Counties of Warren and Washington
Industrial Development Agency

Special Meeting Announcement/Agenda

Tuesday, March 5, 2024 at 4:00 PM
68 Warren Street, Glens Falls NY

Members of the public may also listen/view/comment via the livestreaming on YouTube under Warren Washington IDA.
Minutes of this Warren Washington Industrial Development Special Meeting will be transcribed and posted on the WWIDA website.

Agenda

1. Call to Order, Roll Call and Quorum Confirmation
2. Review of RRP Proposal for Flow Monitoring, Date Analysis, and Report for Stormwater Separations
3. Education Session – Topic TBD
4. Adjournment

REQUEST FOR PROPOSALS (RFP)

FLOW MONITORING, DATA ANALYSIS, AND REPORT FOR STORMWATER SEPARATION

Counties of Warren & Washington Industrial Development Agency (WWIDA)
Warren & Washington Counties NY

RFP Released: January 25, 2024
RFP Due: February 26, 2024

The WWIDA is issuing a Request for Proposals from professional engineering firms to complete an Inflow & Infiltration Reduction Analysis REPORT for a section of sewershed in the Washington County Sewer District No. 2 located in Hudson Falls, NY.

PROJECT DESCRIPTION

The WWIDA is currently working with the Washington County Sewer District No. 2 (WCSD) on a sewer extension to the Canalside Energy Park in Fort Edward that, once connected, will result in 100,000 GPD of effluent added to the WCSD system. To offset the addition of 100,000 GDP to the combined sewer system, the NYS Department of Environmental Conservation (DEC) is requiring a 4:1 wet weather offset be achieved. The WCSD has identified a section of the district where that offset project could be implemented, referred to as HF1A sewershed. The WCSD is currently having a sewer rehabilitation and stormwater separation project designed, with construction presumed in 2025.

In 2022, Environmental Design Partnership, LLP completed a flow monitoring study for the HF1A sewershed (completed report attached), to determine inflow and infiltration rates.

This WWIDA project includes flow monitoring and modeling of the sewer system within the HF1A sewershed (shown as sewershed B in the attached report) to determine if a stormwater separation project will achieve a 4:1 wet weather stormwater offset. The storm intensity is to be determined by the selected firm(s) and discussed with NYSDEC.

SCOPE OF SERVICES

The firm(s) selected will undertake the following services, and the proposal submitted shall be specifically germane to these services:

a. Identify the extent of the sewershed for the 4:1 wet weather stormwater offset,
b. Complete flow monitoring and data analysis for the identified sewershed,
c. Complete a flow monitoring and modeling report,
d. Present the finding of the report to the NYS DEC and WCSD, and
e. Obtain the maximum offset approval from the NYSDEC that a stormwater sewer separation project within this sewershed will allow for, with a 100,000 GPD Goal.

REFERENCE MATERIAL

For additional information on the sewershed, please see the attached report entitled "Flow Monitoring Study for Washington County Wastewater Collection System – Village of Hudson Falls & Town of Kingsbury."

SCHEDULE AND BUDGET

The project **must be completed** by September 10, 2024.

The consultant budget **will not exceed** $40,000.

QUESTIONS

Questions pertaining to this proposal must be submitted in writing to aweaver@warren-washingtonida.com no later than February 8, 2024 at 12:00 pm. Responses to any questions will be provide by written addenda posted to the website at www.warren-washingtonida.com. WWIDA shall not be bound by any verbal responses.

SUBMISSION REQUIREMENTS

When responding to this request, please send appropriate information, such as resumes, description of your company and experience which must include the following information:

1. Description of firm/staff qualifications, experience, and availability. At least

one primary staff contact should be identified that would serve as a project manager for assigned work. Proposed project managers should be experienced with public infrastructure projects.

2. List of three references and description of related work completed.
3. Itemized cost proposal including hourly and / or task-specific rates as feasible and relevant to the potential tasks listed above. Itemized cost proposals must include the Title and Hourly Rate for any proposed staff.
4. Applicants are encouraged to emphasize their relative areas of expertise within their respective proposals.
5. The WWIDA will be looking for unique or diverse skills as part of the selection process.
6. Proposing firms should submit information that describes the background and experience of staff to be available for assignment.
7. Demonstration of meaningful DBE/MBE/WBE/SDVOB participation will also yield a competitive advantage for applicants during the selection process.
8. Cost and past performance will be considered, along with any other qualifications as determined by the WWIDA.

Proposals may be submitted by mail or email **no later than February 26, 2024 at 12:00 pm**. Late proposals will not be considered. Proposals delivered by mail require two printed copies and a PDF document provided on a thumb drive sent to,

Alie Weaver, Administrator

Counties of Warren & Washington Industrial Development Agency

5 Warren Street, Suite 210
Glens Falls, New York 12801

Emailed proposals must have the proposal attached as a single PDF document with the email budget line "Proposal Enclosed – Flow Monitoring, Data Analysis, and Report for Stormwater Separation" and may be submitted to aweaver@warren-washingtonida.com. It is the responsibility of the offer to ensure that their proposal has been received.

All proposals must be submitted in accordance with the terms and specifications.

NYS Certified Minority and Woman Owned Business (MWBE) and/or Service-Disabled Veteran-Owned Businesses (SDVOB) are encouraged to apply.

SELECTION PROCESS AND CRITERIA

The WWIDA intends to evaluate the qualifications of the firms proposing to provide the services and intends to select the firm which, in the WWIDA's judgement, is the most qualified firm and the firm that would best serve the WWIDA's interests, subject to negotiation of fair and reasonable compensation.

In evaluating proposals, the IDA shall utilize the following factors:

- The overall capability of the firm to complete the project scope, along with the overall expertise with like projects.
- The technical skills and expertise of the specific project manager and technical team identified for this project.
- Communication skills related to the firm’s and team’s ability to prepare written information in a clear and concise manner.
- Cost and timeframe.

Subsequent to reviewing and evaluating competitive proposals, the WWIDA may, at its sole discretion, choose to interview some or all firms responding, prior to final selection.

The WWIDA may choose to award the RFP to one or multiple firms.

The WWIDA may reject proposals, or any portions thereof, which are materially incomplete and/or which do not conform to the proposal content or submission requirements. The WWIDA also reserves the right, to the extent permitted by law, to waive any irregularity, variance, or informality in a proposal in keeping with the best interests of the WWIDA and to accept proposals which do not significantly alter the proposal’s scope.

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FLOW MONITORING STUDY FOR WASHINGTON COUNTY WASTEWATER COLLECTION SYSTEM – VILLAGE OF HUDSON FALLS & TOWN OF KINGSBURY

EPG No. 105054

WASHINGTON COUNTY SEWER DISTRICT NO. 2

PREPARED BY:

Environmental Design Partnership, LLP

FEBRUARY 15, 2022

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1.0 EXECUTIVE SUMMARY

The Washington County Sewer District No. 2 owns and operates a wastewater collection, pumping, and treatment system serving the Villages of Hudson Falls and Fort Edward, and portions of the Towns of Kingsbury and Fort Edward. Due to the age and conditions of the collection system, high flows occur during periods of wet weather, often resulting in wastewater surcharging within the collection system as well as overflows to the Hudson River.

As part of ongoing efforts to locate and mitigate sources of inflow and infiltration (I&I) contributing to such peak flow events, the District has chosen to conduct a flow study of the collection system serving portions of the Village of Hudson Falls and the Town of Kingsbury. It is the intent of this report to summarize the results of the flow monitoring conducted, draw conclusions about potential sources of inflow and infiltration quantified as part of the study, and make recommendations for future steps, including mitigation intended to reduce both I&I as well as reduce peak flows experienced in the collection system during wet weather periods.

Although there is quantifiable infiltration within the study area, inflow has a significantly larger impact on peak flows during periods of wet weather. More specifically, directly inflow (the result of stormwater directly entering the collection system through sources such as cross connections with storm water system, roof leaders, manhole in areas prone to temporary flooding by stormwater, etc.) is the predominant source of inflow in the system. There also exists areas (notably subcatchments 1B-9B and 2A-9) where exfiltration may potentially be occurring.

Based on the results of this study, additional investigation is recommended in order to identify and prioritize sources of I&I prior to mitigation work. These investigative efforts should include (but not be limited to) CCTV inspection, smoke testing, and dye testing.

2.0 PROJECT BACKGROUND AND HISTORY

The sanitary sewer system, owned and operated by Washington County, serving Washington County Sewer District No. 2 includes approximately 45 miles of gravity mains, 1,000 manholes, 11 pump stations, and a centralized wastewater treatment facility (WWTF) serving the Town of Kingsbury, the Village of Hudson Falls, the Town of Fort Edward, and the Village of Fort Edward. Due to the age of the collection system and observed flows as received by both the wastewater pumping station and WWTF, it is generally understood that inflow and infiltration is prevalent throughout the collection system, and results in increased flows during wet weather periods.

A comprehensive flow monitoring program was implemented within portions of the collection system located in the Village of Hudson and the Town of Kingsbury at eight monitoring locations in seven separate manholes throughout the collection system. This study area represents approximately 63,600 linear feet of gravity sewer and encompasses a total area of approximately 577 acres. The recorded flow data was used to provide estimates of infiltration related flows during dry periods and inflow estimates during and immediately following precipitation events. Mapping of the collection system in the study area identifying the flow monitoring locations used in the flow study can be found in Appendix A.

As evaluated using the NYSDEC Environmental Resource Mapper, there are no regulated wetlands or endangered species habitats within the study area. Portions of the study area within the Village of Hudson Falls are within areas identified as Potential Environmental Justice Area Communities.

3.0 FLOW MONITORING

Temporary flow monitoring equipment was deployed within a portion of the gravity sewer system serving the northern portion of the Village of Hudson Falls from June 3rd through August 20th 2021. The monitoring was performed using equipment provided by FloWav and utilized radar to measure velocity and pressure differential to measure depth of flow. Flow was indirectly measured every 15 minutes using measurements of velocity and depth of flow within the invert the monitored manholes. Kathleen Suozzo PE, PLLC (KSPE PLLC was retained to operate, maintain, calibrate, and perform initial quality control analyses of the flow monitoring data, and has coordinated with our office with respect to the required flow monitoring locations.

The flow monitoring equipment was installed in a total of eight locations in seven different manholes as selected by EDP and WCSD No. 2 operations staff. These locations were selected as being representative of different portions of the collection system in the area and were also selected, in part, as observing a cumulative flow path taken by wastewater from various catchment areas on the way to the Hudson Falls Pump Station. The individual manhole locations, as well as their contributing catchment areas, are shown in Appendix B.

The flow monitoring locations utilized during this study are as follows:

3.1 Manhole 1B-9A

This monitoring location was located in the 14-inch diameter inlet pipe in Manhole 1B-9 (this manhole was shared with monitoring location 1B-9B) along Ferry Street in close proximity to the water tower. There exists some gaps in the flow data recorded, as from June 26th to July 1st, and from July 6th to July 7th due to cables serving the monitoring equipment became disconnected. Otherwise, all data is considered accurate and reliable. A total of seven surcharge events occurred at this monitoring location during the study period. A copy of the average and maximum daily flows recorded can be found in Appendix C.

Table 1: Summary of Subcatchment 1B-9A

Estimated No. of EDUs	191
Number of Manholes	35
Length of Gravity Sewer Main	±7,700 ft
Catchment Area	49.9 acres

The inlet and outlet piping in this manhole is vitrified clay pipe (VCP). The manhole is constructed of laid brick, with an interior grouted surface. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water.

3.2 Manhole 1B-9B

This monitoring location was located in the 18-inch diameter inlet pipe in Manhole 1B-9 (this manhole was shared with monitoring location 1B-9A) along Ferry Street in close proximity to the water tower. Following a peak flow event on June 8th, it is suspected that the desiccant within the equipment became wet, which caused an overestimation of flow until it was replaced on July 7th. As such, data from this period was excluded for the purposes of establishing estimated baseline flow. A total of four surcharge events occurred at this monitoring location during the study period. A copy of the average and maximum daily flows recorded can be found in Appendix D.

Table 2: Summary of Subcatchment 1B-9B

Estimated No. of EDUs	595
Number of Manholes	104
Length of Gravity Sewer Main	±32,200 ft
Catchment Area	278 acres

The inlet and outlet piping in this manhole is vitrified clay pipe (VCP). The manhole is constructed of laid brick, with an interior grouted surface. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water.

3.3 Manhole 1B-1

This monitoring location was located in the 18-inch diameter pipe in Manhole 1B-1, near the intersection of Ferry Street and Margaret Street. This manhole receives flow from monitoring locations 1B-9A and 1B-9B as part of its catchment area. No surcharge events were observed at this monitoring location during the study period. A copy of the average daily and maximum daily flows recorded can be found in Appendix E.

Table 3: Summary of Subcatchment 1B-1

Estimated No. of EDUs	42
Number of Manholes	10
Length of Gravity Sewer Main	±1,900 ft
Catchment Area	22.5 acres

The inlet and outlet piping in this manhole is vitrified clay pipe (VCP). The manhole is constructed of laid brick. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water.

3.4 Manhole 1D-20

This monitoring location was located in the 18-inch pipe influent pipe in Manhole 1D-20, at the intersection of Spring Street and River Street. This manhole receives flow from monitoring location 1B-1 as part of its catchment area. No surcharge events were observed at this monitoring location during the study period. A copy of the average daily and maximum daily flows recorded can be found in Appendix F.

Table 4: Summary of Subcatchment 1D-20

Estimated No. of EDUs	36
Number of Manholes	8
Length of Gravity Sewer Main	±2,100 ft
Catchment Area	15.5 acres

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The inlet and outlet piping in this manhole is PVC. The manhole is constructed of precast concrete. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water.

3.5 Manhole 1D-1A

This monitoring location was located in a 10-inch pipe in Manhole 1D-1A at the intersection of Ferry Street and River Street. This manhole has a small catchment area and was observed to be prone to clogging, resulting in a loss of flow data for a significant portion of the study period. Additionally, the small catchment area and flows compared to the size of the pipe caused additional issues with flow measurements. No surcharge events were observed at this monitoring location during the study period. A copy of the average daily and maximum daily flows recorded can be found in Appendix G.

Table 5: Summary of Subcatchment 1D-1A

Estimated No. of EDUs	34
Number of Manholes	8
Length of Gravity Sewer Main	±2,000 ft
Catchment Area	20.9 acres

The inlet and outlet piping in this manhole is PVC. The manhole is constructed of precast concrete. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water.

3.6 Manhole 1A-5

This monitoring location was located in the 8-inch discharge pipe of Manhole 1A-5 along Walnut Street. This manhole serves a small catchment area, and recorded flows were very low. In addition, limited cellular service resulted in the loss of significant amounts of flow data. Lastly, when recovering the monitoring equipment, it was discovered that the equipment had dislodged and flowed to an adjacent manhole. As such, it has been determined that flows measure on and after July 26th are unreliable. A copy of the average daily and maximum daily flows recorded can be found in Appendix H.

Table 6: Summary of Subcatchment 1A-5

Estimated No. of EDUs	132
Number of Manholes	19
Length of Gravity Sewer Main	±4,700 ft
Catchment Area	31.0 acres

The inlet and outlet piping in this manhole is vitrified clay pipe (VCP). The manhole is constructed of laid brick. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water.

3.7 Manhole 1A-16

This monitoring location was located in the 24-inch diameter inlet pipe of Manhole 1A-16, along the shoulder of River Street. This manhole receives flow from monitoring locations 1D-1A, 1D-20, and 1A-5 as part of its catchment area. As discussed later in this report, there is a potential that flows at this monitoring location were overestimated. A total of 22 surcharge events occurred at this monitoring location during the study period. A copy of the average daily and maximum daily flows recorded can be found in Appendix I.

