Appendix 5C

Water Resources

2018 Sanitary Sewer Collection System Comprehensive Plan

140 pages

2018 Sanitary Sewer Collection System Comprehensive Plan

Golden Valley Comprehensive Plan

Golden Valley, Minnesota

GOLDV 139902 November 27, 2017 – Revised January 2019

SEH

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November 27, 2017

RE: Golden Valley Comprehensive Plan
2018 Sanitary Sewer Collection System Comprehensive Plan
Golden Valley, Minnesota
SEH No. GOLDV 139902 4.00

Mr. Jeff Oliver, PE
City Engineer
City of Golden Valley
7800 Golden Valley Road
Golden Valley, MN 55427

Dear Jeff:

Please find enclosed our final copy of the City of Golden Valley Sanitary Sewer Collection System Comprehensive Plan for 2018 as required by the Metropolitan Council. As you know, the City's Comprehensive Plan is the part of a long-range planning document for future development of Golden Valley and the regional metropolitan area. This document updates the previous Golden Valley Sanitary Sewer Comprehensive Plan, so the City can complete the wastewater section of their Metropolitan Council 2040 comprehensive plan update.

Our staff developed this plan based on conversations with your staff, our knowledge of the system and information from the previous comprehensive plan. In addition, we used the following information: the City's GIS database, current and future land use plans, water records and I/I data to update and model the City's current sanitary sewer collection system. The existing sanitary sewer model software (InfoSWMM), product licensed by Innovyze, was again used and updated to determine design capacity in the existing collection system and any changes needed to handle future development.

If you have any questions relating to this document, please contact me by email at kvannote@sehinc.com or at 651.490.2144.

Sincerely,

Kirby Van Note, PE
Project Manager

dmk
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2018 Sanitary Sewer Collection System Comprehensive Plan

Golden Valley Comprehensive Plan
Golden Valley, Minnesota

SEH No. GOLDV 139902

November 27, 2017

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

Kirby Van Note, PE

Date: November 27, 2017 License No.: 16241

Reviewed By: Emily Steinweg Date: November 27, 2017

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
St. Paul, MN 55110-5196
651.490.2000

Distribution

No. of Copies	Sent to
___	Jeff Oliver, PE City Engineer City of Golden Valley 7800 Golden Valley Road Golden Valley, MN 55427
___	R.J. Kakach, E.I.T. Utility Engineer City of Golden Valley 7800 Golden Valley Road Golden Valley, MN 55427
___	Joe Hansen Utilities Supervisor City of Golden Valley 7800 Golden Valley Road Golden Valley, MN 55427
___	Emily Steinweg Short Elliott Hendrickson Inc. 3535 Vadnais Center Drive St. Paul, MN 55110

Executive Summary

The Golden Valley sanitary sewer collection system is part of the overall Minneapolis-Saint Paul Regional wastewater collection and treatment system program managed and operated by the Metropolitan Council Environmental Services (MCES). In addition to the interceptor collection system owned by the MCES, the local sanitary collection system is jointly owned under private ownership and the City of Golden Valley. The MCES is required under state and federal requirements to insure all wastewater throughout the Twin Cities Metropolitan area does not leave their interceptors and is properly treated before discharge to local receiving streams.

In order to ensure the capacity of their interceptors, the MCES adopted a surcharge program to make sure all communities were properly maintaining their sanitary sewer collection systems and managing peak discharges caused by inflow and infiltration (I/I) in their sanitary sewer collection systems. Prior to 2003, the Golden Valley sanitary collection system had a history of measuring high peak wastewater flow rates during rainfall events. As a result of the MCES Surcharge Program, peak wastewater flow rates above MCES allowances were identified during rainfall events in September and October of 2005 resulting in the city of Golden Valley committing to an I/I abatement program to manage and reduce their wastewater contributions to the MCES interceptors.

The City of Golden Valley established two goals to effectively manage their wastewater and sanitary sewer collection system. They are consistent with the goals and objectives of the MCES and are as follows:

Goal 1 - Provide adequate capacity to insure wastewater collected for treatment does not leave the Golden Valley sanitary collection system causing a Sanitary Sewer Overflow (SSO).

Goal 2 – Reduce I/I to a manageable level to maintain and reserve wastewater capacity within Golden Valley for future development and reduce operation and maintenance each year.

Over the past ten years, the City of Golden Valley have taken an aggressive approach to reducing the impact of I/I to their collection system. Following a preliminary assessment through flow monitoring, the city implemented a private property inspection program. The inspection program consisted of two parts, a voluntary program through the City's street reconstruction program and a mandatory program through property sales (Point of Sale). The private property inspection program, in conjunction with the City's ongoing sanitary sewer rehabilitation efforts, has reduced peak wastewater flow events caused by I/I across the City. Prior to the program during the spring of 2003, permanent flow meters operated by the MCES recorded peak wastewater flow rates exceeding 19 million gallons per day (mgd). A typical dry weather day would record only 3 mgd on average. In 2014 after eight years of the program, a similar event in the spring recorded less than half the peak wastewater flow rate at the same MCES flow meter location.

Although the inspection program has been very successful, due to the structure of the program, many of the private properties addressed have been more focused on the eastern side of the Golden Valley where more of the street reconstruction programs have been completed over the past eight years. City efforts continue to reduce the negative impact on the system resulting from I/I. The program has been successful in locating and repairing illegal connections to the wastewater conveyance system. Illegal connections include foundation drains or basement sump discharging to the sanitary sewer. As of fall 2016, the City has repaired 310 illegal sump and/or foundation drains throughout the City.

The previous sanitary sewer model developed over ten years ago has been an effective tool for city staff to help with the decision making process as a result of future redevelopment projects throughout the city. The existing model identified a number of areas where pipe capacity has been an issue due to existing I/I and redevelopment in western areas of the city. Future development opportunities in critical areas where pipe capacity could potentially be an issue especially along the Hwy 55 and I-394 corridors can be evaluated to determine how and if

land use changes will impact existing sanitary sewer infrastructure. The success of the I/I program has been reflected in an updated sanitary sewer model by adjusting peak wastewater flow rates and allowing more reserve pipe capacity for potential development.

Much of the City of Golden Valley's wastewater infrastructure was installed prior to 1970. Over eighty-six (86) percent of the wastewater infrastructure is over fifty (50) years old with more than half of that total more than sixty (60) years old. The infrastructure is reaching the end of its typical useful life. It is time to push for infrastructure renewal to maintain the integrity and function of the system. Years of maintenance and clear water from I/I entering the collection system will reduce the overall service life of the existing infrastructure. As the wastewater system ages, the pipes and structures underground crack and break, allowing ground water to enter the system. Groundwater is clean water and does not need to be treated at a wastewater plant. This I/I takes precious wastewater flow space and results in extra fees to the residents of Golden Valley. A programmed lining project can increase the life span of older pipes as well as reduce the amount of I/I entering the wastewater system. Without continued maintenance and renewal, costs to the City will increase, from emergency repairs, to surcharge fees to worst case scenarios like collapsing infrastructure resulting from cracks and breaks in the system.

Through the work of various studies, scans, flow monitoring and emergency repairs, it is apparent the wastewater infrastructure needs repairs and rehabilitation. Regular maintenance has been performed, including cleaning and televising, pipe lining and asset scanning for condition status, but it is not enough to keep up with the aging system. To continue to provide sufficient wastewater capacity to the residents, a dedicated effort to repair and rehabilitate the wastewater infrastructure is highly recommended. In addition to the work completed on private property, the City of Golden Valley has upgraded the sanitary sewer collection system during many street reconstruction projects. In addition, a sewer lining project has been implemented along Laurel Avenue to reduce potential I/I in a high groundwater area and maintain pipe capacity along the I-394 corridor. Work is still needed on lift station repair and rehabilitation. One lift station in particular, at Highway 55, is strongly recommended to be prioritized for evaluation and reconstruction. The lift station currently sits in the flood plain, and has been impacted by flood waters in the past which included City staff needing to place sand bags around the station during a large rain event. The Highway 55 station, if not reconstructed out of the flood plain, will have a negative environmental impact should a flood event cause the station to backup or overflow. Located near multiple ponds, Sweeney Lake, Theodore Worth Regional Park and the Sweeney Lake branch of Bassett Creek, it is in a very visible location should any issues occur. City staff knows this station in particular needs to be reconstructed and plan to address that as soon as fiscally possible. In the meantime, it is recommended to install a grinder pump in the station, to reduce the issues caused by flushable wipes and other materials.

Future development in the core industrial and commercial areas may require the City to evaluate the need for their main collection pipes to be upsized. Due to increased growth and changes in development, certain stretches of wastewater piping may be found to be undersized and impact the City's goals for their infrastructure. Undersized pipes can cause backups in high flow events which result in costly repairs to individual residents and businesses as well as the City as a whole. The sanitary sewer model is an effective tool to determine if future development will impact pipe capacity resulting in undersized pipes and the potential to limit future Golden Valley growth.

Continual work will improve life of residents of Golden Valley by maintaining water quality with the reduction of wastewater overflows and backups, lowering wastewater costs to each resident, and improve the local economy by promoting future growth and development.

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2018 Sanitary Sewer Collection System Comprehensive Plan

Golden Valley Comprehensive Plan

Prepared for the City of Golden Valley

1 Introduction

The City of Golden Valley is a mature suburb in the Minneapolis/St. Paul metropolitan area having a population of 20,371 people in the year 2010 based on the 2010 census supplied by the United States Census Bureau. The Metropolitan Council forecasts that by the year 2040 the City will have a population of approximately 22,900 people.

The following sanitary sewer collection system plan is part of an overall Comprehensive Plan update for the City which provides the technical documentation to support the long range sanitary sewer collection system planning efforts.

Sanitary sewage is collected in over 113 miles of City owned and maintained sewer pipe ranging in sizes from 8-inches to 36-inches in diameter. There are three (3) sewage lift stations which serve small isolated areas. To evaluate the collection system, the City was divided into sanitary sewer drainage districts for this study. The boundaries of the districts are correlated with those defined in the Inflow/Infiltration Study completed in 2005.

Treatment of wastewater is provided by the Metropolitan Council Environmental Services (MCES) at the Metro Plant in St. Paul. MCES collection interceptors extend through the community east to west (MCES Bassett Creek interceptor) and north to south (MCES St. Louis Park interceptor) to collect and transport a large portion of the City wastewater. The average daily flow from Golden Valley to the Metropolitan Council Environmental Services (MCES) system is approximately 2.35 million gallons per day (MGD).

2 System Inventory and Analysis

2.1 Existing Sanitary Sewer Collection System Gravity System

The existing City gravity sewer system is an aged system of approximately 113 miles of pipe ranging in size from 8-in. to 36-in. diameter. Portions of the sewer were installed more than 50 years ago, with over 70 percent of the system installed prior to 1966. An inventory of pipe based on the material and age of the pipe is shown in Table 1. Maps of the sewer size and material are attached at the end of the report as Figures 1 and 2.

Table 1 – Sanitary Sewer Gravity Main by Year of Installation (feet)

Material	Size (inch)	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	Unknown	Grand Total (feet)	Grand Total (miles)
CIP	4				74.10	498.42									301.92	874.44	***0.17***
	6	300.81						49.98								350.79	***0.07***
	8	5250.18	21318.84	3861.46	416.99	268.59	176.37	324.93		229.70		323.61			190.03	32360.69	***6.13***
	9	226.95	947.50	62.37	56.03											1292.86	***0.24***
	10	1497.53	5511.11	1528.38				200.65							189.93	8927.61	***1.69***
	12	3205.81	2120.03													5325.84	***1.01***
	16	1819.65														1819.65	***0.34***
CIP Total		**12300.93**	**29897.49**	**5452.20**	**547.12**	**767.01**	**176.37**	**575.56**		**229.70**		**323.61**			**681.89**	**50951.88**	***9.65***
CIPP CIP	8												1044.00	1127.25		2171.25	***0.41***
CIPP CIP Total													**1044.00**	**1127.25**		**2171.25**	***0.41***
CIPP DIP	10													215.02		215.02	***0.04***
CIPP DIP Total														**215.02**		**215.02**	***0.04***
CIPP RCP	12													2587.10		2587.10	***0.49***
CIPP RCP Total														**2587.10**		**2587.10**	***0.49***
CIPP VSP	9											1232.34	24732.15	17419.37		43383.85	***8.22***
	10													208.99		208.99	***0.04***
CIPP VSP Total												**1232.34**	**24732.15**	**17628.36**		**43592.84**	***8.26***
DIP	4							248.29								248.29	***0.05***
	6				310.48						46.50					356.98	***0.07***
	8	252.90	221.26	691.17	394.65	528.51	1329.78	113.90	3308.68	1454.01	1151.81	833.06	614.27	68.86	1698.06	12660.94	***2.40***
	9													60.90	31.27	92.16	***0.02***
	10		245.68		23.63	476.16		533.40	675.85				134.07		1381.93	3470.71	***0.66***
	12								300.84	278.85		1196.44			395.97	2172.10	***0.41***
	15								108.68							108.68	***0.02***
	16								650.64	426.04						1076.68	***0.20***
	20									385.90						385.90	***0.07***
DIP Total		**252.90**	**466.93**	**691.17**	**728.76**	**1004.68**	**1329.78**	**895.58**	**5044.68**	**2544.81**	**1198.32**	**2029.50**	**748.35**	**129.76**	**3507.23**	**20572.44**	***3.90***
HDPE	10											474.70				474.70	***0.09***
HDPE Total												**474.70**				**474.70**	***0.09***
LJP	16		1049.09													1049.09	***0.20***
	24	200.40	438.49													638.89	***0.12***
LJP Total		**200.40**	**1487.58**													**1687.97**	***0.32***

Material	Size (inch)	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	2011-2015	Unknown	Grand Total (feet)	Grand Total (miles)
PVC	**2**										490.49	610.76				1101.25	***0.21***
	4					255.91										255.91	***0.05***
	8	823.00	1533.87		455.84	1049.78	2519.92	378.07	369.40	803.92	13141.90	2381.62	2001.58	550.83	4859.84	30869.56	***5.85***
	9		239.55		688.34										302.67	1230.56	***0.23***
	10						1154.78									1154.78	***0.22***
	10						92.84									92.84	***0.02***
	10	288.79					168.93					14.36	574.49			1046.57	***0.20***
	12										742.07				394.97	1137.04	***0.22***
PVC Total		**1111.78**	**1773.42**		**1144.17**	**1305.70**	**3936.47**	**378.07**	**369.40**	**803.92**	**14374.46**	**3006.75**	**2576.08**	**550.83**	**5557.48**	**36888.52**	***6.99***
RCP	**9**														676.63	676.63	***0.13***
	12	4863.69	25304.72	1296.07					916.43	347.53				354.83	1722.92	34806.18	***6.59***
	15	3941.12	7005.59						786.79						58.83	11792.34	***2.23***
	18		3023.07													3023.07	***0.57***
	21		7145.47								423.12					7568.59	***1.43***
	24		8476.74		255.91					294.79	229.46				574.74	9831.65	***1.86***
RCP Total		**8804.81**	**50955.59**	**1296.07**	**255.91**				**1703.23**	**642.32**	**652.57**			**354.83**	**3033.13**	**67698.45**	***12.82***
VCP	**6**														1033.24	1033.24	***0.20***
	8						2621.49	502.41	344.34						263.40	3731.63	***0.71***
	9	145.42	1376.96	52.17									937.22		1270.80	3782.57	***0.72***
	10														208.46	208.46	***0.04***
	30														17.32	17.32	***0.00***
VCP Total		**145.42**	**1376.96**	**52.17**			**2621.49**	**502.41**	**344.34**				**937.22**		**2793.22**	**8773.23**	***1.66***
VSP	**6**		187.94		464.47											652.42	***0.12***
	8	18.41	3883.71	175.31	614.05	1091.19	4551.92		338.92		169.35		251.84		248.36	11343.06	***2.15***
	9	76368.21	188995.10	43747.58	20457.65	7772.93	99.34		303.62		325.52	856.30	829.18	703.57	3890.70	344349.68	***65.22***
	10		226.31				484.16									710.47	***0.13***
	12		2245.79													2245.79	***0.43***
VSP Total		**76386.62**	**195538.85**	**43922.89**	**21536.16**	**8864.12**	**5135.42**		**642.54**		**494.87**	**856.30**	**1081.02**	**703.57**	**4139.06**	**359301.42**	***68.05***
Grand Total (feet)		**99202.86**	**281496.83**	**51414.50**	**24212.13**	**11941.51**	**13199.52**	**2351.61**	**8104.19**	**4220.74**	**16720.22**	**7923.20**	**31118.81**	**23296.71**	**19712.01**	**594914.83**	***112.67***
Grand Total (miles)		***18.79***	***53.31***	***9.74***	***4.59***	***2.26***	***2.50***	***0.45***	***1.53***	***0.80***	***3.17***	***1.50***	***5.89***	***4.41***	***3.73***	***112.67***	

Abbreviations in Pipe Table:

CIP – Cast Iron Pipe
CIPP – Cured-in-Place-Pipe
DIP – Ductile Iron Pipe
HDPE – High Density Polyethylene
LJP – Lock Joint Pipe
PVC – Polyvinyl Chloride
RCP – Reinforced Concrete Pipe
VCP – Vitrified Clay Pipe
VSP – Vitrified Sewer Pipe

The system contains almost 70 miles of pipe classified as Vitrified Sewer Pipe (VSP) or Vitrified Clay Pipe (VCP). Aging VCP is commonly associated with I/I problems due to the number of pipe joints in the system. The number of joints also adds to its susceptibility to root intrusion. The majority of VCP pipe was installed in Golden Valley prior to the mid 1970's. The City has developed a Pavement Management Program (PMP), which includes a review of all utilities during the process of updating the City's streets. The program includes an inspection of the sanitary sewer collection system in the public right of way and a voluntary program of sewer lateral inspections on private property. Through sanitary sewer closed-circuit television inspection (CCTV) and evaluation of older sewer pipe in the public right of way, much of which is VCP sewer, the City has developed a successful rehabilitation program for its aging infrastructure using relining or pipe replacement techniques. However, significant portions of the City had streets reconstructed prior to implementation of the sanitary sewer as part of the PMP. Therefore, these areas have significant rehabilitation needs in the public and private systems.

The portion of the sanitary sewer collection system on private property is similar to the public VCP sewer mains, in that there is a significant number of sanitary sewer laterals using VCP materials with the potential to experience similar maintenance problems and contribute I/I. There are an estimated 147 miles of private service lines, which exceeds the City sewer system by 35 miles, making up approximately 55% of the total sewer system. Thus, the City has adopted a voluntary sewer lateral inspection and repair program as part of the pavement management program and a mandatory point of sale program to address these issues on private property as well.

2.2 Lift Stations

The City of Golden Valley's wastewater sanitary sewer system contains three sewage lift stations (Schaper, Highway 55 and Woodstock). Figure 3 displays the location of each station throughout the City. Table 2 identifies the capacity of each station and Table 3 the total detention time, from the last inspection, performed in 2007.

The capacity and physical condition at each station was inspected for the prior comprehensive plan. The purpose of the inspections was to identify deficiencies of each station and to establish a priority for improvements to the stations. Appendix A contains the results of the previous inspections for each lift station.

SEH analyzed the condition of each station and made improvement recommendations for each station. Proposed improvements were divided into six categories:

- **Hydraulic Capacity -** The criteria used for determining adequate hydraulic capacity is compliance with the Minnesota Pollution Control Agency's capacity requirements as published in the Ten States Standards which are recommended standards for wastewater facilities established by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. The information of primary importance is the detention time in the individual stations wet well and the average number of starts per hour of operations for each pump.
- **Pumping Capacity -** Adequacy of pumping capacity was based on whether the station is able to pump the peak instantaneous flow with the largest pump out of service. The lift stations ability to reliably handle the range of average daily flow rates to peak flow rates are also considered in the sewer system hydraulic model.
- **Physical Condition -** The physical condition of each station is a subjective analysis by SEH based upon a visual observation of the concrete, steel components, piping and

valves. The suitability of the station location is a review of the stations accessibility and aesthetics.

- **Electrical Issues -** The electrical condition of the pumps was reviewed by observing the amperage draw of the pumps and the physical condition of the electrical components of the station.
- **Instrumentation/Control -** Instrumentation control review consisted of identifying whether the station alarms are being transmitted to the central control facility.
- **Potential for Sewer Back-up -** The potential for sewer backups include two items: (1) whether the stations contain either a standby generator or a receptacle for plugging to a standby generator and, (2) whether the wet well and influent sewer contain adequate storage capacity to allow a response by the sewer utility staff in the event of a power outage. A retention time of one hour is assumed to be adequate and a retention time of less than one-half hour is unsatisfactory.

All lift stations have recommended improvements of varying degrees that should be included in future planning. The City has made small improvements throughout the years and continues to anticipate future needs. The Highway 55 station is recommended for major repair, to reconstruct the station out of the floodplain.

2.2.1 Station Hydraulic Capacity

The criteria for determining the adequacy of the hydraulic capacity is in conformance with the Ten States Standards which the Minnesota Pollution Control Agency has adopted as the state's guidelines. The information of primary importance is the detention time in the individual stations wet well and the average number of starts per hour of operations for each pump. Lift station wet well capacities are presented in Table 2 and detention times at each lift station are presented in Table 3.

Table 2 – Lift Station Capacities

Station Name	Avg. Daily W/W Flow[1] (mgd)	Max. Daily W/W Flow[1] (mgd)	Peak Hourly W/W Flow[1] (mgd)	Firm Pump Capacity (mgd)	Pump Starts per total run period (Max. April, 2007) (day)	Wet Well Volume (gal)	Wet Well DT (min)	Ten States Standards Requirement (30 Min Max) (min)
Schaper	0.006	0.01	0.02	0.05	43	658	18	30
Highway 55	0.039	0.054	0.114	0.504	344	3226	9	30
Woodstock	0.011	0.015	0.027	0.216	71	1305	7	30

1- Flows obtained from 2008 InfoSWMM hydraulic model

Table 3 – Lift Station Detention Time Calculations

Station Name	Average Max Daily Flow Rate (mgd)	Wet Well				Sewer Line					Total Detention Time (hr)
		Depth (ft)	Surface Area (ft^2)	Floor to Influent Sewer Invert (ft)	Volume (gal)	Detention Time (hr)	Surface Area (ft^2)	Length (ft)	Volume (gal)	Detention Time (hr)	
Schaper	0.009	11.00	12.57	5.60	493.00	1.31	12.6/ 196[1]	240	627/ 8,210[1]	1.7/21.9[1]	24.9
Highway 55	0.054	15.50	75.00	11.75	3226.00	1.43	0.555	107	436	0.19	1.6
Woodstock	0.015	15.20	28.27	10.14	1305.00	2.09	0.349	25	65	0.1	2.2

1- Adjacent emergency storage vault with valve that must be opened manually for maximum storage and detention time

2.2.2 Safety

Safety issues affect both the permanent constructed facility and operational procedures. Construction items address ladders, fall protection devices, presence of safety harnesses, safety grating, railings, the need to access subsurface structures during operation, and whether service vehicles and operating personnel can remain off the public streets during maintenance activities.

The operational procedures which the City employs do not necessarily require construction of permanent facilities, but may include use of portable equipment.

2.2.3 Potential for Sewer Back-up

The evaluation of the potential for sewer back-ups include three items: one is a review of the history of problems at the station, two is whether the stations contain standby power capability (either a generator or a receptacle for plugging to a standby generator) and three, whether the volume of the wet well plus the influent sewer contains adequate storage capacity to allow the sewer utility staff time to connect an emergency generator before wastewater would back-up into houses and/or buildings, in the event of a power outage. A detention time of one hour for the wet well plus gravity sewer is considered excellent. A detention time of 50 to 60 minutes is

considered good, time of 40 to 50 minutes considered average, 30 to 40 minutes undesirable, and less than 30 minutes unacceptable. The previously presented Table 3 shows the calculated detention time for each station.

2.2.4 Pump Review and Capacity

Pump review is a review of pump capacity, pump age, maintenance record, and amperage draw. Pump capacity is a determination of whether the station has capacity to pump the peak hourly flow with the largest pump out of service.

Pumps are typically designed to operate for a period of fifteen (15) years. Any pumps older than 15 years are subject to failure due to age. Maintenance review is a summarization by the City staff of the amount of maintenance required on each pump. Amperage draw is a comparison of the measured draw to theoretical draw required for the particular motor.

2.2.5 Wet Well Physical Condition

The station physical condition evaluation addresses the physical condition of each station's concrete, hatches and miscellaneous metals. Steps into wet wells are considered unacceptable because they can become rusty and are not capable of being retrofitted with full restraints.

2.2.6 Valve Vault or Dry Well, Physical Conditions

The physical condition of the valve vault addresses the condition of the concrete, the steps, access into the station, piping and valves and the overall cleanliness of the structure.

The physical condition of the dry well addresses the condition of the steel access tube and chamber, the ladder, access into the station, piping and valves, and the overall cleanliness of the structure.

2.2.7 Electrical Components

The electrical review evaluates the adequacy of the electrical service to each station, the adequacy of standby power, and the condition and accessibility of the pump control panel. Adequacy of electrical service considers the number of power outages and whether operation of the pumps causes dimming of lights in neighborhood. An unacceptable rating (rating of 5) is given to any station which requires an operator to enter a below ground structure to operate the pumps.

2.2.8 Instrumentation/Control/SCADA

For this parameter, each station was reviewed against the following criteria:

- Whether the station has alarms for station high and low levels
- Whether back-up pump controllers exist
- Whether SCADA transmits to the central control station

Electrical data collected during the last lift station inspection is presented in Table 4 below:

Table 4 – Lift Station Electrical Review

Lift Station	Voltage/ Phase	Type of Control	Pump Controller	Back-up Controller	Inrush Current					
					Pump 1			Pump 2		
					Phase A	Phase B	Phase C	Phase A	Phase B	Phase C
Schaper	230/1	Transducer	Systems Control Technology	Floats	5.7 A	—	—	13.2 A	—	—
Hwy 55	230/3	Transducer	Automatic Pump Control	Floats	22 A	22 A	20.5 A	19 A	17.5 A	18 A
Woodstock	230/1	Transducer	TLC Controls, Inc.	Floats	20.5	—	—	25 A	—	—

2.2.9 Suitability of Location

The suitability of location addresses

- Each station's service area, maintenance accessibility, aesthetics, visibility and proximity to adjacent homes
- Potential for damage by the public
- Position within right-of-ways, easements or City owned property.

Accessibility from a public street is considered very important. The potential for public damage is a consideration of whether the station is susceptible to being struck by an automobile or to vandalism.

A private driveway to the stations is deemed important to allow operation and maintenance staff to function without being threatened by passing traffic.

For the visibility to neighbors and proximity to homes criteria, it is assumed that a lift station detracts from value or desirability of an adjacent home, and aesthetic treatment at the lift station mitigates this detriment.

2.2.10 Acceptability Ratings

Table 5 ranks the condition of each station against the nine general parameters, based. The detailed review for each of the 3 stations is contained in Appendix A.

Table 5 – Lift Station Acceptability Rating

Station Name	Hydraulic Capacity	Safety	Potential Backup	Pump	Station Condition		Electrical	Instrumentation/ Control	Location	Total	Average Acceptability Points
					Wet Well	Valve Well					
Shaper	3	4	2	4	1	3	2	3	3	25	**2.78**
Highway 55	4	3	3	4	3	2	2	3	5	27	**3.22**
Woodstock	3	3	2	3*	3	3	2	3	2	24	**2.67**

Keynote - Acceptability Rating = 1 to 5

1 = Excellent

2 = Better than Average

3 = Average

4 = Below Average

5 = Unacceptable

*Woodstock pump ages could not be verified.

2.3 System Analysis

2.3.1 Sewer System Modeling

In order to provide the City of Golden Valley and the MCES with existing and future planning information, the existing sewer system was evaluated using a hydraulic flow simulation model, MWH Soft InfoSWMM. This model was used to route sewer flows through the developed sewer structure of pipes, manholes, and lift stations. The model calculates various hydraulic parameters during normal flow, surcharge, backflow, flooding and pumping conditions.

The City's existing GIS sewer structure data, as-built information from the City's sewer construction plan sheets, lift station information and lift station inspections were compiled into a GIS database to configure the model. The model was then used to evaluate current and future sewer capacities and required system improvements.

For the purpose of the analysis, parcel acres were multiplied by the sanitary load rate per the assigned land use and then assigned to manholes located closest to parcel center that were considered likely to receive those flows. Sanitary land use loading rates were initially used to determine base flow rates throughout the City. Once the loading rates were assigned, overall flow volumes from each sewer district were calibrated against historical metered data, and loading rates were modified so that flow from each district mirrored actual flow data. The model was overall calibrated to the total volume of sanitary water as measured by MCES and averaged over the past three years, totaling 2.3 MGD.

In order to determine future wastewater flow projections, properties anticipated to have changing land use were adjusted in the model to account for increases or decreases in overall wastewater flow rates due to the anticipated change in land use over the next 20 years. Figure 4 presents the City's proposed land use for 2040. The changes were used to adjust sewer flows in future model flow scenarios. Flow rate determinations are discussed in Section 3.0 Comprehensive Plan with System Needs.

Flows measured by the individual temporary meters installed for the 2005 Inflow/Infiltration Study together with permanent MCES meters measuring flows into and out of Golden Valley were used to calibrate the model. The wastewater flow data from the original portable flow meters used during the Inflow/Infiltration Study and installed throughout the City were the basis for the sub-sewershed or district flow discharge points. The locations of these temporary meters are shown on Figure 5.

3 Comprehensive Plan with System Needs

3.1 Population Trends

The population of the City of Golden Valley is projected to increase 7-8% over the next 20 years. Population and household trends are shown in Table 6. Metropolitan Council projects Golden Valley population of 22,900 by the year 2040. The most significant change in Golden Valley's population will be the result of increased density from changing land use. Table 7 uses the distribution by TAZ to assign this growth to the associated MCES interceptor facility.

Table 6 – Population, Household and Employment Forecast

Year	Population	Households	Employment
2020	21,300	9,300	36,000
2030	22,000	9,600	37,500
2040	22,900	9,800	38,900

Source: 2040 THRIVE MSP Water Resources Policy Plan. Produced by the Metropolitan Council

Table 7 – Forecast Growth by MCES Interceptor

TAZ	MCES Interceptor	2020			2030			2040		
		Pop	HH	Empl	Pop	HH	Empl	Pop	HH	Empl
1384	1-GV-460	18	8	1654	18	8	1746	18	8	1746
1143	1-GV-460	565	251	361	646	287	410	758	337	410
1144	1-GV-460	1494	653	1393	1634	726	1370	1774	776	1370
1145	1-GV-460	119	43	1385	107	45	1600	107	45	1600
1146	1-GV-460	1906	836	224	1906	836	55	1906	836	55
1147	1-GV-460	1683	738	466	1661	738	500	1661	738	500
1148	1-GV-460	3128	1390	1150	3150	1400	980	3150	1400	980
1149	1-GV-460	781	347	1439	856	376	1481	1184	526	1481
1150	1-GV-460	1107	432	3252	1109	493	3466	1346	593	3466
1151	1-GV-460	212	94	3773	212	94	4321	212	94	4540
1156	1-GV-460	146	65	2448	190	78	2317	190	78	2745
1164	1-GV-460	1028	457	331	1044	464	350	1044	464	350
1165	1-GV-460	592	263	73	745	331	73	745	331	73
1166	1-GV-460	1035	456	8	1037	461	8	1037	461	8
1167	1-GV-460	1853	808	108	1848	818	108	1841	818	108
1372	1-GV-461	392	174	32	394	175	32	394	175	32
1376	1-GV-461	180	80	0	180	80	0	180	80	0
1152	1-GV-461	252	112	840	251	111	810	251	111	810
1153	1-GV-461	198	88	1947	266	118	2091	266	118	2230
1154	1-GV-461	1044	454	276	1098	488	120	1098	488	120
1155	1-GV-461	534	215	2831	599	266	2722	599	266	2722
1157	1-GV-461	764	332	373	819	348	260	819	348	260
1158	1-GV-461	683	301	59	790	351	90	902	401	90
1159	1-GV-461	797	354	2674	837	372	2856	837	372	3070
1160	1-GV-461	1988	840	1741	2098	920	2100	2098	920	2100
1161	1-GV-461	639	278	137	655	285	140	641	285	140
1162	Combined	925	402	1402	913	402	1160	905	402	1160
1163	Combined	740	329	4623	740	329	4834	740	329	4834
Total	-	24,800	10,800	35,000	25,800	11,400	36,000	26,700	11,800	37,000
* Met Council	-	21,300	9,300	36,000	22,000	9,600	37,500	22,900	9,800	38,900

** Met Council forecast values; City and MC staff met and came to concurrence on City Totals*

3.2 Future Land Use

The information contained in this Comprehensive Sewer Plan Update is based on the ultimate land uses which are anticipated to occur at full development. The Ultimate Land Use Map is contained in Figure 4.

3.3 Sanitary Sewer Design Criteria

3.3.1 Flow Rates

Anticipated wastewater flows from the various sub districts were determined by applying flow rates based on land use in each area. Actual metered water usage was used to calibrate the flow to MCES metered flow from Golden Valley. Flows from future areas anticipated to undergo redevelopment were assigned based on the current land use plan and preliminary development plans available from the City.

3.3.1.1 Residential Flow Rates

An average of water records used for this study revealed an average water usage (averaging use from 2010-2016) of 275 gallons per residential unit based on a Met Council projection of 8,816 residential units in the year 2010 and 9,300 residential units in the year 2020. The MCES metered wastewater flow from the City of Golden Valley averaged 2.35 MGD in 2010, which averages 260 gallons per residential unit averaging the residential unit growth suggested by MCES from 2010-2020 or 114 gallons per resident per day based on the projected population rate from 2010-2020, for years 2010-2016. This does not account for commercial, industrial, or institutional property flows.

The metered wastewater flow is greater than the water sales, which is typical among metro area communities. MCES staff believes this difference is primarily due to the difference in accuracy between the individual home water meters and the MCES wastewater meters. It can also be explained by the amount of additional clear water which could be entering the sanitary sewer system through groundwater infiltration.

Future flows were calculated using the land use method with the calibrated loading rates per land use from the existing land use. Loading rates were calibrated using metered data from winter months. The same loading rates were then applied to the future land use, to determine future system flows. Densities for different residential types varied from 450 gallons per day per acre to 1,800 gallons per day per acre.

3.3.1.2 Non-Residential Flow Rates

Generally, Golden Valley's non-residential land use is made up of commercial and industrial users that do not contribute disproportionately to the sewer system in comparison to residential users. The City separates sewer flows from non-sewered water use for major users. The separated information for industries was used for this study.

Model calibrations to assess existing land use loading rates resulted in an industry rate of 1,100 Gallons per Acre per Day (GAD) used to estimate flows from other undeveloped properties within the City where future land use is shown to be commercial or industrial. 5 GAD was used for parks and open spaces (noted as Active) and 800 GAD was used for institutional, commercial and office space.

3.3.2 Peak Flow Factors

The sanitary sewage conveyance system must be capable of handling the anticipated peak flows. These peak flow rates can be expressed as a variable ratio applied to the average flow rates. This variable ratio, called the peak flow factor, generally decreases with increasing average flow rates. The peak flow factors applied in this study were individually created for each

sewershed and are shown below in the Peak Flow Factor Table 8. These values were obtained by comparing dry weather flows to peak flows from the largest, metered storm event from July 2013. A unit hydrograph of the storm event was created and different peaking factors were assigned to each sewershed so that the discharge from each sewershed matched the metered discharge of each sewershed. Peaking factors were again compared to the largest metered storm event of 2014, which occurred April 2014.

