35,000	L	13
	MH 561	MH 199	10	171	LF	$220	$38,000	L	13
	MH 192	MH 561	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
	MH 308-2	MH 308	10	63	LF	$220	$14,000	B	8
	MH 307B	MH 306	10	155	LF	$220	$34,000	B	8
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				71	DAYS	$10,000	$710,000		
Subtotal							$3,363,000		
General Conditions							$336,000		
Subtotal							$3,699,000		
Contenginces							$370,000		
Subtotal							$4,069,000		
Technical Services							$610,000		
Total							**$4,680,000**		

Alternative 2: Lift Station C, B, and D Improvements with 20% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	12	19	LF	$230	$4,000	B	6
	MH 306B	MH 305-1	12	413	LF	$230	$95,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	15	175	LF	$245	$43,000	L	11
	MH 232	MH 231	15	410	LF	$245	$100,000	L	11
	MH 231	MH 230	15	130	LF	$245	$32,000	L	11
	MH 230	MH 229	15	122	LF	$245	$30,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	15	206	LF	$245	$50,000	L	WWTP
	MH 214	Lift Station L	15	28	LF	$245	$7,000	L	WWTP
	MH 200	MH 201	10	183	LF	$220	$40,000	L	13
	MH 562	MH 200	10	194	LF	$220	$43,000	L	13
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 58	MH 57	12	118	LF	$230	$27,000	F	17
	MH 57	MH 56	12	262	LF	$230	$60,000	F	17
	MH 56	MH 55	12	309	LF	$230	$71,000	F	17
	MH 55	MH 54	12	211	LF	$230	$49,000	F	17
	MH 54	MH 53	12	154	LF	$230	$35,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	24	447	LF	$290	$130,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				598	LF	$100	$60,000		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				55	DAYS	$10,000	$550,000		
Subtotal							$2,634,000		
General Conditions							$263,000		
Subtotal							$2,897,000		
Contenginces							$290,000		
Subtotal							$3,187,000		
Technical Services							$478,000		
Total							**$3,665,000**		

Alternative 2: Lift Station C, B, and D Improvements with 40% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 495	MH 494	12	360	LF	$230	$83,000	WWTP	18
	MH 496	MH 495	12	213	LF	$230	$49,000	WWTP	18
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	18	189	LF	$260	$49,000	WWTP	17
	MH 18	Lift Station F	18	249	LF	$260	$65,000	F	17
	MH 19	MH 18	18	438	LF	$260	$114,000	F	17
	MH 53	MH 48	12	272	LF	$230	$63,000	F	17
	MH 48	MH 44	12	421	LF	$230	$97,000	F	17
	MH 13	MH 12	18	156	LF	$260	$41,000	WWTP	17
	MH 12	MH 11	18	138	LF	$260	$36,000	WWTP	17
	MH 11	MH 10	18	319	LF	$260	$83,000	WWTP	17
	MH 10	MH 9	18	90	LF	$260	$23,000	WWTP	17
	MH 9	MH 5	18	212	LF	$260	$55,000	WWTP	17
	MH 5	MH 3	18	692	LF	$260	$180,000	WWTP	17
	MH 3	MH 546	18	447	LF	$260	$116,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				2	EA	$10,000	$20,000		
New Sewer Installation									
Sewer 8"				598	LF	$90	$54,000		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				45	DAYS	$10,000	$450,000		
Subtotal							$2,162,000		
General Conditions							$216,000		
Subtotal							$2,378,000		
Contenginces							$238,000		
Subtotal							$2,616,000		
Technical Services							$392,000		
Total							**$3,009,000**		

Alternative 2: Lift Station C, B, and D Improvements with 60% Reduction in I/I									
Excavate and Replace	**Upstream Manhole**	**Downstream Manhole**	**New Diameter (in)**	**Length**	**Unit**	**Unit Cost**	**Total Cost**	**Downstream Lift Station**	**Downstream Flow Meter**
	MH 304	Lift Station B	10	19	LF	$220	$4,000	B	6
	MH 306B	MH 305-1	10	413	LF	$220	$91,000	B	6
	MH 306	MH 306B	10	264	LF	$220	$58,000	B	8
	MH 305-1	MH 304	12	258	LF	$230	$59,000	B	6
	MH 233	MH 232	12	175	LF	$230	$40,000	L	11
	MH 232	MH 231	12	410	LF	$230	$94,000	L	11
	MH 231	MH 230	12	130	LF	$230	$30,000	L	11
	MH 230	MH 229	12	122	LF	$230	$28,000	L	11
	MH 268	MH 230	10	137	LF	$220	$30,000	L	11
	MH 267	MH 268	10	322	LF	$220	$71,000	L	10
	MH 229	Lift Station L	12	206	LF	$230	$47,000	L	WWTP
	MH 16	MH 13	15	189	LF	$245	$46,000	WWTP	17
	MH 13	MH 12	15	156	LF	$245	$38,000	WWTP	17
	MH 12	MH 11	15	138	LF	$245	$34,000	WWTP	17
	MH 11	MH 10	15	319	LF	$245	$78,000	WWTP	17
	MH 10	MH 9	15	90	LF	$245	$22,000	WWTP	17
	MH 9	MH 5	15	212	LF	$245	$52,000	WWTP	17
	MH 3	MH 546	15	447	LF	$245	$110,000	WWTP	WWTP
	MH 546	MH 1	24	110	LF	$290	$32,000	WWTP	WWTP
New Manhole				0	EA	$10,000	$0		
New Sewer Installation									
Sewer 8"				0	LF	$90	$0		
Sewer 10"				0	LF	$100	$0		
Sewer 12"				0	LF	$110	$0		
Sewer 18"				0	LF	$140	$0		
Sewer 24"				0	LF	$170	$0		
Restoration									
Sewer Bypass Pumping				27	DAYS	$10,000	$270,000		
Subtotal							$1,235,000		
General Conditions							$124,000		
Subtotal							$1,359,000		
Contenginces							$136,000		
Subtotal							$1,495,000		
Technical Services							$224,000		
Total							**$1,719,000**		

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