Table 7: Summary of Subcatchment 1A-16

Estimated No. of EDUs	373
Number of Manholes	44
Length of Gravity Sewer Main	±11,300 ft
Catchment Area	159 acres

The inlet and outlet piping in this manhole is vitrified clay pipe (VCP). The manhole is constructed of precast concrete. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water. This manhole also includes a diversion structure for the routing of extreme high flows to the Hudson River during periods of sanitary sewer overflow (SSO). The diversion weir installed in this manhole for this purpose appears to be in acceptable condition.

3.8 Manhole 2A-9

This monitoring location was located in the 15-inch diameter inlet pipe of Manhole 2A-9 north of the Hudson Falls Pump Station. This portion of the gravity main is a trunk sewer, with Manhole 2A-9 receiving only flows from Manhole 1A-16 (i.e., flows in Manhole 2A-9 are expected to be the same as those in 1A-16). As discussed later in this report, there is a potential that flows at this monitoring location were underestimated. A total of six surcharge events occurred at this monitoring location during the study period. A copy of the average daily and maximum daily flows recorded can be found in Appendix J.

Table 8: Summary of Subcatchment 2A-9

Estimated No. of EDUs	0
Number of Manholes	6
Length of Gravity Sewer Main	±1,700 ft
Catchment Area	0 acres

The inlet and outlet piping in this manhole is vitrified clay pipe (VCP). The manhole is constructed of precast concrete. The manhole and associated inverts are in good condition, with no observed evidence of intrusion of ground or surface water.

4.0 PRECIPITATION MONITORING

Precipitation was measured using a rain gauge temporarily located at the Hudson Falls Pump Station. The equipment used was an Onset tipping bucket-type rain gauge which measured accumulated rainfall every five minutes and is accurate to 0.01 inches of rainfall.

During the study period, there were approximately 13 significant storm events (defining a significant storm as a storm producing at least 0.20 inches of rainfall over a two-hour period). Moreover, during the study period there were (based on data from the Northeast Regional Climate Center) two storms approximately equivalent to one-year storms (June 8th and June 21st) and one storm approximately equivalent to a five-year storm (July 29th). Based on precipitation records maintained by NOAA dating to 1894, June 2021 was the tenth wettest June on record (with 5.65 inches of rain received compared to an average of 3.72 inches, as measured in Glens Falls) and July 2021 was the third wettest July on record (with 8.06 inches of rain received compared to an average of 4.26 inches as measured at Glens Falls). It should further be noted that while monthly rainfall records are not available for Hudson Falls, the total rainfall recorded in July as part of this study was 8.69 inches, which would well exceed the record for Glens Falls.

Total daily rainfall during the study period can be found in Appendix K, as well as in Appendices C through J showing flows at each monitoring location.

5.0 INFILTRATION ESTIMATES

Infiltration to the sanitary sewer systems is an estimate of the quantity of groundwater entering the system through cracked pipes, poor pipe connections, leaking manholes, and other possible defects in the collection system. An "expected" flow rate for each flow monitoring location within the system has been calculated for use in evaluating the severity of infiltration in the system. Expected flow rates include two separate components: average wastewater flows and anticipated infiltration.

According to the United States Census Bureau, the average household size in the Village of Hudson Falls has been estimated to be 2.41 persons/household. For purposes of this analysis, an average household size of 2.5 persons/household has been used. Assuming a theoretical wastewater flow rate of 100 gallons per person per day, a single-family residence is thus equivalent to 250 gallons per day (gpd) of wastewater. Flows for non-residential properties were estimated using design flow rates as described in *New York State Design Standards for Intermediate Sized Wastewater Treatment Systems – 2014*. Total flows are determined by the Equivalent Dwelling Unit method (EDU) wherein one EDU is equivalent to the wastewater produced by a single-family residence; 250 gpd. The EDUs given in Section 3 were determined using this method and used in the estimation of expected flows.

Anticipated infiltration was included in the expected flows understanding that no sanitary sewer system can be considered to fully be without infiltration, even when built with modern construction techniques. As stated in *Recommended Standards for Wastewater Facilities – 2014* as prepared by the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (i.e., '10 States Standards'), anticipated infiltration is estimated to be 100 gallons per inch of pipe diameter per mile per day.

Expected flows have also been included in Appendices C through J for purpose of comparison to measured flows during the study period.

Following a determination of expected flows at each monitoring location, these expected flows can then be compared to the base flows as measured during the study period. Base flows as presented herein are based on the median flows recorded during the study period (thus reducing the inordinate impact represented by periods, though brief, of extremely high flows during wet-weather events). A summary of the expected flow and base flow at each location is presented in Table 9 below.

Table 9: Estimated Infiltration by Monitoring Location

Monitoring Location	Expected Flow (MGD)	Base Flow (MGD)	Ratio of Infiltration (Base/Expected)
1B-9A	0.049	0.176	3.6
1B-9B	0.154	0.085	0.5
1B-1	0.216	0.347	1.6
1D-20	0.225	0.376	1.7
1D-1A	0.009	0.012	1.4
1A-16	0.329	0.547	1.7
1A-5	0.034	0.105	3.1
2A-9	0.364	0.424	1.2

Infiltration rations of less than one are likely indicative of either an overly conservative theoretical expected flow estimate, underestimated based flow based on instrumentation error, or exfiltration occurring within the gravity sewer. As the same method of determining expected flow was used for all catchment areas,

Based on the above, it can be concluded that the catchment areas with the most significant infiltration (that is, the highest base flows compared to expected flows) are those served by Manholes 1B-9A and 1A-5. As the same method of determining expected flow was used for all catchment areas, when compared to other catchment areas it is unlikely that these high ratios of base flow to expected flow are the result of miscalculation of theoretical flow, unless many large, significant users have been uncounted; no such large users are suspected to exist in these catchment areas. To better evaluate the accuracy of expected flow estimates for these areas, water usage for the properties served should be compared with the flow data contained in this report.

The catchment area for Manhole 1B-9B may potentially experience exfiltration. It is also possible that flow at this monitoring location may be underestimated. As a point of comparison, Manhole 1B-1 receives flow from both monitoring locations 1B-9A and 1B-9B, as well as a small catchment area of its own. As the base flows measured at 1B-1 (0.347 MGD) are less than the sum of those at 1B-9A and 1B-9B (.280), it is possible that flows at 1B-9B are under reported. As above, to better evaluate the accuracy of expected flow estimates for this area, water usage for the properties served should be compared with the flow data contained in this report.

Contrary to what is expected, measured base flows in Manhole 2A-9 are significantly lower than Manhole 1A-16. As discussed in Section 3.8, this Manhole 2A-9 is approximately 1,740 linear feet downstream of Manhole 1A-16, with no known service connections or diversion structures between the two. As such it is expected that the flows received by Manhole 2A-9 would be equal to those received by Manhole 1A-16, if not higher (accounting for inflow and infiltration). However, as shown in Table 9, base flows as measured in Manhole 2A-9 are approximately 24% lower than those measured in Manhole 1A-16. It is understood however, a diversion structure is installed in this manhole that diverts excess flow to the Hudson River during peak flow events. While this explains the discrepancy in flow during peak flow events (it is noted that 22 surcharges were observed in Manhole 1A-16, while only six were observed in 2A-9), it does not account for the difference in base flow. Other potential explanations include instrumentational error, though upon review by both EDP and KSPE there is no indication of malfunction in the flow monitoring equipment installed in Manhole 2A-9, nor that installed in Manhole 1A-16 (following the repair of this equipment on June 30th). It should also be noted, that base flows recorded in Manhole 1A-16 are higher than expected based on the base flows measured in the contributing upstream manholes (Manholes 1D-1A, 1D-20, and

1A-5). While this could be the result of infiltration, it could also potentially be the result of over-estimation of flows in Manhole 1A-16 (flows measured in Manhole 2A-9 are similar to the sum of the flows measured in the contributing manholes). Barring equipment malfunction, another potential explanation is that wastewater is exfiltrating from this trunk sewer between the two manholes.

6.0 INFLOW ESTIMATES

Inflow within the system (i.e., excess flow derived from rainfall and surface water intrusion) was evaluated using multiple methods. The first method was a volume-based comparison evaluating flow data during a given storm, and comparing it to a "reference" storm for comparison purposes. Based on modeling by the Northeast Regional Climate Center, a one-year, six-hour storm for the area produces approximately 1.48 inches of rain with a peak intensity of 0.73 inches per hour. A similar such storm occurred on June 8th, 2021, with a total rainfall of 1.45 inches over seven hours, with a peak measured rainfall intensity of 0.72 inches per hour.

By adjusting the measured data to reflect the one-year reference storm event, the total inflow volume (i.e., total flow minus the base flow volume) was calculated at both six and 24 hours after the storm began. As suggested in *Massachusetts Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Survey* – 1993, areas of the system that indicated high inflow during the first six hours were assumed to have the worst direct inflow problems (i.e., storm sewer cross connections, roof leaders, and manholes in areas with local flooding). Areas of the system with significant inflow between six and 24 hours were assumed to have the worst indirect inflow problems (i.e., sump pump and under-drain connections).

Table 10: Estimated Inflow (Reference Storm Analysis)

Monitoring Location	Direct Inflow	Indirect Inflow
	Total Inflow (gal)	24 hr-6 hr Inflow (gal)
1B-9A	240,671	167,550
1B-9B	312,296	N/A[1]
1B-1	155,187	-9,811
1D-20	277,945	-9,482
1D-1A	27,974	N/A[2]
1A-16	286,369	21,173
1A-5[3]	N/A	N/A
2A-9	175,771	-8,940

[1]As per Section 3.2, this flow meter reported overestimated flows following the June 8th storm. As such, this flow is presumed to be in error.
[2]Flow meter briefly malfunctioned following the peak storm flow, likely caused by water intrusion during the observed surcharging.
[3]Flow meter was not functioning during the storm.

As can be seen above throughout much of the study area, significantly more inflow is the result of direct inflow as opposed to indirect inflow (the Manhole 1B-9B catchment area being the exception). This assessment is reinforced by examining directly the flows associated with individual storms. During all significant storm events, flows quickly peaked, often surcharging manholes during periods of high intensity rainfall, and then quickly returned to base levels shortly following the end of rainfall. Negative flows 24 hours after a storm indicate that not only have flows returned to base flows, but in fact that flows are below the median base flow for the area; indicative of little or no direct inflow.

While there is significant inflow into the collection system during rainfall events, the catchment area for monitoring location 1B-9B has the most significant inflow, as measured. Moreover, as shown in Table 10, it is believed that the indirect inflow recorded for Manhole 1B-9B is inaccurate due to submergence of the flow meter during the peak flow event. This confirmed by downstream flow meters, which did not witness the increased flows observed at location 1B-9B at a point 24 hours following the beginning of the storm.

A second method used to evaluate inflow within the system compares the difference between peak precipitation related flows and the base flow. This method evaluated peak overall flow at each flow meter location regardless of the size storm event. In an effort to eliminate extraneous data points, the peak flow was evaluated as an average of several individual data points and reported as peak one-hour and peak two-hour flows. Peak flows evaluated over both a one-hour and two-hour average period are presented below.

Table 11: Estimated Inflow (Peak Flow-Based Analysis)

Monitoring Location	Ratio Inflow (Peak/Base, MGD)		Total Inflow (Peak-Base, MGD)	
	1 Hour Peak	2 Hour Peak	1 Hour Peak	2 Hour Peak
1B-9A	14	11	2.24	1.84
1B-9B	38	35	3.12	2.90
1B-1	7	5	1.96	1.54
1D-20	8	7	2.76	2.39
1D-1A	90	78	1.11	0.96
1A-16	4	4	1.65	1.63
1A-5	18	18	1.83	1.83
2A-9	4	4	1.34	1.33

As per the above data, it can again be seen that the 1B-9B catchment area experiences significant inflow. Even in the event of instrumentation error, which could potentially result in total flows being over estimated (which would result in an error using the reference storm method), the analysis shows that flows during peak wet weather events are significantly higher than base flows, particularly when compared to other catchment areas in the study area. Furthermore, while the high volume of infiltration seen under the reference storm method may reflect the large size of the catchment area, being the largest of all the study areas, comparing peak flow to base flow negates the influence of area as a chief contributing factor in the presence of inflow in this area.

Catchment areas 1B-9A, 1D-1A, and 1A-5 also demonstrate a high of amount of inflow relative to base flow. However, given that these catchment areas are small in area compared to the other catchment areas means that while the inflow to base flow rate is high, the amount of inflow volume actually contributed is small (as seen in the inflow estimates based on the reference storm method).

7.0 CONCLUSIONS

Based on analysis of the data from the flow study, the following conclusions can be drawn regarding the condition of the wastewater collection system in the study area:

- While there does appear to be quantifiable infiltration within the study area, inflow has a significantly larger impact on peak flows and thus a larger impact on downstream facilities and capacities. Surcharges were observed several times during the study period, including during storm events which with a likelihood of occurring at least once a year, if not more often.
- The most severe impacts of infiltration were observed in catchment areas 1B-9A and 1A-5; two adjacent catchment areas. This may be indicative of high local groundwater levels.
- Direct inflow has a significantly larger impact on peak flows than does indirect inflow. At all flow monitoring locations, flows were observed to peak shortly after periods of intense rainfall, and then quickly return to flow conditions at or approximating average base flow conditions.
- The catchment area for monitoring location 1B-9B stands out in that it both appears to experience both exfiltration as well as the highest degree of inflow across the study area (even when accounting for flow monitoring equipment malfunction). While the 1B-9B catchment area is the largest in the overall study area, it appears to experience these effects regardless of the effects of size. More investigation of this catchment area appears to be warranted.
- After 1B-9B, catchment areas 1B-9A, 1A-5, and 1D-5A experience the most significant inflow on the basis of comparing peak flows to base flows.
- Based on the recorded data, there appears to be an unexplained loss of base flow between Manholes 1A-16 and 2A-9. One potential explanation for this discrepancy could be an over-estimation of flows in Manhole 1A-16. Conversely, this difference could be indicative of exfiltration along this length of trunk sewer. Additional investigation of this trunk sewer, including CCTV inspection, may be warranted.

8.0 RECOMMENDATIONS

Based on the conclusions discussed above, it is recommended that Washington County Sewer District No.2 take additional steps to further evaluate the sources of inflow and infiltration in the collection system. As the majority of the impact of wet weather events has been concluded to be through direct inflow, it is recommended that further investigations include a focus on identifying sources of such inflow, including:

- Cross connections between sanitary and storm sewers
- Locations of roof leaders which may be connected to the sanitary sewer system
- Manholes in areas prone to flooding
- Damaged manholes or cleanouts
- Manholes or cleanouts installed concurrent with stormwater features (e.g., drainage swales, stormwater detention areas, etc.)