Table 8 – Peak Flow Factor

Flow Meter District	Peak Flow Rate (gpm, July 2013)	Peaking Factor
FM-01	5650	7.7
FM-02	112	0.5
FM-03	323	1.4
FM-04	1592	0.95
FM-04A	147	0.8
FM-04B	49	0.7
FM-05	799	0.3
FM-06	197	0.65
FM-06A	--	0.65
FM-07	485	1.4
FM-07A	--	1.4
FM-08	755	0.85
FM-08A	38	0.85
FM-08B	101	0.65

The design average flow for Golden Valley is 2.35 MGD and the correlated peak flow exiting the City (metered at M117) is approximately 10 MGD, on par with the peak metered flow from the July 2013 and April 2014 storm events, including flow from neighboring communities.

3.3.3 Design Flows

The sewer design flows were developed based on metered data from the City of Golden Valley and MCES. The current average daily flow, averaged from MCES flow data over the past three years, from the City is 2.35 MGD. This flow was matched in the model by adjusting peaking factors from each sewershed discussed in Section 3.3.2.

To determine ultimate flow rates in the year 2040, calibrated loading rates for each land use type were input into the model for future development and land use conditions. Additional future flows based on future land use resulted in an average flow of 2.9 MGD for the City under fully developed conditions in the year 2040. Flow rates calculated by the land use method in the modeling scenarios were compared to MCES flow projects for the City, shown below.

Table 9 – Wastewater Flow Projections

Year	Flow Projection (MGD)
2010 (Actual)	2.35
2020	2.38
2030	2.37
2040	2.37

3.4 Future System Needs

The results of the InfoSWMM model indicate that the system should be capable of conveying ADFs without any capacity issues. Figure 6 represents pipe capacities for the peak wet weather flows. The hydraulic condition of the sewer system under future flow conditions is discussed in the following section.

The Golden Valley sewer system was evaluated under the peak hourly flow rate that mimicked the largest storm event that was recorded in the past few years and resulted in surcharge assessments, in April 2014. The peak discharge at M117 recorded by MCES was approximately 10 MGD during that event. The future conditions assessment of the system was analyzed using those peak flow factors and the flow rates generated from new land use designations anticipated by the City through the year 2040. The additional flow anticipated from redevelopment were modeled under the same storm/peak factor assumptions as the modeled storm.

These flow conditions do not take into account any additional flows from future anticipated development within St. Louis Park. Metered flows were used as contributions from neighboring communities. Since the last Comprehensive Plan, MCES has constructed a lift station to reroute flow upstream of meter station M120, in St. Louis Park. Flows are rerouted during peak flow conditions to the MCES interceptor to the north, running along Highway 55. The new lift station was implemented to take the high peak flows away from the Tyrol Hills area of Golden Valley. Another condition assumed by the model is that the sewer lines are in perfectly maintained condition, free of defects and debris, which is not always the case.

The assessment for future sewer system capacities and needs were evaluated using flow rates generated from land use requirements anticipated by the City through the year 2040. The land use flow rates were calibrated using existing land use and MCES metered flows and were used in the future land use model scenario, for 2040.

Peaking factors were assigned to the individual sewersheds and cumulative flows to determine the anticipated peak flows in lateral and trunk facilities. Peak flows were compared to existing pipe capacity to determine the suitability of the existing system for conveying future flows.

Figure 6 illustrates used pipe capacities when the system is conveying the MCES peak metered flow for the City of Golden Valley at 10 MGD. The outlet on the east side of the City (owned by MCES) does exhibit some pipe capacity issues, shown on the figure. During 2014, the MCES allowable peak hourly flow rate for the City of Golden Valley was 7.96 MGD. The surcharge storm was used in modeling and analysis to analyze a more intense storm, with higher flow volumes in the sanitary system. The previous areas know for flow capacity issues no longer exist, due to the work of the I/I reduction, private property inspections and overall decreased water use by the City.

One small area with capacity issues is located at Golden Valley Road between Bassett Creek Drive and Bonnie Lane. In this location, a 12-inch segment connects to a 36-inch segment, only 0.3-feet above the invert of the 36-inch segment. The 12-inch segment does back up due to higher flows in the 36-inch segment. A similar situation occurs at Sweeney Lake and Hidden Lakes Parkway where an 8-inch segment connects to a 36-inch segment at the manhole invert, causing backup into the 8-inch segment.

The area of Bassett Creek, between Legend Drive and Noble Avenue North also shows capacity restrictions. This is a section where a City gravity line discharges into an MCES gravity line.

The City has aggressively been working to reduce I/I, with regular pipe rehabilitation and wye connection projects and private property inspections. MCES, with Brown and Caldwell, undertook an I/I study project, to determine if reduced wastewater flows could be attributed to I/I mitigation projects performed by various cities in the metro area, including Golden Valley. The study began in 2004 with data collection and I/I mitigation documentation. The study results shows that Golden Valley had a 24% total flow reduction and a 28% I/I flow reduction. The previous work performed and results of the study are provided in Appendix D.

The positive results of the work Golden Valley has done on public and private infrastructure are apparent in the model, showing reduced capacity issues in the sanitary system. The tasks and projects the City has undertaken to reduce I/I in the system has been proven as working and is strongly recommended to continue. Persistent work will continue lowering costs to the City from backups and surcharge events. The City is still liable to maintain and rehabilitate the sewer system. Proactive work will reduce emergencies in the future. I/I still exists in the system, and the City of Golden Valley and MCES are paying to treat clean water. More work can and is recommended to be done to continue efforts to remove I/I from the system to allow for more capacity and growth.

The individual sub-sewer districts each have a peaking factor applied to regular flow to account for the excess I/I entering the sanitary sewer system. Areas that have higher factors show more of an increase of flow in the system during storm events. Those areas should be targeted for the next phase of rehabilitation.

4 Operation and Maintenance Plan

The purpose of an operation and maintenance plan is to serve as a guide to operate, monitor, maintain, and rehabilitate the City's Sanitary Sewer system.

Primary goals of the plan include reducing claims against the City related to sewer backups and continued compliance with local and regional standards for wastewater, including the control of inflow and infiltration (I/I) to the system. Specific recommendations in this plan include

- Rehabilitating system components with concerns related to safety and welfare of City residents and employees
- Rehabilitating system components to improve system effectiveness
- Implementing programs to periodically evaluate system condition
- Develop or expand maintenance programs to help ensure periodic maintenance of the sewer system
- Establishing policies and ordinances to protect the City's sewer infrastructure
- Determining equipment and staffing needs of the City

4.1 Existing Public Works Utility Maintenance Division

Golden Valley Public Works has developed over the years as infrastructure additions warranted additional staff and equipment. Public Works staff, management staff and the elected officials of the community have worked together to develop an efficient staff that is cross-trained in various other aspects of duties assigned to all of Public Works.

4.1.1 Sewer Maintenance Districts

City Maintenance staff has divided the City into three sewer service districts to manage maintenance activities in the system. The City aggressively inspects and/or cleans 40 miles of sewer each year, equating to inspecting/cleaning one third (1/3) of the City each year, in addition to the areas needing emergency cleaning.

4.1.2 Sewer Maintenance Equipment

The City has equipment typical of most communities the size of Golden Valley. The list of equipment specific to sewer maintenance includes:

- Jetter Truck
- Vactor Truck
- Closed-Circuit Television (CCTV) Truck
- Service Lateral Camera
- Service Lateral Cleaning Equipment
- Hydraulic Pump (750-1000 GPM)
- Trailer Mounted Generator

The City has sufficient sewer maintenance equipment to maintain its municipal sewer system. There may be times when additional needs require contracting for services. Maintaining the current equipment mix, in combination with proper maintenance and rotation of equipment in/out of service, will likely serve the community in an efficient manner for many years.

The City does have televising equipment as part of its jetting equipment. The equipment is best used to inspect sewers as they are cleaned to help ensure that all debris have been removed.

4.1.3 City Maintenance Staff

The public works utility staff includes one utilities supervisor, two utility crew leaders, and eight staff positions. This staff is cross-trained to assist in other areas of public works. Areas of water system maintenance, snow plowing, and disaster clean-up occasionally require that utility staff perform duties outside the area of sewer maintenance. Staffing levels for public works utility staff seem appropriate.

The City should evaluate the prioritization process and assign a higher level of importance to the maintenance of the sewer system. The current staff level combined with the current prioritization process creates a situation that makes it extremely challenging to accomplish the goals outlined in this report, in addition to regular maintenance duties.

4.2 System Needs

4.2.1 Gravity Sewer

Utility maintenance staff indicates that a significant portion of its time and budget is used in areas constructed of VCP. This is a result of root intrusion, cracked and broken pipe, poor joints and poor seals between pipes in this type of pipe. This is not unique to the City of Golden Valley and is typical of VCP throughout the metro area. Many communities have lined or replaced VCP sewer to eliminate the high maintenance needs often associated with these types of sewers. The City has undertaken projects to line the VCP sewers, through the Pavement Management Program (PMP) as well as other sewer rehabilitation projects, but to reduce the strain and work for the sewer maintenance staff, a more aggressive lining program should be considered.

Maintenance in the sewer system typically involves cleaning the sewer using a combination of jetter and vactor trucks to remove debris from the sewer pipes. Root intrusion in joints of the pipe requires cutting and removal to remove obstructions in the pipe and allow flow of the sewage through the system. Once roots begin to enter sewers, it is very difficult to eliminate the recurring growth. The simple cutting of roots often promotes additional growth. Unmanaged root growth can also cause the VCP pipe to crack, impacting the integrity of the pipe. Cracked pipes allow groundwater and soil into the sewer system, which can cause road collapses and sewer blockages. The continued efforts to cut roots in the VCP portions of the system annually results in other portions of the City's sewer system having a lower priority for maintenance.

The League of Minnesota Cities Insurance Trust (LMCIT) provides insurance coverage for the City to protect against claims resulting from sewer backups and other claims that may result from problems related to the City's utility services. LMCIT also provides no-fault insurance for private sewer connection to owners whose sewers cause damage to the City's municipal system. LMCIT have noted increased claims in specific areas of sewer systems throughout the state. One item of note is VCP sewers having higher than normal claims. They have suggested a cleaning of VCP sewer pipes every three years. Golden Valley has a practice of televising all Pavement Management Program (PMP) areas and rehabilitating all sub-standard sewers in conjunction with its PMP each year. This equates to approximately one to two miles of lined pipe and an additional two to five miles of televised pipe per year. The City is currently planning for a full reconstruct of all areas to be complete by 2023, pending no issues with water mains and sanitary sewers.

Restaurant grease has also become an issue in some areas of the system. Maintenance activities have already been increased in known problem areas. Golden Valley cleans the problem areas in the spring and fall and spot checks and flushes problematic manholes on a weekly and monthly schedule. With increased development in certain areas of the City, restaurant grease has been a growing problem, requiring more time and attention from Maintenance staff. There have been some efforts to modify ordinances and policies regarding the installation, maintenance, and inspection of grease traps. In 2015, an ordinance was adopted to require all Food Service Facilities (FSFs) that produce fats, oils and grease to install grease collection devices. This should be monitored and promoted to reduce the amount of grease in the system. The ordinance is attached as Appendix C.

4.3 Recommended Maintenance Program

Because of the high percentage of VCP pipe comprising the sewer system in Golden Valley, those portions of the system should be more closely evaluated for replacement or lining to negate the concerns of root intrusion and to continue the maintenance schedule suggested by LMCIT.

Proper monitoring and maintenance of the existing system is an important factor in the long-term viability of the system. Maintaining the system extends the life of the system and decreases the likelihood of sewer backups. Sewer backups often lead to property damage claims against the City. This results in increased costs to the City to pay those claims with associated increases in insurance premiums. It is recommended to create a program for total system cleaning, televising and rehabilitation to ensure the system lasts and to reduce potential expenses from collapsed/broken sewers or other backups that result from deferred maintenance. Documentation of condition of VCP gravity segments is recommended to be prioritized first, due to the known issues of VCP, but it also is recommended for a full system condition baseline and regular maintenance program.

4.3.1 System Cleaning

Cleaning practices vary from city to city depending on available budgets and the condition of the sewer system. Practices range from annual cleaning of all sewers to inconsistent cleaning of known problem areas. Many communities have set goals of cleaning all of its system at least once every five years.

For reasons mentioned above, LMCIT recommends that cities clean VCP sewers every three years, or more often when conditions require it, to minimize sewer backups. Similarly, they recommend that other sewer systems, that are not VCP, be cleaned every five to seven years.

Establishing a jetting plan to clean approximately 37 miles per year in perpetuity in the City of Golden Valley meets the recommendations and practices of the LMCIT and other communities. Setting a goal of 37 miles per year allows a combination of lines requiring annual cleaning; VCP on a three-year rotation; and all other on a five-year rotation. The City currently cleans the entire sewer system every three years, approximately 38 miles per year, plus additional trouble areas. The current program addresses the needs of the sewer system that are VCP and those areas that are documented problem areas. The production rate per year is primarily controlled by two factors:

1. Number of Staff and Outside Influences including
    a. Emergency Sewer Needs
    b. Emergency Water Needs
    c. Natural Disaster – Cleanup efforts
2. Options to increase the amount of sewers cleaned would include:
    a. Increase Sewer Maintenance Staff
    b. Double Shift Current Staff
    c. Contract Services

4.3.1.1 System Cleaning Costs

Cleaning costs are estimated at $2,500 per mile when contracted. A program to clean 37 miles per year results in a contract cost of $92,500 per year. The actual cost to the City may be different depending on the amount of work accomplished with City forces versus private contractors.

4.3.2 System Televising

It is recommended that Golden Valley establish a televising program to televise all sewers. This would establish a "base line" televising database for all sewers in the community. The televising records, currently stored separately, will soon be digitally attached to City GIS to provide a tool available to maintenance and engineering personnel.

The City has already established a practice of televising sewers in areas where street rehabilitation or reconstruction is scheduled to occur. This allows the City to be efficient with infrastructure management and to avoid situations that require removing portions of a newly constructed street.

Contracts for new sewer construction should include the televising of the new sewer. A copy of the televising should be provided to the City at the end of the project. Televising provides baseline information for the sewer and validates service locations.

4.3.2.1 System Televising Costs

The most efficient means to do this would be to develop a televising program that coincides with the cleaning program described above. A long term recommendation is that the City televise the entire system every 10 years. Currently, the City televises two to five miles per year, largely during the PMP work. A 10-year schedule equates to 12 miles per year. Televising costs are estimated at $4,000 per mile. A program to televise 12 miles per year results in a contract cost of $48,000 per year.

4.3.2.2 Televising Schedule

Beginning as soon as fiscally possible the City should:

- Schedule the digital televising of 12 miles of sanitary to coincide with cleaning activities in a manner with a goal of completing the televising of all sewers in a 10-year period
- Televise sewers in streets slated for rehabilitation or reconstruction
- Schedule repeat televising as necessary in high risk areas
- Require digital televising of all new sewer pipe installation
- Develop ongoing televising program - 10 year cycle

Table 10 – Gravity Sewer Maintenance Summary

Activity	Quantity	Cost	Frequency
Cleaning & Jetting	37 miles	$92,500/year	Annually
Televising	12 miles	$48,000/year	Annually[1]

[1] Ten year program. Future costs after ten years will depend on condition of the system.

4.3.3 Equipment

The general feeling is that the City has developed an equipment inventory and replacement plan that satisfies the needs of the community. Additional needs are often more efficiently contracted rather than owning specialized equipment. Examples of items often contracted for include televising and the jetting and cleaning of larger sewer lines. As stated earlier, the City has purchased a sewer lateral camera which is available for emergency inspections and flow metering equipment to continue investigating high peak hour flows in areas identified during the I/I Study. The City has a new sewer jet truck in the CIP for 2018 as well to continue to provide sanitary pipe maintenance at a reasonable cost to the City.

4.3.4 Lift Station Access Procedures

The City should maintain written maintenance procedures for accessing the lift stations. The procedures should include the following items:

- Maintain barriers or grating whenever structures are open - either temporary or permanent
- Never enter a subsurface structure without a partner present
- Follow confined space requirements
- Check for applicable gases with appropriate meter
- Operate appropriate ventilation, either portable or permanent
- Maintain required light levels
- Make sure temporary lighting is intrinsically safe
- Make sure temporary ladders meet safety codes and are properly secured
- Use fall protection and safety harnesses
- Carry an electronic communication device such as a radio

4.3.5 Lift Station Maintenance

It is important that the City maintain an active preventive maintenance program for each station. The program should consist of two parts: actions performed on a twice weekly basis and actions performed annually. A SCADA system would provide more complete recording with less City staff time. However, the City Utilities staff documents lift station condition and maintenance needs. With the City's significant GIS database and the current detail in lift station maintenance it is recommended that the City consider implementation of a GIS compatible maintenance record system.

The following maintenance tasks should be performed and recorded twice weekly:

- Visual site inspection.
- Visual inspection of wet well.
- Observe pump operation cycle.
- Record pump run times.
- Monitor system alarms.
- Inspect auxiliary equipment in dry well such as sump pump, dehumidifier, etc.
- Clean collection basket at Highway 55 Lift Station

Once per year each pump should receive a field and shop inspection, by a pump engineer, which covers the following items:

- Check electrical condition of insulation on power cable.
- Check for function of control panel and any loose or faulty electrical connections.
- Check voltage supply between all phases on the line side of the electrical control panel with pump off.
- Check amperage draw on all phases of the pump motor.
- Check voltage between all phases on the load side of the pump motor starter. Check control power.
- Check condition and operation of motor thermal protectors.
- Remove submersible pumps from lift station for physical inspection.
- Check condition of upper shaft seals and inspect condition of oil.
- Check condition and operation of moisture sensors.
- Check lower shaft seals and inspect condition of oil.
- Change oil.
- Check whether impeller is loose or worn.
- Check all impeller wear rings.
- Check for noisy upper and lower bearings.
- Check damaged or cut pump cable.
- Clean, reset and check operation of the pump alternator and level sensors.
- Check for correct shaft rotation.
- Reinstall pump and check for leakage at the discharge connection.
- Observe one operating cycle.
- Prepare inspection report.

4.3.6 Lift Station Improvements

The previous Table 5 contains acceptability ratings for each sewage lift station in the City.

4.4 Inflow and Infiltration

The Golden Valley sanitary sewer collection system is part of the overall Minneapolis-Saint Paul Regional wastewater collection and treatment system program managed and operated by the Metropolitan Council Environmental Services (MCES). In addition to the interceptor collection system owned by the MCES, the local sanitary collection system is jointly owned under private ownership and the City of Golden Valley. The MCES is required under state and federal requirements to insure all wastewater throughout the Twin Cities Metropolitan area does not leave their interceptors and is properly treated before discharge to local receiving streams.

The City of Golden Valley previously established two goals to effectively manage their wastewater and sanitary sewer collection system. They are consistent with the goals and objectives of the MCES and are as follows:

Goal 1 - Provide adequate capacity to insure wastewater collected for treatment does not leave the Golden Valley sanitary collection system causing a Sanitary Sewer Overflow (SSO).

Goal 2 – Reduce I/I to a manageable level to maintain and reserve wastewater capacity within Golden Valley for future development and reduce operation and maintenance each year.

4.4.1 Background Information

The City of Golden Valley, like the many communities in the metropolitan area, has spent considerable time and energy managing inflow and infiltration (I/I) within their sanitary sewer collection system. The Met Council (MCES) has implemented a surcharge program which is designed to encourage metropolitan communities to reduce inflow entering their interceptors in order to preserve wastewater capacity for daily domestic dry weather demand flows from municipalities they serve around the Twin Cities metro area. Prior to 2003, the Golden Valley sanitary collection system had a history of measuring high peak wastewater flow rates during rainfall events. As a result of the MCES Surcharge Program, peak wastewater flow rates above MCES allowances were identified during rainfall events in September and October of 2005 resulting in the City of Golden Valley committing to an I/I abatement program to manage and reduce their wastewater contributions to the MCES interceptors.

In 2005, the City of Golden Valley took the first step in their I/I program by completing an Inflow/Infiltration Study to isolate the source of the inflow within the City and determine the methods needed to identify and remove specific sources of inflow. The initial study included the following tasks:

- Reviewed past Sanitary Sewer Evaluation Survey (SSES) work and maintenance work completed by the City during the past 10 years
- Evaluated MCES flow rates and all calculations used to determine the volume of I/I generated in Golden Valley
- Reviewed the City's sanitary lift station pumping records
- Implemented a flow monitoring program to determine if possible which areas have a higher potential for I/I entering the collection system
- Installed a recording rain gauge to monitor rainfall intensity and daily storm events locally
- Installed monitoring wells or piezometers to monitor groundwater elevations around the City
- Reviewed the existing building inspection and compliance program
- Reviewed and evaluate the City's current sump drainage collection system
- Performed a sump pump inspection program in the Manor area neighborhood of the City
- Updated the geographic information system (GIS) database with additional attribute information for the City's sanitary sewer collection system
- Evaluated the flow monitoring data to establish a priority for future SSES activities and quantifying potential I/I impacts within the Golden Valley sanitary sewer collection system
- Developed an I/I abatement plan to cost-effectively eliminate I/I from the City's wastewater collection system

Following recommendations of the study, the City initiated the second step in the program which included performing the following tasks some of which are still ongoing:

- The City has continued its cleaning and CCTV program with an emphasis on Districts 9, 10, 13, 16, and 17. Monitor the piezometer and conduct CCTV during periods of higher groundwater or after significant rainfall events
- Met with the City of Robbinsdale to redevelop a plan to address I/I from District 19
- Developed and implemented a strategy for performing private property inspections as part of their pavement management program. Implemented a point of sale inspection requirement for any property transfers within the City.
- Developed financing options for the City and/or residents
- Continued with the sump drainage collection system program
- Met with MCES staff to update the St Louis Park and the Bassett Creek Interceptors. Worked with MCES staff to implement interceptor rehabilitation on the Bassett Creek Interceptor.
- Reviewed MCES flow monitoring results to determine if there are any significant trends during peak hour flows or I/I since MCES surcharges will be based on data collected from future rainfall events
- Continue to maintain records and document all I/I investigation and sewer rehabilitation expenses in the event of an MCES surcharge in the future
- Developed a long term flow monitoring program to measure and track the success of future sewer rehabilitation measures
- Implemented a sewer ordinance revision which strengthens the enforcement of removing clear water (I/I) out of the sanitary sewer system and eliminated existing or future connections to the City's sanitary sewer collection system

For the past eleven years, Golden Valley's private property inspection program, in addition to the efforts to rehabilitation sanitary mains and manholes, has been successful in reducing peak wastewater flow discharges during rainfall events. Golden Valley has taken an aggressive approach to reducing the impact of I/I to their collection system. Prior to the beginning of the MCES Surcharge Program, permanent flow meters operated by the MCES recorded peak wastewater flow rates exceeding 19 million gallons per day (mgd) from the Golden Valley sanitary sewer collection system. A typical dry weather day from the City of Golden would record only 3 mgd on average. In 2014, after eight years of the program, a similar event in the spring recorded less than half the peak wastewater flow rate at the same MCES flow meter location.

Although the inspection program has been very successful, due to the structure of the program, many of the private properties addressed have been more focused on the eastern side of Golden Valley where more of the street reconstruction programs have been completed over the past ten years. City efforts continue to reduce the negative impacts on the system resulting from I/I. The program has been successful in locating and repairing illegal connections to the wastewater conveyance system. Illegal connections include foundation drains or basement sump discharging to the sanitary sewer. As of fall 2016, the City has repaired 310 illegal sump and/or foundation drains throughout the City. Figure 7 presents a map of the City with corrected connections as a result of the private property program.

In addition to the work on the private sewer laterals, city staff continues to perform maintenance and inspection on the sanitary sewer mains in the public right of way including sewer CCTV, electro scan testing and pipe lining to reduce I/I in critical areas of the City under high

groundwater conditions and/or structural defects with the potential for future maintenance and I/I issues.

4.4.2 Overall Sanitary Sewer Program Policy

The City of Golden Valley has adopted policies, procedures and strategies as a support to local sewer ordinances. Operation and maintenance procedures and the adoption of new sewer ordinance requirements through revisions dating back to August 2008 has enable the city to improve their sanitary sewer infrastructure and reduce I/I contributions, both on the public and private side of the system. The City's policies serve as a guide to operate, monitor, maintain, and rehabilitate the City of Golden Valley sanitary sewer system. These procedures are necessary to prevent sewer backups into homes and businesses, and the natural environment. It also provides continued compliance with local and regional standards for wastewater, including the control of inflow and infiltration (I/I) to the system. Maintenance also protects and extends the life of the City's sanitary sewer system.

4.4.2.1 Subsurface Sewage Treatment (SSTS)

Very few properties have subsurface sewage treatment devices in the City (less than 5). The City requires that properties be connected into the public sanitary sewer system in order to become I/I complaint, at time of sale.

4.4.2.2 Local Sanitary Sewer Ordinances

Golden Valley's current City Ordinance Section 3.30 (Appendix C) identifies the rules and regulations relating to the City's municipal sanitary sewer system. Subdivision 3 - Unlawful Discharge prohibits any clear water discharges to the sanitary sewer system including any roof surface, sump pump, footing tile or drains, swimming pool, any other natural precipitation or groundwater, cooling water or industrial process into the sanitary sewer system or be allowed to infiltrate into the sanitary sewer system as a result of defective plumbing or a defective lateral sewer service. Any property owner applying for a plumbing permit is required to have an inspection of the structure's sump pump, footing or foundation drain discharge for compliance with the City's sanitary sewer system ordinance. The ordinance also requires a connection and inspection permit and the licensing of all contractors used for installation of any new sanitary sewer connections as a method to reduce the potential for illegal connections.

Section 3.30, Subdivision 9 of current City ordinances and policies indicate that the property owner is responsible for the sewer service line between the mainline in the street and building or home and is defined in the ordinance as follows:

> ***Subdivision 9. Ownership of a Sewer Service Lateral***
>
> *The property owner shall own and be responsible for the maintenance of the sanitary sewer service lateral between the sanitary sewer main within the street and the building being served, including the connection to the main.*

This is consistent with many other communities. The City has experienced some problems related to owner maintenance of sewer services. Most notably are sewer backups that occur because of debris left in mainline sewers after service cleaning. The City already requires property owners or their contractors to notify the City when maintenance is performed on

services. The compliance with this is law and difficult to enforce. Options to address this issue include:

- Require permits for sewer service maintenance activities
- Require private maintenance companies to obtain a City license renewed on a regular basis

Permitting each service maintenance activity would be an added administrative activity that could become laborious. The City should consider developing a licensing program that requires maintenance companies to obtain a City license that is renewed periodically. Conditions of the permit should be notification of sewer maintenance staff of all activities on private and public sewers prior to performing the maintenance activity. Failure to comply would result in revoking of the license or prevent renewal in the future.

The City of Golden Valley continues to promote voluntary disconnection of existing foundation drains, sump pumps, roof leaders and service lateral defects from the City's sanitary sewer collection system through their annual pavement management program (PMP). Other methods supporting the ordinance used by the city to promote the reduction of I/I includes installation of drainage pipe behind the street curb to allow individual property homeowners to connect their sump pump discharge pipes, funding assistance to make repairs and a public program to encourage voluntary compliance.

The City's current sewer ordinance also includes under Section 3.31 – Certificate of Inflow and Infiltration Compliance specific language requiring any existing buildings or structures to meet the same requirements under Section 3.30 of the City Ordinance when there is a transfer of property for sale (Appendix C). The point of sale (POS) program is designed to provide beneficial removal of I/I by focusing on private property sources, which based on the initial I/I investigation was the largest source of clear water entering the sanitary sewer system. Section 3.31 of the ordinance addresses existing properties before the sale or transfer of the property and requires each to obtain a certificate of compliance with the I/I ordinance or provide the means through escrow that any work required to obtain compliance with the ordinance will be completed. The ordinance provides the City legal authority to inspect all properties either by city personnel or a third party acceptable to all parties.

4.4.2.3 Potential Sanitary Ordinance Revisions

The reduction of peak hourly rates during rainfall events measured by MCES at Meter Station M117 and Long Term Flow Monitoring (LTFM) network established over ten years ago has shown that the Golden Valley I/I program has been successful. But with the success of any program, there are always ways to make improvements. Based on the LTFM results, the northwest and southwest areas of the Golden Valley sanitary sewer collection system still contribute the highest peak rates during any significant rain event. Potential changes discussed have been some modifications to the point of sale (POS) program and changing the effective life of the certificate of compliance. Any changes to the sewer ordinance will need to be implemented consistent with the goals and objectives of other City programs including ongoing infrastructure operation and maintenance activities.

4.4.3 Current and Future Measures to Mitigate I/I

The City of Golden Valley employs full time utility maintenance personnel to perform daily operation and maintenance on their sanitary sewer collection system. Contractors are used only

as needed to perform the work outside regular maintenance activities to maintain the collection system. The City of Golden Valley performs routine cleaning and closed-circuit television (CCTV) inspection and performs all of the private property inspections required under the I/I program with in-house city staff. The City has also used Electro Scan technology to isolate potential defects and quantify I/I in a number of pipe sections around the city. The City, as part of the Infrastructure Renewal Program, has targeted high potential I/I pipe segments for past and future lining projects. Figure 8 presents the work completed through City's on-going lining program and the Pavement Management Program.

As part of a routine public maintenance program, the City of Golden Valley performs manhole inspection, sewer cleaning and CCTV inspection to evaluate their entire sanitary sewer collection system. Over the past ten years of the inspection program, the following issues have been found:

- Minor pipe sags through the pipe.
- Pipe cracks, roots, and poor joints in sections.
- Root blockages, debris and joint failure in isolated sections of the pipe.
- Manhole casting rings are deteriorated and in need of repair.

Sewer rehabilitation in past years has included the following remedial measures which includes manhole replacement/rebuild to reduce the potential for I/I entering the sanitary sewer collection system.

- Sealing between manhole castings and the manhole structures at manhole locations outside of the bituminous pavement.
- Raising the existing manhole casting to provide access.
- Sewer lining in sewer sections with multiple poor and deteriorating pipe joints.
- Manhole cover "open pick hole" replacement

The City of Golden Valley plans to continue their current operation and maintenance program on the sanitary sewer collection system with the goal of providing an effective and efficient piping network and reduce the potential of I/I entering the MCES interceptor system. I/I direct sanitary sewer connection sources from foundation drains, sump pits/pumps and roof leaders will not be allowed by ordinance from future development, transfer of property or upgrades to the existing plumbing structures. In addition, the City will continue their public education program to discourage these types of connections from existing Golden Valley properties.

5 Capital Improvement Plan

The purpose of a capital improvement plan is to serve as a guide to monitor, maintain, and rehabilitate the City's sanitary sewer system. Primary goals of the plan include the renewal of aging infrastructure, reduction of claims against the City related to sewer backups and continued compliance with local and regional standards for wastewater, including the control of inflow and infiltration (I/I) to the system. Specific recommendations in this plan include:

- rehabilitation and renewal of system components to maintain the safety, health, and welfare for City residents, businesses and employees;
- rehabilitation of system components to improve system effectiveness;
- implementation of programs to periodically evaluate system condition;
- development or expansion of maintenance programs to ensure periodic maintenance of the sewer system;

- continued protection of the natural environment;
- establishing policies and ordinances to protect the City's sewer infrastructure; and
- equipment and staffing needs of the City.

5.1 Sewers

Rehabilitation of sewers in disrepair improves flow through the sewers and reduces maintenance expenditures on the system. The proper maintenance and rehabilitation of existing sewers and I/I reduction extends the life of the sewer, reduces City liability and reduces costly reconstruction of the system. The current system is aged and deteriorating. Continual renewal is needed to maintain the level of system function and to provide a safe and functional sewer system for the residents. The work that has been done on the system has proven its worth and must continue due to its positive impact on the system and environment.

5.1.1 VCP Sewers

It is recommended that the City continue to rehabilitate VCP sewers with pavement management programs and implement a more aggressive rehabilitation program. As shown in Table 1, the majority of sewers were installed over 30 years ago and are reaching the need for rehabilitation. Most VCP sewers can be successfully rehabilitated through in-place lining. This process installs a liner inside the pipe. Excavations are seldom necessary. The liner typically provides some increase in structural strength of the pipe. More importantly, the liner seals joints and removes points of access for roots and I/I. The installation of a liner typically does not affect the flow through the sewer or reduce the capacity of the pipe.

Some areas may not be suitable for lining. Pipes with sags that limit flow through the pipe or areas that are in extreme disrepair may require spot repairs including excavation and replacement. Larger areas that are unsuitable for lining would require reconstruction. These areas will be identified and quantified through the televising program.

It is recommended that televising be concentrated in VCP areas for the first three years to develop a prioritization for the rehabilitation program. This program could conceivably begin the year after the first areas are televised. The program may be reduced for the first years as the City televises areas and develop prioritizations. Once a prioritization is developed, the City may complete larger portions of the program annually to accelerate the rehabilitation program.

5.1.1.1 VCP Sewer Rehabilitation Cost

The City continues to invest in the repair and replacement of the sanitary sewer collection system through its PMP. Because a large percentage of the collection system contains VCP pipe and a significant amount of this pipe experiences significant root intrusion, an additional rehabilitation program may be needed to address this issue. A budgetary number of $200,000 per mile was used to estimate the cost of lining VCP sewers.

Much of the City has or will be addressed through the pavement management program (PMP). Below are examples of the timeframe the City can expect based on annual expenditures for the rehabilitation:

- $600,000 rehabilitates 3 miles per year (20+ year program)
- $1,200,000 rehabilitates 6 miles per year (12+ year program)
- $1,800,000 rehabilitates 9 miles per year (8+ year program)

Under current practices, the cost of rehabilitation would be borne by the City. Maintenance and rehabilitation of existing sewers typically cannot be assessed. Possible funding sources include sewer enterprise funds, franchise fees and rate increases to all users of the system. Reconstruction of sewers often results in costs that approach 5-6 times the cost of lining. As most sewers are over 30 years old, more funding for rehabilitation will result in lowered costs to the City resulting from emergency repairs, backups and other resulting issues. In addition to current funding, the City is continually investigating other funding opportunities for infrastructure rehabilitation.

The City is currently conducting relining operations in conjunction with the Pavement Management Program (PMP). Future zones that will be televised and reconstructed if required are identified on the Pavement Management Capital Improvement Plan, located in Appendix B. The City is currently prioritizing the reconstruction in accordance with available funds.

The City should televise and inspect areas scheduled for rehabilitation prior to contracting for the work. This will identify areas that may need reconstruction, spot repairs, or manhole rehabilitation.

5.1.2 VCP Sewer Services

The City has experienced root problems with sewer services similar to those occurring in the sewer mains. The property owner owns sewer services from the building to the sewer main and is typically responsible for the maintenance and rehabilitation of its service. The cost to line services would exceed the cost of lining mainline sewers. Options for rehabilitation include lining or excavation.

The sanitary sewer work during the PMP program was developed out of construction feasibility and need to reduce I/I but also can include VCP mainline sewer rehabilitation. VCP services can be repaired at the same time as street PMP programmed construction. The result will be a rehabilitated system that reduces maintenance costs for both the City and property owners. The City will benefit from the rehabilitation of sewer services through reduction of I/I and the minimization of root cuttings from service maintenance that end up in the mainline sewer, often creating additional maintenance needs for the City or, in some cases, sewer backups.

Current discussions are occurring to change the POS program and changing service condition assessment frequency. It is recommended to follow through with this change in inspection frequency to clarify ordinance regulations.

5.1.2.1 VCP Sewer Service Rehabilitation Cost

The cost of rehabilitating service lines will exceed the cost of mainline rehabilitation. The anticipated cost to line sewer services is estimated at $90 per lineal foot for service lines.