These steps should include:

- CCTV inspections or sanitary sewer mains in the study area
- Inspections of all accessible manholes in the study area, particularly the diversion structure in Manhole 1A-16
- Smoke testing of all sanitary sewer mains in the area
- Dye testing of the trunk sewer between Manholes 1A-16 and 2A-9 as a means to potentially identify any points of exfiltration

Following the location and evaluation of such sources of inflow, it is recommended that Washington County Sewer District No. 2 take remedial action as necessary to mitigate these deficiencies, including:

- Replacement or relining of sewer mains. In particular replacement or relining of the trunk sewer between Manholes 1A-16 and 2A-9, in the event that further investigation determines the presence of exfiltration in the portion of the collection system
- Replacement or repair of manholes
- Separation of sources of stormwater from the sanitary sewer collection system

9.0 SUMMARY

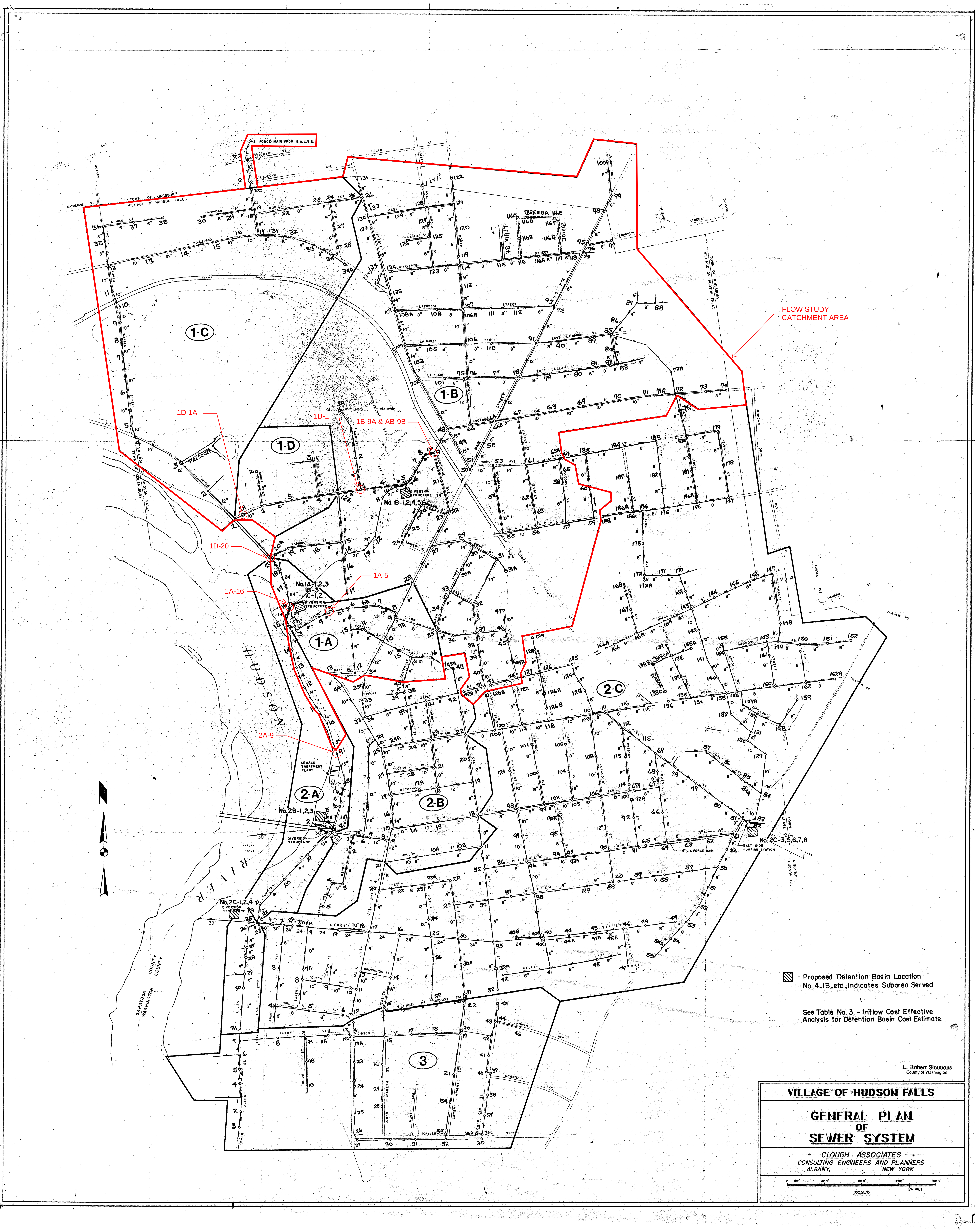
To summarize, due to the age and condition of the wastewater collection system in the study area, inflow and infiltration both contribute to high flow conditions during periods of wet weather. However, inflow, specifically direct inflow, are concluded to be the overwhelming factor in these peak flow events, which routinely result in surcharging within the collection system. As such, it is recommended that Washington County Sewer District No. 2 take additional steps to better locate and quantify sources of inflow and infiltration, followed by undertaking a capital improvement project to mitigate the impact of the same on the collection, pumping, and treatment system.

REFERENCES:

(Ten State Standards) *Recommended Standards for Wastewater Facilities – A Report of the Wastewater Committee of the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers*, Health Research, Inc., 2014 Edition.

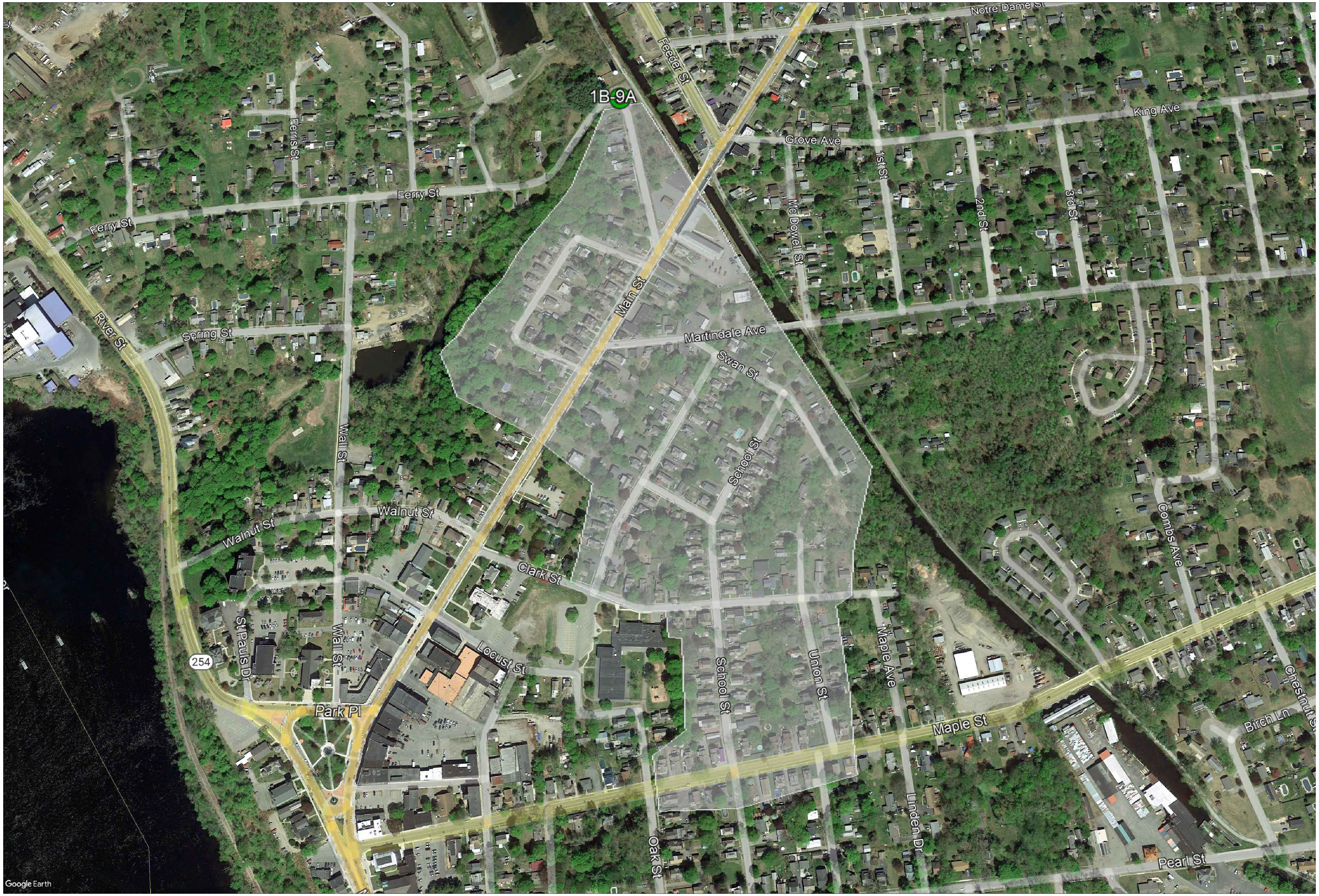
Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Survey – Commonwealth of Massachusetts Department of Environmental Protection, 1993 Edition.

APPENDIX A: VILLAGE OF HUDSON FALLS SANITARY SEWER SYSTEM AND MONITORING LOCATIONS



VILLAGE OF HUDSON FALLS
GENERAL PLAN OF SEWER SYSTEM
CLOUGH ASSOCIATES
CONSULTING ENGINEERS AND PLANNERS
ALBANY, NEW YORK
SCALE
L. Robert Simmons
County of Washington
Proposed Detention Basin Location
No. 4, 1B, etc., Indicates Subarea Served
See Table No. 3 - Inflow Cost Effective Analysis for Detention Basin Cost Estimate.
FLOW STUDY CATCHMENT AREA
8" FORCE MAIN FROM B.O.C.E.S.
1-A
1-B
1-C
1-D
2-A
2-B
2-C
3
1D-1A
1B-1
1B-9A & AB-9B
1D-20
1A-5
1A-16
2A-9
DIVERSION STRUCTURE
No. 1B-1,2,4,5,6
No. 1A-1,2,3
1B-3
1C-1,2
No. 2B-1,2,3
No. 2C-1,2,4
No. 2C-3,5,6,7,8
EAST SIDE PUMPING STATION
SEWAGE TREATMENT PLANT
HUDSON RIVER
TOWN OF KINGSBURY
VILLAGE OF HUDSON FALLS
SARATOGA COUNTY
WASHINGTON COUNTY

APPENDIX B: MONITORING LOCATION CATCHMENT AREAS



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WASHINGTON COUNTY SEWER DISTRICT NO. 1
FLOW STUDY - MANHOLE 1B-9A
VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK
DECEMBER 6, 2021

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CHECK BY	TJM
EDP PROJECT NUMBER	12929

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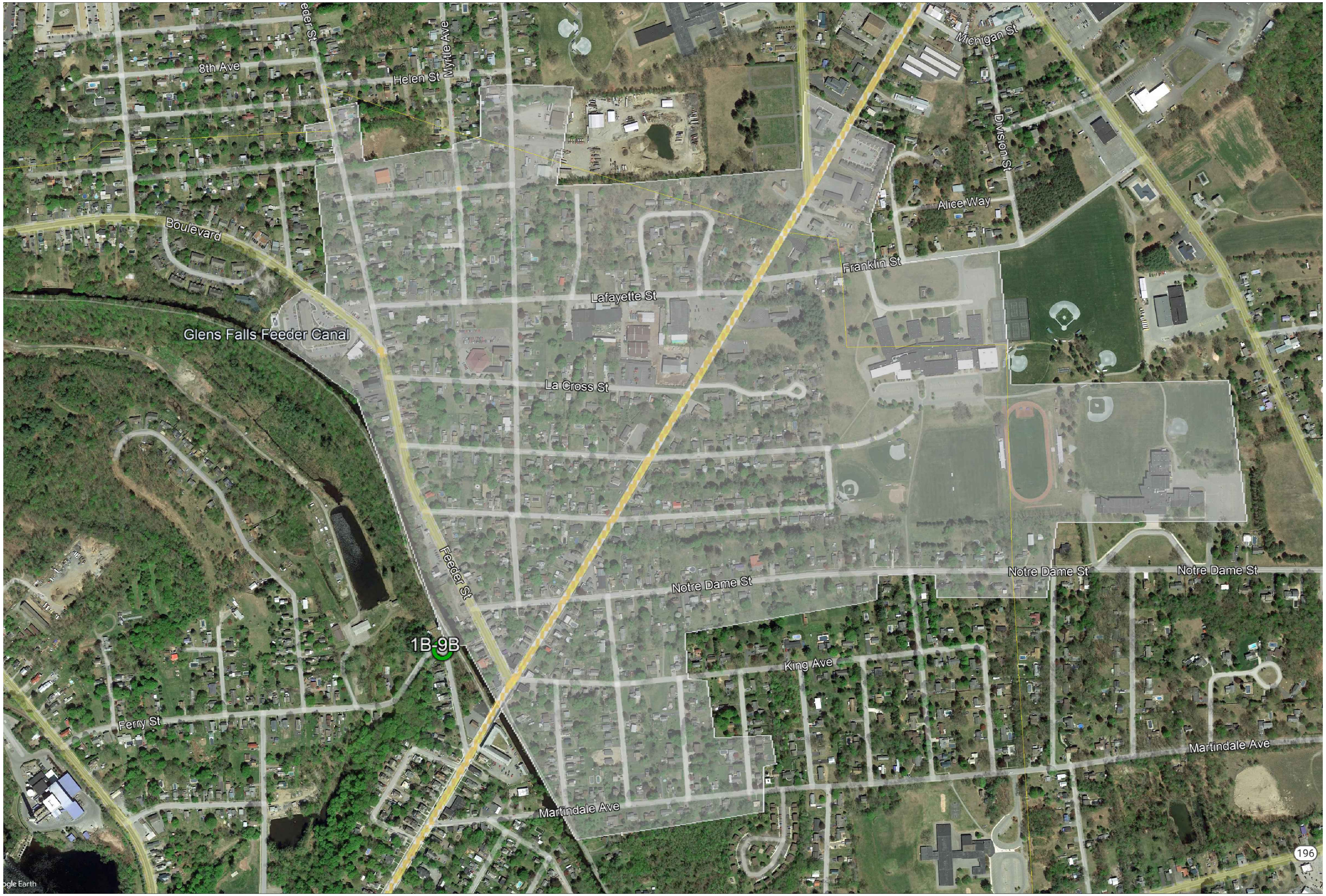
SCALE: AS NOTED

NOT FOR CONSTRUCTION

SHEET TITLE: FLOW MONITORING LOCATIONS

SHEET: 1 of 1



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WASHINGTON COUNTY SEWER DISTRICT NO. 1

FLOW STUDY - MANHOLE 1B-9B

VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK

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WASHINGTON COUNTY SEWER DISTRICT NO. 1

FLOW STUDY - MANHOLE 1B-1

VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK

DECEMBER 6, 2021

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WASHINGTON COUNTY SEWER DISTRICT NO. 1

FLOW STUDY - MANHOLE 1D-20

VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK

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WASHINGTON COUNTY SEWER DISTRICT NO. 1
FLOW STUDY - MANHOLE 1D-1A
VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK

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SHEET TITLE: FLOW MONITORING LOCATIONS