The property owner owns the sewer service line from the house to, and including, the wye location on the main. Likewise, the maintenance of the services is typically the responsibility of the property owner. The City has worked with local and state officials to develop a method to help property owners deal with the cost of rehabilitating their sanitary sewer laterals. To date, only limited funds are available to property owners to deal with this cost.

Table 11 – Sewer Summary

Activity	Quantity	Cost	Frequency
VCP Mainline Sewer Rehabilitation	6 miles	$1.2 mil/year	Annually[1]
VCP Service Rehabilitation	4,480[2] services	$7,000 per service	As Required[3]

[1] 12-year rehabilitation program.

[2] Estimated remaining number of services per MCES Meter Review and Analysis technical memorandum

[3] Property Owner cost unless subsidized by City.

5.1.3 Estimated Cost of Trunk Facilities

The City has constructed the necessary trunk facilities to serve the community. The remaining undeveloped land in the community will be served with sanitary sewer from existing mains. The City typically installs the necessary sanitary sewer pipes to serve the development area. The cost of this is typically paid for by the developer through special assessments without expense to the City.

5.2 Lift Stations

The adequacy of each station was evaluated during the last comprehensive plan update against the following nine (9) parameters:

- Station Hydraulic Capacity
- Safety
- Potential for Sewer Back-up
- Pump Review and Capacity
- Wet Well Physical Condition
- Valve Vault or Dry Well, Physical Condition
- Electrical Components
- Instrumentation/Control Issues
- Suitability of Location

The criteria by which each of these parameters was evaluated as discussed in Section 2.

An acceptability rating scale of 1 to 5 was established for the evaluation criteria listed above for each of the three (3) stations. A rating of 1 is excellent; a rating of 2 is good meaning the station is better than the average lift station in the metropolitan area; a rating of 3 means it is similar to an average station in the metropolitan area; a rating of 4 indicates this parameter is below average, and a rating of 5 is unacceptable and the condition should be corrected in the near future. It must be understood that rating scores are subjective and different individuals would likely give different scores for any given parameter. Also, no universal standard exists. However, since the goal of the rating system is to establish a sense of relative need rather than concise determinations, the evaluations are deemed suitable for this study.

5.2.1 LIFT STATION IMPROVEMENTS

Table 5 contains acceptability ratings for each sewage lift station in the City. All the stations have an overall rating of better than the industry average. Individual parameters in each of the stations contain a range of moderate to unacceptable ratings. Such deficiencies can most likely be corrected individually at each station. The decision of which to pursue depends upon the severity of the individual deficiencies.

No major repairs are recommended at this time, outside of regular maintenance and inspection activities. For future planning the Highway 55 lift station is located in the floodplain and should be relocated or flood-proofed in the next 5-10 years to remove issues caused by flooding events.

5.2.1.1 Schaper Lift Station

The following items are rated below average for the Schaper Lift Station and should be corrected within the next 3 to 5 years:

- Provide security from public damage
- Install a concrete valve vault to contain the station's valves, install access hatch on the structure
- Add safety railing around wet well or provide safety grating on wet well

The following items which are rated average for the Schaper Lift Station will likely require correction within the next 6 to 10 years:

- Replace the piping and valves
- Replace 2" discharge line with minimum 4", per 10 States Standard

Any parameters which received a rating of above average quality are not listed as requiring improvement during the next 10 years in the capital improvement plan.

5.2.1.2 Highway 55 Lift Station

The following items which are rated unacceptable for the Highway 55 Lift Station should be addressed within the next two years:

- Replace collection basket that requires multiple cleanings per week with another solution
- Install grinder pump to reduce issues caused by ragging
- Install LED lights
- Lift station is located in flood plain and needs relocation

The following items are rated below average for the Highway 55 Lift Station and should be corrected within the next 3 to 5 years:

- Provide safety grating on wet well

The following items which are rated average for the Highway 55 Lift Station will likely require correction within the next 6 to 10 years:

- Increase access area to valve and pump location
- Install generator for lift station

Any parameters which received a rating of above average quality are not listed as requiring improvement during the next 10 years in the capital improvement plan.

5.2.1.3 Woodstock Lift Station

The following items are rated below average for the Woodstock Lift Station and should be corrected within the next 3 to 5 years:

- Provide safety grating on wet well
- Replace the piping and valves

The following items which are rated average for the Woodstock Lift Station will likely require correction within the next 6 to 10 years:

- Provide drive-up service access
- Replace pumps (one of two has been replaced)
- Replace 2” discharge line with minimum 4”, per 10 States Standard

Any parameters which received a rating of above average quality are not listed as requiring improvement during the next 10 years in the capital improvement plan.

5.3 Ten Year Plan Summary

A summary of the costs related to the proposed capital improvements plan (CIP) for the Golden Valley water and sanitary sewer budget can be found on the City of Golden Valley website. The costs are based on the existing program requirements currently implemented and proposed activities to address future capital improvements including aging infrastructure, lift station improvements and inflow/infiltration reduction.

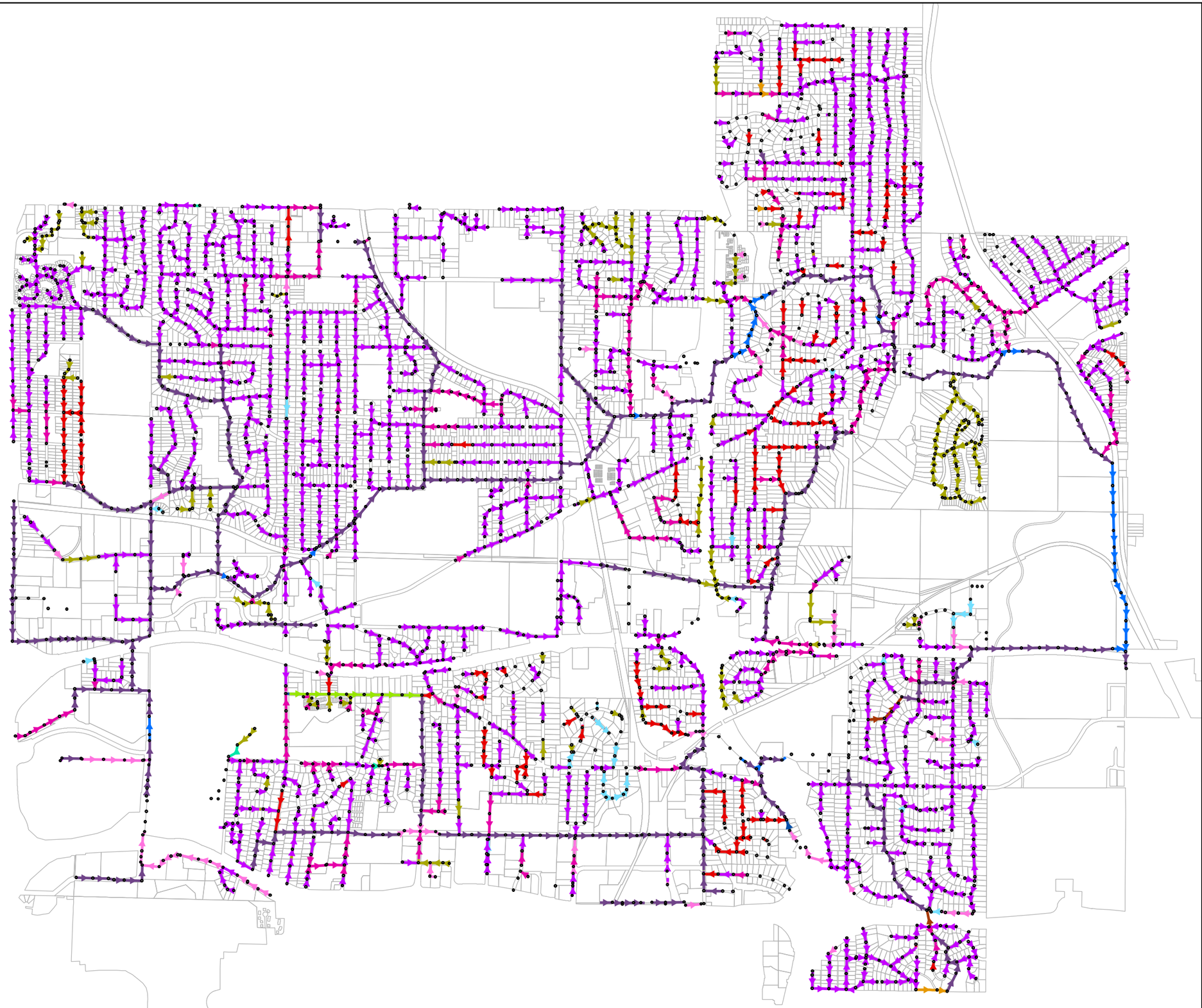
Future CIP planning should consider the following items for continued I/I abatement and renewal/rehabilitation of the gravity sanitary system:

- Gravity sanitary sewer lining
- Service connection repairs
- Private property inspection, including voluntary and Point-of-Sale
- Operation and Maintenance, including sewer cleaning and televising
- Lift station improvements, included relocation of the Highway 55 Lift Station

dmk

Figures

Figure 1 – Pipe Material
Figure 2 – Sanitary Sewer Pipe Diameters
Figure 3 – Sanitary Lift Stations
Figure 4 – Proposed 2040 Land Use
Figure 5 – 2013 Temporary Flow Meter Locations
Figure 6 – d/D Pipe Capacities at Max Flow
Figure 7 – I&I Status Map
Figure 8 – Sanitary Sewer – Sealed Manholes – Lined Main



Legend

Sanitary Pipe Material

- UNKNOWN
- Cast Iron Pipe
- Cured-in-Place Cast Iron Pipe
- Cured-in-Place Ductile Iron Pipe
- Cured-in-Place Reinforced Concrete Pipe
- Cured-in-Place Vitrified Clay Pipe
- Ductile Iron Pipe
- High Density Polyethylene
- Inner Circle Pipe
- Lock Joint Pipe
- Prestressed Concrete Cylinder Pipe
- Polyvinyl Chloride
- Reinforced Concrete Pipe
- Vitrified Clay Pipe
- Vitrified Sewer Pipe
- Sanitary Manhole

N

0 925 1,850 3,700 Feet

Map by: ELS
Projection:
Source: SEH, City of Golden Valley, Hennepin County
Project: GOLDV 139902
Print Date: 10/3/2017

EXISTING SANITARY SEWER NETWORK
Pipe Material

2040 Comprehensive Plan

This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.

SEH | city of golden valley | Figure 1

Path: S:\F-N\GIS\Goldv\139902\5-final-dsgn\50-final-dsgn\90-GIS\MXDs\MXDs for Report\Pipe Material_8.5x11.mxd

Legend

Pipe Diameter (inch)

- 6
- 8
- 9
- 10
- 12
- 15
- 16
- 18
- 20
- 21
- 24
- 27
- 30
- 32
- 36
- 41
- 42
- Sanitary Manhole

0 925 1,850 3,700 Feet

Map by: ELS
Projection:
Source: SEH, City of Golden Valley, Hennepin County
Project: GOLDV 139902
Print Date: 8/29/2017

SANITARY SEWER PIPE DIAMETERS

2040 Comprehensive Plan

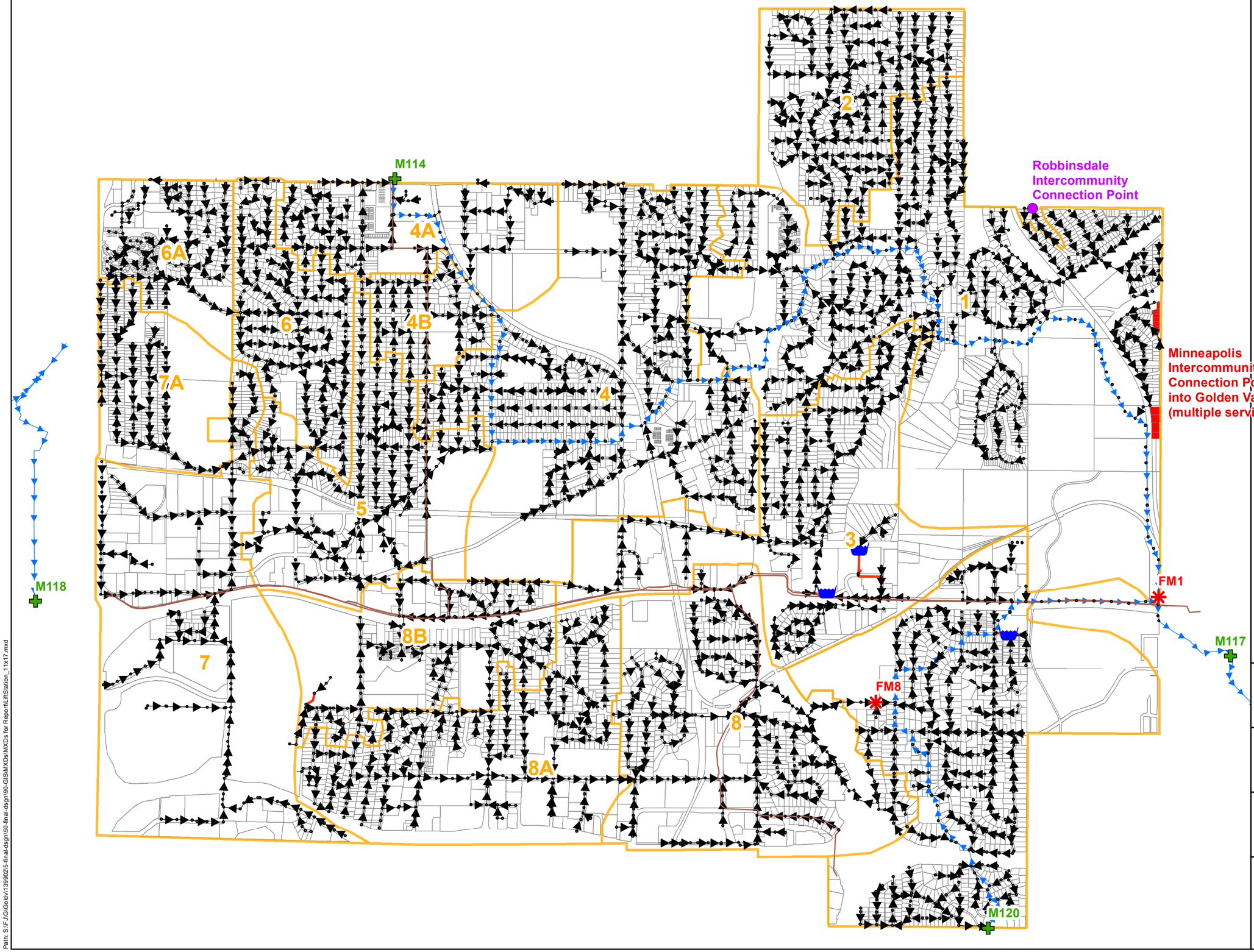
This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.

SEH

city of golden valley

Figure 2

Path: S:\F.A\GV\Gvlv\139902\5-final-dsgn\50-final-dsgn\99-GIS\MXDs\MXDs for Report\Pipe Size_8.5x11.mxd



Legend

- MCES Meter Station
- Intercommunity Connection Point
- Golden Valley/MCES Connection Point
- Sanitary Lift Station
- Sanitary Manhole

Pipe Type

- City Forcemain
- City Gravity
- MCES Forcemain
- MCES Gravity
- Sewer Sub-Districts

0 925 1,850 3,700 Feet

Map by: RLD
Projection:
Source: SEH, City of Golden Valley, Hennepin County
Project: GOLDV 139902
Print Date: 4/26/2019

SANITARY LIFT STATIONS

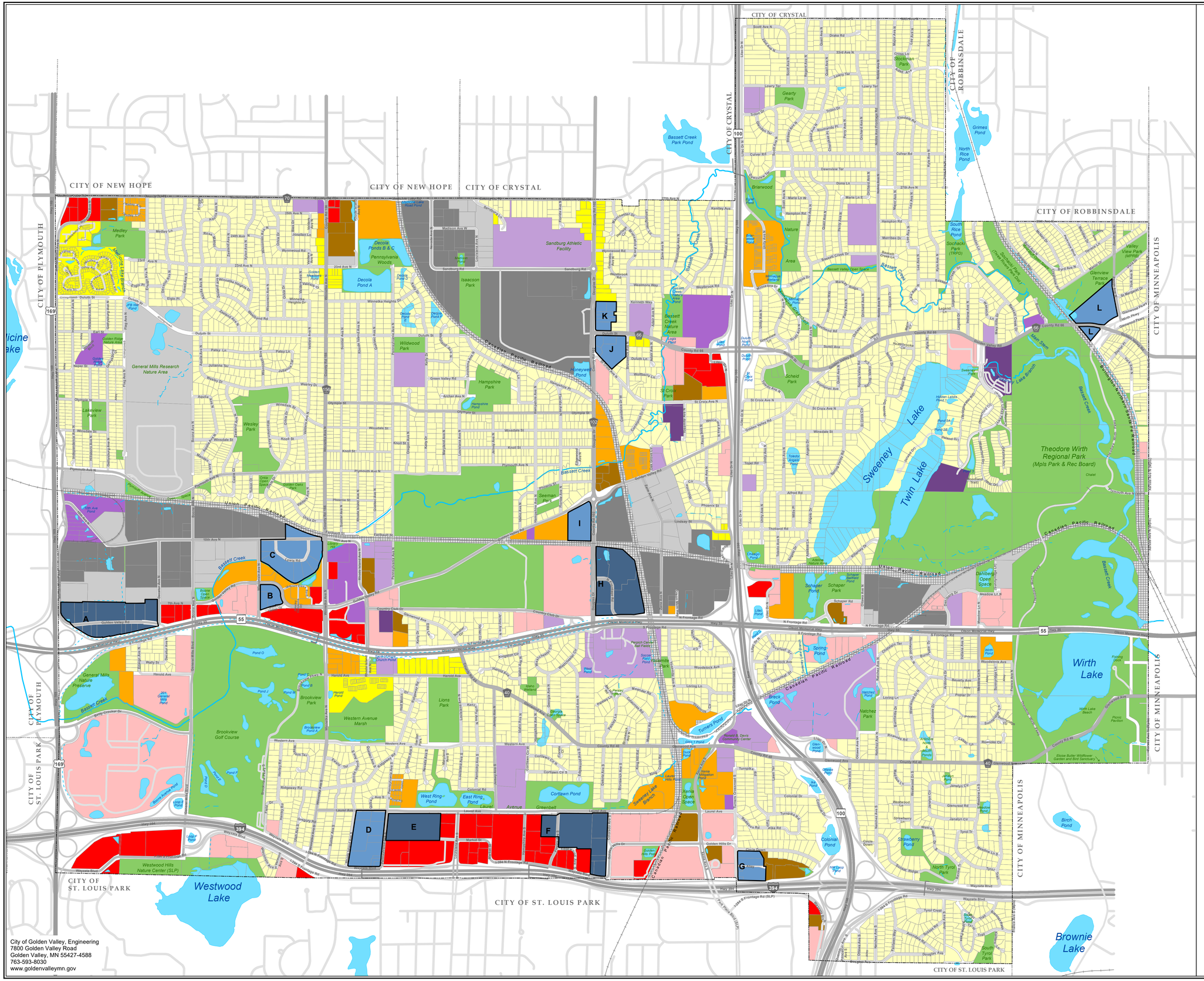
2040 Comprehensive Plan

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Figure 3

Path: S:\F-JG\Gold\v\139902\5-final-dsgn\50-final-dsgn\90-GIS\MXDs\MXDs for Report\LiftStation_11x17.mxd



City of Golden Valley, Engineering
7800 Golden Valley Road
Golden Valley, MN 55427-4588
763-593-8030
www.goldenvalleymn.gov

city of golden valley

Figure 4

2040 Future Land Use Map

Residential
- Low Density
- Moderate Density
- Medium Density
- High Density

Mixed Use
- Neighborhood
- Community

Commercial
- Office
- Retail/Service

Industrial
- Light Industrial
- Industrial

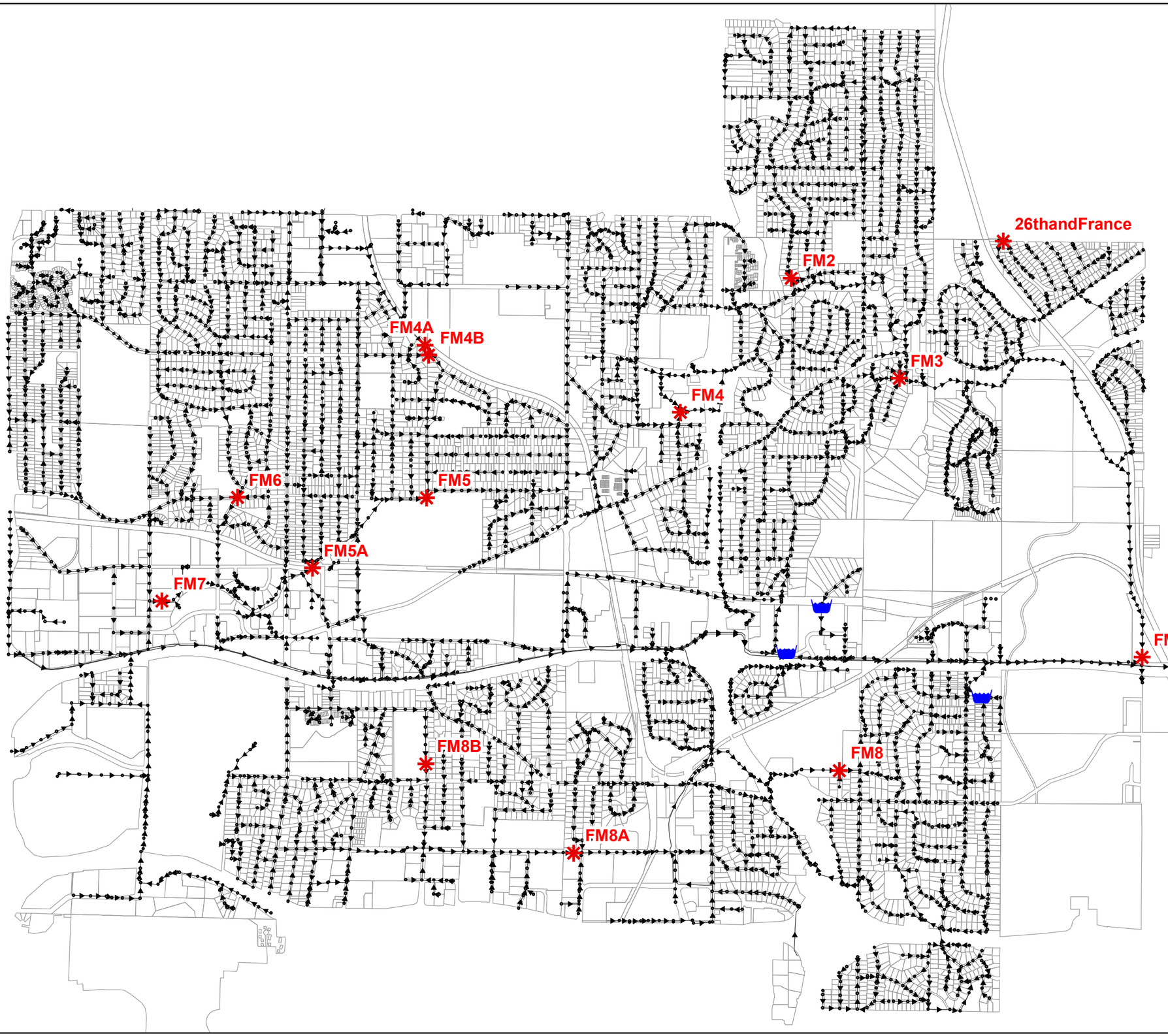
Institutional
- Assembly
- Civic
- Medical

Open Space
- Parks and Natural Areas

Right-of-Way
- Railroad
- Right-of-Way (public and private)

Water
- Open Water

Other
- Mixed Use Site



Legend

- 2013 Flow Meter Locations
- Sanitary Manhole
- Sanitary Pipe
- Sanitary Lift Station

0 925 1,850 3,700 Feet

Map by: ELS
Projection:
Source: SEH, City of Golden Valley, Hennepin County
Project: GOLDV 139902
Print Date: 8/29/2017

2013 TEMPORARY FLOW METER LOCATIONS

2040 Comprehensive Plan

This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.

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Figure 5

Path: S:\F-IG\Golden\139902\5-final-dsgn\50-final-dsgn\90-GIS\MXDs\MXDs for Report\Temporary Flow Meters_8.5x11.mxd

Legend

- Sanitary Manhole
- Sanitary Lift Station
- Sanitary Forcemain

Depth over Diameter

- 0.00 - 0.60
- 0.60 - 0.80
- 0.80 - 1.00

0 925 1,850 3,700 Feet

Map by: ELS
Projection:
Source: SEH, City of Golden Valley, Hennepin County
Project: GOLDV 139902
Print Date: 8/29/2017

d/D PIPE CAPACITIES AT MAX FLOW

2040 Comprehensive Plan

This map is neither a legally recorded map nor a survey map and is not intended to be used as one. This map is a compilation of records, information, and data gathered from various sources listed on this map and is to be used for reference purposes only. SEH does not warrant that the Geographic Information System (GIS) Data used to prepare this map are error free, and SEH does not represent that the GIS Data can be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction or precision in the depiction of geographic features. The user of this map acknowledges that SEH shall not be liable for any damages which arise out of the user's access or use of data provided.

SEH

city of golden valley

Figure 6

Path: S:\F-JG\Goldv\139902\5-final-dsgn\50-final-dsgn\90-GIS\MXDs\MXDs for Report\d.D_MaxFlow.mxd

city of golden valley

Figure 7

INFLOW AND INFILTRATION INSPECTION STATUS

Parcel Data - As of 9/7/2016

- No Inspection Data
- Compliant
- Non-Compliant
- Further Investigation Needed
- Unable to Inspect
- Compliant, Illegal Sump or Foundation Corrected

I & I Meter Districts

- Sewer District, Number Labeled

Note:
Due to issues with geocoding or matching PIDs from the MT Database to the Hennepin County parcel layer, properties with common interests (condo, co-op's, etc) and properties with more than one service lateral, may not be shown correctly on this map.

CITY OF CRYSTAL
CITY OF NEW HOPE
CITY OF ROBBINSDALE
CITY OF MINNEAPOLIS
CITY OF ST. LOUIS PARK

Date: 11/16/2016
Sources:
- I & I Access Database
- Hennepin County Surveyors Office for Property Lines (2016).
- City of Golden Valley for all other layers.

600 300 0 600 1,200 1,800 Feet

City of Golden Valley
7800 Golden Valley Road
Golden Valley, MN 55427-4588
763-593-8030
www.goldenvalleymn.gov

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Figure 8
Sanitary Sewer

Sewer Manhole

- No Drop
- Inside
- Outside
- Both
- Sealed Manhole

Sewer Main

- City Gravity
- City Forcemain
- MCES Gravity
- MCES Forcemain
- Other City Main
- Private Sewer
- Private Forcemain
- Lined Main

Print Date: 1/30/2017
Sources:
-Hennepin County Surveyors Office for Property Lines (2017)
-City of Golden Valley for all other layers.

0 400 800 1,600 2,400 3,200 Feet

City of Golden Valley, Engineering
7800 Golden Valley Road
Golden Valley, MN 55427-4588
763-593-8030
www.goldenvalleymn.gov

Appendix A

2007 Lift Station Inspection Report

Inspection Report

Schaper – Lift Station

Description:

The Schaper Lift Station is a submersible pump station which contains piping within the wet well with the inlet valve located below grade outside the wet well. The valve stem extends to a valve box located adjacent to the wet well. The wet well manhole is 4 ft. diameter and 11 ft. deep. The concrete in and around the wet well is in good condition. The steps have been removed from within the wet well. The metal access hatch to the wet well is in good condition with a holding mechanism for the hatch. The wet well houses two Hydromatic submersible pumps that were installed in 2006. The rails and chains for pump removal are in good condition. The wet well has a ventilation gooseneck. There was minimal scum in the wet well.

The wet well is directly connected to a storage vault by a 6-inch ductile iron pipe (DIP) with a valve. The valve is closed during normal operation and opened for emergency storage. The pumps discharge via a flexible hose to a 2" diameter PVC pipe. There was an excessive amount of discharge hose wrapped around the pump rail support system.

The operator stated that this lift station was experiencing plugging with medical debris. During power out there is no system down alarm until power resumes.

Capacity:

Drawdown Test

- Pump #1: 36 gpm, 51,840 gpd
- Pump #2: 39 gpm, 56,160 gpd
- Measured Influent Flow: 1.54 gpm

Pump Run Times (hr)/Starts (wet weather, April 2007)

Pump	Average	Max Day	Min Day
#1	2.5	3	.7
#2	1.6	2.5	0.6

Pump Flow Rate (gpd)

Pump	Average	Max Day	Min Month
#1	5,400	6,480	1,512
#2	3,744	5,850	1,404

Process:

Condition

- No safety grating in wet well
- The 2-inch receiving force main is considered sub-standard. The Ten State Standards guidelines require a 4-inch or greater diameter force main.

Electrical:

Service: 460V / 1Ø
Pump Currents:

Pump	Full Load	Inrush
#1	3	5.7
#2	3	13.2

Control System:

- Four floats (Pumps Off, Lead Pump On, Lag Pump On, High Level Alarm) with Systems Control Technology pump controller.

Control System Modifications:

- Add fifth float (Low Water Cutoff) for additional pump protection in case of low water level.
- Use control relays to add backup pumping scheme in case of pump controller failure.
- Add relay to send alarm at power failure prior to power returning to the system. There is already a battery in place for this.
- Add SCADA to the system.

Inspection Report – Hwy. 55

Highway 55 - Lift Station

Description:

Highway 55 Lift Station Lift Station is a wet well/dry well pump station which contains the pumps, piping and valves within a dry valve vault. The wet well is 75 square feet (10'x7.5') and 15.5 feet deep. The concrete in and around the wet well is in good condition. The steps into the pump and valve vault are in good condition. The access hatch to the wet well is in good condition with extension rails. The dry vault houses two Chicago Pump Flush Kleen long shaft pumps with U.S. Electrical motors. The pumps were rebuilt last year and bearings were replaced on the long shafts. The piping and valves are 6-inch ductile iron pipe (DIP) and are in good condition. There was minimal scum in the wet well.

The wet well is cleaned at least one time per month and pumps have been getting clogged with clinic debris. During power out there is no system down alarm until power resumes.

Capacity:

Drawdown Test

- Pump #1: 213 gpm, 306,720 gpd
- Pump #2: 168 gpm, 241,920 gpd
- Measured Influent Flow: 28 gpm

Pump Run Times (hr)/Starts (wet weather, April 2007)

Pump	Average	Max Day	Min Month
#1	1.6	3	.9
#2	1.7	5	.8

Pump Flow Rate (gpd)

Pump	Average	Max Day	Min Month
#1	20,448	38,340	11,502
#2	17,136	50,400	8,064

Process:

Condition

- No safety grating in wet well

Electrical:

Service: 230V / 3 Ø
Pump Currents:

Pump	Average (A)
#1	21.5
#2	18.2

Control System:

- Four floats (Pumps Off, Lead Pump On, Lag Pump On, High Level Alarm) with Systems Control Technology pump controller.

Control System Modifications:

- Add fifth float (Low Water Cutoff) for additional pump protection in case of low water level.
- Use control relays to add backup pumping scheme in case of pump controller failure.
- Add relay to send alarm at power failure prior to power returning to the system
- Add SCADA to the system.

Inspection Report – Woodstock

Woodstock – Lift Station

Description:

The Woodstock Lift Station is a submersible pump station which contains piping within the wet well with the inlet valve located outside the wet well in a valve manhole. The wet well manhole is 6 ft. diameter and 15.2 ft. deep. The concrete in and around the wet well is in good condition. There are no steps within the wet well. The metal access hatch to the wet well is steel and in good condition with a holding mechanism for the hatch. The wet well houses two Peabody Barnes submersible pumps. The rails and chains for pump removal are in good condition. The wet well has a ventilation gooseneck. There was a small amount of scum in the wet well, but concentrated around the north pump because the floats were all hung in this one location. The piping and valves are 4 in. diameter ductile iron pipe (DIP) and are in moderate condition. The check valve was replaced in 2006.

The operator did not report any problems with this station except no alarm until power resumes. During power out there is no system down alarm until power resumes.

Capacity:

Drawdown Test

- Pump #1: 272 gpm 391,680 gpd
- Pump #2: 238 gpm, 342,720 gpd
- Measured Influent Flow: 28 gpm

Pump Run Times (hr)/Starts (wet weather, April 2007)

Pump	Average	Max Day	Min Month
#1	0.9	1.5	0.6
#2	0.9	1.5	0.6

Pump Flow Rate (gpd)

Pump	Average	Max Day	Min Month
#1	14,688	24,480	9,792
#2	14,688	24,480	9,792

Process:

Condition

- No safety grating in wet well
- The 2-inch discharge line is considered sub-standard. The Ten State Standards guidelines require a 4-inch or greater diameter discharge line.

Electrical:

Service: 460V / 1Ø
Pump Currents:

Pump	Full Load	Inrush
#1	1.4	20.5
#2	1.4	25

Control System:

- Four floats (Pumps Off, Lead Pump On, Lag Pump On, High Level Alarm) with Systems Control Technology pump controller.

Control System Modifications:

- Add fifth float (Low Water Cutoff) for additional pump protection in case of low water level.
- Use control relays to add backup pumping scheme in case of pump controller failure.
- Add relay to send alarm at power failure prior to power returning to the system
- Add SCADA to the system.

Appendix B

Pavement Management Capital Improvement Plan

Pavement Management Capital Improvement Plan

NOTE: THE SCHEDULE SHOWN ON THIS MAP IS A PLAN ONLY AND IS SUBJECT TO CHANGE.

Year Programmed

- 2017 1.11 miles local
- 2018 1.30 miles local
- 2019 1.51 miles local, 0.80 miles State Aid
- 2020 1.27 miles local
- 2021 1.33 miles local
- 2022 1.27 miles local
- 2023 1.22 miles local
- Not Programed
- Other Street

Print Date: 10/4/2017
Sources:
-Hennepin County Surveyors Office for Property Lines (2017)
-City of Golden Valley for all other layers.

0 400 800 1,600 2,400 3,200 Feet

City of Golden Valley
7800 Golden Valley Road
Golden Valley, MN 55427-4588
763-593-8030
www.goldenvalleymn.gov

Appendix C

City Ordinances

Section 3.30: Rules and Regulations Relating to Sanitary Sewer Service

The following apply only to sanitary sewer service.

Subdivision 1. Metered Water Not Discharged

If a portion of the water furnished to any premises is consumed and not directly or indirectly discharged into the sanitary sewer system, the consumer may request a separate water meter for the portion of the water consumed and not discharged in the sanitary sewer. There shall be no sanitary sewer charges associated with the water meter account for water consumed but not discharged to the sanitary sewer system.

Subdivision 2. Deleterious Substances

Metropolitan Council Environmental Services standards shall control disposal of types of substances discharged.

Source: Ordinance No. 351, 2nd Series
Effective Date: 10-13-06

Subdivision 3. Unlawful Discharge

Except as otherwise expressly authorized in this subdivision, no water from any roof surface, sump pump, footing tile or drains, swimming pool, any other natural precipitation or groundwater, cooling water or industrial process shall be discharged into the sanitary sewer system or infiltrate into the sanitary sewer system as a result of defective plumbing or a defective lateral sewer service. Dwellings, buildings and structures with sump pumps or footing tiles or drains shall have a permanently installed discharge line which shall not at any time discharge water into the sanitary sewer system, except as provided herein. A permanent installation shall be one which provides for year-round discharge capability to either the outside of the dwelling, building or structure, or is connected to a city storm sewer or draintile. It shall consist of a rigid discharge line without valving or quick connections for altering the path of discharge or a system otherwise approved by the City Manager or his/her designee.

A. Any person, firm or corporation having a roof surface, ground water sump pump, footing tile or drain, swimming pool, cooling water or unpolluted industrial process water now connected and/or discharging into the sanitary sewer system shall disconnect or remove the same. Any disconnects openings, or defects in the sanitary sewer system shall be closed or repaired in an effective, workmanlike manner with the proper permits and inspected by a representative of the City. If a City draintile or storm sewer system is available to the property these discharges may be connected to it. If a public system is not utilized, these discharges must be accommodated on the owner's property.

B. Any property owner or consumer applying for a plumbing permit (excluding permits for water heaters), variance, minor subdivision or other action from the City shall agree to an inspection of the structure's sump pump, footing or foundation drain discharge for compliance with this code. All inspections and

inspection reports must include a date-stamped video record of the complete lateral line from the property to sewer main. All inspections must be performed and reports completed in accordance with City standards and specifications. In lieu of having the City inspect the property, the owner may furnish a certificate from a licensed plumber in a form acceptable to the City, certifying that the inside of the property owner's home, or other building(s) on the property, is (are) is in compliance with this Chapter, that the licensed plumber completing the certification was the individual who performed the inspection, that he or she is licensed to perform such inspections, and that the videotape of the lateral line is accurate. The date-stamped video record shall be submitted to the City and reviewed and approved by the City for assessment of compliance with this section of the Code. Requested actions shall not be forwarded to City boards or commissions or the City Council for review until the discharges are in full compliance with this section of City Code.

C. Every person owning real estate to which sanitary sewer service is provided shall allow the City or a designated representative of the City to inspect the buildings, if any, to confirm there is no sump pump or other prohibited discharge into the sanitary sewer system. In lieu of having the City inspect such property, the owner may no later than thirty (30) days after mailed written notice from the City that the property is subject to inspection, furnish a certificate from a licensed plumber in a form acceptable to the City, certifying that the property is in compliance with this Chapter. All inspections and inspection reports must include a date-stamped video record of the complete lateral line from the property to the sewer main. All inspections must be performed and reports completed in accordance with City standards and specifications. In lieu of having the City inspect the property, the owner may furnish a certificate from a licensed plumber in a form acceptable to the City, certifying that the inside of the property owner's home is in compliance with this Chapter, that the licensed plumber completing the certification was the individual who performed the inspection, that he or she is licensed to perform such inspections, and that the video record of the lateral line is accurate. The date-stamped video record shall be submitted to the City and reviewed and approved by the City for assessment of compliance with this section of the Code. The City may inspect or re-inspect any buildings to confirm there is no sump pump or other prohibited discharge into the sanitary sewer system with a valid warrant.

Source: Ordinance No. 405, 2nd Series
Effective Date: 08-29-08

D. All new structures with sumps for which a building permit is issued shall be plumbed to the outside of the dwelling, and connected to a City draintile or storm sewer system, if available, before a certificate of occupancy is issued except that upon City approval discharge may be made to privately or publicly-owned infiltration basins. A maintenance agreement with the City is required for any such basin in the right-of-way.

Source: Ordinance No. 354, 2nd Series
Effective Date: 12-15-06

E. Any property with a sump pump found not in compliance with this Code but subsequently verified as compliant shall be subject to an annual re-inspection to confirm continued compliance. If that property is found not to be in compliance upon re-inspection, or any person refusing to allow their property to be re-inspected within thirty (30) days after receipt of mailed written notice from the City, or failing to furnish a certificate certifying compliance with this Chapter from a licensed plumber in a form acceptable to the City as described in subdivision 3, sections (B) and (C), that property shall be subject to a nonrefundable surcharge of five hundred ($500) dollars per month, to be imposed on each sewer bill thereafter to that property until the noncompliance or refusal to allow entry is corrected. All properties found during any re-inspection to have violated this section shall be subject to a nonrefundable monthly surcharge that is double the previously charged surcharge. The nonrefundable surcharge for all properties which are not single family residential shall be one thousand ($1,000) dollars per month.

F. In the event a foundation drain is connected to the sanitary sewer service it shall not only be disconnected but the property owner shall install a sump basket and pump properly discharged outside the structure to provide adequate drainage from the foundation drain system.

Source: Ordinance No. 405, 2nd Series
Effective Date: 08-29-08

Subdivision 4. Winter Discharge

The City Manager or his/her designee is authorized to permit a property owner to discharge clear water into the sanitary sewer system. Prior to issuance of the permit the City Manager or his/her designee must verify that the criteria to issue the permit have been satisfied. The fee for this permit shall be in an amount to be fixed by the Council and adopted by ordinance. The permit shall authorize such discharge only from November 15 to March 15, shall require the owner to permit an inspection of the property on March 16 or as soon thereafter as possible to determine that discharge into the sanitary sewer has been discontinued and shall subject the owner to a five hundred ($500) dollar monthly non-refundable surcharge in the event the owner refuses an inspection or has failed to discontinue the discharge into the sanitary sewer. The non-refundable charge will commence with the April water billing and continue until the property owner establishes compliance with this section. A property owner is required to meet at least one (1) of the following criteria in order to obtain a permit:

A. The freezing of the discharge from the sump pump, footing or foundation drain is causing a dangerous condition, such as ice buildup or flooding, on either public or private property.

B. The property owner has demonstrated that there is a danger that the sump pump, footing or foundation drain pipes will freeze up and result in either failure or damage to the sump pump unit or the footing or foundation drain and cause basement flooding.

C. The water being discharged from the sump pump, footing or foundation drain cannot be readily discharged into a city draintile or storm sewer system or other acceptable drainage system.

Following ten (10) days written notice and an opportunity to be heard, the City Manager or his/her designee may require the owners of the property to discharge their sump pump or footing or foundation drain into the sanitary sewer from November 15 to March 15 if the discharge is causing an icy condition on streets.

Subdivision 5. Separate Connections

A separate sewer service connection shall be provided for each building, except where one (1) building stands at the rear of another on an interior lot and no such separate connection is available, provided that more than one (1) service may be connected to the sewer system through one (1) connection where a manhole is provided and the City has specifically approved the arrangement.

Source: Ordinance No. 351, 2nd Series
Effective Date: 10-13-06

Subdivision 6. Materials

Where any pipe or other material is found in repairing a sewer service which does not then meet the requirements of the State Building Code or current City standards and specifications, the repaired or replaced portion of the sewer service pipe shall comply with current City standards and codes and shall be removed and replaced at the expense of the consumer.

Source: Ordinance No. 354, 2nd Series
Effective Date: 12-15-06

Subdivision 7. Elevation

Wherever possible, the sewer service shall be brought to the building to be served at an elevation below the floor of the lowest level in the building. No such service shall be laid parallel to or within three (3) feet of any bearing wall. The depth shall be sufficient to afford protection from frost. To the extent possible, the sewer service shall be laid at uniform grade and in straight alignment. If the service is too low to afford gravity flow, an appropriate device shall be installed for lifting sewage to the service.

Subdivision 8. Connections

Wherever possible, the sewer service shall be connected to the wye provided or the stub at the lot line. If such connection cannot be used, the main may be tapped upon the approval of the City and at the expense of the owner. All connections must be constructed in accordance with the current City standards, be appropriately permitted, and be inspected by the City.

Subdivision 9. Ownership of Sewer Service Lateral

The property owner shall own and be responsible for the maintenance of the sanitary sewer service lateral between the sanitary sewer main within the street and the building being served, including the connection to the main.

Subdivision 10. Unmetered Water Supply

The discharge of sewage into the sewer system from water sources other than the City's water supply is prohibited without a permit from the City and shall include metering of the water supply or discharge. The metered supply or discharge must use meters purchased from the City.

Subdivision 11. Additional Rules and Regulations

The Council may, by resolution, adopt such additional rules and regulations relating to placement, size and type of equipment as it, in its discretion, deems necessary or desirable. Copies of such additional rules and regulations shall be kept on file in the office of the City Manager or his/her designee, and uniformly enforced.

Source: Ordinance No. 351, 2nd Series
Effective Date: 10-13-06

Section 3.31: Certificate of Inflow and Infiltration ("I&I") Compliance

Subdivision 1. Required

No person shall sell, advertise for sale, give or transact a change in title or property ownership of real property with one (1) or more buildings or structures, without first obtaining a certificate of I&I compliance from the City or complying with Subd. 5 hereof.

Source: Ordinance No. 370, 2nd Series
Effective Date: 5-25-07

Subdivision 2. Application and Fees

A. Unless the property owner already has a certificate of I&I compliance for a property, the owner or owner's representative is required to apply for a certificate and complete an inspection thereof before such property is offered for sale, gifted or transferred, and before the owner or owner's representative enters into any contract for deed or other transaction changing the party responsible for the property. Even if the property owner already has a certificate of I&I compliance, if it is more than one (1) year old, a sump pump inspection is required for all properties containing sump pumps.

Source: Ordinance No. 405, 2nd Series
Effective Date: 08-29-08

B. At the time of application, the applicant for either a certificate of I&I compliance or a sump pump inspection shall pay the appropriate application fee. Such fees shall be set from time to time by the City.

Source: Ordinance No. 370, 2nd Series
Effective Date: 5-25-07

Subdivision 3. Inspection

The applicant for a certificate of I&I compliance or sump pump inspection is responsible for providing an inspection of the property after making application and payment of fees. An inspection shall be made either 1) by the City or 2) by a licensed plumber to determine whether the property use is in accordance with City sanitary sewer service regulations, as provided in Section 3.30 of this Chapter. The entire property and all buildings on the property shall be made available for inspection.

Source: Ordinance No. 405, 2nd Series
Effective Date: 08-29-08

Subdivision 4. Compliance and Expiration

A. Upon inspection, when the property use is in accordance with City sanitary sewer services regulations, a certificate of I&I compliance will be issued by the City.

Source: Ordinance No. 370, 2nd Series
Effective Date: 5-25-07

B. A Certificate of I&I compliance is valid to be used for the transfer of property.

C. The certificate of I&I compliance must be conspicuously displayed on the premises at all times when the property is being shown for sale and the owner is responsible for informing any potential buyers, gift recipients or other persons to whom he or she intends to transfer title as to his receipt of the certificate of I&I compliance.

D. If, within one (1) year of the issue of a certificate of I&I compliance, the owner named on the certificate of I&I compliance does not agree to an inspection of the structure's sump pump, footing or foundation drain discharge, or furnish a certificate from a licensed plumber in a form acceptable to the City as described in Section 3.30, subd. 3, sections (B) and (C), certifying that the property is in compliance with this Chapter, when required by Section 3.30, subd. 3(B) of this Chapter, the certificate is immediately void. Such inspections trigger the administrative sanctions found in Section 3.30, subd. 3 of this Chapter.

Source: Ordinance No. 405, 2nd Series
Effective Date: 08-29-08

Subdivision 5. Correction Notice

If an inspection discloses that use of a property is not in accordance with City sanitary sewer service regulations, a correction notice may be issued by the City permitting the transfer of property, providing;

A. An agreement by the owner or owner's representative has been executed with the City, whereby the owner or owner's representative agrees to complete corrections to the property necessary to bring it within compliance of the City sanitary sewer service regulations, Section 3.30 of this Chapter within sixty (60) days of the transfer of property.

B. A security to ensure completion of any corrections to the property must be posted with the closing agent in the form of an escrow, or with the City when a closing agent is not involved, at the time of property transfer or closing. The security shall be in an amount at least equal to one hundred twenty-five percent (125%) of the retail value of the work necessary for compliance with this Section. The escrow must be fully maintained until a certificate of I&I compliance is issued. A correction notice shall not be issued for more than one hundred eighty (180) days following the first inspection of the property,

but it may be extended for additional periods up to one hundred eighty (180) days each by the City Manager's designee.

The owner (or transferor) and any real estate agents involved in the transaction are responsible for disclosing the correction notice to the transferee and all other persons or entities involved in the transaction. The responsibility for repairing any nonconformance with the sanitary sewer service regulations runs with the land and not only rests with the owner or transferor but is also an obligation of the transferee(s) of the property.

Source: Ordinance No. 370, 2nd Series
Effective Date: 5-25-07

Subdivision 6. Sanctions

At all times during the certification process, the owner is responsible for any sanctions or surcharges under Section 3.30, subd. 4 of this Chapter.

Source: Ordinance No. 351, 2nd Series
Effective Date: 10-13-06

Subdivision 7. Repeated Inspection

Upon inspection, when the property use is not legal in accordance with City sanitary sewer service regulations, the owner shall be entitled to a second inspection to be scheduled within ninety (90) days of the original inspection. If, as a result of this inspection, the City inspector determines (or a licensed plumber certifies and the certified videotape is determined by the City to be compliant) that all violations of City sanitary sewer regulations have been corrected, the City shall immediately issue a certificate of I&I compliance.

Source: Ordinance No. 405, 2nd Series
Effective Date: 08-29-08

Subdivision 8. Previously Issued Certificates

Certificates of sewer regulations compliance issued under prior laws between January 1, 2007 and May 31, 2007 shall have the same force and effect as certificates of I&I compliance issued under this section 3.31. Temporary certificates of sewer regulations compliance issued under prior laws between January 1, 2007 and May 31, 2007 shall have the same force and effect as provided under prior laws.

Source: Ordinance No. 370, 2nd Series
Effective Date: 5-25-07

Section 3.32: Discharge of Fats, Oils, and Grease (FOG)

Subdivision 1. Installation
Any existing, new, renovated, or expanded Food Service Facility must install a Grease Interceptor/Trap upon notice by the City that it has been determined that the Fat, Oil and Grease discharge from such Food Service Facility significantly impacts the City sewer system requiring undue additional maintenance. Upon notification, the Food Service Facility shall have a period of time stated in the notice, not exceeding one (1) calendar year, to install the Grease Interceptor/Trap.

Subdivision 2. Design
All Grease Interceptors/Traps must be designed and installed in accordance with the State of Minnesota Plumbing Code (MN Rule 4715) and the Hennepin County Environmental Health Department.

Subdivision 3. Location
All Grease Interceptors/Traps shall be located as to be readily and easily accessible for cleaning and inspection.

Subdivision 4. Annual Maintenance Record
By April 1 of each year, Food Service Facilities with Grease Interceptors/Traps must submit annual maintenance records to the City on a form that is provided by the City. The City may also perform periodic inspections of Food Service Facilities to ensure that Grease Interceptors/Traps are being properly maintained by each Food Service Facility.

Subdivision 5. Installation and Maintenance Policy and Procedures
The City shall maintain an Installation and Maintenance Policy and Procedures which will document specific requirements of this Section. This policy will be available to each Food Service Facility at the City.

Subdivision 6. Additional Control Measures
The City reserves the right to require additional control measures if existing Grease Interceptors/Traps are determined to be insufficient to protect the wastewater collection system from interference due to the discharge of FOG from the Food Service Facility.

Source: Ordinance No. 531, 2nd Series
Effective Date: 10-31-14

Appendix D

2016 Meter Analysis

Metropolitan Council Environmental Services (MCES) prepared this Executive Summary for the public works community as a supplement to the Brown and Caldwell (B&C) Meter Review and Analysis technical memorandum (Report) received on December 8, 2016 (attached). The B&C Report used measured rainfall data, measured wastewater flows, and a computational model to determine the amount of flow reduction that can be attributed to inflow and infiltration (I/I) mitigation. Rainfall data were collected from 2004 through 2015 and wastewater flow data were collected during two monitoring periods: pre-rehabilitation from 2004 to 2007, and post-rehabilitation from 2013 to 2015. The monitoring periods occurred before and after I/I mitigation activities were completed in many communities in the region, including those chosen for this analysis.

The results of the analysis indicate that I/I flows were reduced at rates from 11% to 75% in the communities selected. The rate of reduction appears to have a positive correlation with the amount of I/I mitigation reported. A summary of the key points of the Report is included below.

Section 1: Introduction

The section describes the approach used by B&C for the meter review and analysis. Given that wastewater flows have reduced in the region in recent years, this evaluation was completed to determine if the reduced flows could be attributed to I/I mitigation projects. The evaluation used a hydrological modelling software to compare wastewater flow data for the two monitoring periods. The modeling approach used wastewater flow rates that occurred during a wide-range of rainfall events, and therefore, increased the reliability of the model. With this modeling approach, the results could be processed to determine a statistical once in 10-year recurrence interval of a peak flow event. The recurrence interval is the likelihood of a given wastewater flow amount, regardless of whether the flow was influenced by a single rainfall or the combination of many smaller rainfall events. This approach was used to account for the effects of antecedent conditions (soil moisture, surface water elevations, etc.) that can affect the base and peak flow associated with I/I.

Section 2: Data Evaluation

This section describes the process and data used to determine which wastewater areas (metersheds) were used for the analysis. The data sets included hourly wastewater flow measurements recorded by MCES for twenty communities within the metropolitan region and rainfall measurements from the National Weather Service and the Minneapolis-St Paul (MSP) airport rain gauge. The twenty sites were evaluated to determine which had the most complete and useful data sets for this evaluation. These locations were also evaluated for criteria such as relative amount of I/I mitigation efforts, presence of MCES facilities in the metershed, and completeness of data for upstream tributaries. Using these criteria, three metersheds were chosen for analysis and one metershed was selected as a control. The communities selected for evaluation were Shoreview, Golden Valley, Minneapolis, and Burnsville (control). For each metershed used in the analysis, the Report identifies the I/I mitigation activities documented, rainfall and wastewater flow data sets used, and a map of the contributing area(s).

Section 3: Flow reduction Analysis

This section describes the technical aspects of the analysis and includes the modeling tools, inputs to the model, calibration techniques, outputs, and the flow reduction results. The Report includes descriptions of the calibration approach used including model output hydrographs and flow comparison charts, as well as data gaps and the percent error of results.

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The measured and predicted wastewater flows were statistically compared to determine the differences in total flow and I/I flow between the two monitoring periods. If the measured wastewater flow was less than the model-predicted wastewater flow in the post-rehabilitation period, then there was a reduction in flow. The I/I flow rate is the difference between the total peak flow and the base flow. Flow reductions are presented for a 10-year recurrence interval in the table below and in chart form on the following pages.

Results Summary									
Metershed	Pre-Rehab (mgd)			Post-Rehab (mgd)			Reduction		
	Base Flow	Peak Flow	I/I Flow	Base Flow	Peak Flow	I/I Flow	Base Flow	Peak Flow	I/I Flow
Shoreview M048	1.5	3.7	2.1	1.2	3.1	1.9	24%	17%	**11%**
Minneapolis SW M101	13.9	155	140	12.3	47	35	11%	69%	**75%**
Golden Valley M117	2.3	12.9	10.9	2.2	9.8	7.8	5%	24%	**28%**
Burnsville M501A	7.8	17.8	9.3	7.4	17.1	9.3	6%	4%	**0%**

Section 4: Summary

This section includes a description of the results which show that there has been a decrease in I/I flow for each community evaluated – except for the control site – as expected. The flow reductions and contributing factors are described below;

- The most significant reductions occurred at M101 in Minneapolis. The flow reductions were 69% for peak flow and 75% for I/I flow. The measured flow data also indicate the sharp peaks in flow previously exhibited during rainfall events were not as notable in the post-rehab period. Minneapolis completed extensive private and public rehabilitation efforts between the monitoring periods, with emphasis on disconnection of storm water inflow sources.
- The flow reductions for M117 in Golden Valley were 24% for peak flow and 28% for I/I flow. Golden Valley completed private and public rehabilitation efforts between the monitoring periods, with emphasis on sewer main and service lateral infiltration sources.
- The results for M048 in Shoreview indicate that the base flow was reduced by greater percentages than the peak flow or I/I flow. The flow reductions in were Shoreview were 17% for peak flow and 11% for I/I flow. Shoreview reported rehabilitation of public infrastructure between the monitoring periods, with emphasis on sewer main rehabilitation.
- The 4% reduction in peak flows at site M501A in Burnsville is likely due to the 6% reduction in base flow, which is consistent with the regional base flow reduction of roughly 8%. The flows through M501A included contributions from upstream metersheds in portions of Apple Valley, Lakeville, and Savage.

This section also includes notes on limitations of data inputs, calibration, and use of results. The approach used assumed that changes within each community- including mitigation work during the flow monitoring periods, growth, water conservation, and system degradation- were not considered and are not expected to have material influence on the results.

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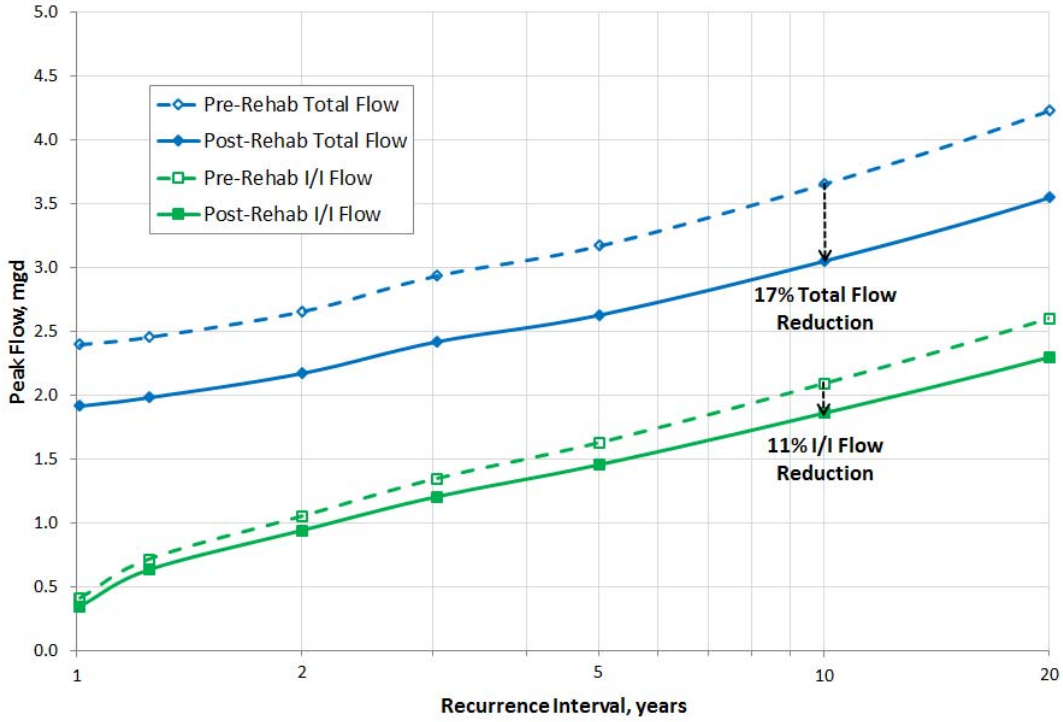


Figure 1: Shoreview (M048) peak hourly flow recurrence intervals

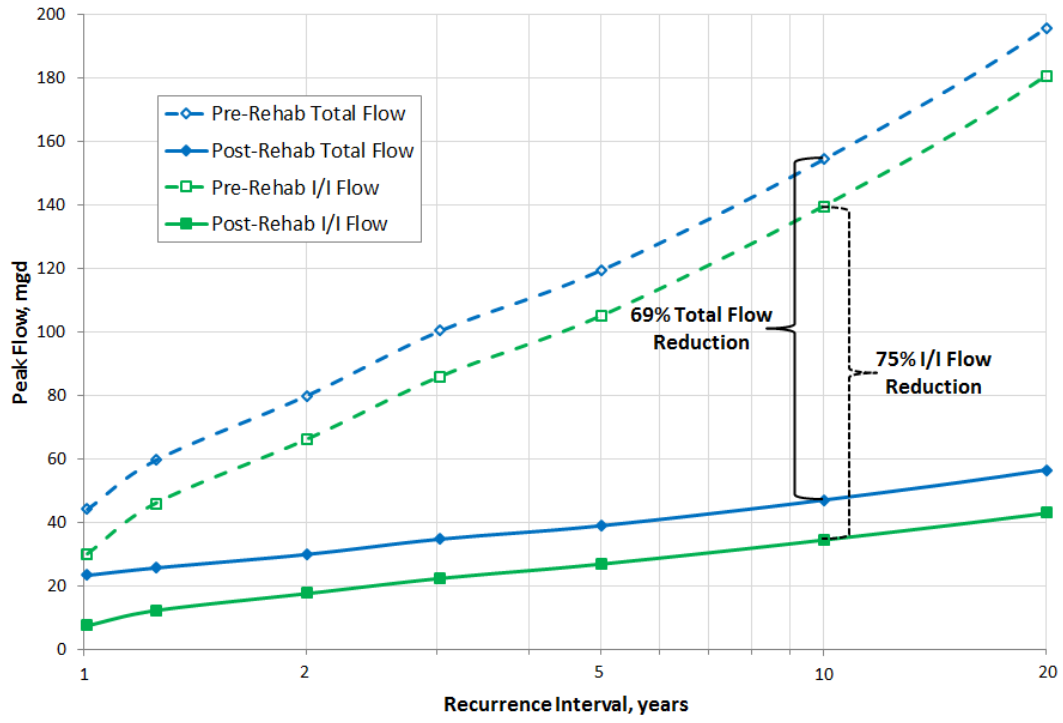


Figure 2: Minneapolis (M101) peak hourly flow recurrence intervals

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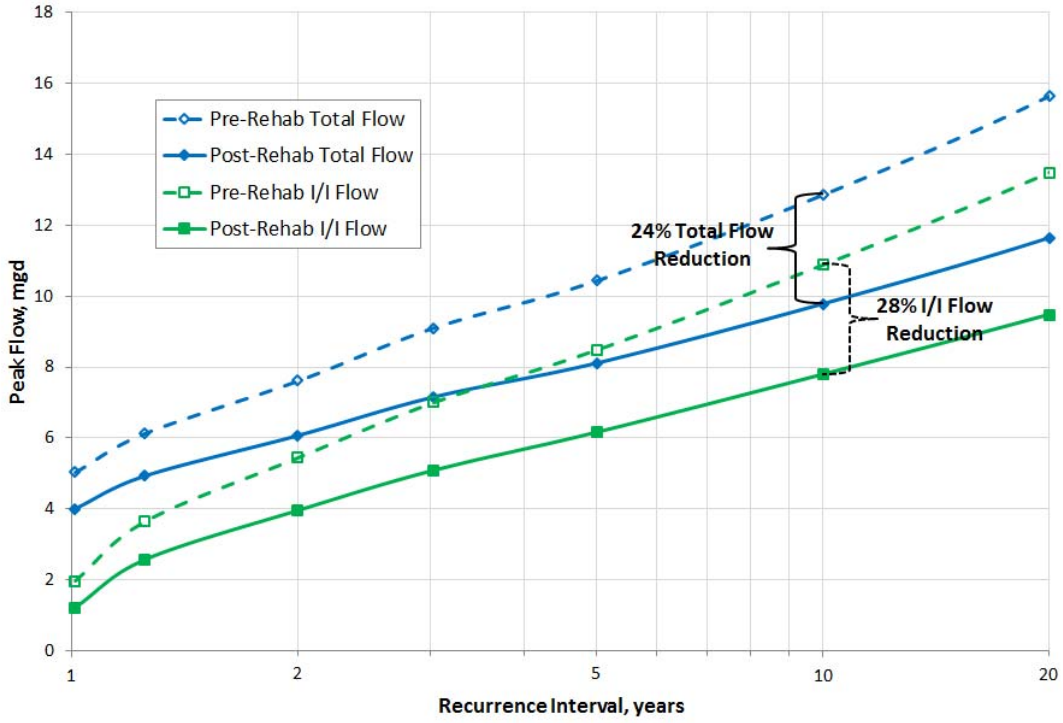


Figure 3: Golden Valley (M117) peak hourly flow recurrence intervals

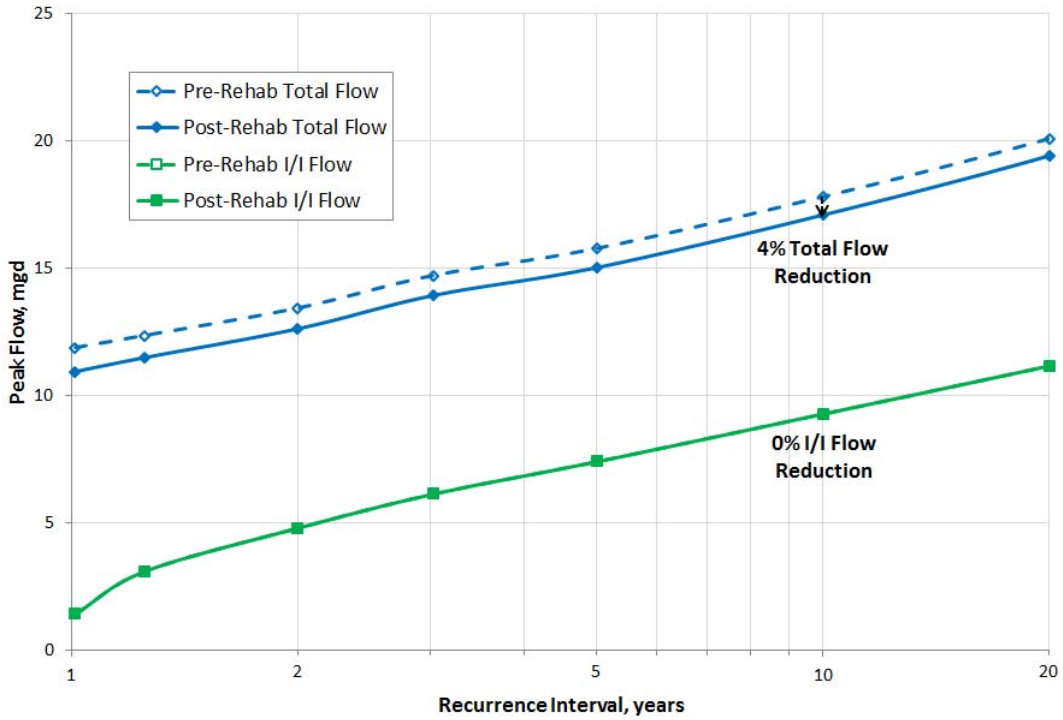


Figure 4: Burnsville (M501A) peak hourly flow recurrence intervals

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Technical Memorandum

30 7th Street East, Suite 2500
Saint Paul, MN 55101

T: 651.298.0710
F: 651.298.1931

Prepared for: Metropolitan Council Environmental Services

Project Title: I/I Task Force Assistance

Project No.: 149008

Technical Memorandum

Subject: Meter Review and Analysis

Date: December 8, 2016

To: Jeannine Clancy, Metropolitan Council Environmental Services
Marcus Bush, Metropolitan Council Environmental Services

From: Andy Lukas, Brown and Caldwell

Copy to: Chuck Lewis, Brown and Caldwell

Prepared by: _____
Erica Schierholz

Reviewed by: _____
David Perry

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List of Abbreviations

BC	Brown and Caldwell
CAPE	Capacity Assurance Planning Environment
City	City of Minneapolis
CSO	combined sewer overflow
EPA	U.S. Environmental Protection Agency
HSPF	Hydrologic Simulation Program-Fortran
I/I	inflow and infiltration
in/hr	inch(es) per hour
ISURO	impervious land surface runoff *(HSPF runoff generation component)*
LF	linear foot/feet
MCES	Metropolitan Council Environmental Services
mgd	million gallons per day
MSP	Minneapolis-St. Paul International Airport
NCDC	National Climatic Data Center
NEXRAD	Next Generation Weather Radar
NWS	National Weather Service
PAGWO	pervious land active groundwater *(HSPF runoff generation component)*
PIFWO	pervious land interflow groundwater *(HSPF runoff generation component)*
post-rehab	post-rehabilitation
pre-rehab	pre-rehabilitation
PSURO	pervious land surface runoff *(HSPF runoff generation component)*
RTK	R: percentage of rainfall that the enters the sanitary sewer as I/I T: time to peak flow K: ratio of time to recession to time to peak
SWMM	Storm Water Management Model
TM	technical memorandum
USGS	U.S. Geological Survey

Section 1: Introduction

This technical memorandum (TM) describes the Meter Review and Analysis task (Task 4) for the Metropolitan Council Environmental Services (MCES) Inflow and Infiltration (I/I) Task Force Assistance project, and summarizes the evaluation and peak flow reductions.

Task 4 of the I/I Task Force Assistance project includes gathering, reviewing, and evaluating flow and rainfall data for several communities; determining the usefulness of the data for analysis; and evaluating flow reduction at four selected metering sites using hydrologic modeling tools.

Mitigation efforts to reduce I/I flows entering the sanitary sewer collection system continue in many communities discharging to the MCES collection system. The effectiveness of these I/I mitigation efforts can be observed in the flow meter records for these areas. When comparing pre-rehabilitation (pre-rehab) and post-rehabilitation (post-rehab) periods, a reduced wastewater flow response to rainfall can be a result of I/I mitigation. Quantifying the I/I flow reduction, however, is complicated by wet weather conditions, such as soil moisture and groundwater levels, that vary between large rainfall events. These conditions that exist prior to each rainfall event are known as antecedent conditions. Wastewater flows attributable to I/I vary based on the intensity of wet weather, antecedent soil conditions, and the amount of the infiltration into the collection system.

Reduction of measured flow between the pre-rehab and post-rehab periods could be evidence of flow reduction due to I/I mitigation or it could be the result of dry conditions and less rainfall. In order to determine if the reductions in measured flow are attributable to I/I mitigation, Brown and Caldwell (BC) completed this Meter Review and Analysis by calibrating hydrologic models to determine if wastewater flows attributable to I/I have changed from pre-rehab to post-rehab periods. Flow frequency analyses were performed to define flow recurrence interval curves for both pre-rehab and post-rehab periods. An evaluation of flow reduction from pre-rehab to post-rehab periods was based on reduction in flows defined by the flow recurrence interval curves. This approach has the advantage of comparing pre-rehab and post-rehab conditions on an equal basis for a range of wet weather event sizes, and avoids problems associated with comparing measured events in the flow meter record not caused by equal wet weather events. Using a statistical comparison across all simulated events provides a more sound basis for stating I/I reduction that was achieved by rehabilitation.

The following steps were taken to carry out this approach, as described in more detail in Section 2:

1. Review flow and rainfall data for 20 candidate monitoring sites for a pre-rehab period of 2004–06 and post-rehab period of 2013–15
2. Evaluate and recommend up to four sites for modeling analysis of I/I flow reduction: three sites defined as rehabilitation meters and one defined as a control meter
3. Calibrate pre-rehab and post-rehab hydrologic models for selected sites
4. Perform statistical analyses of modeled flows using the Log Pearson Type III flow frequency distribution
5. Analyze flow reduction at selected sites for a 10-year recurrence interval event
6. Report findings and recommendations for future action

Section 2: Data Evaluation and Selection

This section describes evaluation of data and site selection.

2.1 Monitoring Data

Monitoring data provided to BC included flow data collected by MCES and National Weather Service (NWS) Next Generation Weather Radar (NEXRAD) rainfall data. These data are summarized below.

MCES provided 1-hour interval flow data at 20 sites for review. Data for all sites were made available for a pre-rehab period (2004–06) and post-rehab period (2013–15). Table 2-1 lists the flow metering sites.

MCES provided 1-hour interval NWS NEXRAD rainfall data, generated for each flow meter site identified in Table 2-1, for the same periods as the metering data. For a long-term rainfall record, BC downloaded data for the Minneapolis-St. Paul International Airport (MSP) rain gauge from the National Climatic Data Center (NCDC) website for the August 1948–April 2016 period. Outside of the monitoring periods, and when NEXRAD data appeared to be questionable or were missing, rainfall data were supplemented or replaced with data from the long-term MSP rain gauge.