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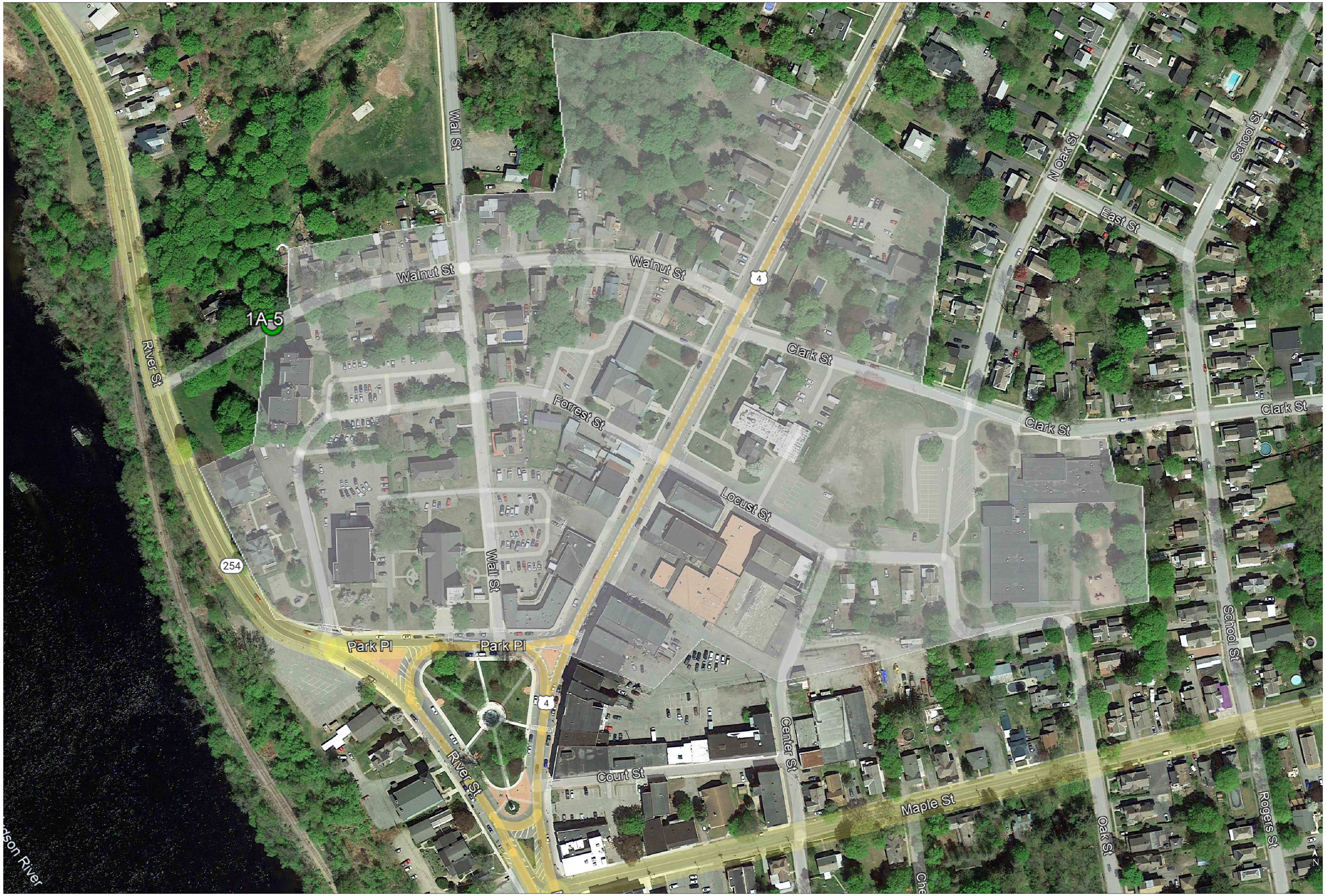

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WASHINGTON COUNTY SEWER DISTRICT NO. 1

FLOW STUDY - MANHOLE 1A-5

VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK

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SHEET TITLE: FLOW MONITORING LOCATIONS

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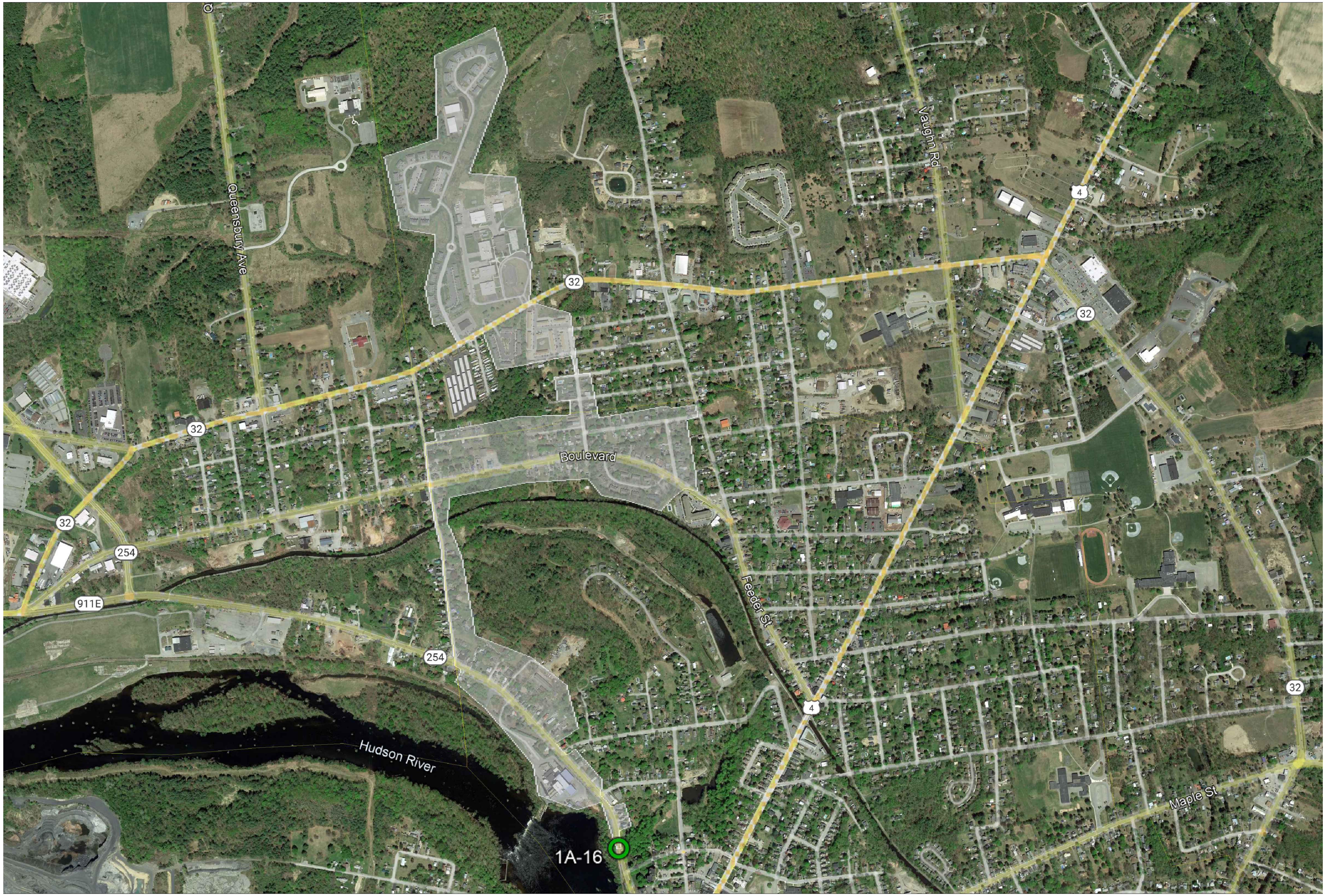

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WASHINGTON COUNTY SEWER DISTRICT NO. 1

FLOW STUDY - MANHOLE 1A-16

VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK

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WASHINGTON COUNTY SEWER DISTRICT NO. 1

FLOW STUDY - MANHOLE 2A-9

VILLAGE OF HUDSON FALLS

WASHINGTON COUNTY, NEW YORK

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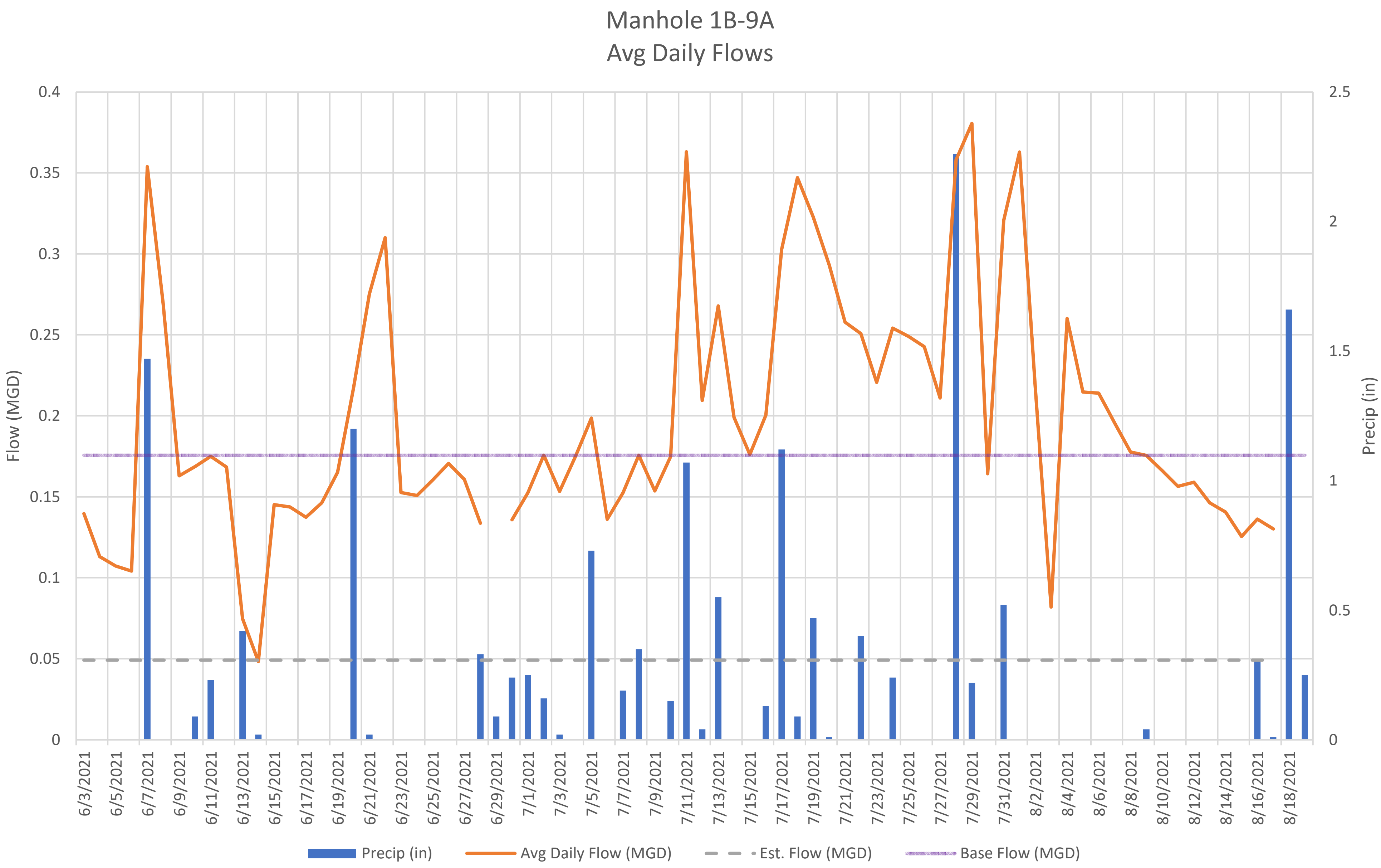
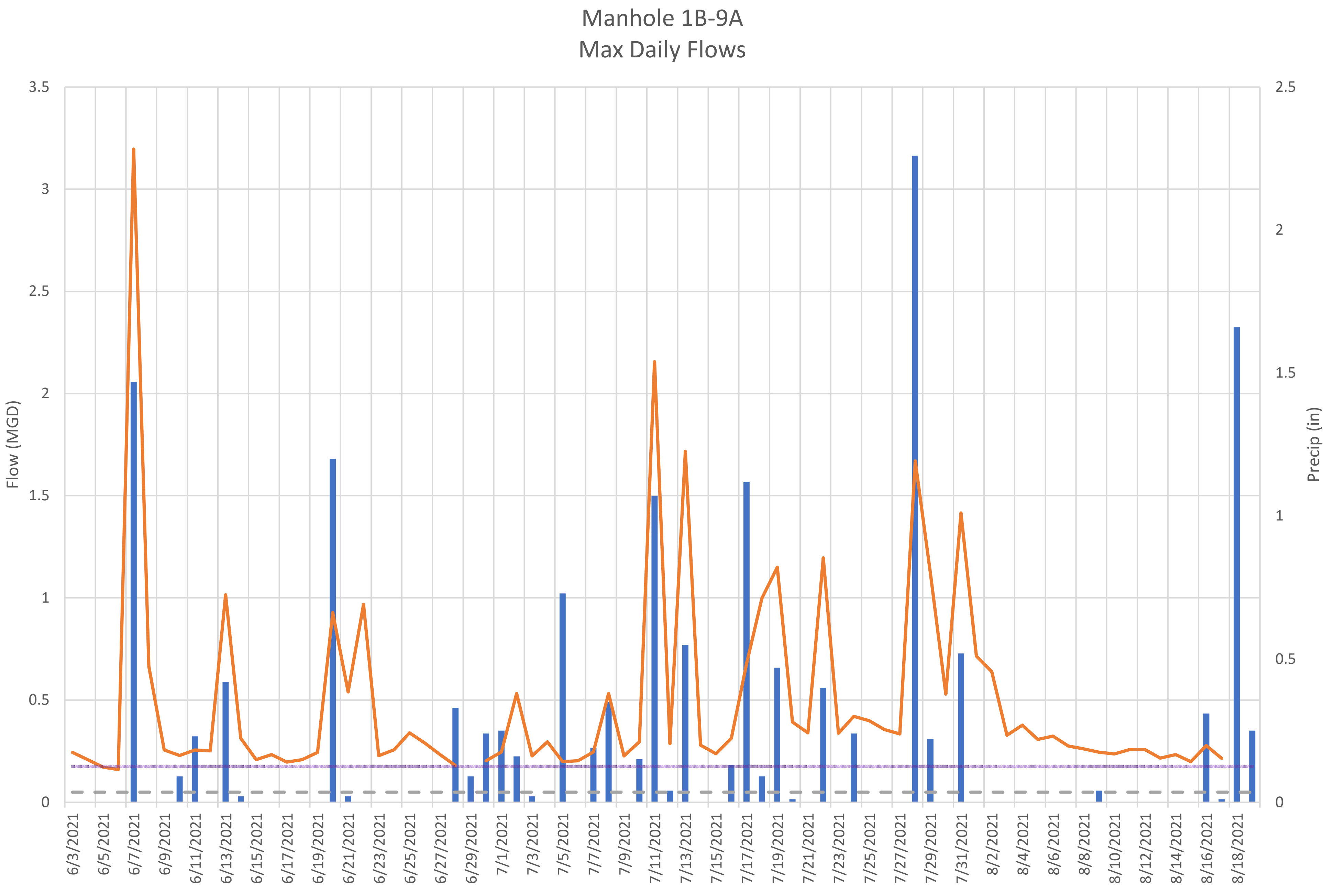
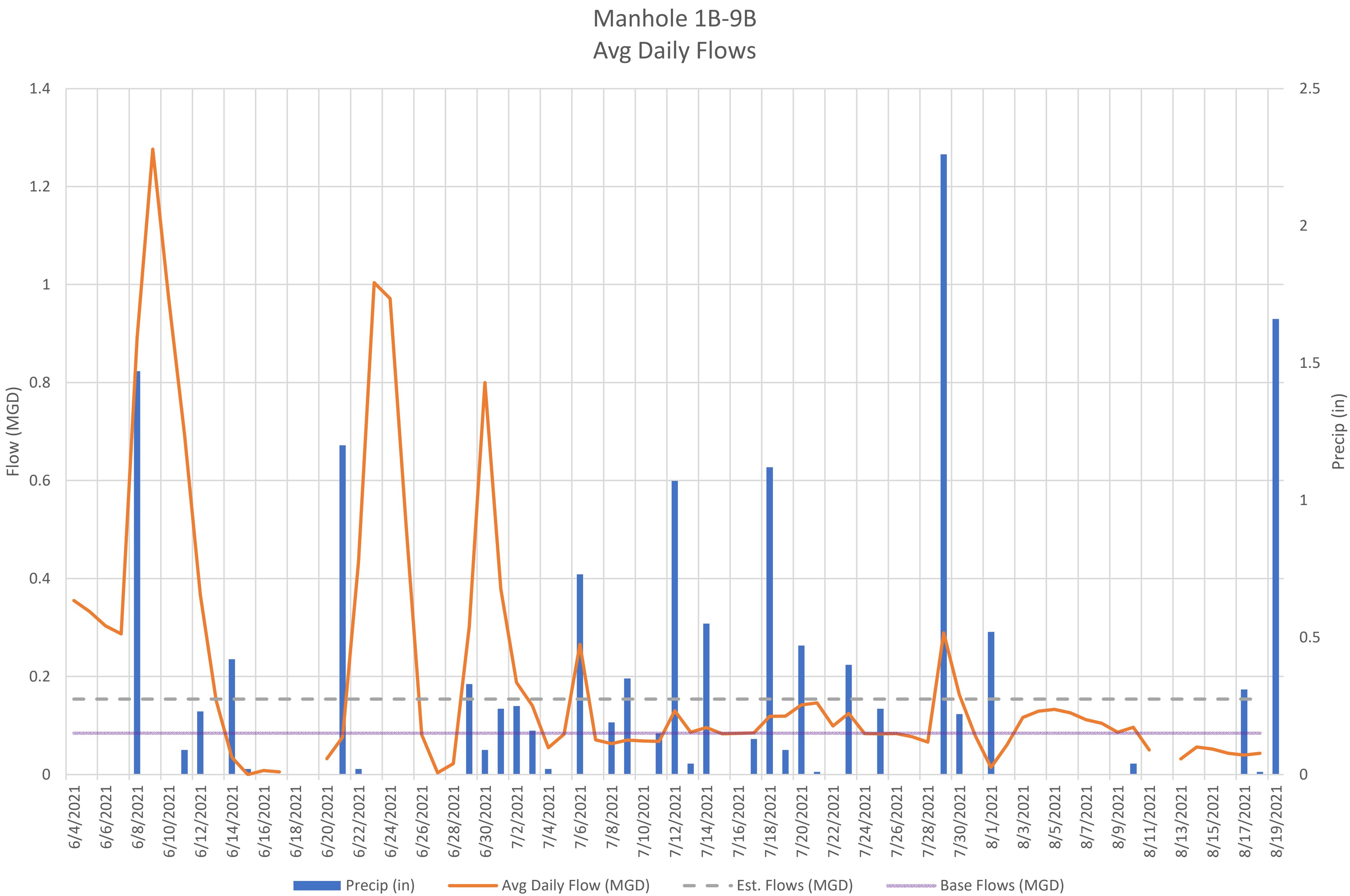
APPENDIX C: MONITORING LOCATION 1B-9A FLOWS