The monitoring sites (listed in Table 2-1) and the MSP rain gauge are identified on Figure 2-1.

Table 2-1. Flow Monitoring Sites

Community	Flow Meter	Upstream Tributary Flow Meters
Anoka	M303	M302 M304
Blaine	M216	-
Brooklyn Center	M110	-
Burnsville	M501A	M405 M406 [a] M644A M630
Chanhassen	M413	M439 [a]
Farmington	M642	-
Golden Valley	M117	M120
Mound	M423	M426 [a] M422 M455
Moundsview	M212	-
Minneapolis SW	M101 (M101A+M101B)	M121 (M122) M127 M130 (M128, M129)
New Hope	M114	-
Newport	M603	-

Table 2-1. Flow Monitoring Sites		
Community	Flow Meter	Upstream Tributary Flow Meters
Plymouth	M118	M119
Shoreview	M048	-
	M050	-
	M204	M205 M219 M208
Spring Lake Park	M214	-
Stillwater	M606	-
West St. Paul	M056	-
	M058	-

a. *Flow meter data not provided.*

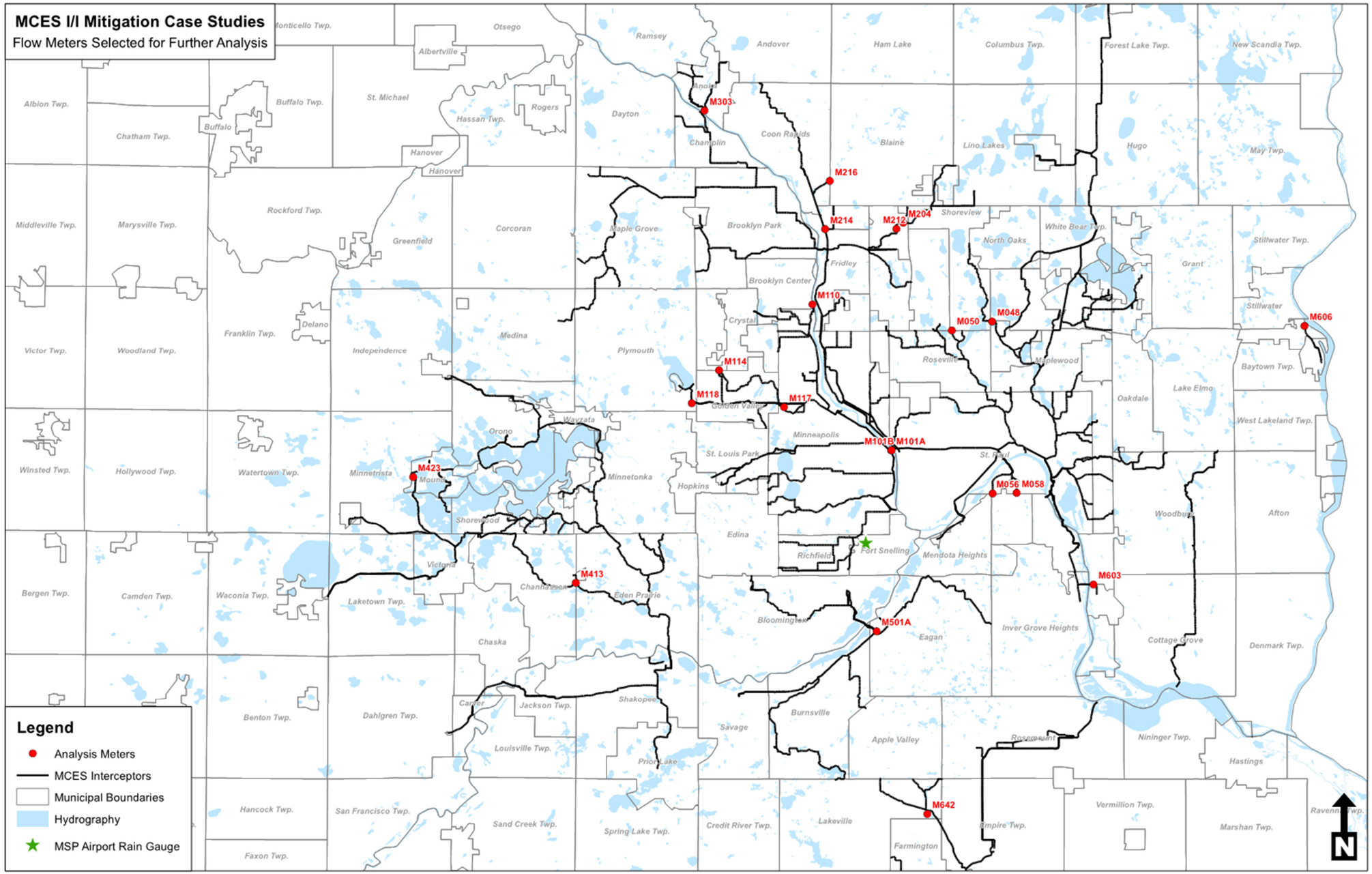


Figure 2-1. MCES flow monitoring sites

2.2 Site Selection

Flow monitoring sites were screened based on the following criteria developed by BC and MCES:

- Rehabilitation meter criteria:
  - Presence of complete data record (standalone and in relation to other sites)
  - Presence of quality flow data (i.e., no truncated and/or erroneous data)
  - Evidence of significant I/I flow (positive rainfall-to-flow correlation)
  - Visual evidence of flow reduction based on initial data evaluation
  - Presence of rehabilitation work completed in metershed
  - Type and cost of rehabilitation work completed (public and/or private)
  - Evidence of little to no rehabilitation in upstream metersheds (if any)
  - Presence of MCES infrastructure in metershed
- Control meter criteria:
  - Presence of complete data record (standalone and in relation to other sites)
  - Presence of quality flow data (i.e., no truncated and/or erroneous data)
  - Evidence of some I/I flow (positive rainfall-to-flow correspondence)
  - Demonstrated stable I/I flow response over time
  - Evidence of little to no rehabilitation work completed in the metershed
  - Evidence of little to no rehabilitation work completed in upstream metersheds (if any)
  - Presence of MCES infrastructure in metershed

Information available for each flow metering site is provided in Table 2-2.

Table 2-2. Available Metershed Information

Community	Flow Meter	I/I Mitigation Efforts	MCES Facilities in Metershed	Notes
Anoka	M303	None	2+ miles gravity, 1+ mile force main, two lift stations	Poor correlation of rain and flow
Blaine	M216	None	None	Possible control site Meter currently measures 65% of the community's metered flow
Brooklyn Center	M110	Little to none	None	Variable flows
Burnsville	M501A	None	15+ miles gravity, 0.5 mile force main, one lift station	Possible control site
Chanhassen	M413	Public work with some minor private work	3+ miles gravity, 2+ miles force main	Incomplete data
Farmington	M642	Some public work	None	Old pipe network
Golden Valley	M117	Extensive public and private work	7+ miles gravity	Good flow data
Mound	M423	Extensive public work; no private work	5 miles gravity and force main, six lift stations	Incomplete data

Table 2-2. Available Metershed Information				
Community	Flow Meter	I/I Mitigation Efforts	MCES Facilities in Metershed	Notes
Moundsview	M212	Little to none	None	Possible control site
Minneapolis SW	M101 (M101A+M101B)	Extensive public work; some private work	15+ miles gravity	Unmetered upstream Edina connections
New Hope	M114	Some public; no private	None	
Newport	M603	Public and private	<1,000 feet gravity	
Plymouth	M118	Public work only	1+ miles gravity, one lift station	
Shoreview	M048	Public work only	None	Meter currently measures more than 50% of the community's metered flow
	M050	Public work only	None	Meter currently measures less than 5% of the community's metered flow
	M204	Public work only	2.5 miles gravity	Meter currently measures more than 35% of the community's metered flow
Spring Lake Park	M214	None	None	Possible control site
Stillwater	M606	Public work only	None	Flow measured at influent flume to treatment plant
West St. Paul	M056	Little to none	None	Possible control site Meter currently measures less than 5% of the community's metered flow
	M058	Extensive public and private work	None	Meter currently measures more than 35% of the community's metered flow

Based on the above conditions, the following monitoring sites are recommended for further evaluation of I/I flow reduction:

- Site 1: M048, Shoreview
- Site 2: M101 (M101A + M101B), Minneapolis Southwest
- Site 3: M117, Golden Valley
- Site 4 (control): M501A, Burnsville

2.2.1 Site 1: M048, Shoreview

Meter M048 receives and measures wastewater flow from 4,476 acres of developed land in the City of Shoreview (Shoreview). It is a well-defined metershed basin with no upstream meters or tributary areas. Meter M048 measures more than 50 percent of the community's metered flow.

M048 was chosen as a rehabilitation site because there was visual evidence of flow reduction during the initial data evaluation and because available data indicate that the Shoreview public system has been rehabilitated.

Figure 2-2 provides a detailed view of metershed M048; Figure 2-3 depicts the measured hourly flow and rain data for M048 for the pre-rehab and post-rehab periods (2004–06 and 2013–15).

Mitigation efforts in metershed M048, provided by the City of Shoreview, are summarized below:

- Public infrastructure I/I mitigation work:
  - One lift station was added and three existing lift stations were replaced
  - A complete inventory of the sewer mains was completed in 2013. All lines were televised and rated as part of Shoreview's "red zone" asset management program.
  - 2 percent of sewer mains repaired or replaced (approximate)
  - 2-3 percent of sewer mains lined (approximate)
  - 5 percent of sewer services repaired, replaced or lined (approximate)
  - Additional 2 percent of sewer services repaired, replaced or lined as part of private work completed (approximate)
- Private infrastructure I/I mitigation work:
  - Meter change-outs and sump pump inspections were completed at each home in 2009
  - All commercial buildings and properties were inspected for proper roof drain discharges

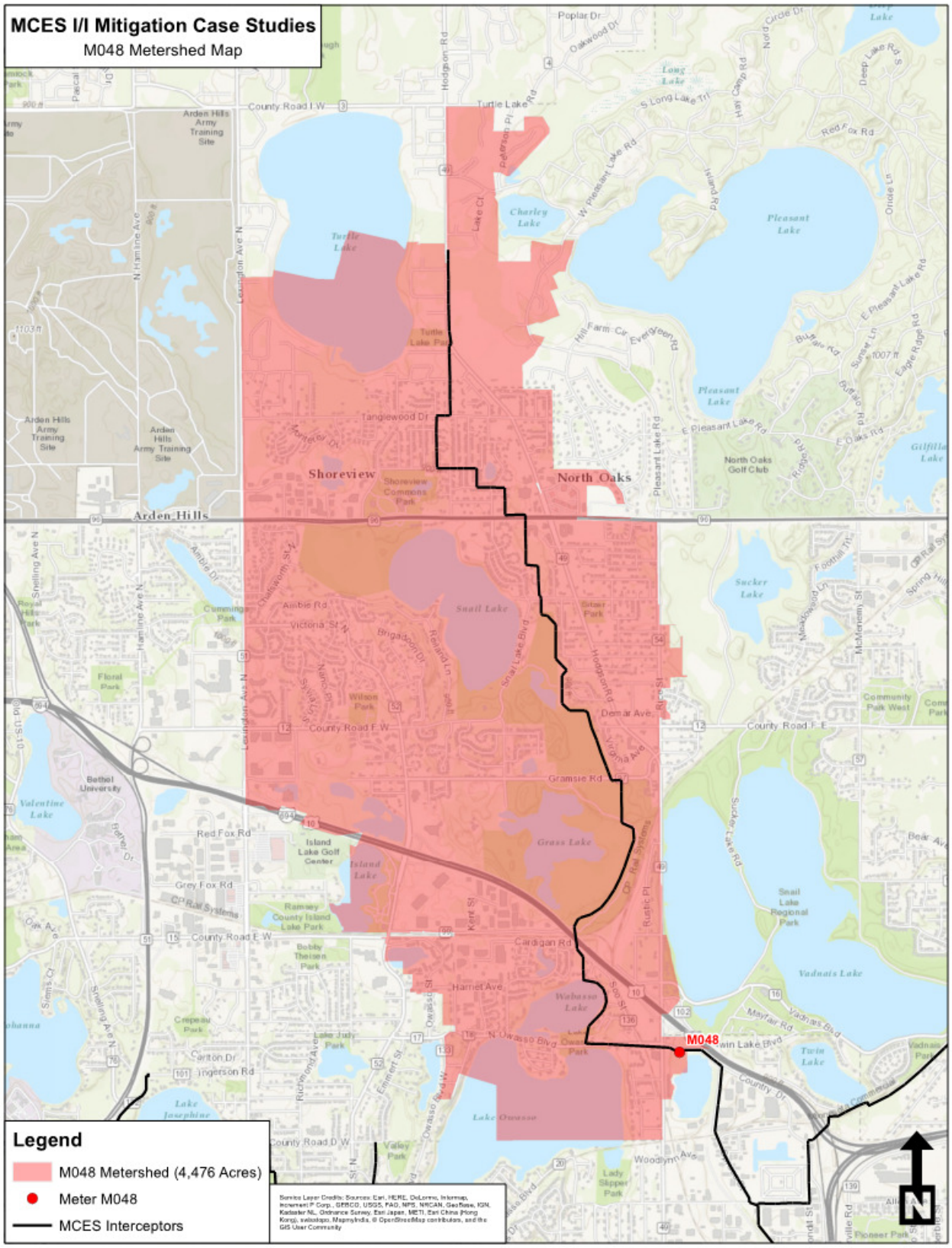


Figure 2-2. Site 1: Shoreview M048 metershed map

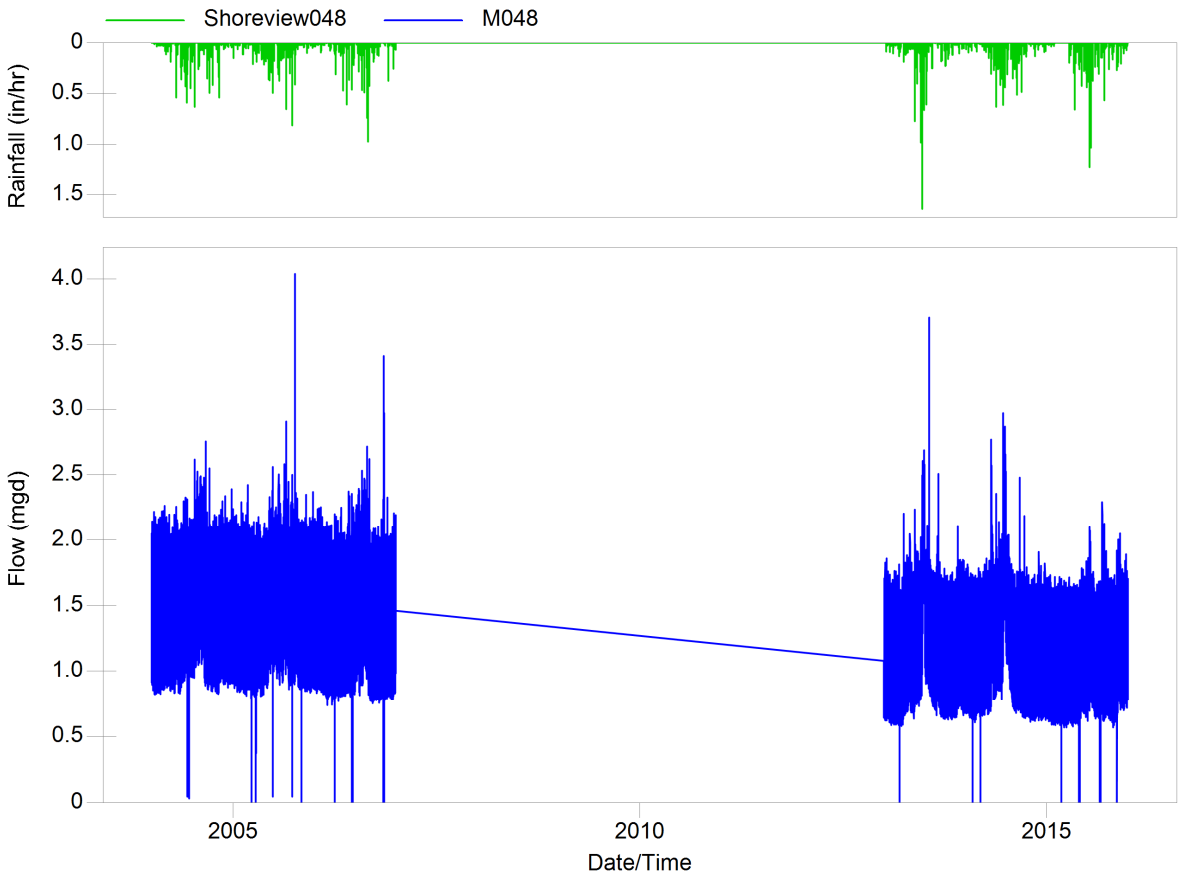


Figure 2-3. Site 1: Shoreview M048 monitoring data

2.2.2 Site 2: M101, Minneapolis Southwest

Meters M101A and M101B receive and measure wastewater flows from 18,489 acres of developed land in the southwest part of the City of Minneapolis (Minneapolis) and other upstream communities. Its total tributary area is 37,195 acres and includes MSP. Three meters directly upstream (M121, M127, and M130), as well as three meters farther upstream (M122, M128, and M129), account for flow from St. Louis Park, Hopkins, Edina, Richfield, and Fort Snelling. Approximately 402 acres of the tributary area from Edina is not metered. The combined flow from these metersheds are measured at meters M101A and M101B, each receiving a portion of the total flow. The measured flows from M101A and M101B have been added together and are referred to as M101 for this evaluation.

This region of Minneapolis was chosen as it represented the least complicated, defined area in which flow reduction achieved by Minneapolis's continuing inflow disconnection efforts could be evaluated. Since the mid-2000s, Minneapolis has embarked on a thorough program to identify and disconnect remaining areas of stormwater inflow to the sewer system that remained after completing the combined sewer separation program. According to Minneapolis's 2016 report, areas of connected inflow and downspouts remain, but a significant number have been disconnected since 2003.

Figure 2-4 provides a detailed view of metershed M101, along with the six metersheds that are upstream of M101. Figure 2-5 depicts the measured hourly flow and rain data for M101, along with the measured flow data from the meters directly upstream (M121, M127, and M130). There is a noticeable change in the shape of the hydrographs from pre-rehab to post-rehab periods. The pre-rehab period flows have sharp (high peak and short duration) hydrograph shapes. The post-rehab hydrograph peaks are lower with longer recession periods after the events.

A summary of the known mitigation efforts in metershed M101 is provided below:

- Public property I/I mitigation projects: Minneapolis began a sewer separation program in 1986 that separated more than 4,600 acres in Minneapolis that were served by combined sewers (now referred to as Phase 1 of the Combined Sewer Overflow (CSO) Program). Minneapolis continues its separation program to convert combined sewer areas to separated sewer areas. Based on Minneapolis's CSO annual reports, from 2003 to 2015 an additional 545 acres were separated. Of the 545 acres, 449 acres (82 percent) were separated prior to the post-rehab period (2013–15).
- Private property I/I mitigation projects: Based on Minneapolis's CSO annual reports, 6,989 downspouts have been disconnected since 2003 (90 percent prior to the post-rehab period). As of March 1, 2016, there were 276 remaining connections.

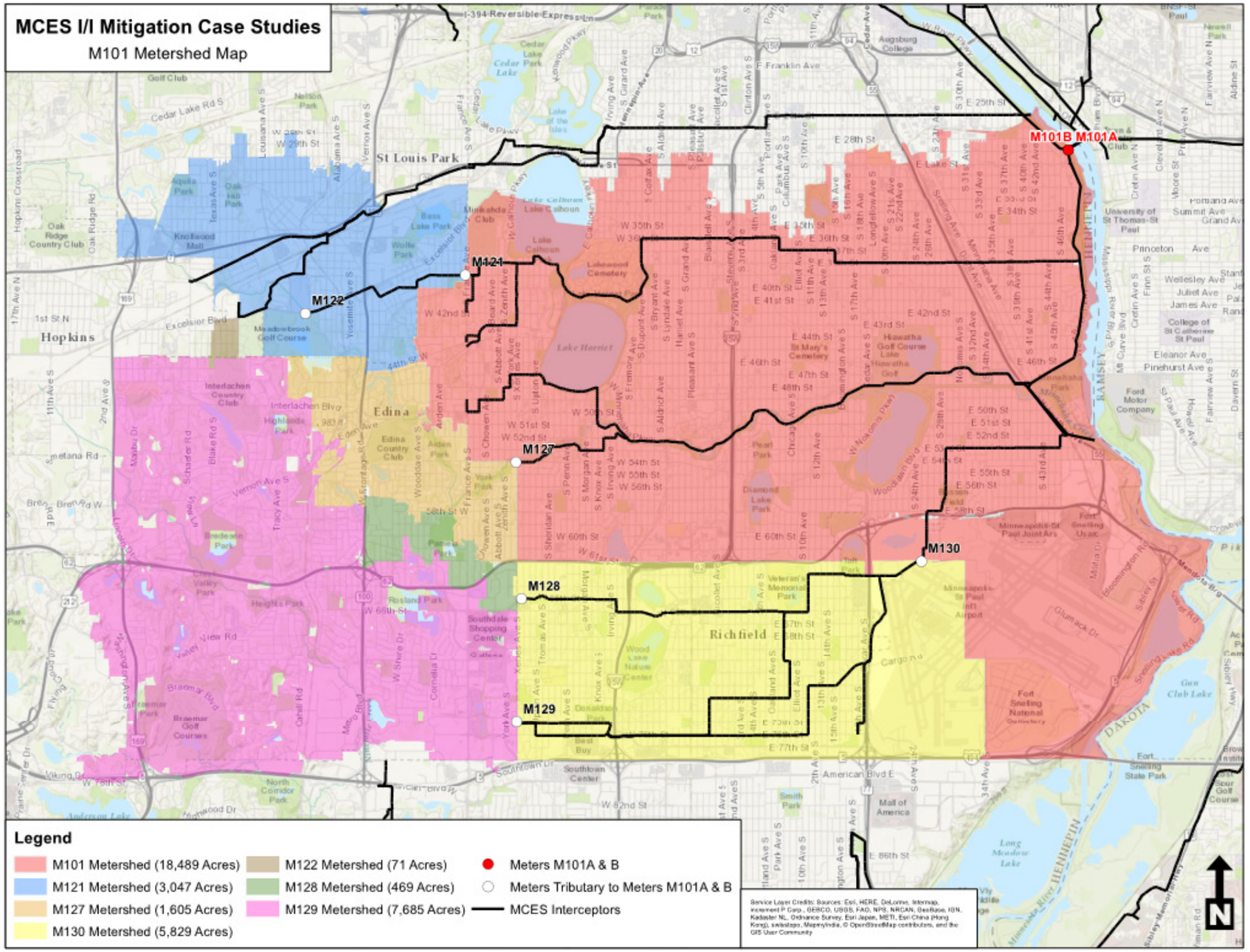


Figure 2-4. Site 2: Minneapolis Southwest M101 metershed map

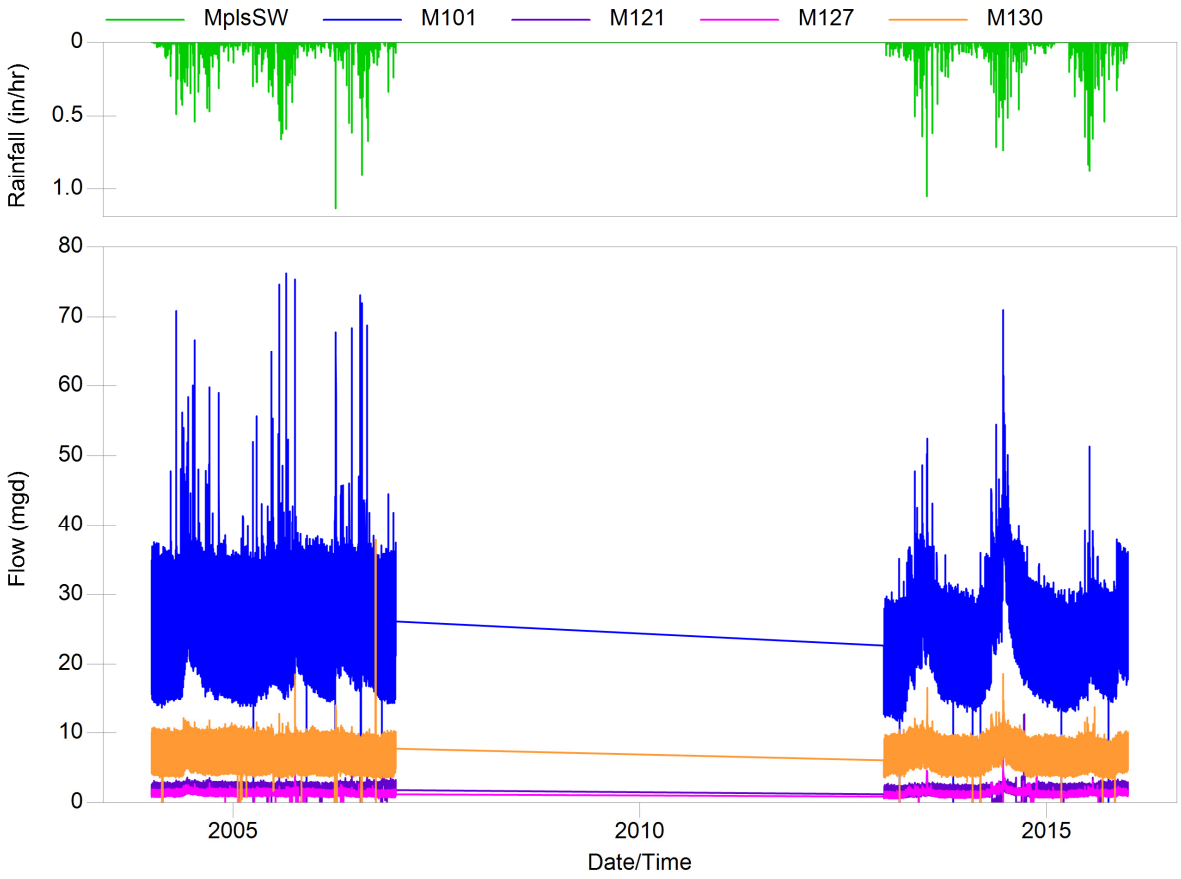


Figure 2-5. Site 2: Minneapolis Southwest M101 monitoring data

2.2.3 Site 3: M117, Golden Valley

Meter M117 receives and measures wastewater flow from 6,398 acres of developed land in the City of Golden Valley (Golden Valley) and upstream areas in the City of St. Louis Park. Its total tributary area is 9,684 acres. Upstream flow from the City of St. Louis Park is monitored at meter M120.

This area was chosen as a rehabilitation site because Golden Valley has undergone extensive public and private rehabilitation and because there was visual evidence of flow reduction during the initial data evaluation.

A map of metershed M117 and its upstream metershed M120 is provided as Figure 2-6. Figure 2-7 depicts the measured hourly flow and rain data for M117, along with the upstream measured flow data for M120.

Within Golden Valley there are 113 miles of public sanitary sewer mains and approximately 147 miles of private sewer laterals. Mitigation efforts since 2006 in Golden Valley (provided by the City of Golden Valley) are summarized below:

- Public infrastructure I/I mitigation work:
  - 49,570 LF of sewer main lined or replaced
  - 2,770 manhole covers with holes replaced with solid covers
  - 1,046 manhole rings and casting frames sealed
  - 6 manhole structures sealed
  - $8.9M construction cost
- Private infrastructure I/I mitigation work:
  - 3,520 out of 8,000 laterals (44 percent) have completed I/I compliance repairs (lining or replacement)
  - $17.1M construction cost (estimated)

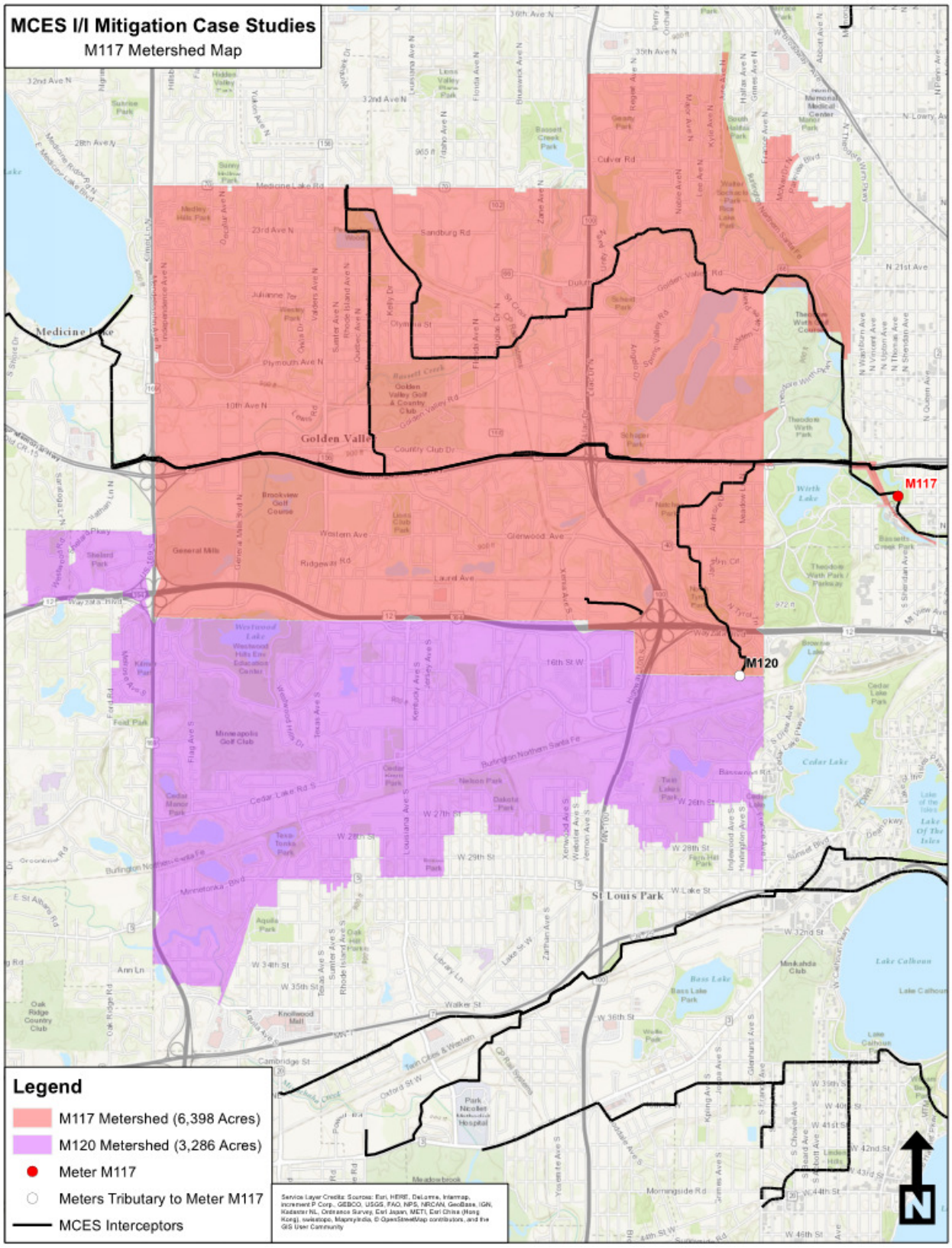


Figure 2-6. Site 3: Golden Valley M117 metershed map

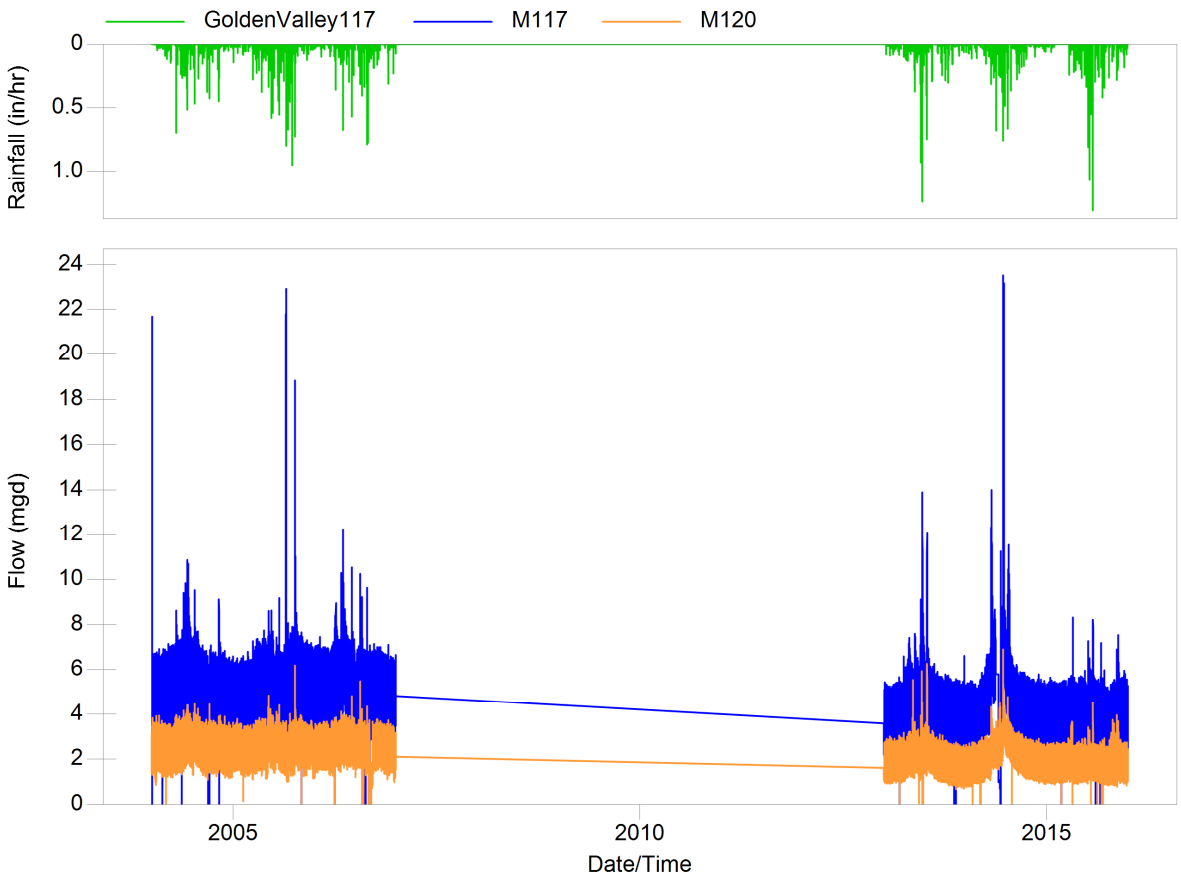


Figure 2-7. Site 3: Golden Valley M117 monitoring data

2.2.4 Site 4 (Control): M501A, Burnsville

Meter M501A receives and measures wastewater flow from 12,852 acres of developed land in the City of Burnsville (Burnsville) and upstream areas in the Cities of Apple Valley, Lakeville, and Savage. Its total tributary area is 21,380 acres. Upstream flows are monitored at meters M405, M406, M630, and M644A.

No known mitigation efforts have taken place in the M501A area in Burnsville, and the flow data indicated a stable I/I flow response over time. Based on these criteria, M501A was selected as the control meter site for this analysis.

Figure 2-8 provides a detailed view of metershed M501A, along with the four metersheds that are upstream (M405, M406, M630, and M644A). Figure 2-9 depicts the measured hourly flow and rain data for M501A. Flow data for the meters upstream are not shown because data were not provided for all four sites.