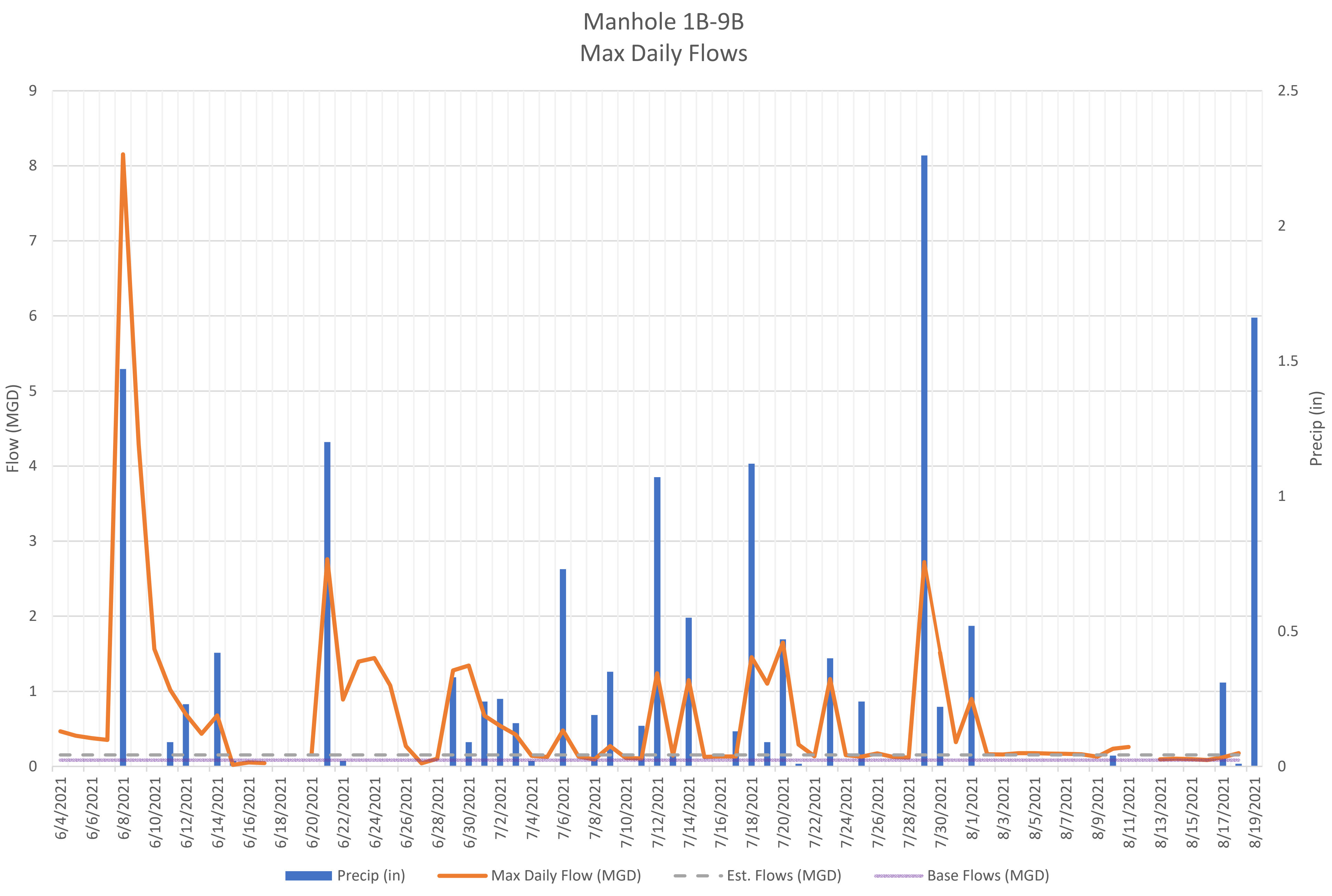


Manhole 1B-9A
Avg Daily Flows
Flow (MGD)
Precip (in)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2.5
2
1.5
1
0.5
0
6/3/2021
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
8/16/2021
8/18/2021
Precip (in)
Avg Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

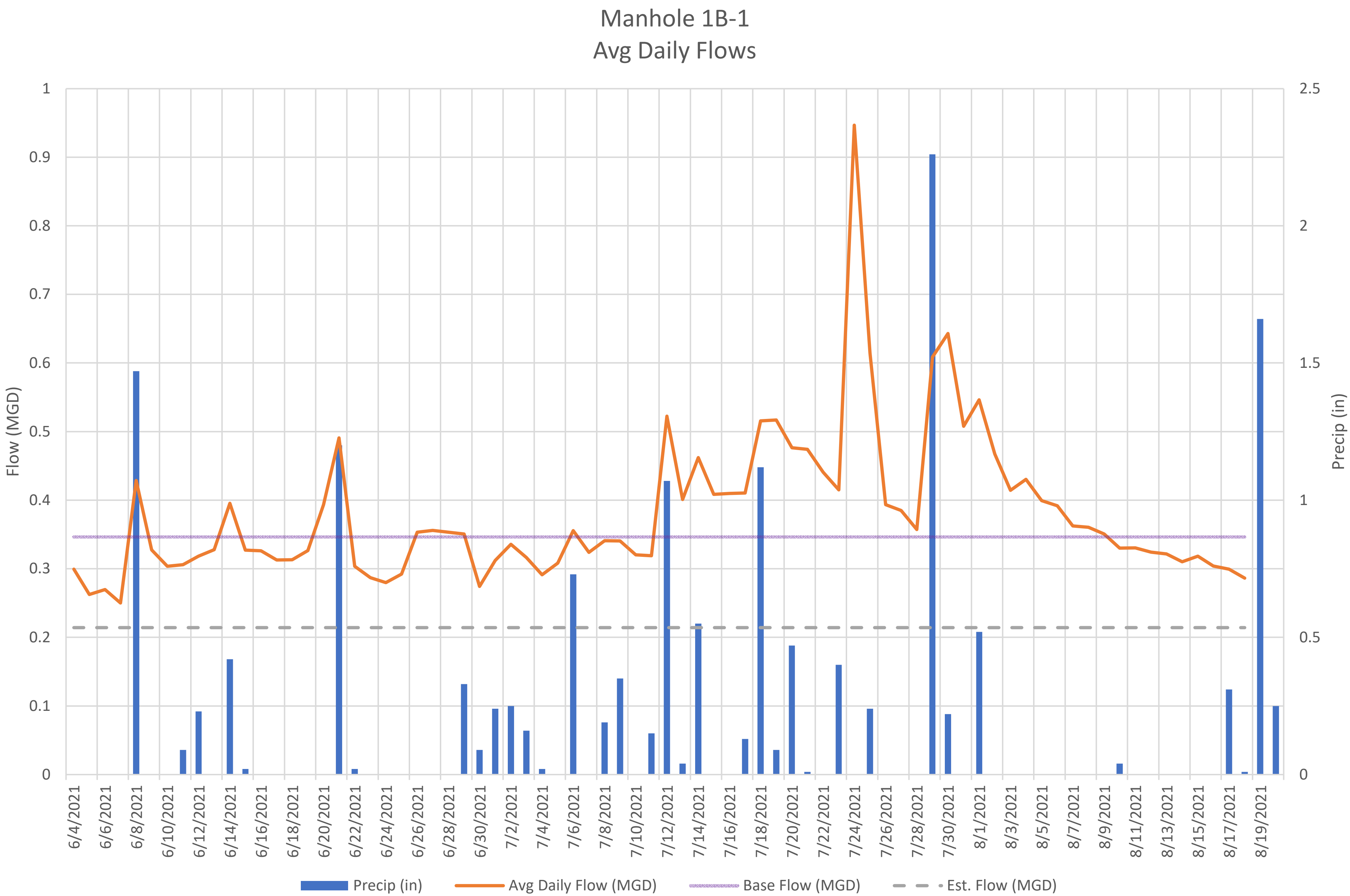

Manhole 1B-9A
Max Daily Flows
Flow (MGD)
Precip (in)
3.5
3
2.5
2
1.5
1
0.5
0
2.5
2
1.5
1
0.5
0
6/3/2021
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
8/16/2021
8/18/2021

APPENDIX D: MONITORING LOCATION 1B-9B FLOWS

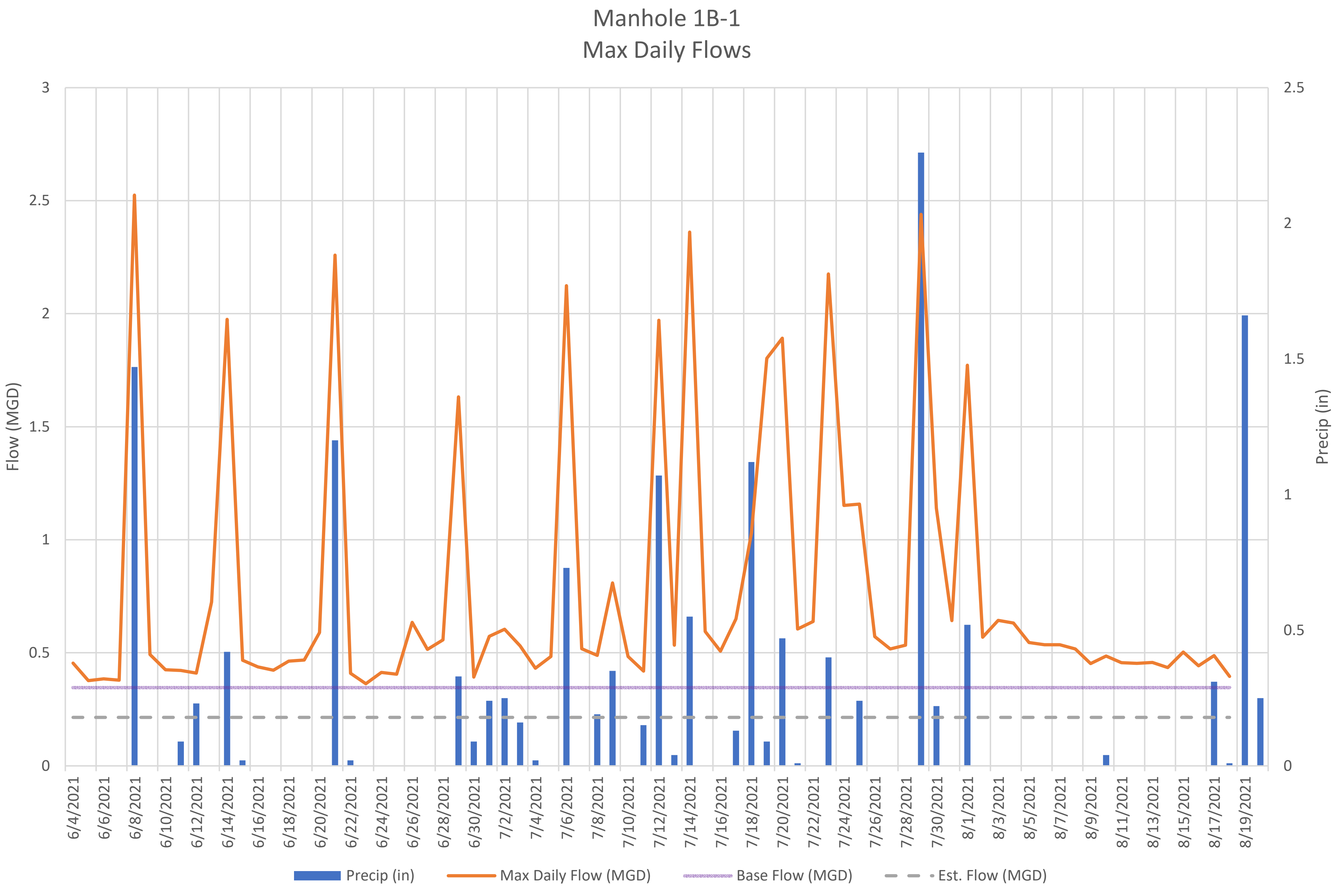

Manhole 1B-9B
Avg Daily Flows
Flow (MGD)
Precip (in)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2.5
2
1.5
1
0.5
0
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Avg Daily Flow (MGD)
Est. Flows (MGD)
Base Flows (MGD)


Manhole 1B-9B
Max Daily Flows
Flow (MGD)
Precip (in)
0
1
2
3
4
5
6
7
8
9
0
0.5
1
1.5
2
2.5
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Max Daily Flow (MGD)
Est. Flows (MGD)
Base Flows (MGD)

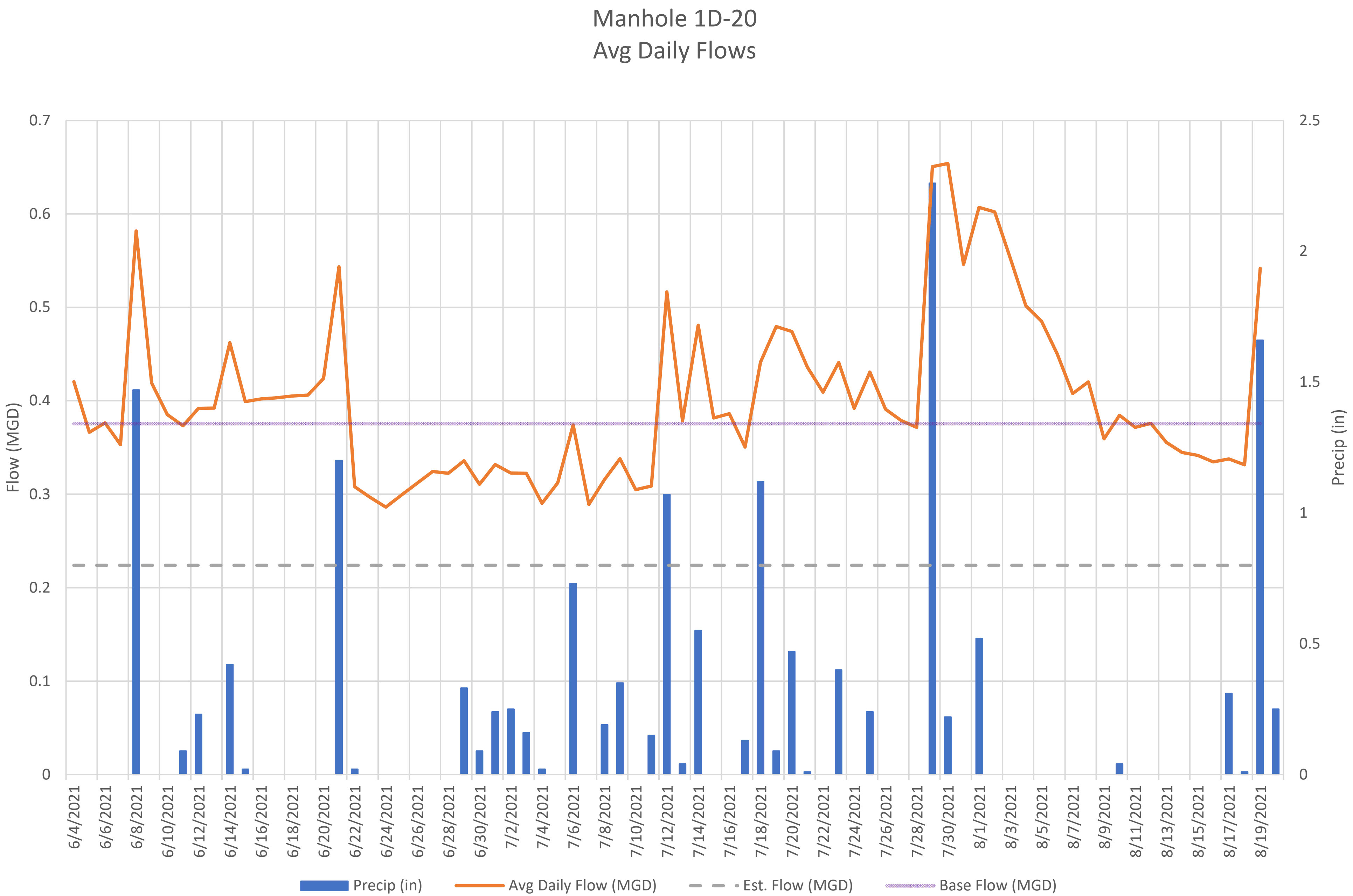
APPENDIX E: MONITORING LOCATION 1B-1

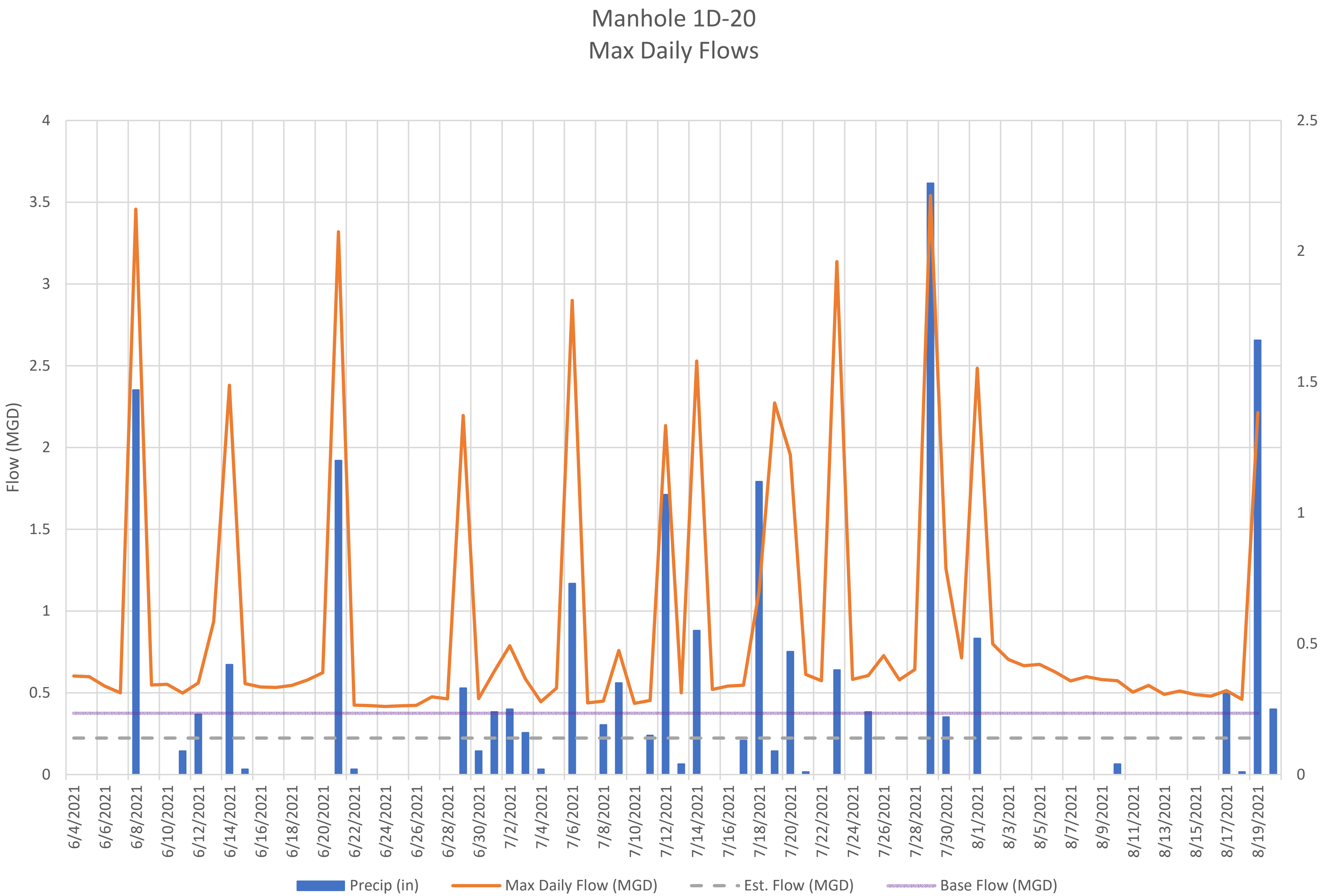


Manhole 1B-1
Avg Daily Flows
Flow (MGD)
Precip (in)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2.5
2
1.5
1
0.5
0
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Avg Daily Flow (MGD)
Base Flow (MGD)
Est. Flow (MGD)


Manhole 1B-1
Max Daily Flows
Flow (MGD)
Precip (in)
3
2.5
2
1.5
1
0.5
0
2.5
2
1.5
1
0.5
0
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Max Daily Flow (MGD)
Base Flow (MGD)
Est. Flow (MGD)

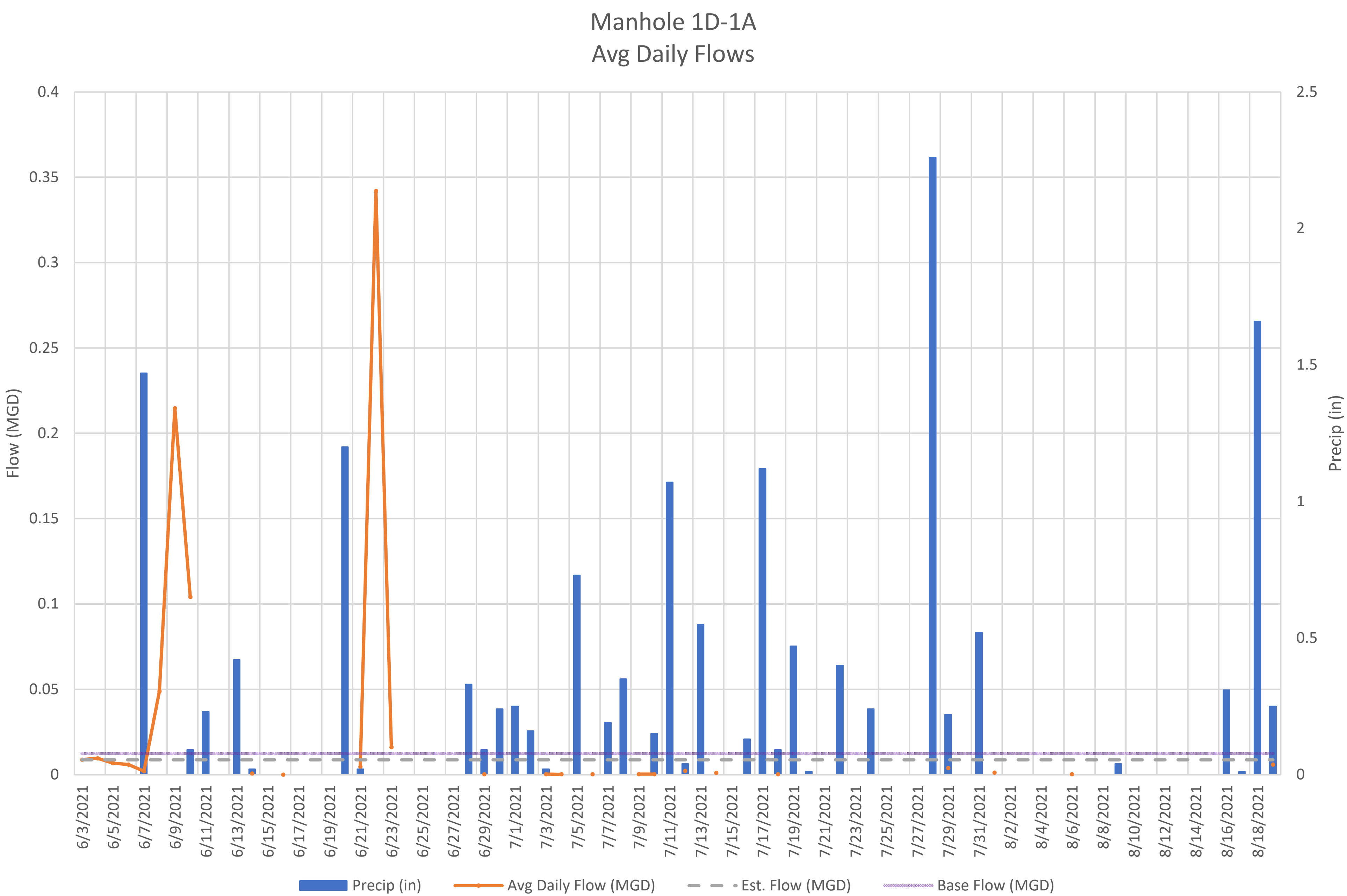
APPENDIX F: MONITORING LOCATION 1D-20 FLOWS


Manhole 1D-20
Avg Daily Flows
Flow (MGD)
Precip (in)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
0.5
1
1.5
2
2.5
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Avg Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

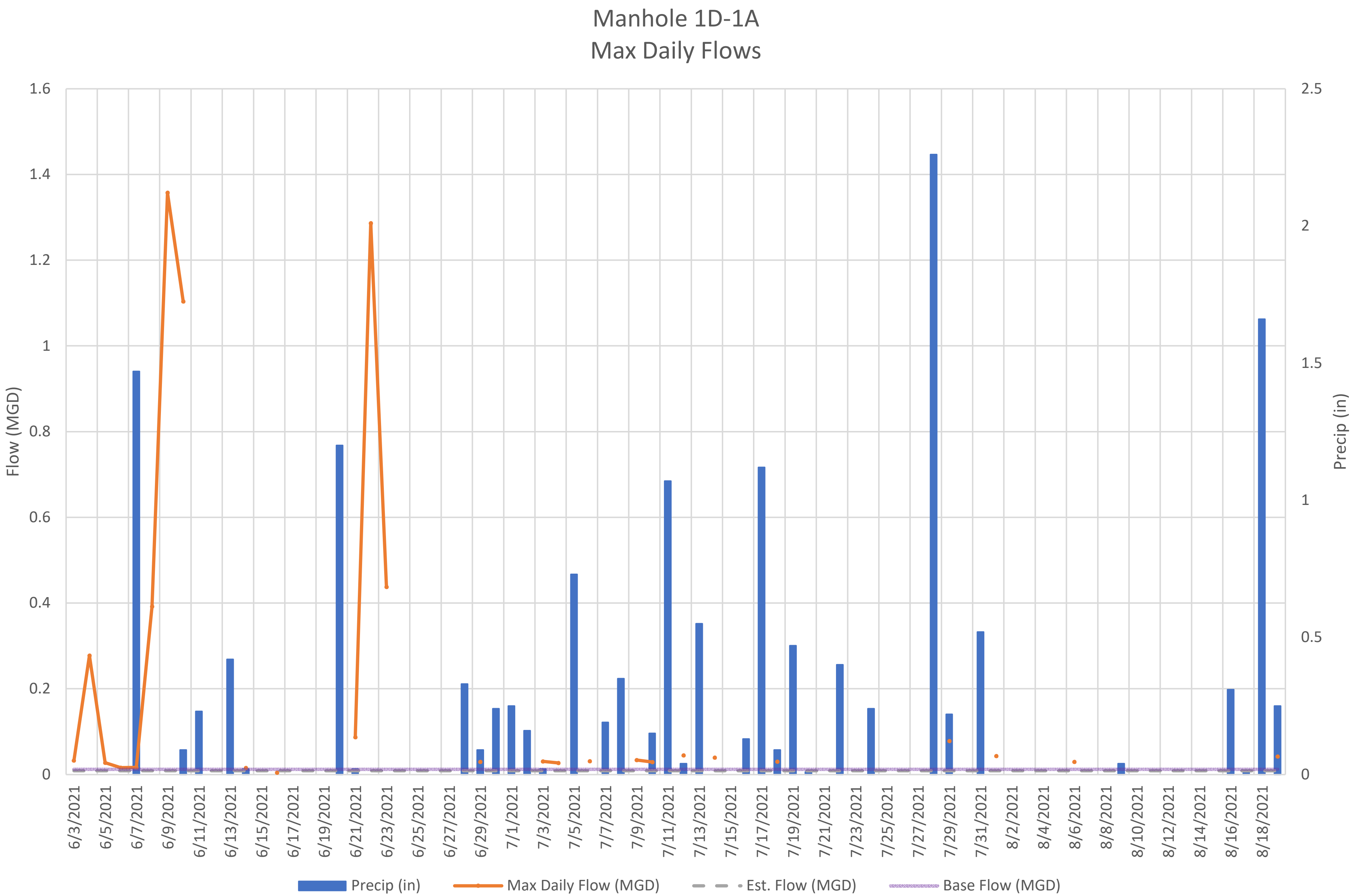


Manhole 1D-20
Max Daily Flows
Flow (MGD)
Precip (in)
0
0.5
1
1.5
2
2.5
3
3.5
4
0
0.5
1
1.5
2
2.5
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Max Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