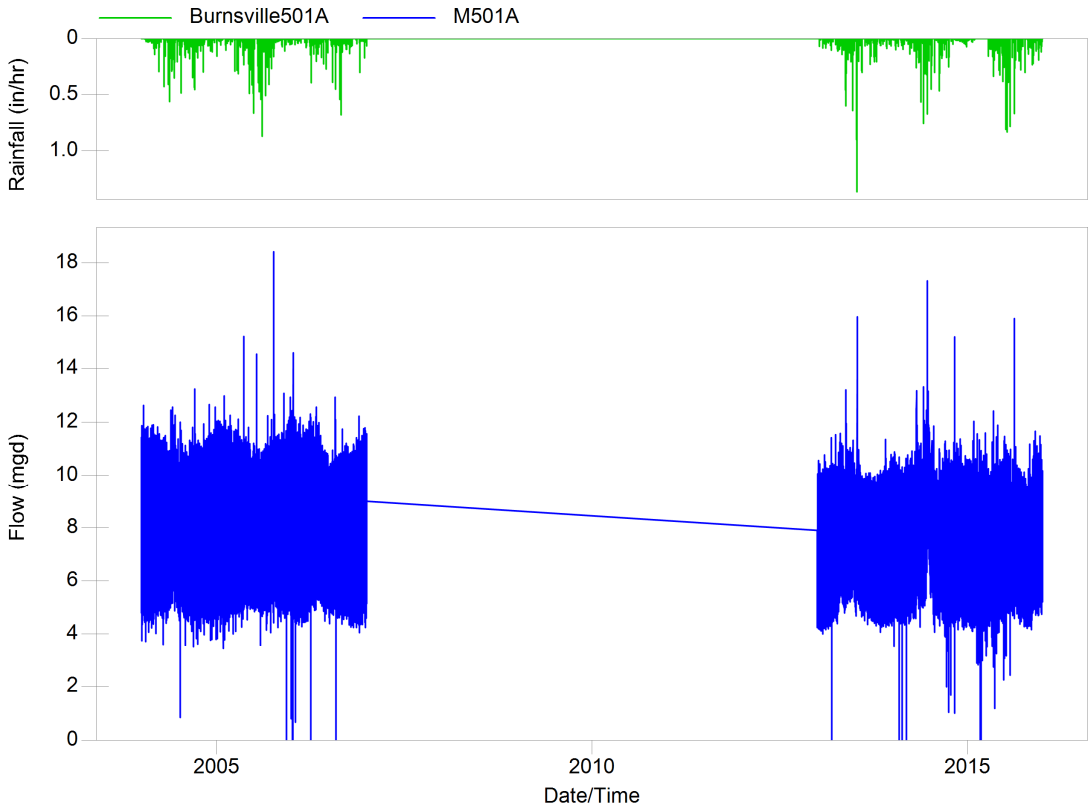


Figure 2-9. Site 4: Burnsville M501A monitoring data

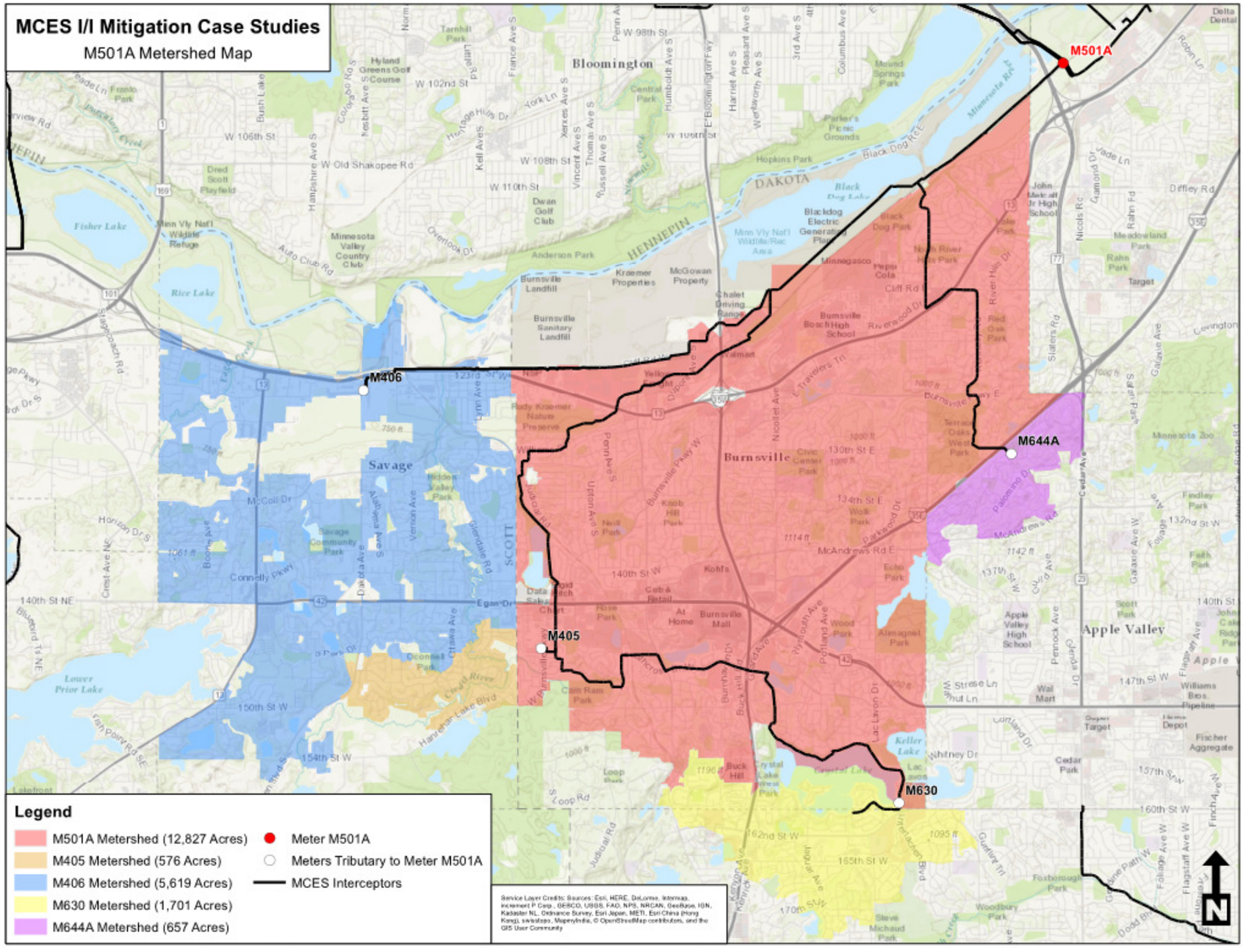


Figure 2-8. Site 4: Burnsville M501A metershed map

Section 3: Flow Reduction Analysis

This section presents the flow reduction analysis, including modeling tools and calibration parameters, model output hydrographs, and flow reduction results.

3.1 Modeling Tools and Calibration Parameters

Hydrologic flow generation models predict how wastewater flows respond relative to metershed characteristics and the rainfall intensity of wet weather events. Model calibration is the process of modifying model parameters and comparing modeled results to actual measurements.

The flow generation models for this study were constructed using the Capacity Assurance Planning Environment (CAPE) software (version 3). Within the CAPE model the continuous hydrology was simulated using the Hydrologic Simulation Program-Fortran (HSPF). HSPF is a public-domain regional hydrologic model currently supported by the U.S. Geological Survey (USGS) that uses local rainfall and other meteorological data to simulate the general rainfall response of the watershed environment. The HSPF model generates runoff in four components: pervious land active groundwater (PAGWO), pervious land interflow groundwater (PIFWO), pervious land surface runoff (PSURO) and impervious land surface runoff (ISURO).

Using CAPE, the general rainfall response (from HSPF) was applied to the rehabilitation and control metershed basins to predict flows attributed to I/I flow in the sanitary sewers by adjusting connected area calibration parameters. A sample of the model parameter input screen within CAPE is shown as Figure 3-1. The PAGWO and PIFWO connected area calibration parameters are used to represent the slower I/I flow components that are sensitive to soil moisture. The ISURO and PSURO connected area calibration parameters can be used to represent the rapid I/I flow components; however, these were not used for this study. Instead, an alternative surface runoff routine was applied that has three sets of surface runoff unit hydrograph components, each with a connected area, time to peak (T), and recession factor (K), allowing for a more refined fit to the rapid I/I component. (The routine is similar to the RTK unit hydrograph method used in U.S. Environmental Protection Agency [EPA] Storm Water Management Model [SWMM] models, where R is the percentage of rainfall that enters the sanitary sewer as I/I, T is the time to peak flow, and K is the ratio of time to recession to time to peak.) The total modeled flow into the sewer system is the sum of the base sanitary flow, HSPF I/I flow components, and three sets of surface runoff I/I flow components.

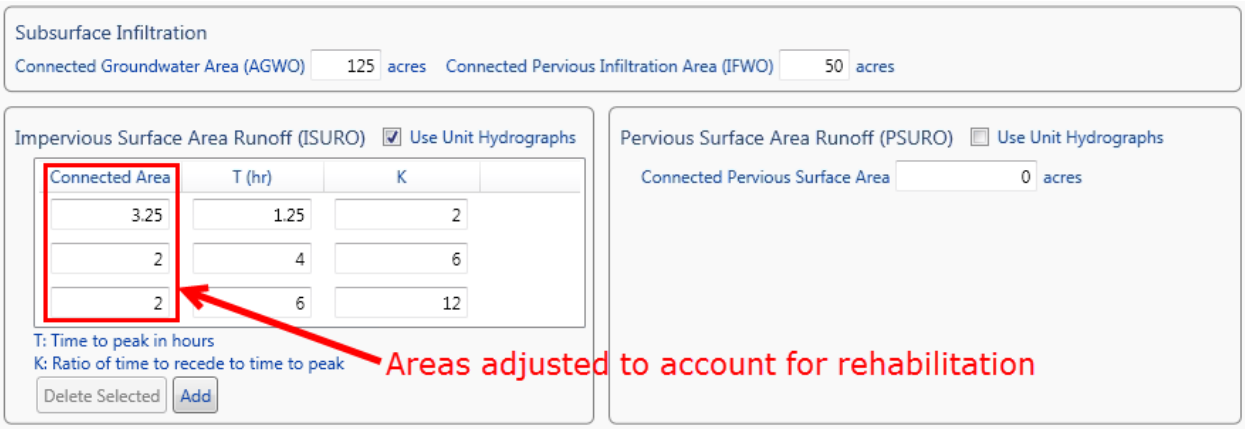


Figure 3-1. Model parameter input screen

CAPE provides a flexible method that can calibrate events with a wide range of antecedent moisture conditions. It also provides a modeling structure that accounts for rehabilitation work by varying the parameters that are most affected by rehabilitation efforts. For this study, with the exception of Site M101, only the connected areas in the surface runoff component were modified from pre-rehab to post-rehab conditions. At Site M101 the time to peak parameter was also modified, but only for the first surface runoff unit hydrograph.

Table 3-1 is a summary of the CAPE modeling parameters used for each model: PAGWO, PIFWO, and the surface runoff components. The calibration parameters are the connected areas for each I/I flow component, as well as the unit hydrograph components T and K. The table lists the parameters for both the pre-rehab and post-rehab models for each flow meter area.

Table 3-1. CAPE Modeling Parameters

Model	Incremental Metershed Area, acres	Connected Groundwater Area (PAGWO), acres	Connected Pervious Infiltration Area (PIFWO), acres	Pervious Surface Area Runoff (PSURO), acres	Impervious Surface Area Runoff [a]		
					Connected Area, acres	Time to Peak (T), hours	Ratio of Time to Recede to Time to Peak (K)
Shoreview M048 pre-rehab	4,476	125	50	0	3.25	1.25	2
					2	4	6
					2	6	12
Shoreview M048 post-rehab	4,476	125	50	0	2.75	1.25	2
					1.75	4	6
					1.75	6	12
Minneapolis SW M101 pre-rehab	18,489	4,500	640	0	230	0.5	1.5
					40	2	3
					30	3	12
Minneapolis SW M101 post-rehab	18,489	4,500	640	0	40	1	1.5
					30	2	3
					30	3	12
Golden Valley M117 pre-rehab	6,398	810	250	0	15	2	2
					9	3	4
					8	4	8
Golden Valley M117 post-rehab	6,398	810	250	0	10	2	2
					4	3	4
					3	4	8
Burnsville M501A pre-rehab	21,380 [b]	825	350	0	9	1	2
					5	2	4
					6	3	8
Burnsville M501A post-rehab	21,380 [b]	825	350	0	9	1	2
					5	2	4
					6	3	8

a. Three sets of surface runoff unit hydrograph parameters were used instead of the ISURO component.

b. Metershed area for M501A includes upstream metershed areas.

3.2 Model Output Hydrographs

Figures 3-2 through 3-21 are model output hydrographs that show the peak flow rate and total volume of water, as well as the general shape of the hydrograph, for both modeled and measured flows at each site. The CAPE modeled hourly flow data are shown in red and labeled “total flow”, the measured hourly flow data are shown in blue and labeled “outlet flow”, and rainfall intensity is shown in orange (plotted downward from the top of the figure using the scale on the right-side axis) and labeled “rain”. Each model included numerous rain events that were taken into consideration during calibration. The greater number of quality calibration events results in a greater confidence in calibration and the ability of the model to be representative of the wet weather response of the collection system.

3.2.1 Site 1: M048, Shoreview

Figure 3-2 shows the measured hourly flow data for both the pre-rehab and post-rehab periods, along with the pre-rehab modeled hourly flow data for site M048. During the pre-rehab period the modeled and measured flows are nearly equal, indicating the model is accurately predicting flow. However, when applying the pre-rehab model calibration parameters to the post-rehab period rain data, the modeled flows are greater than the measured flows.

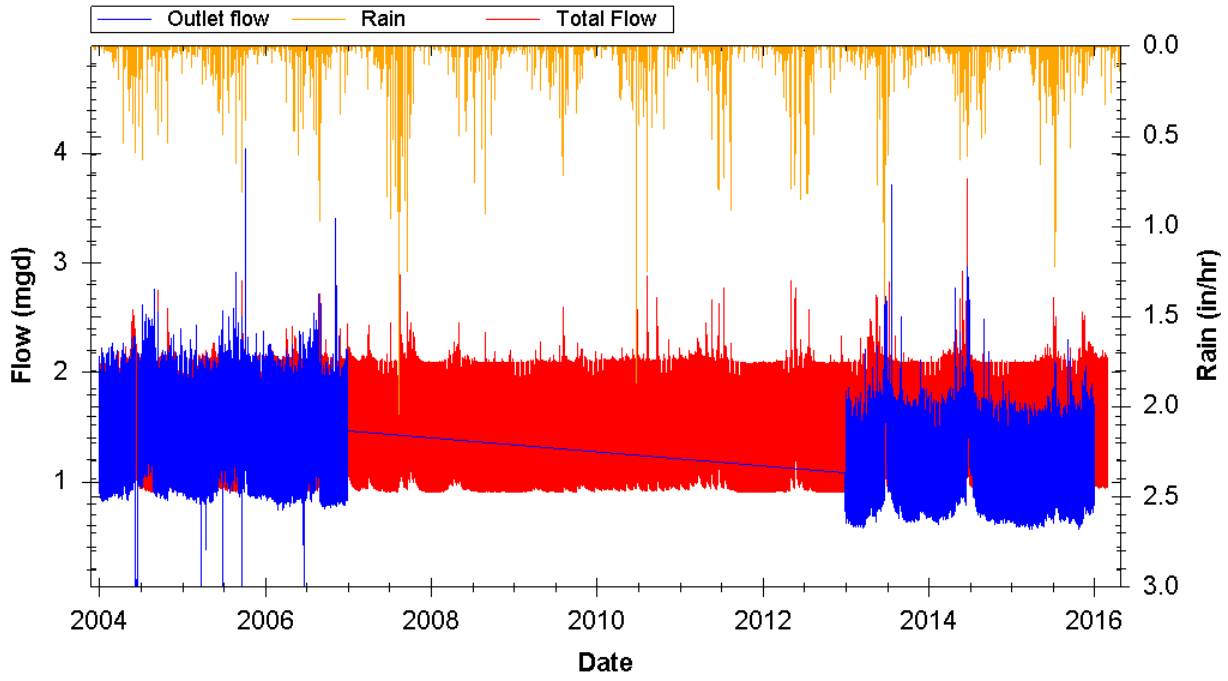


Figure 3-2. Site 1: M048, pre-rehab and post-rehab flow data using pre-rehab model parameters

Figures 3-3 and 3-4 are plots that show shorter time frames during both the pre-rehab and post-rehab periods depicted in Figure 3-2. The pre-rehab modeled flow data in Figure 3-3 indicate a positive correlation to the pre-rehab measured flow data, while the pre-rehab modeled flow data shown in Figure 3-4 are greater than the post-rehab measured flow data. This is evidence of a flow reduction.

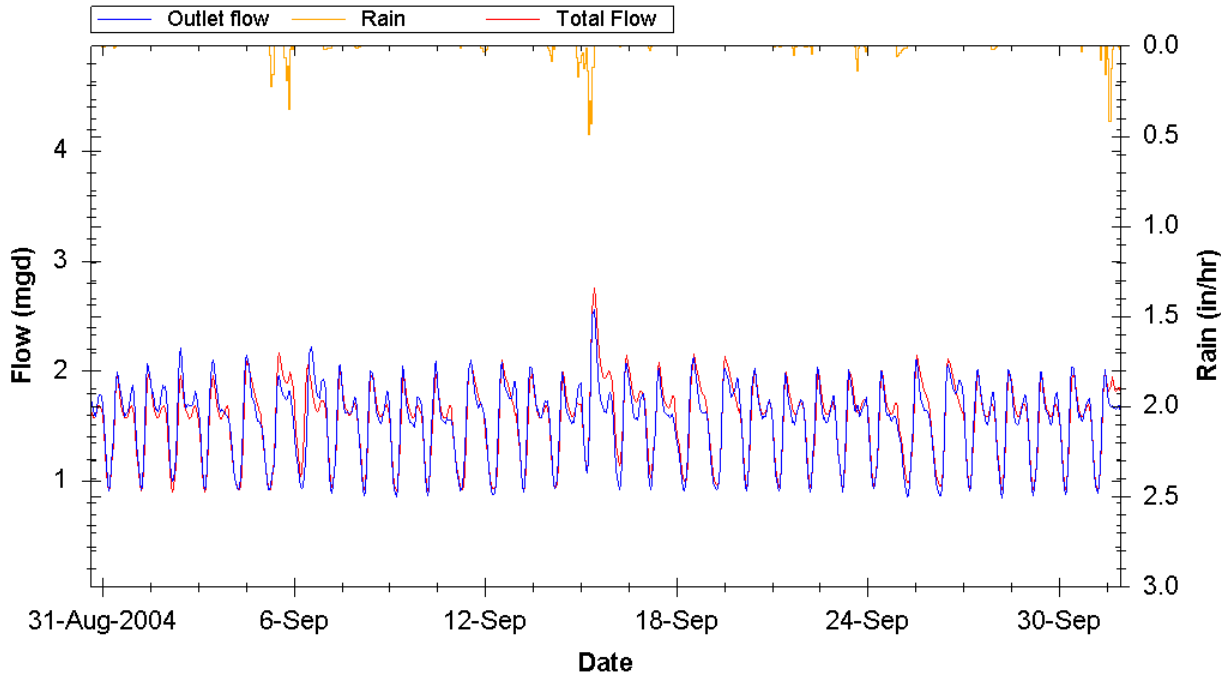


Figure 3-3. Site 1: M048, example of pre-rehab flow data using pre-rehab model parameters

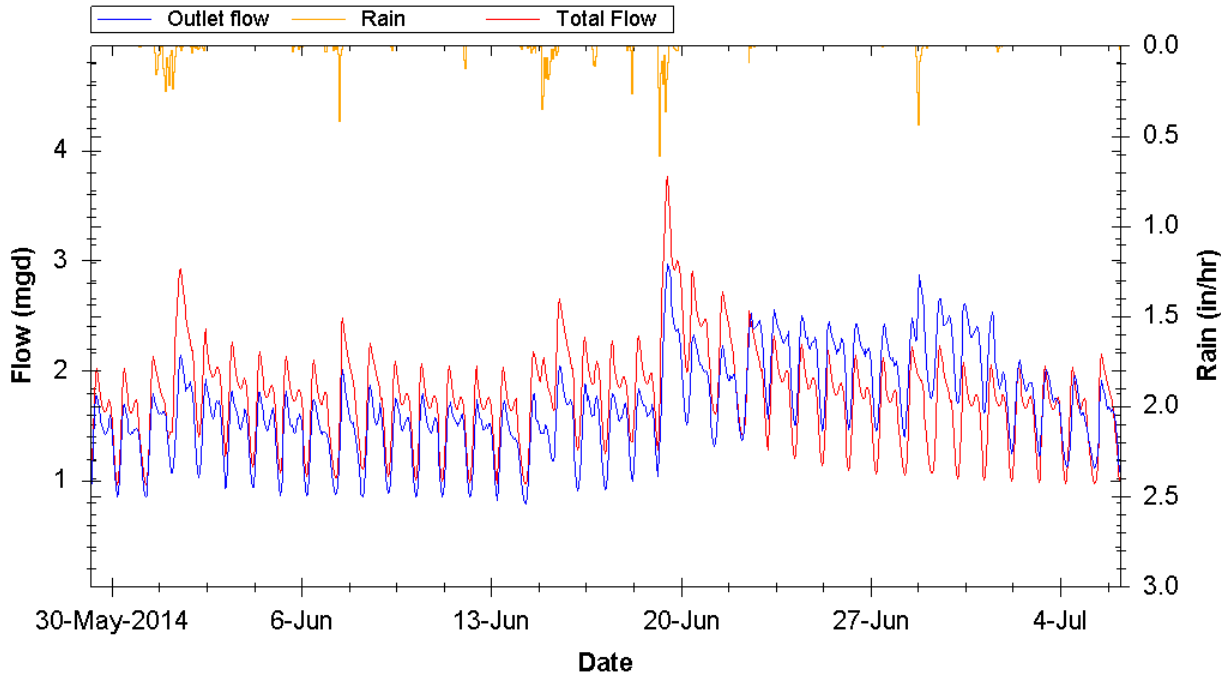


Figure 3-4. Site 1: M048, example of post-rehab flow data using pre-rehab model parameters

Figure 3-5 shows the model results after recalibrating the model to fit the post-rehab period. Base flow and I/I modeling parameters were adjusted down to better match the post-rehab measured flow data. Figure 3-6 shows the same period as Figure 3-4, but uses the improved post-rehab modeled flows. The post-rehab model more accurately predicts dry and wet weather flows in the post-rehab period than the pre-rehab model. Note that the elevated measured flow data circled in green on Figure 3-6 also occurred during the same period (end of June) in previous years. While it is possible that the rain data during these periods are inaccurate, it is more likely that scheduled operations and maintenance activities may have been taking place.

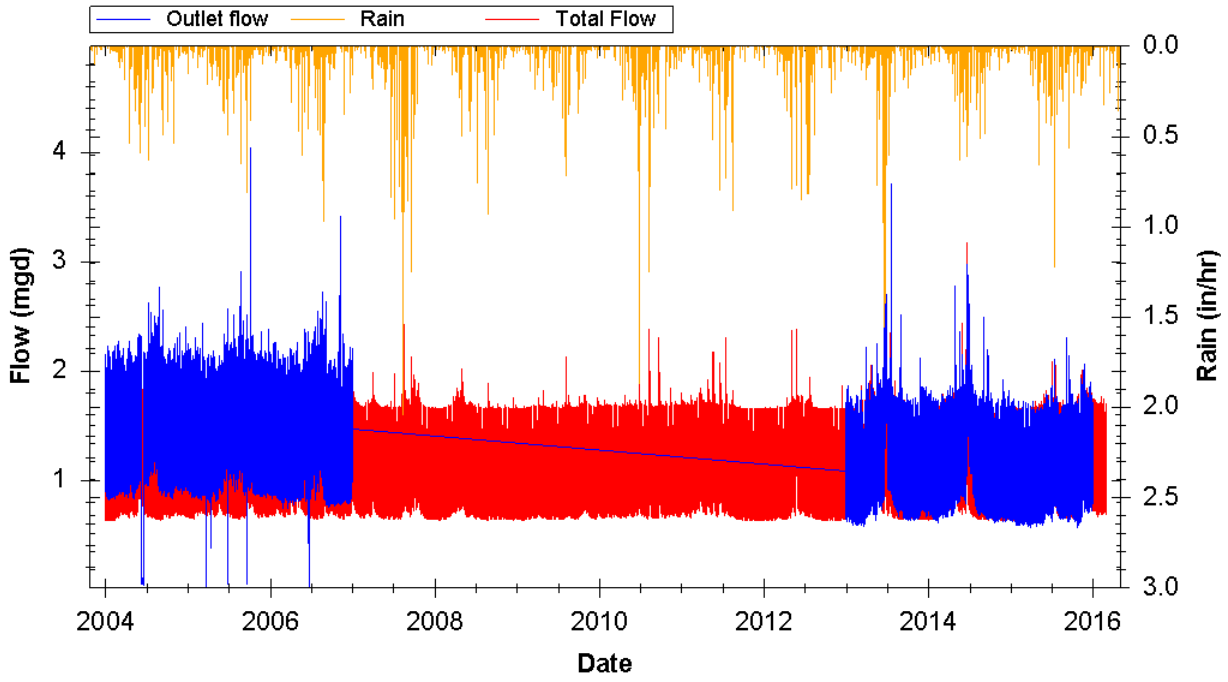


Figure 3-5. Site 1: M048, pre-rehab and post-rehab flow data using post-rehab model parameters

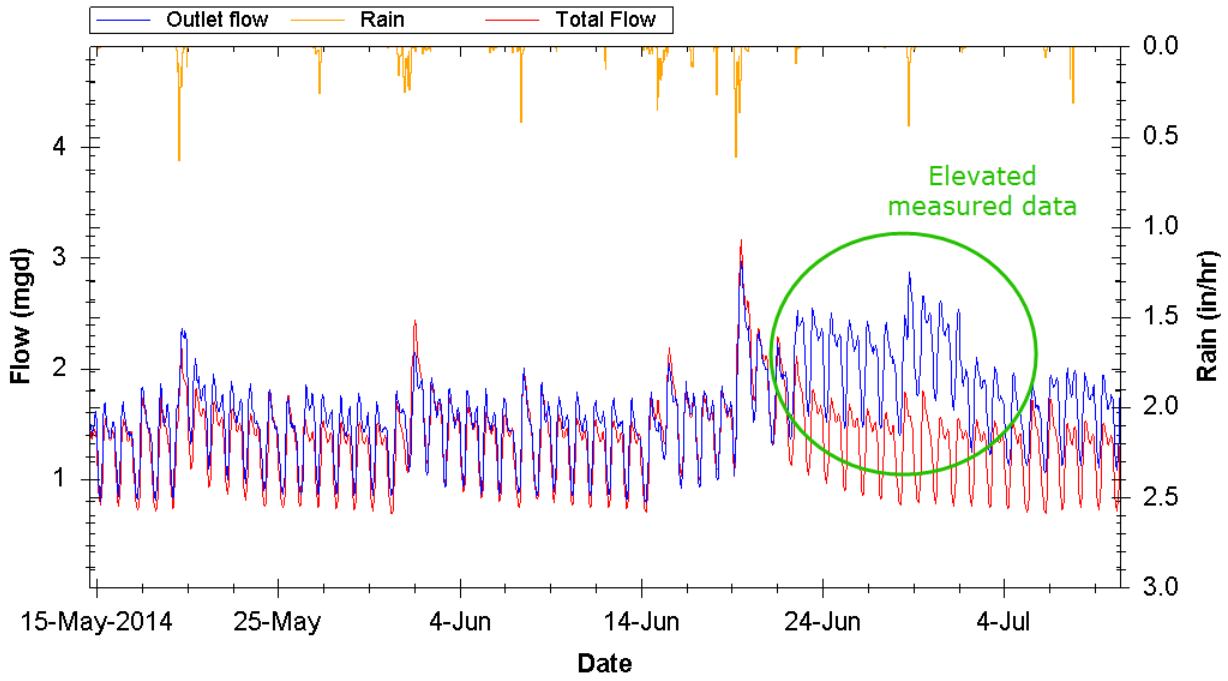


Figure 3-6. Site 1: M048, example of post-rehab flow data using post-rehab model parameters

3.2.2 Site 2: M101, Minneapolis Southwest

Figure 3-7 shows the measured hourly flow data for both the pre-rehab and post-rehab periods, along with the pre-rehab modeled hourly flow data for site M101. The measured upstream flow is the sum of the measured flows at meters M121, M127, and M130. These upstream flow data are shown as the purple colored hydrograph labeled "inlet flow" in the legend. These areas are necessary to account for as the analysis of flow reduction is focused only on the area downstream of these meters and upstream of M101.

During the pre-rehab period the modeled and measured flows are nearly equal, indicating the model is accurately predicting flow. However, when applying the pre-rehab model calibration parameters to the post-rehab period rain data the modeled base flow is greater than the metershed's measured base flow, and the modeled wet weather event peak flows are significantly greater than the measured wet weather event peak flows.

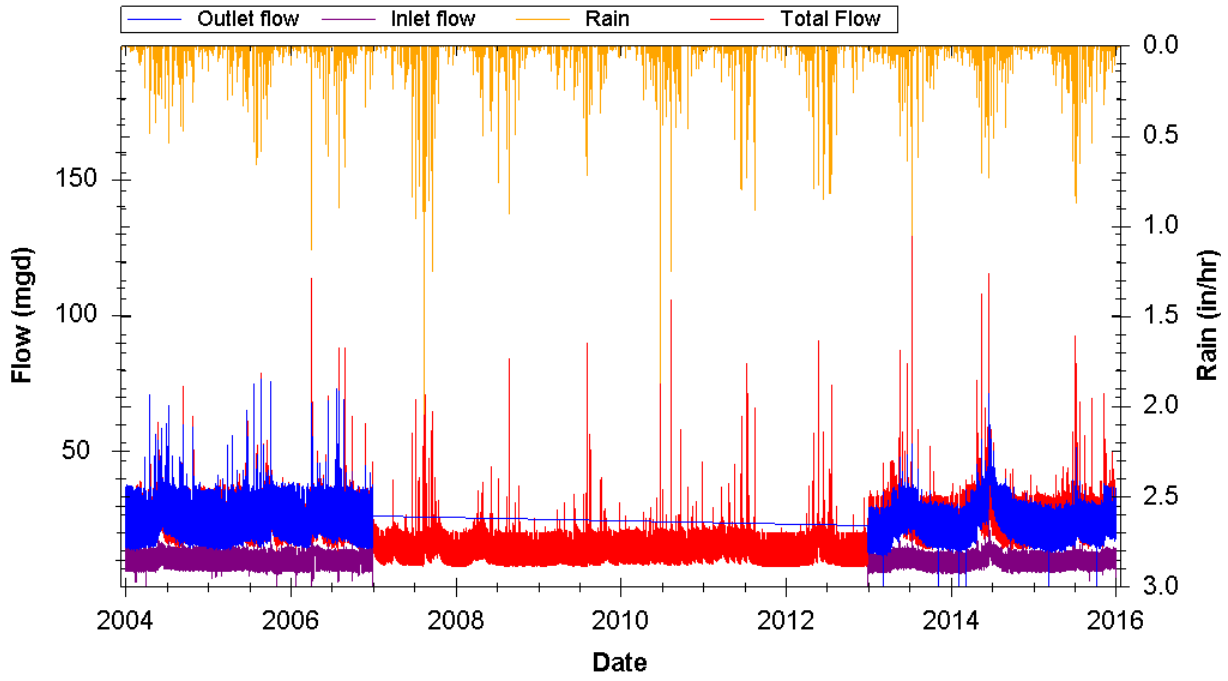


Figure 3-7. Site 2: M101, pre-rehab and post-rehab flow data using pre-rehab model parameters

Figures 3-8 and 3-9 are plots that show shorter time frames during both the pre-rehab and post-rehab periods depicted in Figure 3-7. The pre-rehab modeled flow data in Figure 3-8 indicate a positive correlation to the pre-rehab measured flow data, while the pre-rehab modeled peak flows shown in Figure 3-9 are much greater than the post-rehab measured peak flows.

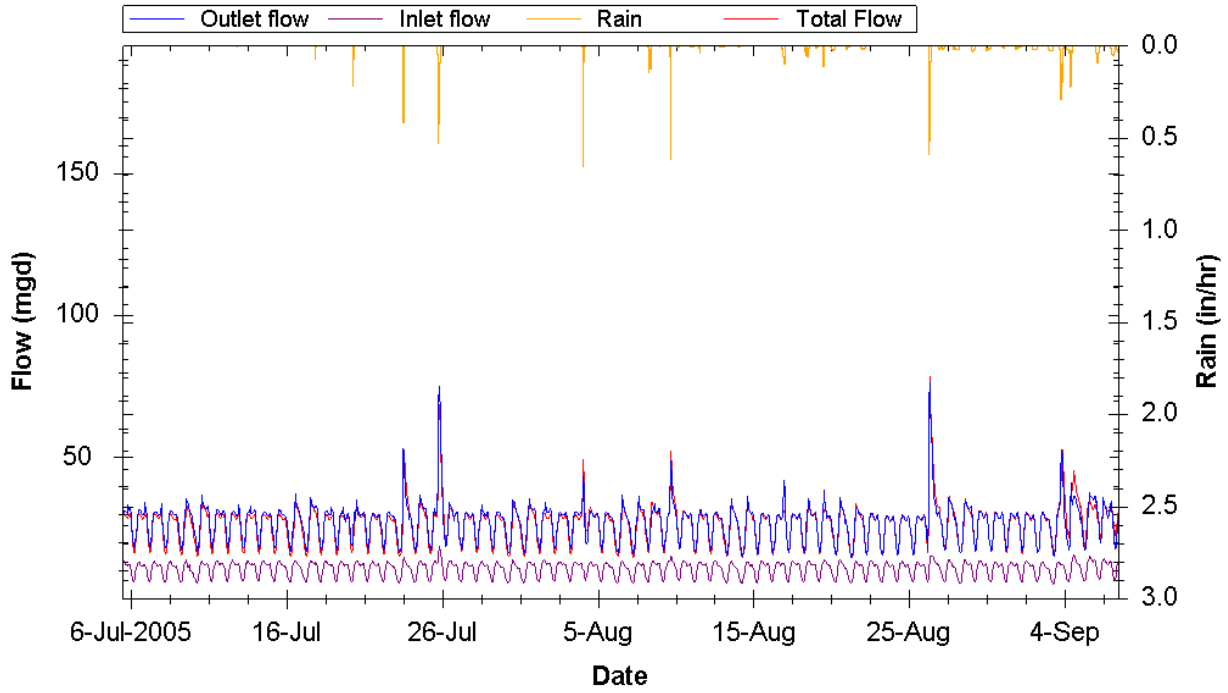


Figure 3-8. Site 2: M101, example of pre-rehab flow data using pre-rehab model parameters

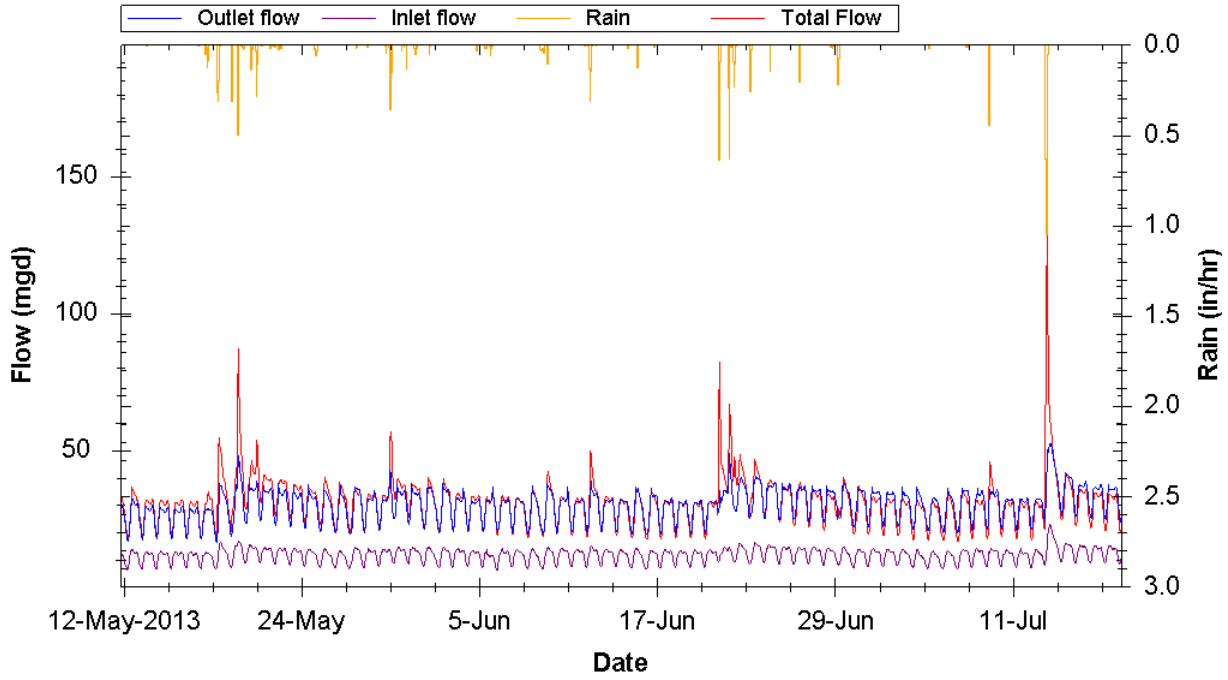


Figure 3-9. Site 2: M101, example of post-rehab flow data using pre-rehab model parameters

Figure 3-10 shows the model results for M101 after the model was recalibrated to fit the post-rehab period. The I/I modeling parameters were modified considerably in order to match the post-rehab measured flow data; the site's base flow was adjusted slightly down. Figure 3-11 shows the same period as Figure 3-9, but uses the improved post-rehab modeled flows. The post-rehab model more accurately predicts dry and wet weather flows in the post-rehab period than the pre-rehab model.