APPENDIX G: MONITORING LOCATION 1D-1A FLOWS

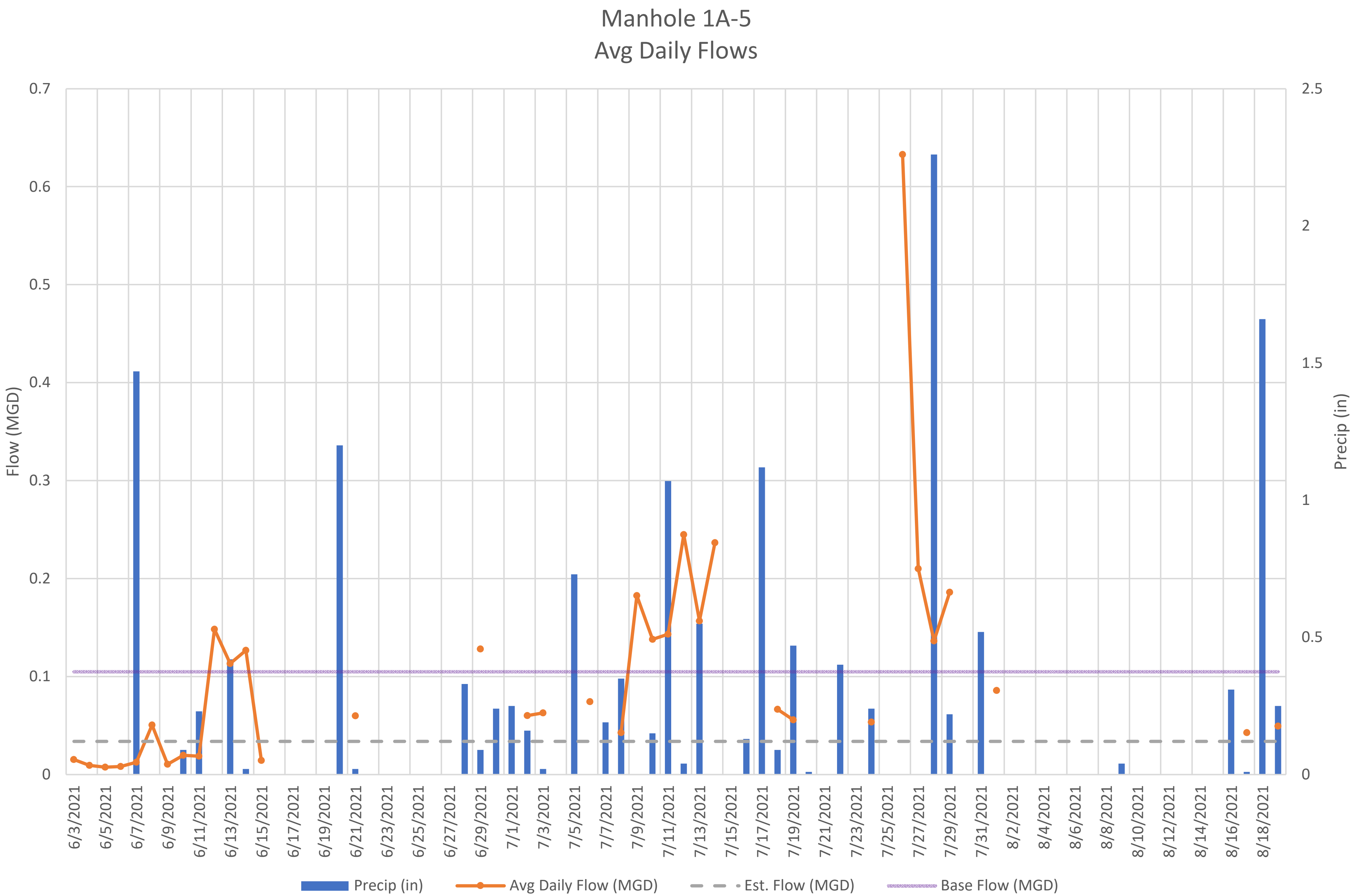


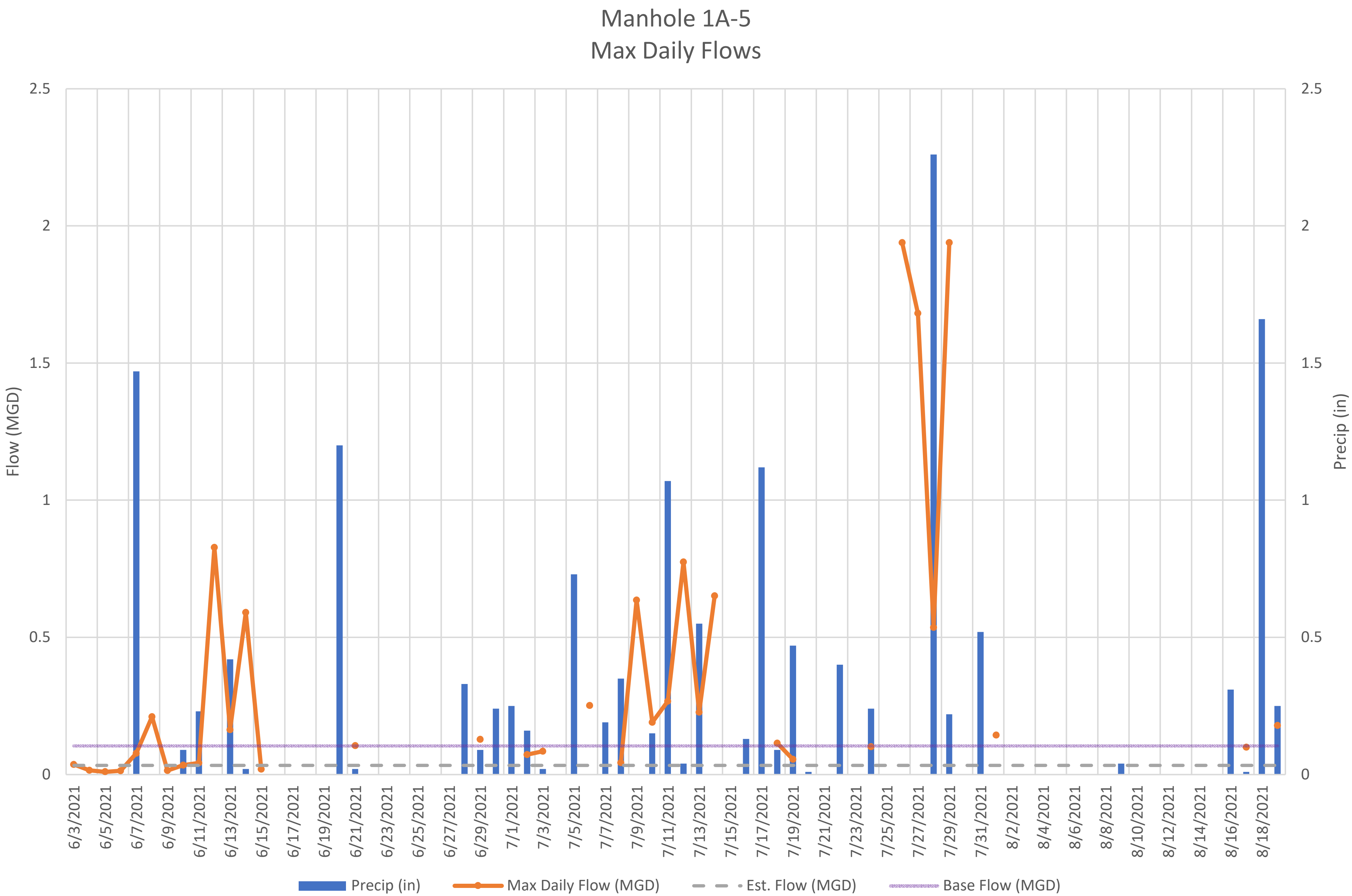
Manhole 1D-1A
Avg Daily Flows
Flow (MGD)
Precip (in)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2.5
2
1.5
1
0.5
0
6/3/2021
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
8/16/2021
8/18/2021
Precip (in)
Avg Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)



Manhole 1D-1A
Max Daily Flows
Flow (MGD)
Precip (in)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2.5
2
1.5
1
0.5
0
6/3/2021
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
8/16/2021
8/18/2021
Precip (in)
Max Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

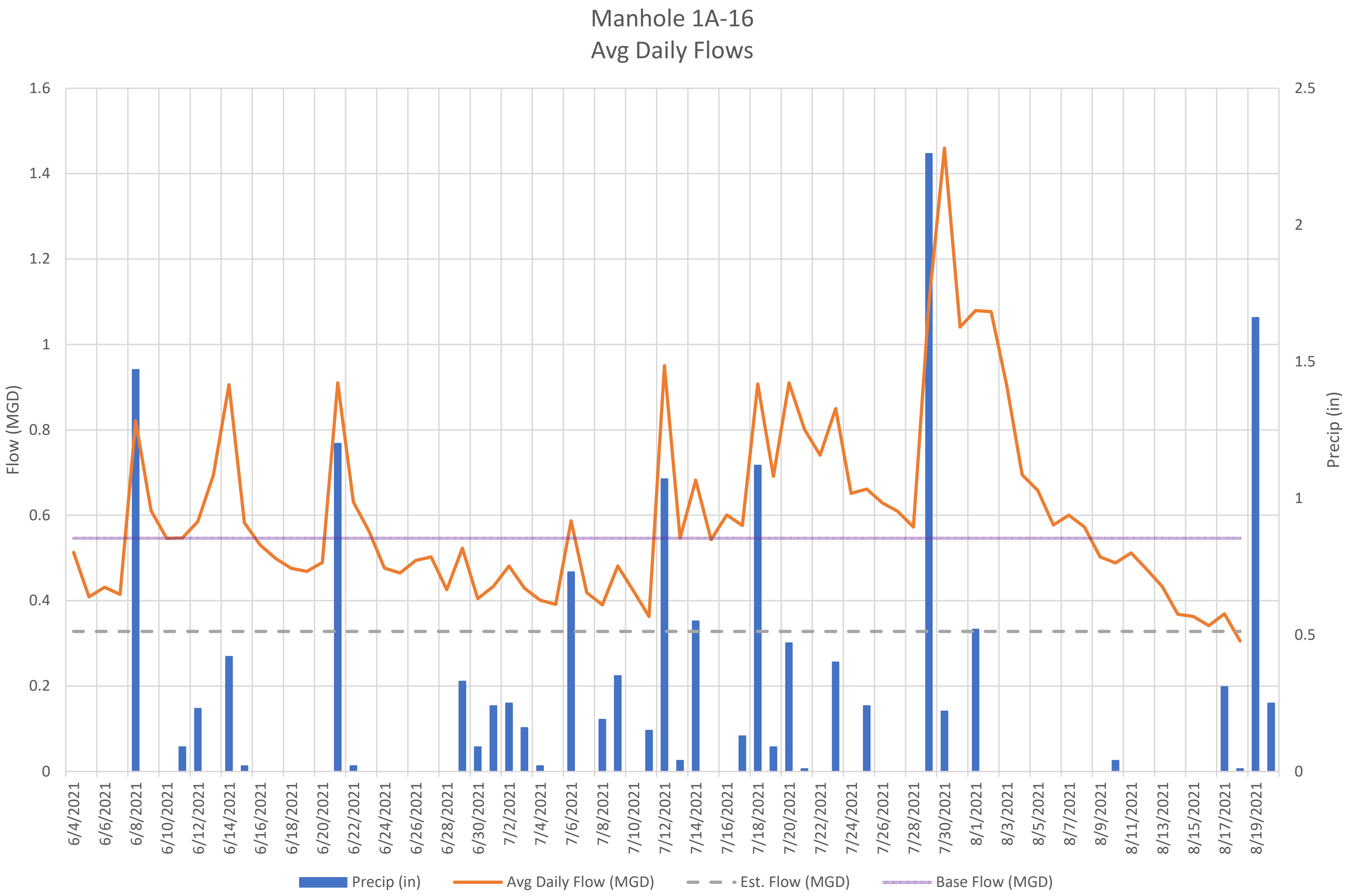
APPENDIX H: MONITORING LOCATION 1A-5 FLOWS

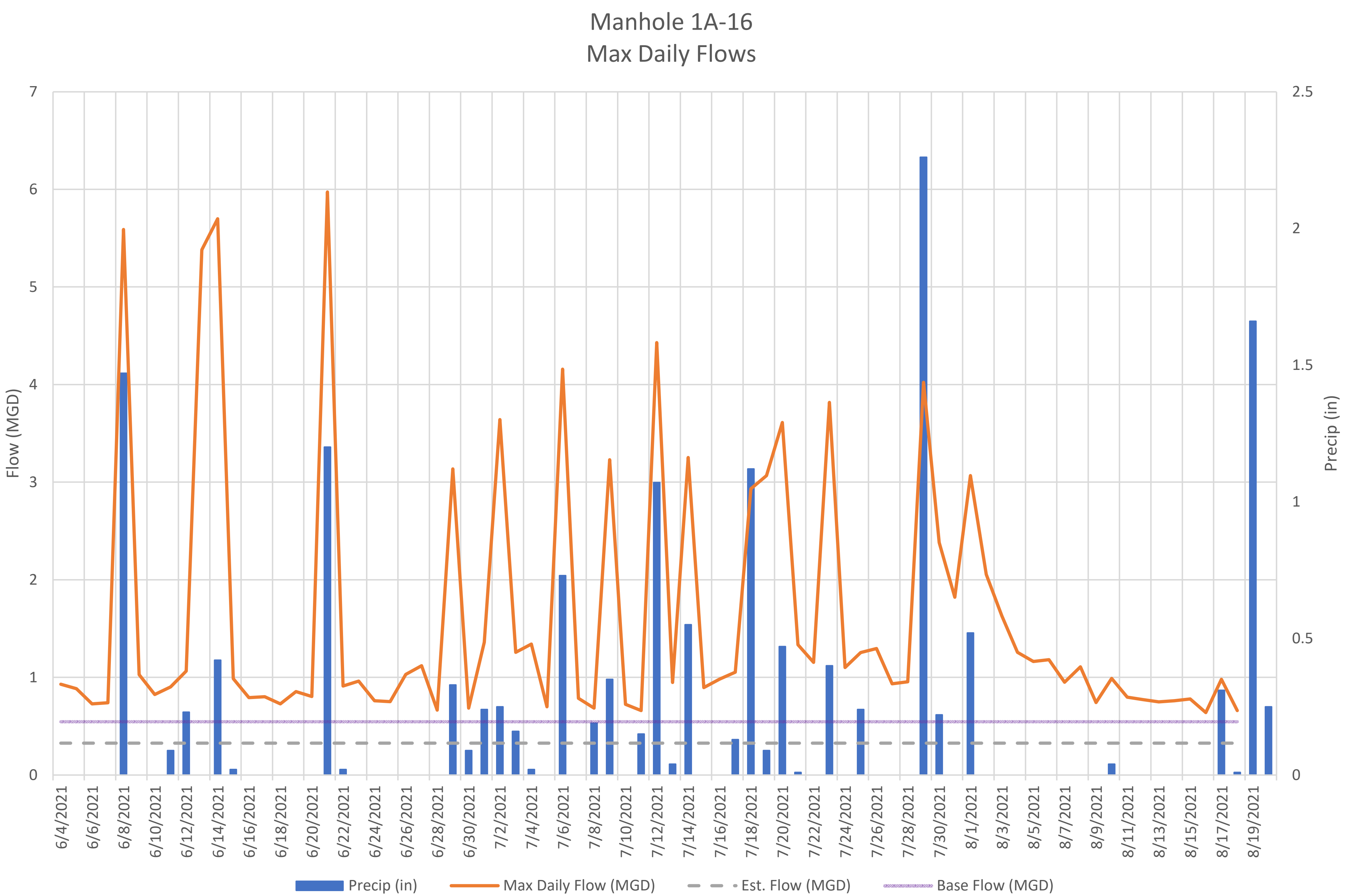

Manhole 1A-5
Avg Daily Flows
Flow (MGD)
Precip (in)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
0.5
1
1.5
2
2.5
6/3/2021
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
8/16/2021
8/18/2021
Precip (in)
Avg Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)