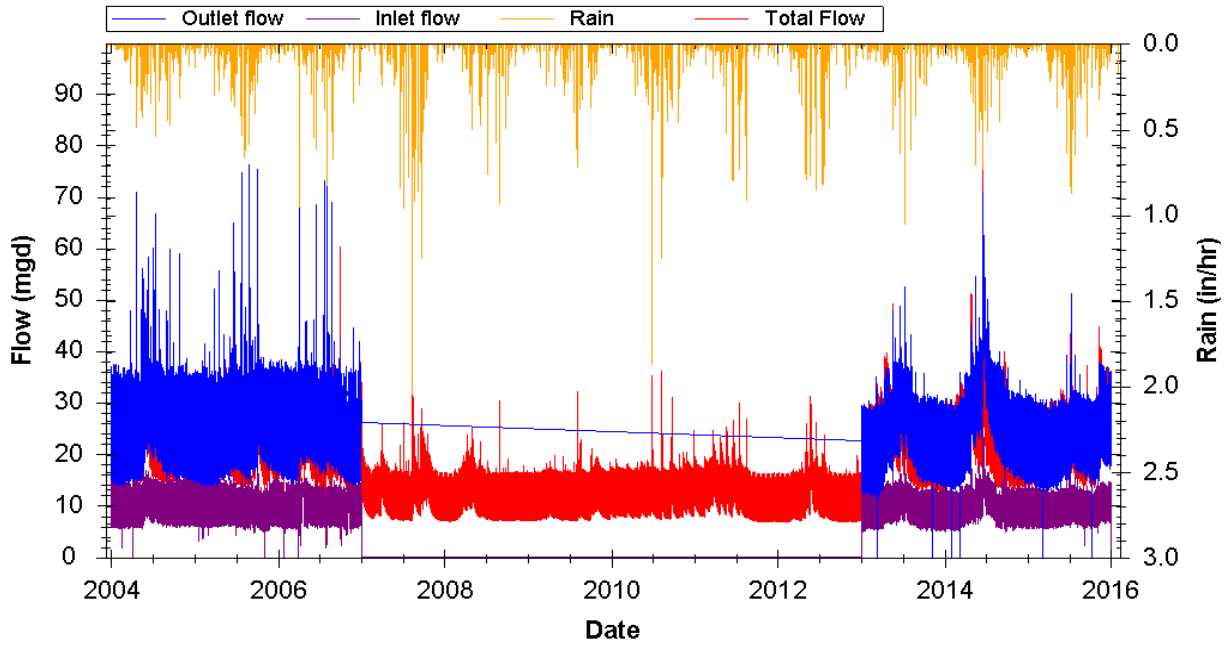


Figure 3-10. Site 2: M101, pre-rehab and post-rehab flow data using post-rehab model parameters

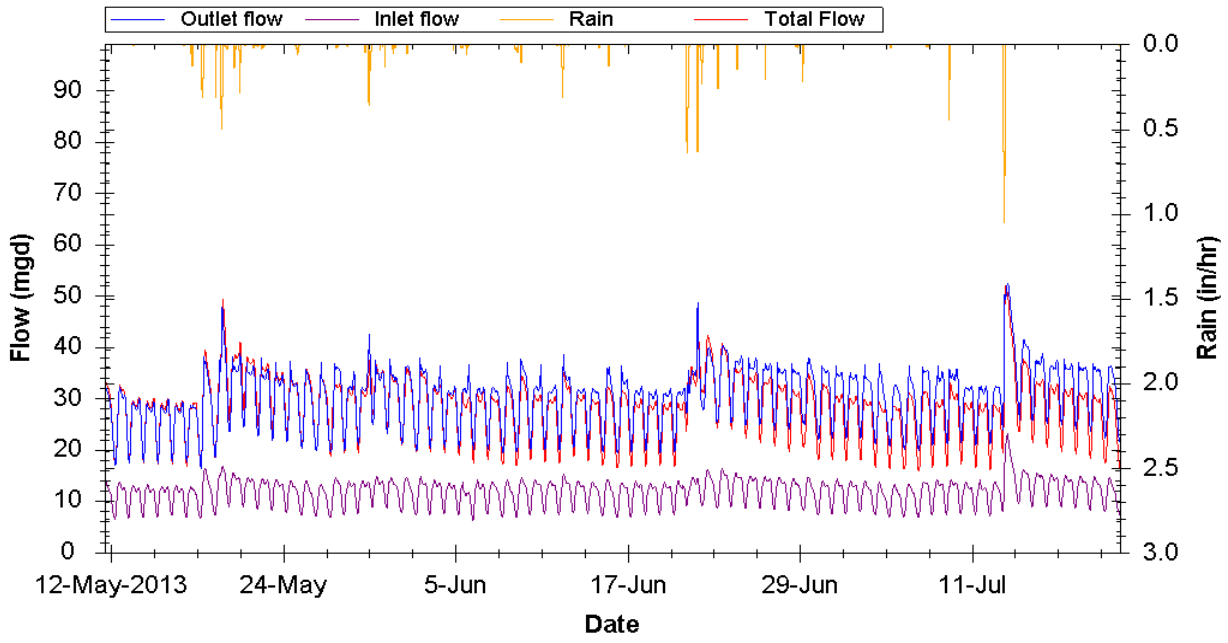


Figure 3-11. Site 2: M101, example of post-rehab flow data using post-rehab model parameters

3.2.3 Site 3: M117, Golden Valley

Figure 3-12 shows the measured hourly flow data for both the pre-rehab and post-rehab periods for site M117, along with the pre-rehab modeled hourly flow data. The measured upstream flow data from site M119 are also shown. During the pre-rehab period the modeled and measured flows are nearly equal, indicating the model is accurately predicting flow. However, when applying the pre-rehab model calibration parameters to the post-rehab period rain data the modeled base flow is greater than the metershed's measured base flow, and the modeled wet weather event peak flows are slightly greater than the measured peak flows.

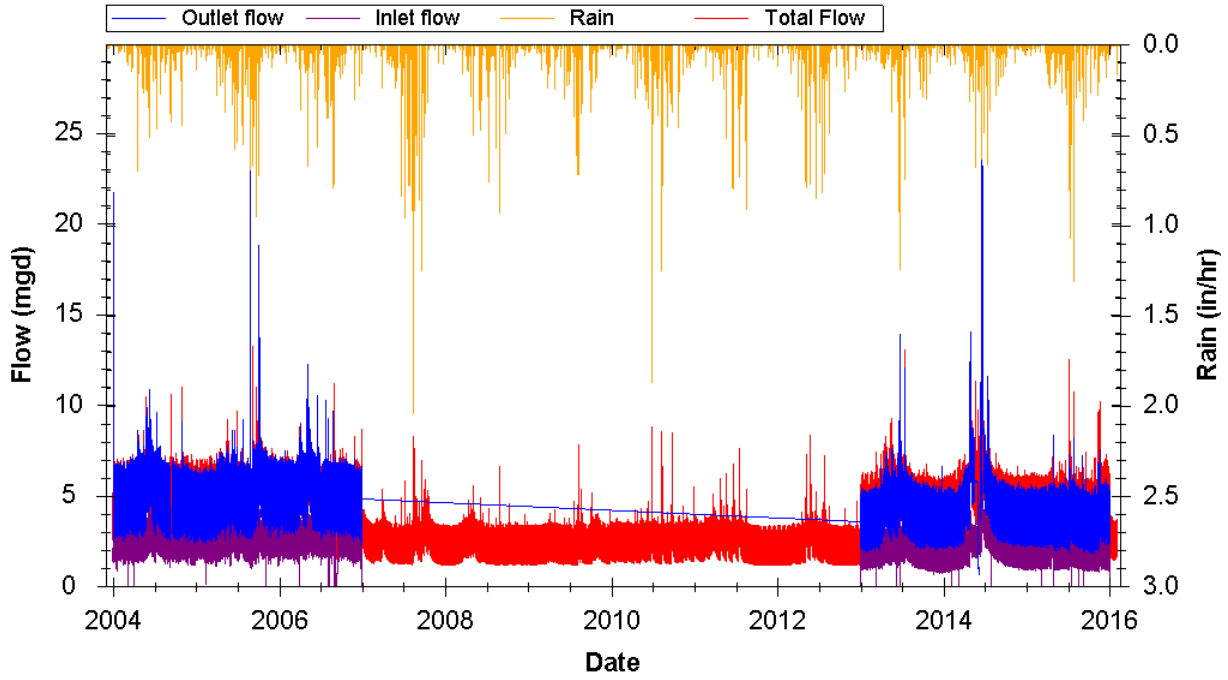


Figure 3-12. Site 3: M117, pre-rehab and post-rehab flow data using pre-rehab model parameters

Figures 3-13 and 3-14 are plots that show shorter time frames during both the pre-rehab and post-rehab periods depicted in Figure 3-12. The pre-rehab modeled flow data shown in Figure 3-13 closely match the pre-rehab measured flow data. The pre-rehab modeled flow data shown in Figure 3-14 are a reasonable match to the post-rehab measured flow data, but are slightly greater. Therefore, this area does not show a strong reduction in flow after rehabilitation. Note on Figure 3-14 (and subsequently on Figure 3-16) that the discrepancy between the measured and modeled flow data following the June 21, 2013, rainfall event is influenced by missing upstream flow data from meter M119.

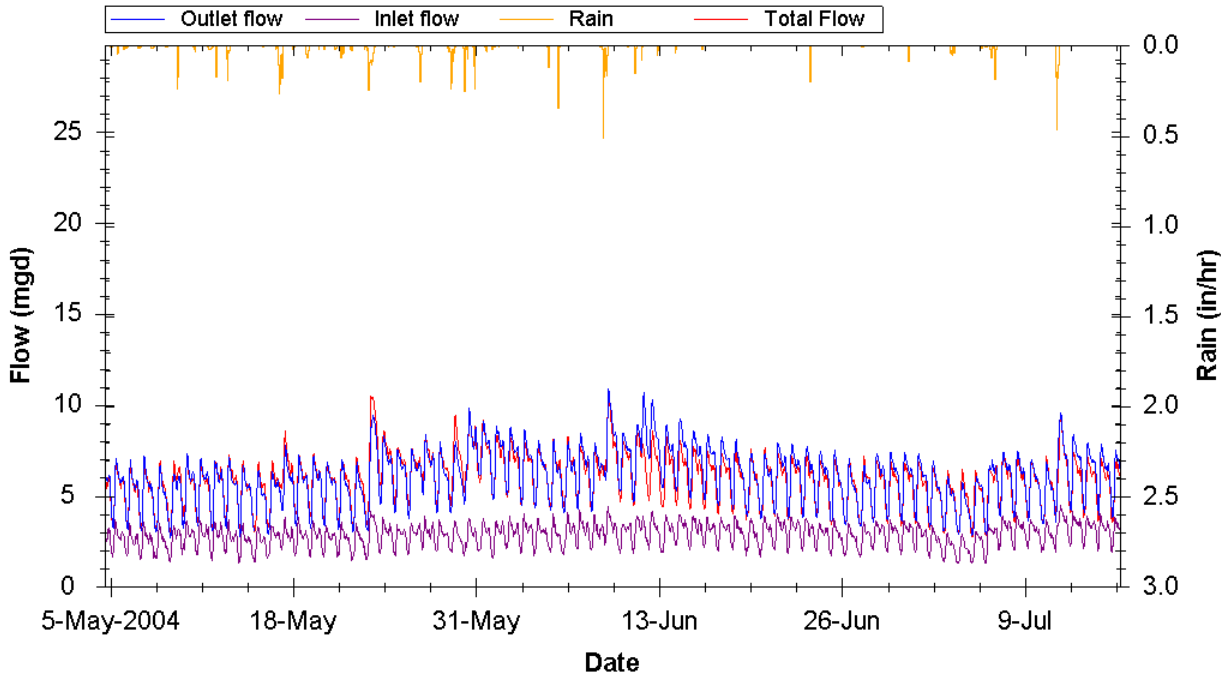


Figure 3-13. Site 3: M117, example of pre-rehab flow data using pre-rehab model parameters

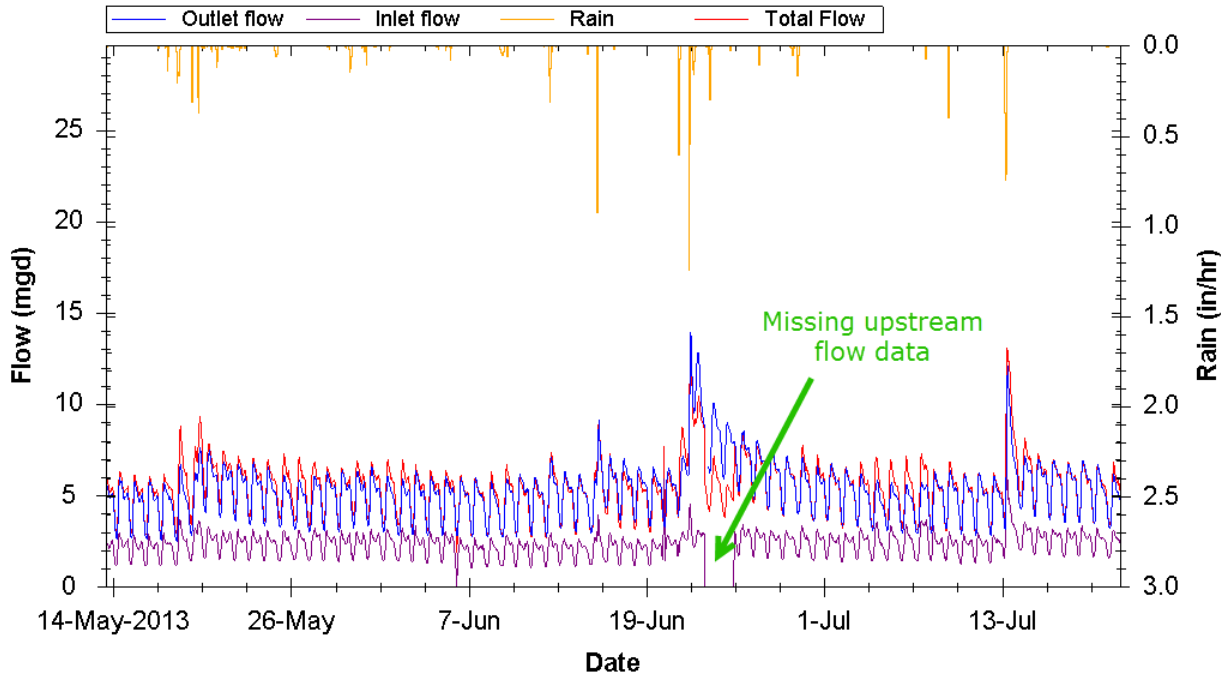


Figure 3-14. Site M117, example of post-rehab flow data using pre-rehab model parameters

Figure 3-15 shows the model results after recalibrating the model to fit the post-rehab period. Base flow and I/I modeling parameters were adjusted down to better match the post-rehab measured flow data. Figure 3-16 shows the same period as Figure 3-14, but uses the improved post-rehab modeled flows. The post-rehab model more accurately predicts dry and wet weather flows in the post-rehab period than the pre-rehab model.

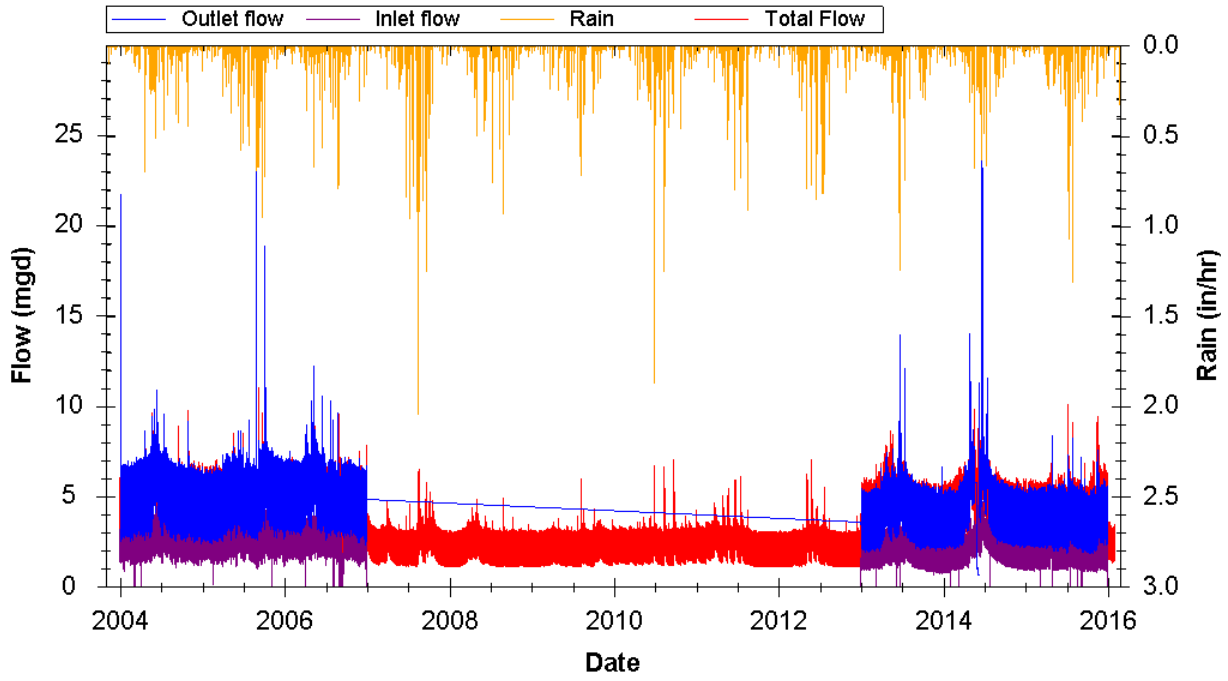


Figure 3-15. Site 3: M117, pre-rehab and post-rehab flow data with post-rehab model

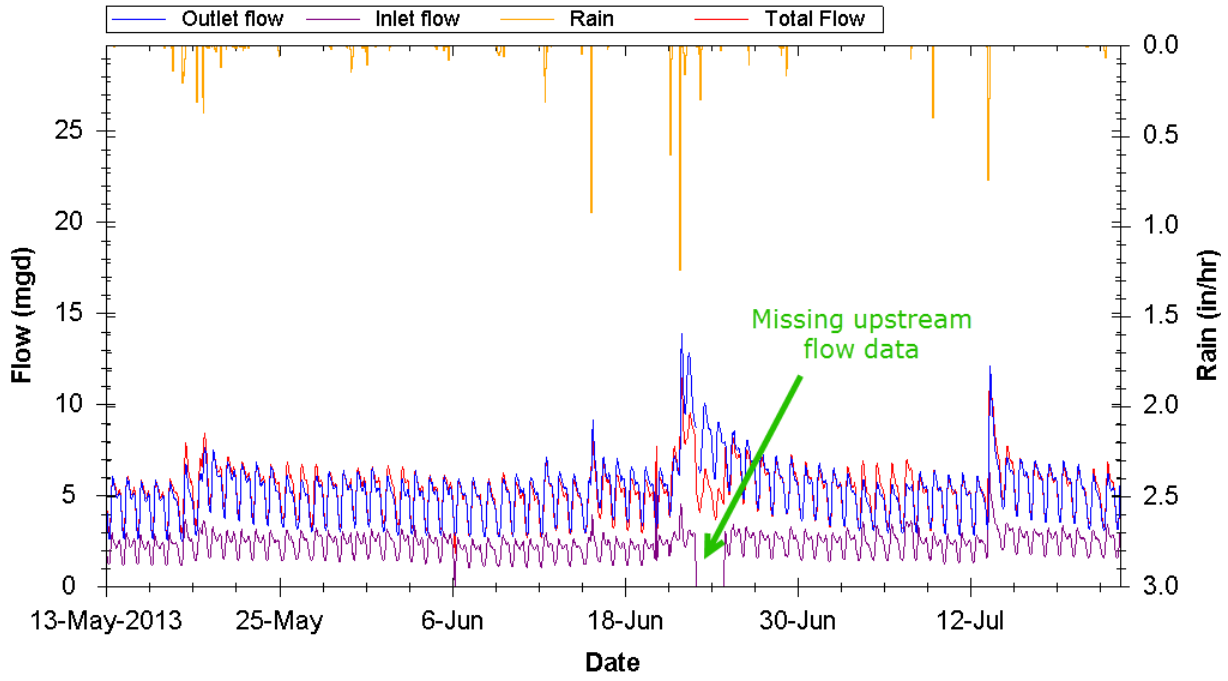


Figure 3-16. Site 3: M117, example of post-rehab flow data with post-rehab model

3.2.4 Site 4: M501A, Burnsville

Figure 3-17 shows the measured hourly flow data for both the pre-rehab and post-rehab periods, along with the pre-rehab modeled hourly flow data for site M501A. While no known mitigation efforts have taken place in metershed M501A, for consistency, the periods shown are still referred to as pre-rehab and post-rehab. During the pre-rehab period the modeled and measured flows are nearly equal, indicating the model is accurately predicting flow. When applying the pre-rehab model calibration parameters to the post-rehab period rain data the modeled base flow is slightly greater than the measured base flow, but the wet weather event peak flows are a good match.

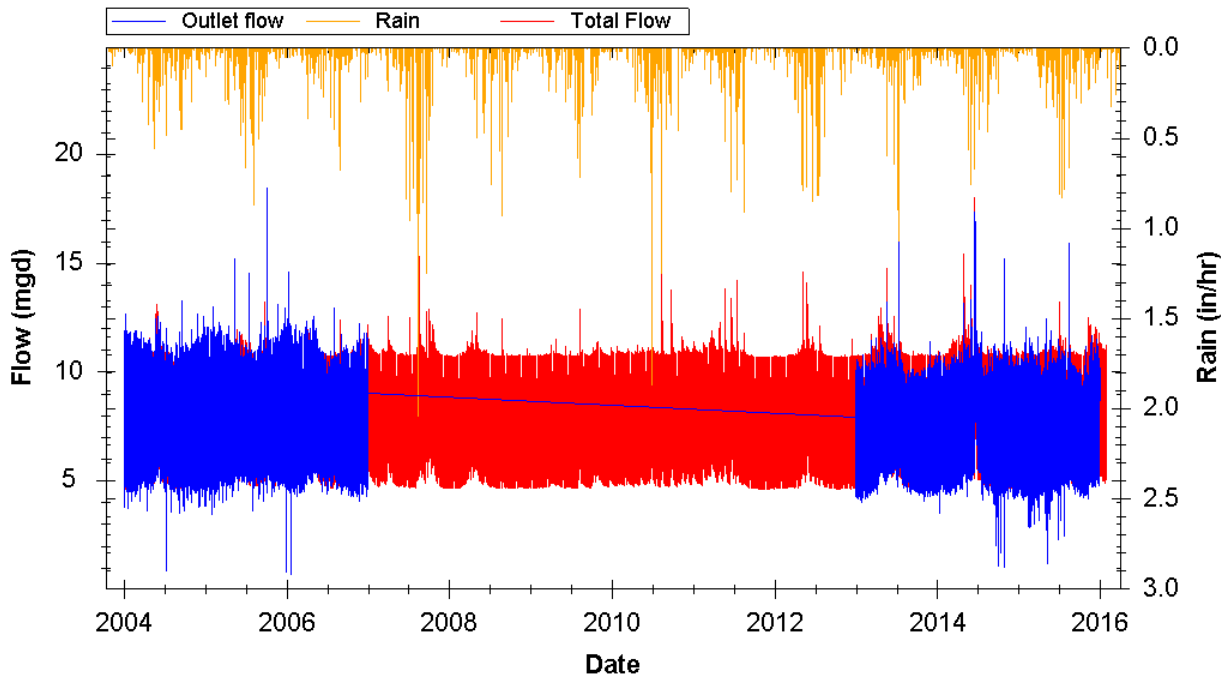


Figure 3-17. Site 4: M501A, pre-rehab and post-rehab flow data with pre-rehab model

Figures 3-18 and 3-19 are plots that show shorter time frames during both the pre-rehab and post-rehab periods depicted in Figure 3-17.

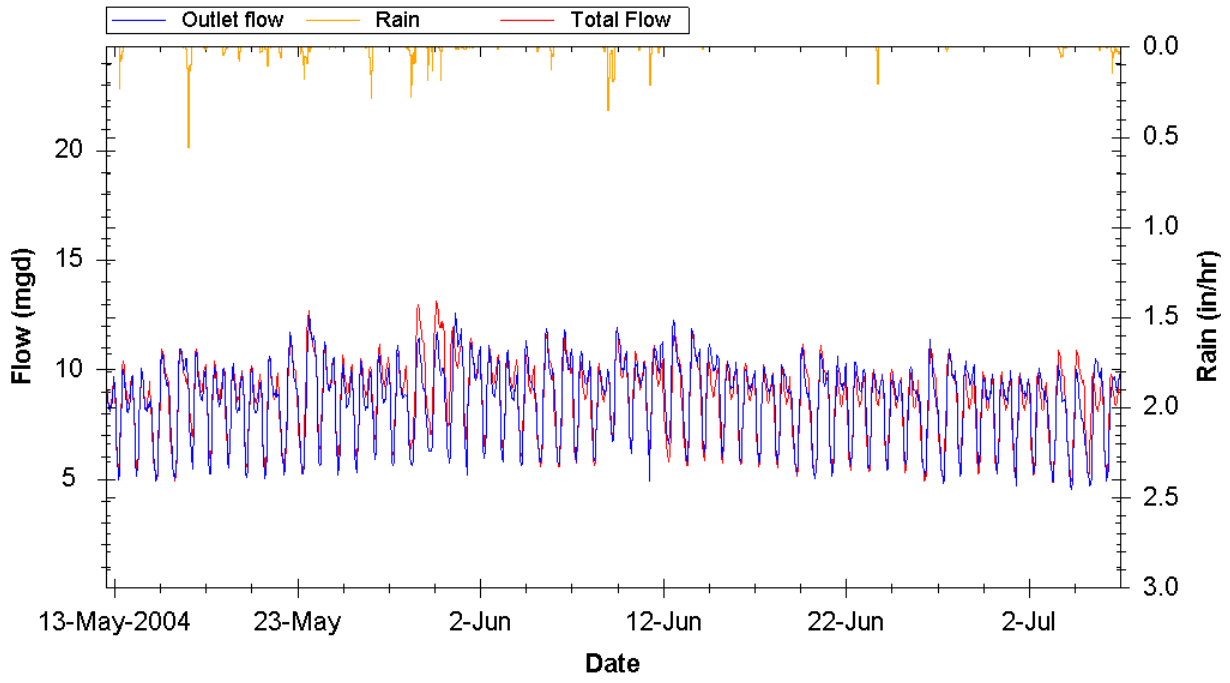


Figure 3-18. Site 4: M501A, example of pre-rehab flow data with pre-rehab model

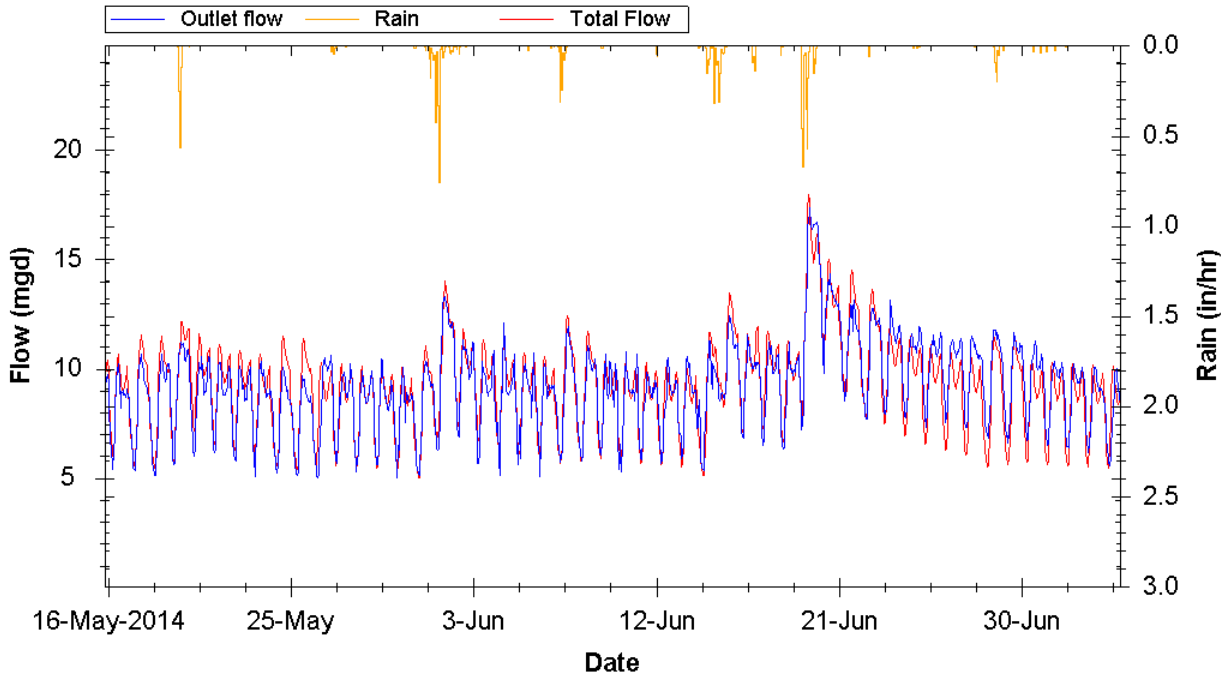


Figure 3-19. Site 4: M501A, example of post-rehab flow data with pre-rehab model

The model was changed slightly for the post-rehab period. The base flow for M501A was adjusted down to better match the post-rehab measured flow data, but the I/I modeling parameters were left unchanged.

Figure 3-20 shows the measured flow data for both the pre-rehab and post-rehab periods, along with the post-rehab modeled flows. Figure 3-21 shows the same period as Figure 3-19, but uses a reduced base flow.

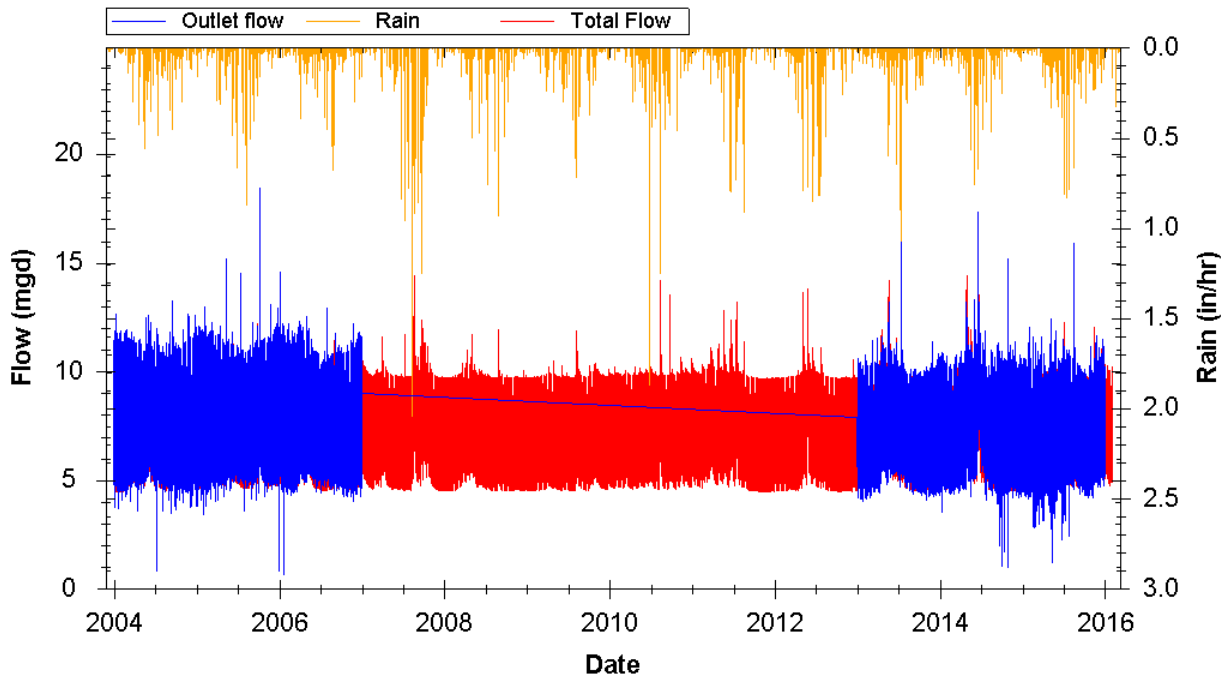


Figure 3-20. Site 4: M501A, pre-rehab and post-rehab flow data with post-rehab model

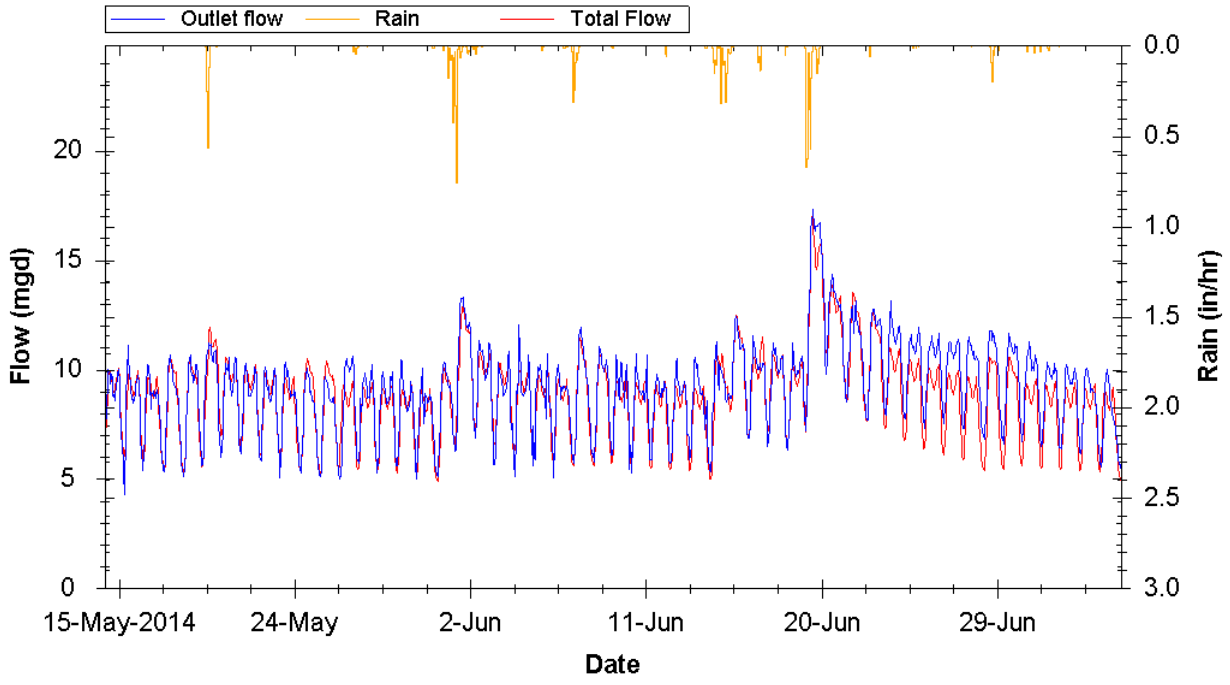


Figure 3-21. Site 4: M501A, example of post-rehab flow data with post-rehab model

3.2.5 Calibration Summary

The validity of the pre-rehab and post-rehab model calibrations was also evaluated using volume and peak flow error percentages derived from differences between measured and modeled event values. For each event, the difference between the modeled and measured peak hourly flow values was compared. Event volumes were also compared similarly. Individual event errors were averaged to get an estimate of how well the model performs over all of the events. This approach helps to balance the events that are more or less than the measured values. Table 3-2 summarizes the average volume and peak flow error percentages, as well as the number of events and base flow used, for each metershed. A negative error value indicates that the modeled flow data were less than the measured flow data and a positive number indicates that the modeled flow data were greater than the measured flow data.