Manhole 1A-5
Max Daily Flows
Flow (MGD)
Precip (in)
2.5
2
1.5
1
0.5
0
6/3/2021
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
8/16/2021
8/18/2021
Precip (in)
Max Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

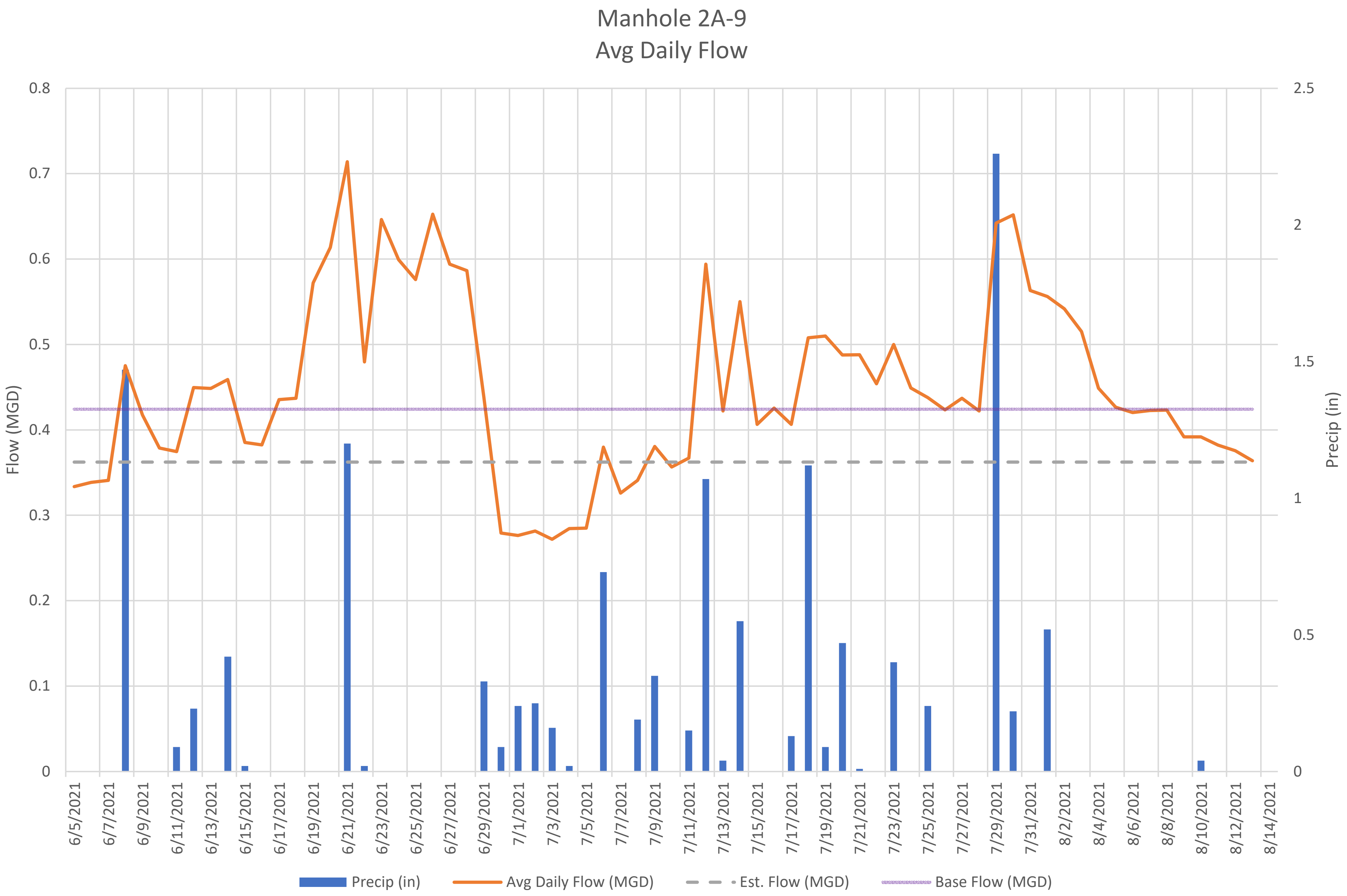
APPENDIX I: MONITORING LOCATION 1A-16 FLOWS


Manhole 1A-16
Avg Daily Flows
Flow (MGD)
Precip (in)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2.5
2
1.5
1
0.5
0
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Avg Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

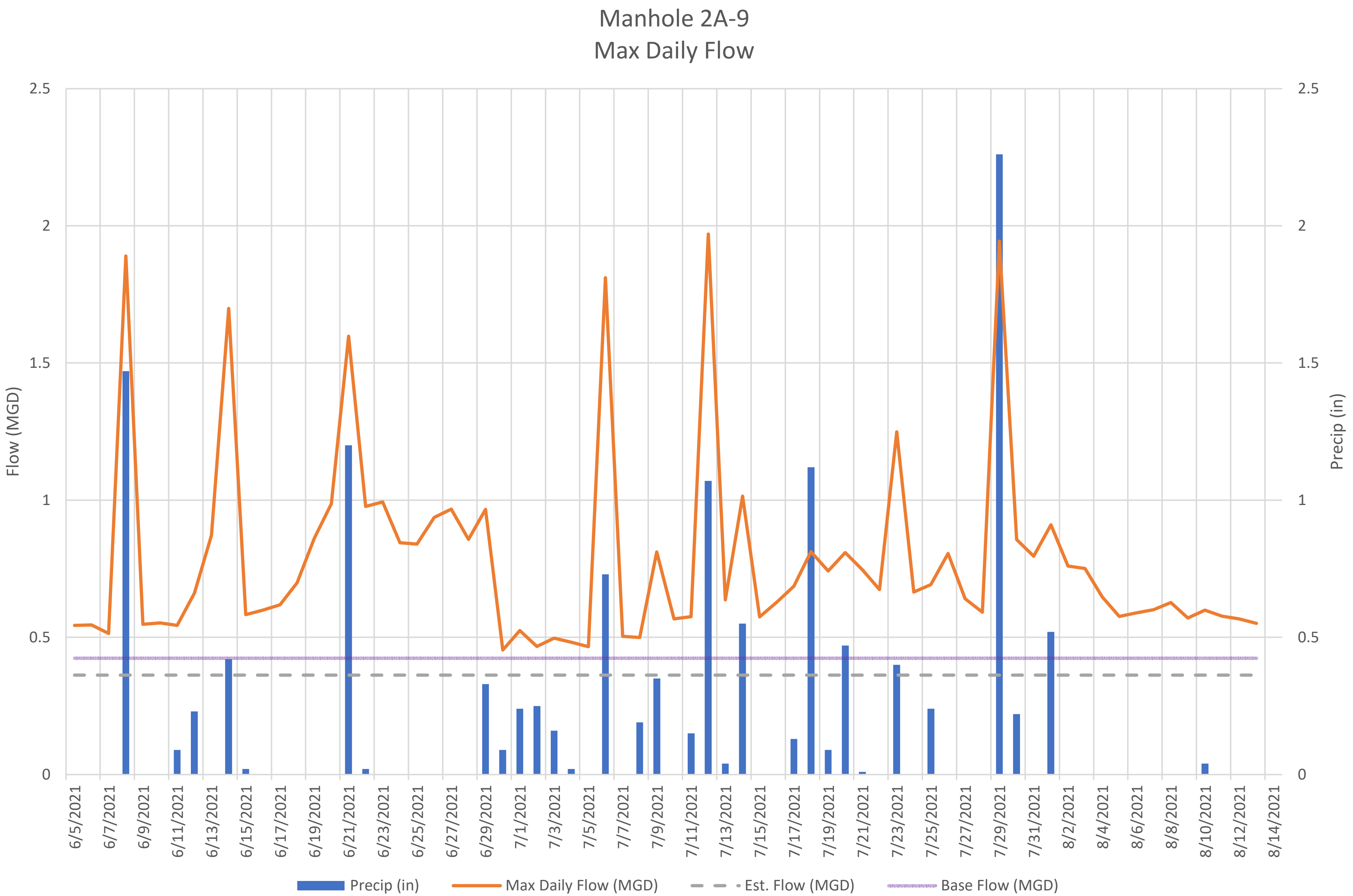


Manhole 1A-16
Max Daily Flows
Flow (MGD)
Precip (in)
7
6
5
4
3
2
1
0
2.5
2
1.5
1
0.5
0
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021
Precip (in)
Max Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

APPENDIX J: MONITORING LOCATION 2A-9 FLOWS

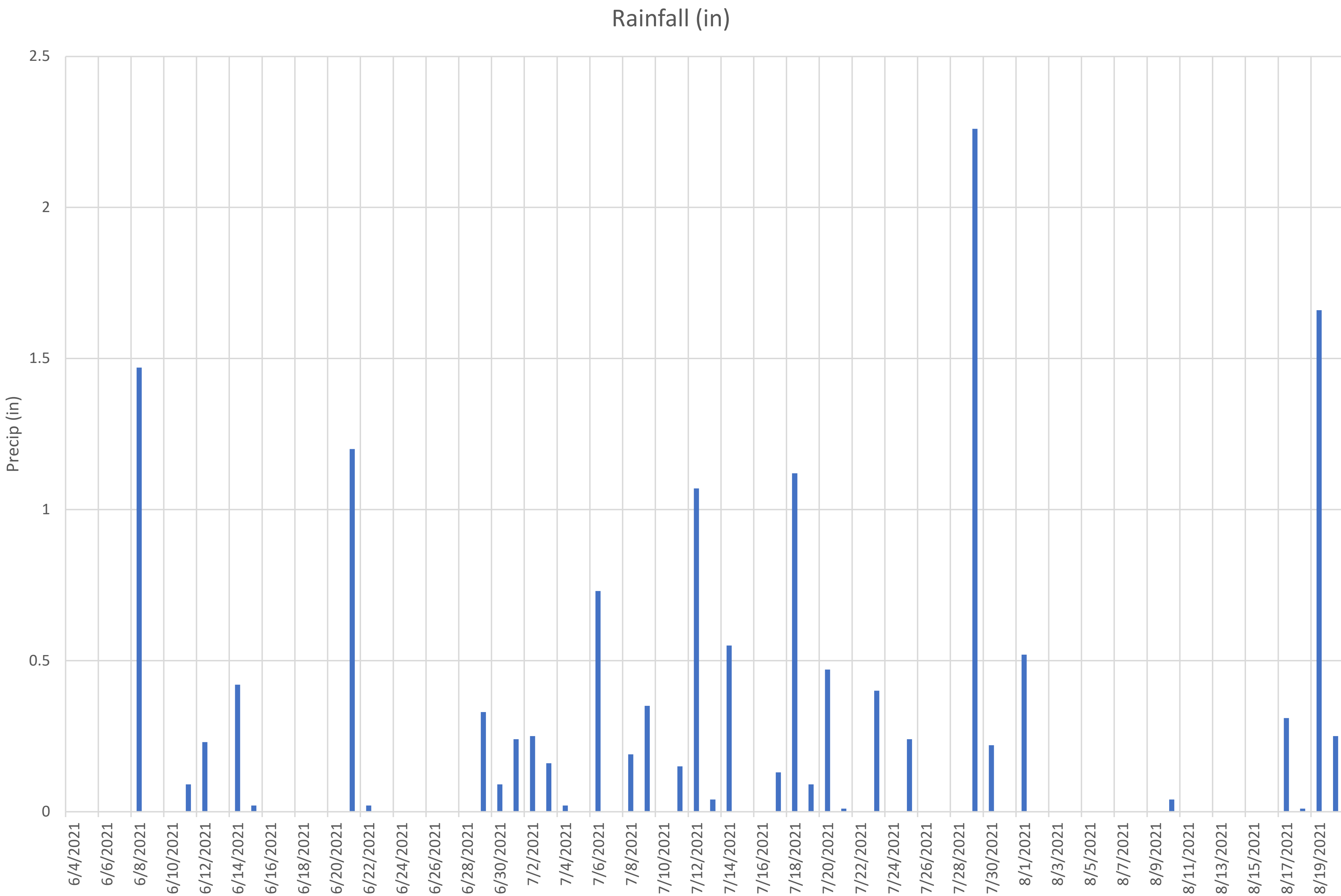


Manhole 2A-9
Avg Daily Flow
Flow (MGD)
Precip (in)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2.5
2
1.5
1
0.5
0
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
Precip (in)
Avg Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)



Manhole 2A-9
Max Daily Flow
Flow (MGD)
Precip (in)
2.5
2
1.5
1
0.5
0
6/5/2021
6/7/2021
6/9/2021
6/11/2021
6/13/2021
6/15/2021
6/17/2021
6/19/2021
6/21/2021
6/23/2021
6/25/2021
6/27/2021
6/29/2021
7/1/2021
7/3/2021
7/5/2021
7/7/2021
7/9/2021
7/11/2021
7/13/2021
7/15/2021
7/17/2021
7/19/2021
7/21/2021
7/23/2021
7/25/2021
7/27/2021
7/29/2021
7/31/2021
8/2/2021
8/4/2021
8/6/2021
8/8/2021
8/10/2021
8/12/2021
8/14/2021
Precip (in)
Max Daily Flow (MGD)
Est. Flow (MGD)
Base Flow (MGD)

APPENDIX K: RAINFALL DATA


Rainfall (in)
Precip (in)
2.5
2
1.5
1
0.5
0
6/4/2021
6/6/2021
6/8/2021
6/10/2021
6/12/2021
6/14/2021
6/16/2021
6/18/2021
6/20/2021
6/22/2021
6/24/2021
6/26/2021
6/28/2021
6/30/2021
7/2/2021
7/4/2021
7/6/2021
7/8/2021
7/10/2021
7/12/2021
7/14/2021
7/16/2021
7/18/2021
7/20/2021
7/22/2021
7/24/2021
7/26/2021
7/28/2021
7/30/2021
8/1/2021
8/3/2021
8/5/2021
8/7/2021
8/9/2021
8/11/2021
8/13/2021
8/15/2021
8/17/2021
8/19/2021