Table 3-2. Model Calibration Summary

Model	Incremental Metershed Area, acres	Base Flow, mgd	Number of Events Used	Average Volume Error	Average Peak Flow Error
Shoreview M048 pre-rehab	4,476	1.5	30	1.6%	1.0%
Shoreview M048 post-rehab	4,476	1.2	41	3.3%	0.5%
Minneapolis SW M101 pre-rehab	18,489	13.9	38	5.2%	1.9%
Minneapolis SW M101 post-rehab	18,489	12.3	44	1.1%	-0.4%
Golden Valley M117 pre-rehab	6,398	2.3	33	6.7%	5.5%
Golden Valley M117 post-rehab	6,398	2.2	38	9.3%	6.9%
Burnsville M501A pre-rehab	21,380 [a]	7.8	36	2.6%	0.4%
Burnsville M501A post-rehab	21,380 [a]	7.4	45	4.0%	0.8%

a. Metershed area for M501A includes upstream metershed areas.

3.3 Flow Reduction Results

After hydrologic model calibrations were finalized, flow frequency analyses were used to define peak flow recurrence interval curves for both pre-rehab and post-rehab periods. Figures 3-22 through 3-25 represent the peak hourly flow recurrence interval curves for each modeled site. Both I/I flow and total flow recurrence curves were generated. Total flow includes base sanitary flow and I/I flow, including the PAGWO, PIFWO, and surface runoff components.

An evaluation of flow reduction from pre-rehab to post-rehab conditions was based on the reduction in flows defined by the flow recurrence interval curves. The reduction was quantified for both total flow and I/I flow for the 10-year recurrence interval.

Table 3-3 summarizes the flow reduction results by site for both base flow and 10-year recurrence interval peak hourly flow. The reduction in peak hourly total flow for site M048 (17 percent) is influenced by both a reduction in base flow and a reduction in I/I flow. The I/I modeling parameters (previously summarized in Section 3.1) were reduced only slightly in the M048 post-rehab model, resulting in an 11 percent I/I flow reduction.

Peak hourly total flow reduction for M101 was more substantial (69 percent). The reduction in I/I flow was 75 percent because the I/I modeling parameters were modified significantly.

Flow reduction for M117 was 24 percent for total flow and 28 percent for I/I flow.

Meter M501A is a control meter. There was no reduction in I/I flow because the I/I modeling parameters for M501A were unchanged from pre-rehab to post-rehab periods. The reduction in total flow was 4 percent, due solely to the base flow reduction in the post-rehab period. The differences in flow from the pre-rehab to post-rehab period reflect the general variability in flows over time, not a reduction due to rehabilitation work. Therefore, a 4 percent change is not considered significant. The other meter sites had greater reductions, so those areas reflect a significant and measurable benefit from rehabilitation.

Table 3-3. Flow Reduction Summary

Site	Base Flow, mgd			10-year Peak Hourly Total Flow, mgd			10-year Peak Hourly I/I Flow, mgd		
	Pre-Rehab	Post-Rehab	Reduction	Pre-Rehab	Post-Rehab	Reduction	Pre-Rehab	Post-Rehab	Reduction
Shoreview M048	1.5	1.2	24%	3.7	3.1	17%	2.1	1.9	11%
Minneapolis SW M101	13.9	12.3	11%	155	47	69%	140	35	75%
Golden Valley M117	2.3	2.2	5%	12.9	9.8	24%	10.9	7.8	28%
Burnsville M501A [a]	7.8	7.4	6%	17.8	17.1	4%	9.3	9.3	0%

a. Flows for metersheds upstream of M501A are included in the base flow and peak hourly flow values for M501A.

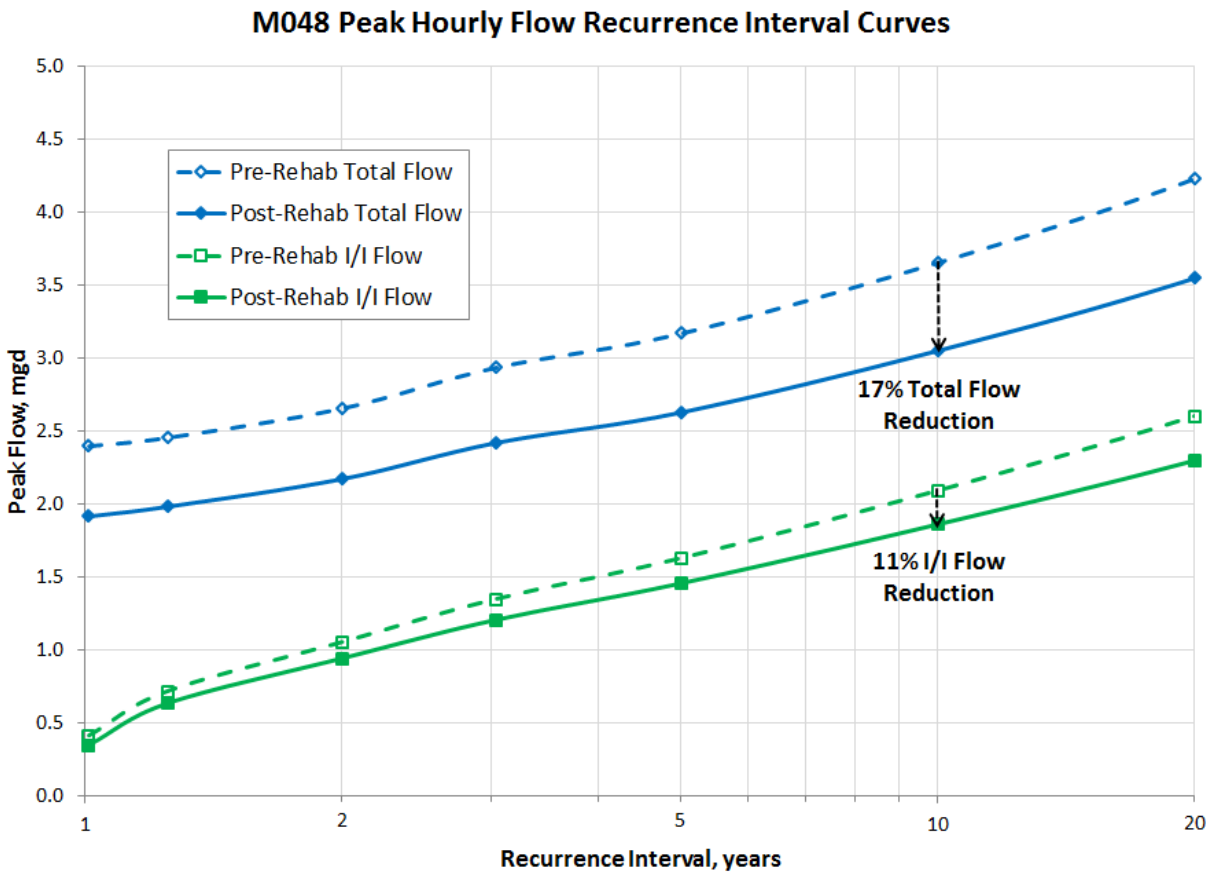


Figure 3-22. Site 1: M048 pre-rehab and post-rehab peak hourly flow recurrence intervals

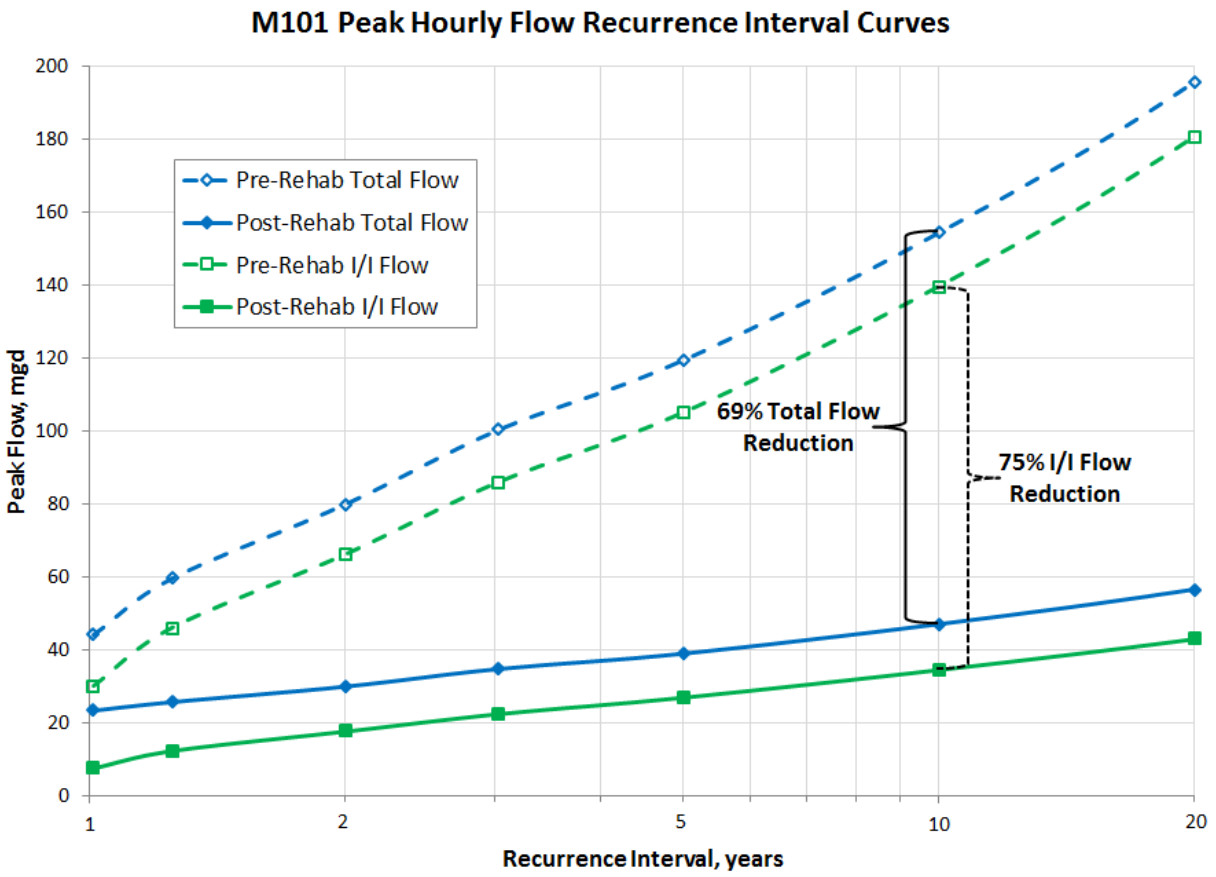


Figure 3-23. Site 2: M101 pre-rehab and post-rehab peak hourly flow recurrence intervals

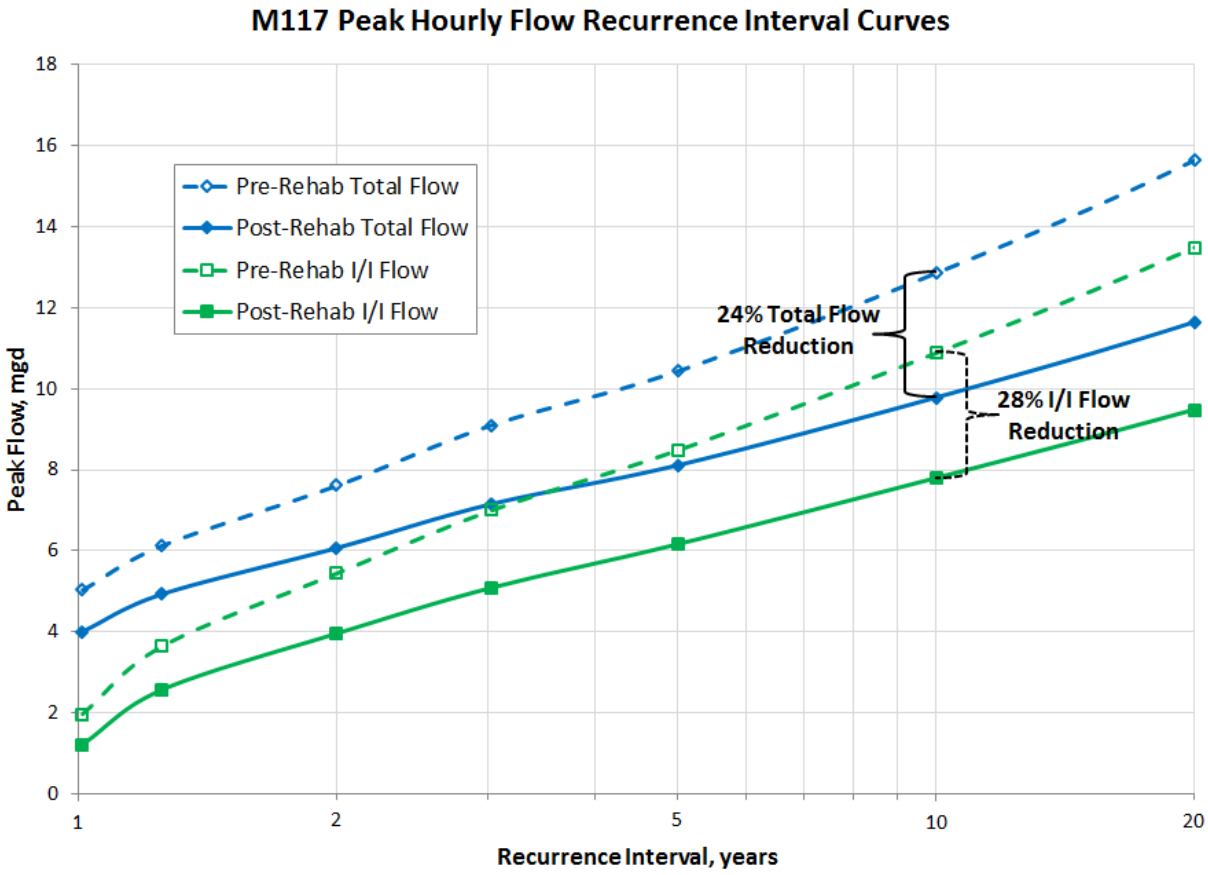


Figure 3-24. Site 3: M117 pre-rehab and post-rehab peak hourly flow recurrence intervals

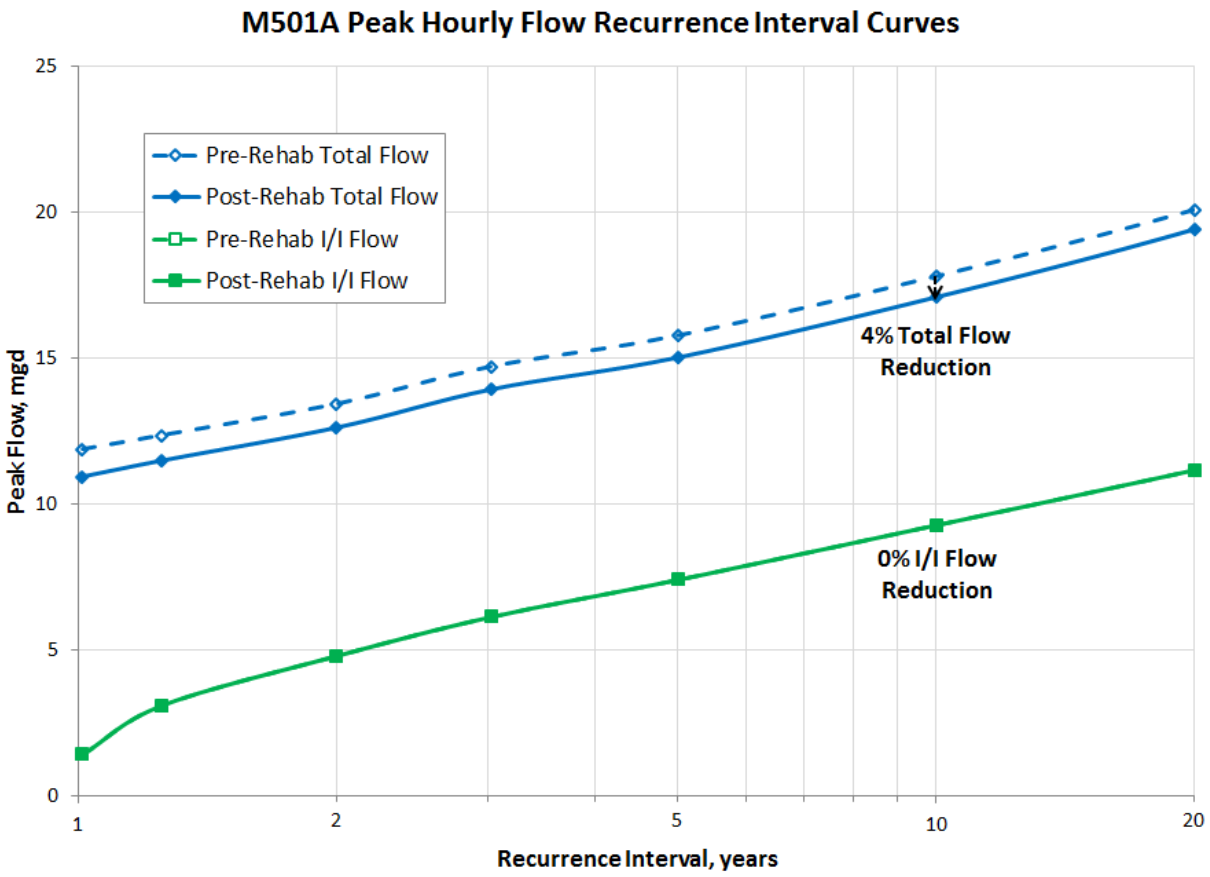


Figure 3-25. Site 4: M501A pre-rehab and post-rehab peak hourly flow recurrence intervals

Section 4: Summary

The effectiveness of I/I mitigation efforts in communities served by MCES were evaluated for three monitoring sites across the region: M048 (Shoreview), M101 (Minneapolis SW), and M117 (Golden Valley). A fourth site, M501A (Burnsville), is a control meter for an area with no changes. Calibrated pre-rehab and post-rehab hydrologic models were used to develop flow recurrence interval curves; these interval curves were used to estimate reduction in flows. For a 10-year recurrence interval, the reduction in peak hourly total flows ranged from 17 to 69 percent in the metersheds where rehabilitation efforts were made. The analysis did not indicate a significant decrease in flow at the control meter.

The most significant peak flow reduction (69 percent) occurred at Minneapolis site M101. The post-rehab flow data at M101 do not exhibit sharp peak flows that are visible during the pre-rehab period. The City's rehabilitation efforts within this metershed are measurable at site M101.

Rehabilitation in Golden Valley produced a 24 percent reduction in peak hourly total flows at site M117, resulting from extensive private and public rehabilitation efforts.

Rehabilitation in Shoreview produced a 17 percent reduction in peak hourly total flows at site M048, resulting from rehabilitation of only public infrastructure.

Rehabilitation has not occurred in Burnsville. The 4 percent reduction in peak hourly total flows at site M501A is due only to a reduction in base flow.

For an analysis of this nature, there are always issues that can influence the results. The following items provide general descriptions of the issues that concern this specific analysis. None of them are believed to materially influence the conclusions provided in this report.

- The monitoring areas are very large relative to the area rehabilitated within each basin. Therefore, the effectiveness of the rehabilitation may be greater than estimated closer to where the rehabilitation was performed.
- Certain periods of flow monitoring data for some of the sites evaluated were inconsistent with the recorded rainfall conditions or the rest of the recorded monitored history. In such cases, these periods were not used in the calibration as noted in the report.
- Rainfall data used as an input to the models for calibration was radar-rainfall data obtained from MCES. In some cases, these data were in question, and the MSP airport rainfall data were used instead.
- Rainfall is variable within the basin areas. The rain data used for the evaluation reflects the average rainfall over the area.
- The results reported are based on flow models that simulate the hydrologic response of the areas evaluated. They are not detailed hydraulic models of the sewer collection system upstream. This approach ignores any travel time, system storage, system bottlenecks, or concentration of large I/I inputs that may be present in the actual system. The approach assumes that these hydraulic behaviors are manifest in the flow data used for model calibration and therefore are inferred by the approach. When measured data contains events with magnitudes similar to the 10-year flows, then these results have been tested for events of that size.
- There were approximately 10 years from the pre to post-rehabilitation periods. Other changes in the basin besides the benefits of rehabilitation (such as growth and development, or further degradation of the rest of the system) are reflected in the final outcome.

- In some cases, a community may have been actively performing system rehabilitation during either the pre- or post-rehabilitation analysis time periods, or both, and from a strict sense one could consider these periods as “non-stationary.” Because these rehabilitation efforts are long term and much of the efforts occurred during the time between pre and post-rehab analysis periods, these changes during the analysis periods are not believed to have a significant influence on the outcome.

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Appendix E

Water and Sanitary Sewer CIP

Water and Sanitary Sewer Utility Section

A five-year projection of the Water and Sanitary Sewer Fund reveals some potential financial challenges the City may have to address. The contract pricing with the City of Minneapolis and Golden Valley-Crystal-New Hope Joint Water Commission was renewed in 2013. The Metropolitan Council Environmental Services (MCES) surcharge program related to inflow and infiltration will have a direct affect on rates as it requires the City to make improvements to the sanitary system that will reduce the rate of inflow and infiltration into the system.

Fees from the City's utility bill are the main source of revenue.

City of Golden Valley, Minnesota

Capital Plan

2017 thru 2021

PROJECTS BY DEPARTMENT

Department	Project#	Priority	2017	2018	2019	2020	2021	Total
Water & Sewer Systems								
Sanitary Sewer & Water Line Repair/Recon.	*W&SS-001*	n/a	870,000	500,000	500,000	500,000	500,000	*2,870,000*
Sewer Jet Truck	*W&SS-012*	n/a		190,000				*190,000*
Multiquip Portable Generator	*W&SS-041*	n/a					10,000	*10,000*
Mill and Overlay Water/Sewer Repairs	*W&SS-051*	n/a	50,000					*50,000*
Portable Generator	*W&SS-052*	n/a		10,000				*10,000*
Televising and Electroscan Equipment	*W&SS-053*	n/a		225,000				*225,000*
Rubber Tired Excavator	*W&SS-056*	n/a	245,000					*245,000*
Step Van	*W&SS-060*	n/a		80,000				*80,000*
Radio Meter Reading System	*W&SS-063*	n/a	355,000	355,000	355,000	100,000		*1,165,000*
Utility Building Locker Room Repair/Upgrades	*W&SS-065*	n/a	100,000					*100,000*
Valve Replacement/Watermain Lining	*W&SS-066*	n/a					100,000	*100,000*
Tractor Loader Backhoe	*W&SS-070*	n/a		150,000				*150,000*
I-394 Inflow/Infiltration Project	*W&SS-074*	n/a		300,000		300,000		*600,000*
Sewer Flow Meters	*W&SS-076*	n/a				35,000		*35,000*
Asset Management Software	*W&SS-079*	n/a	30,000					*30,000*
Asset Management Equipment	*W&SS-080*	n/a	20,000					*20,000*
800 MHz Radios	*W&SS-081*	n/a			40,000			*40,000*
Water & Sewer Systems Total			**1,670,000**	**1,810,000**	**895,000**	**935,000**	**610,000**	***5,920,000***
GRAND TOTAL			**1,670,000**	**1,810,000**	**895,000**	**935,000**	**610,000**	***5,920,000***

Project # W&SS-001

Project Name Sanitary Sewer & Water Line Repair/Recon.

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Water and Sewer
Priority

Description

Major repairs and reconstruction on the City's sanitary sewer and water systems as needed. Repairs will be done in conjunction with the City's Pavement Management Program (See S #1).

Justification

To maintain City's water mains and sanitary sewer mains.

Expenditures	2017	2018	2019	2020	2021	Total
Construction/Maintenance	870,000	500,000	500,000	500,000	500,000	2,870,000
Total	**870,000**	**500,000**	**500,000**	**500,000**	**500,000**	**2,870,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund	870,000	500,000	500,000	500,000	500,000	2,870,000
Total	**870,000**	**500,000**	**500,000**	**500,000**	**500,000**	**2,870,000**

Project # W&SS-012

Project Name Sewer Jet Truck

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Water and Sewer
Priority

Description

High pressure sewer jet/rodder truck for the Utility Division, Unit 678 is an essential piece of equipment for mainline sewer cleaning.

Justification

Increased repair and maintenance expenditures on Unit 648, which will be 11 years old.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings		190,000				190,000
Total		**190,000**				**190,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund	190,000					190,000
Total	**190,000**					**190,000**

Project # W&SS-041

Project Name Multiquip Portable Generator

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Water and Sewer
Priority

Description

A Multiquip portable generator Unit 692, a 2010 portable generator.

Justification

Increased repair and maintenance expenditures on Unit 692.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings					10,000	10,000
Total					**10,000**	**10,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund					10,000	10,000
Total					**10,000**	**10,000**

Project # W&SS-051

Project Name Mill and Overlay Water/Sewer Repairs

Department Water & Sewer Systems
Contact
Type Improvement
Useful Life
Category Water and Sewer
Priority

Description

Water and Sanitary Sewer repairs willl be made in conjuction with the annual Asphalt Overlay program. Repairs include but not limited to valve and hydrant replacement, manhole adjustments, manhole sealing, and pipe replacement.

Justification

To maintain the City's sanitary sewer and water systems.

Expenditures	2017	2018	2019	2020	2021	Total
Construction/Maintenance	50,000					50,000
Total	**50,000**					**50,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund	50,000					50,000
Total	**50,000**					**50,000**

Project # W&SS-052

Project Name Portable Generator

Department Water & Sewer Systems
Contact
Type Equipment
Useful Life
Category Water and Sewer
Priority

Description

Generator to replace Unit 692 a 2010 standby generator utilitized for emergency response.

Justification

Increased repair and maintenance expenditures on Unit #692 which will be eight years old.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings		10,000				10,000
Total		**10,000**				**10,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund		10,000				10,000
Total		**10,000**				**10,000**

Project # W&SS-053

Project Name Televising and Electroscan Equipment

Department Water & Sewer Systems
Contact
Type Equipment
Useful Life
Category Water and Sewer
Priority

Description

Sewer televising mainline computer and electronic equipment purchased with the televising truck will be five years old. The televising equipment will be replaced along with new Electroscan equipment.

Justification

Update computer and electronic equipment that will televise and incorporate electroscan into the upgraded televising equipment. Enhanced sanitary sewer inspection to identify, quantify and prioritize defects in the sanitary sewer system.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings		225,000				225,000
Total		**225,000**				**225,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund		225,000				225,000
Total		**225,000**				**225,000**

Project # W&SS-056

Project Name Rubber Tired Excavator

Department Water & Sewer Systems
Contact
Type Equipment
Useful Life 15 years
Category Water and Sewer
Priority

Description

Rubber tired excavator to replace Unit #671, a 2000 Caterpillar Excavator.

Justification

Increased repair and maintenance on Unit #671, a tractor backhoe that will be eighteen years old.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings	245,000					245,000
Total	**245,000**					**245,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund	245,000					245,000
Total	**245,000**					**245,000**

Project # W&SS-060

Project Name Step Van

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Unassigned
Priority

Description

Step Van for the Utility Department to replace Unit #674, a 2002 Work Horse Step Van.

Justification

Increased repair and maintenance expenditures on Unit #674.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings		80,000				80,000
Total		**80,000**				**80,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund		80,000				80,000
Total		**80,000**				**80,000**

Project # W&SS-063

Project Name Radio Meter Reading System

Department Water & Sewer Systems
Contact
Type Equipment
Useful Life
Category Water and Sewer
Priority

Description

Fixed base radio metering reading system for utility billing..

Justification

Existing FCC radio frequency utilized for reading city water meters has been banned by the FCC and city is forced to comply with the rule changes.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings	355,000	355,000	355,000	100,000		1,165,000
Total	**355,000**	**355,000**	**355,000**	**100,000**		**1,165,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility - Operating				100,000		100,000
Water & Sewer Utility Fund	355,000	355,000	355,000			1,065,000
Total	**355,000**	**355,000**	**355,000**	**100,000**		**1,165,000**

Project # W&SS-065

Project Name Utility Building Locker Room Repair/Upgrades

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Unassigned
Priority

Description

Utility Building is the oldest maintenance building and is in need of locker room repairs and upgrades to meet current staffing.

Justification

Utility building locker room was designed for a smaller staff levels. Currently utility division has twelve staff utilizing a locker room that was designed for a staff size of 6-8 utility operators.The health and safety issue with the current locker room size and configuration is that staff is forced to use the shower stall space as a changing and clothing locker area. This is a problem for utility staff that needs to shower after a day of sewer system maintenance. Staff also is using the shop/garage area for lockers and changing area.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings	100,000					100,000
Total	**100,000**					**100,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund	100,000					100,000
Total	**100,000**					**100,000**

Project # W&SS-066

Project Name Valve Replacement/Watermain Lining

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Unassigned
Priority

Description

Watermain valve replacement and strategic watermain lining associated with future overlay project.

Justification

Includes the cost to replace leaking water valves and line minor portions of the public watermain in conjunction with the future overlay program.

Expenditures	2017	2018	2019	2020	2021	Total
Construction/Maintenance					100,000	100,000
Total					**100,000**	**100,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund					100,000	100,000
Total					**100,000**	**100,000**

Project # W&SS-070

Project Name Tractor Loader Backhoe

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Unassigned
Priority

Description

Tractor loader backhoe to replace Unit 675, a 2004 Cat tractor loader backhoe.

Justification

Increased repair and maintenance expenditures on Unit 675, which will be 14 years old.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings		150,000				150,000
Total		**150,000**				**150,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund		150,000				150,000
Total		**150,000**				**150,000**

Project # W&SS-074

Project Name I-394 Inflow/Infiltration Project

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Unassigned
Priority

Description

Reduce inflow/infiltration in the I-394 sewer shed district.

Justification

The sanitary sewer in the I-394 sewer shed is currently near capacity following large storm events. The reduction of I/I in the sewer shed is necessary in order to continue to allow future redevelopment of the corridor.

Expenditures	2017	2018	2019	2020	2021	Total
Construction/Maintenance		300,000		300,000		600,000
Total		**300,000**		**300,000**		**600,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund		300,000		300,000		600,000
Total		**300,000**		**300,000**		**600,000**

Project # W&SS-076

Project Name Sewer Flow Meters

Department Water & Sewer Systems
Contact
Type Unassigned
Useful Life
Category Unassigned
Priority

Description

Portable sewer flow meters for monitoring inflow and infiltration in sanitary sewer system.

Justification

Replace older portable sewer flow meters to accurately monitor sewer flows.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings				35,000		35,000
Total				**35,000**		**35,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund				35,000		35,000
Total				**35,000**		**35,000**

Project # W&SS-079

Project Name Asset Management Software

Department Water & Sewer Systems
Contact
Type Equipment
Useful Life
Category Water and Sewer
Priority

Description

Conversion from the existing Cartegraph Software Navigator desktop software to a web-based Asset and Work Managemement Software with mobile component. Includes software purchase, data migration, implementation, and training. 50% of purchase from the Vehicle and Equipment CIP, 25% Water and Sewer CIP and 25% from the Storm Sewer CIP.

Justification

The move to a mobile web-based work management system will improve efficiencies within the organization and service delivery to external customers. The software will be utilized to manage routine tasks and business workflows, track inspections and maintenance, and assist in programming future expenditures.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings	30,000					30,000
Total	**30,000**					**30,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund	30,000					30,000
Total	**30,000**					**30,000**

Project # W&SS-080

Project Name Asset Management Equipment

Department Water & Sewer Systems
Contact
Type Equipment
Useful Life
Category Water and Sewer
Priority

Description

Purchase of hardware, mobile devices and equipment necessary to support the implementation of the new mobile web-based Asset and Management Software system.

Justification

The move to a mobile web-based work management system will improve efficiencies within the organization and service delivery to external customers. The software will be utilized to manage routine tasks and business workflows, track inspections and maintenance, and assist in programming future expenditures.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings	20,000					20,000
Total	**20,000**					**20,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund	20,000					20,000
Total	**20,000**					**20,000**

Project #	**W&SS-081**	**Department**	Water & Sewer Systems
Project Name	**800 MHz Radios**	**Contact**	
		Type	Equipment
		Useful Life	
		Category	Water and Sewer
		Priority	

Description

8-800 MHz portable radios and accessories to be purchased in 2019.

Justification

Replace current raidos purchased in 2008. Hennepiin County will no longer support the current 800 Mhz radios past December 31, 2019. New radios P25 Phase II modulation compliant.

Expenditures	2017	2018	2019	2020	2021	Total
Equip/Vehicles/Furnishings			40,000			40,000
Total			**40,000**			**40,000**

Funding Sources	2017	2018	2019	2020	2021	Total
Water & Sewer Utility Fund			40,000			40,000
Total			**40,000**			**40,000**

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