

DATE: July 15, 2024
TO: City of Duvall
FROM: Andrew Stevens
SUBJECT: I/I Report
PROJECT NUMBER: 216-3240-024
PROJECT NAME: Inflow & Infiltration Engineer Services

Executive Summary

Inflow and Infiltration (I/I) is stormwater (inflow) and groundwater (infiltration) that enters a sanitary sewer collection system. Excessive I/I can impact capacity in the collection system, and once in the collection system, I/I requires additional treatment capacity and costs of treatment at the wastewater treatment plant (WWTP).

The City of Duvall (City) requested an Inflow and Infiltration (I&I) Study (Study) of four basins within the City's collection system with the intent of identifying basins with the highest I/I and locating pipe segments in need of repairs and rehabilitation. The Study included flow monitoring, I/I analysis of the gathered flow data, smoke testing, video investigations, and recommendations for repairs and further study.

The Study started with the gathering of flow monitoring and rain gauge data conducted by ADS Environmental Services (ADS) within the four metered basins. Using the data collected by ADS, an I/I analysis was then performed by Johnson, Mirmiran & Thompson (JMT). This analysis determined the dry weather flow, base infiltration, wet weather flow, and rainfall derived inflow and infiltration (RDII). JMT concluded the most severe I/I response was in meter basin DUV_SWRMH430 (Basin CH), located in the Midtown area. JMT recommended additional evaluation surveys focus on that specific basin.

Based on the I&I analysis recommendations, smoke testing was conducted by Bravo Environmental (Bravo) at 24 setup locations within basin 430, testing approximately 60 segments of sewer main. Bravo discovered six locations within basin 430 that could be large contributors of I&I into the system. Bravo further investigated these locations through video inspection of the identified pipe segments with the intent of locating pipe defects requiring repair or rehabilitation. Parametrix reviewed the video inspections, and no immediate pipe rehabilitation is recommended within the studied basins based on the inspection results. Parametrix has provided recommendations for the next steps to correcting the potential I/I

The following report provides additional details of the various tasks performed throughout the Study and provides recommendations for short- and long-term maintenance and operation of the City's collection system.

Background

The City owns and maintains a wastewater treatment plant and a wastewater collection system serving the majority of the area within the City limits. The City has had ongoing issues with I&I in the collection system, resulting in significantly increased wet weather flows to the WWTP. The City's



2021 Sewer Utility Capital Improvement Program Update (CIP), recommended an annual budget for an I/I Program to identify and address I/I issues throughout the collection system. An annual budget for System Repair and Replacement was also recommended to fund repair and rehabilitation of the collection system, in part to correct issues identified by the I/I Program.

This report documents the first phase of planning for the I/I Program, including establishing base flow data within the collection system (dry and wet weather and RDII), investigating locations of potential I&I, and providing repair and rehabilitation recommendations. This phase of the program completed flow monitoring for the northerly portion of the City’s collection system, flow and I&I analysis, smoke testing, and video inspection within the four basins of highest concern. The results and conclusions of each process are provided in the following subsections.

Over time, the planning effort is intended to extend to the entire conveyance system to identify and eliminate all major sources of I/I.

The intent of annual collection system repair and replacement budget is to periodically accumulate enough specific repair and/or rehabilitation projects identified by the I/I Program to allow for cost-effective construction, to provide the required construction documents, and complete the work.

ADS Environmental Services Flow Monitoring

The initial phase of the I/I Program included flow monitoring of the northwesterly portion of the collection system, focusing on the oldest pipes in the collection system in the oldtown and midtown areas. Four basins were selected based on pipe age and suspected I/I issues, and flow monitoring locations were strategically selected to collect data for basin sizes within ADS’ recommended parameters for basin area and pipe length. ADS conducted flow monitoring over a 5-month period, from March 1 to August 10, 2023, at selected locations and monitored one rain gauge. The locations of the flow meters and rain gauge are shown in Figure 1 below and include SWRMH0428, SWRMH430, SWRMH459, and SWRMH466. The flow monitoring measured and gathered flow depth and velocity with the objective of collecting dry weather and wet weather flow data for use in subsequent evaluation. The flow meter and rain gauge site reports are included in Appendix A.

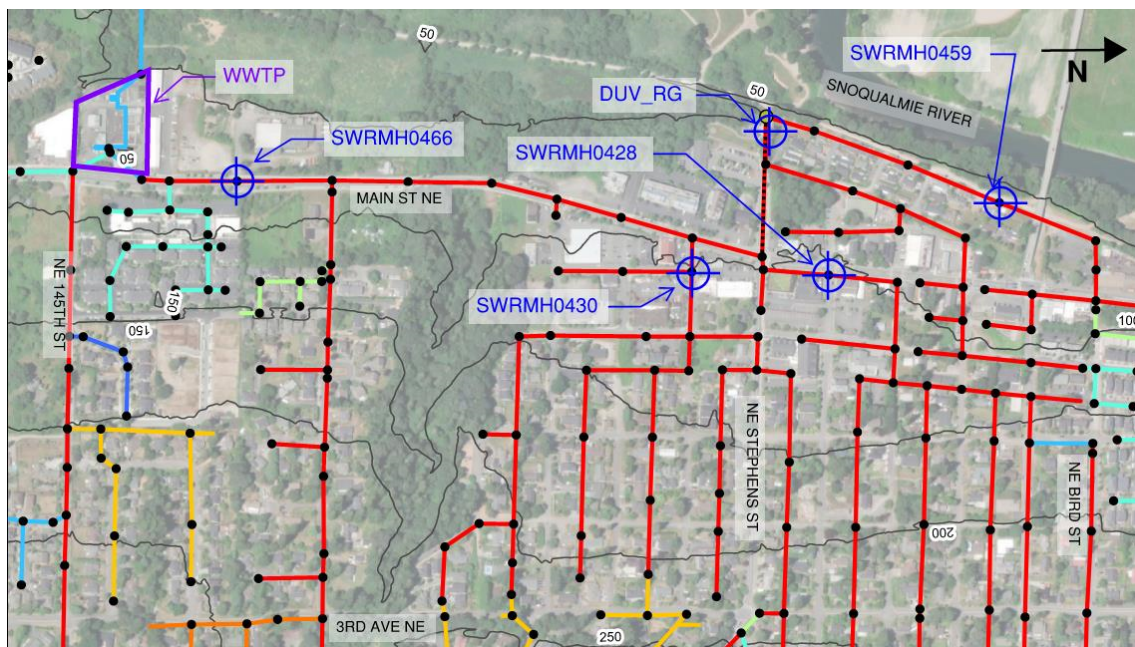


Figure 1. Flow Monitoring Manhole Locations

Table 1 summarizes the characteristics of the four flow monitoring basins. The Net Sewer Footprint presented in the table is an aggregate measure of the pipe length and diameters in units of inch-diameter-mile, or IDM, tributary to each meter, which allows for consistent comparison of I/I characteristics between basins with different lengths and diameters of pipe.

Table 1. Meter Basin Sewer System Characteristics

Meter Basin ID	Net Basin Area (acres)	Length of Net Sewer (Linear Feet)	Net Sewer Footprint (inch-diameter-mile)
DUV_SWRMH428	60	11,080	16.73
DUV_SWRMH430	117	18,768	28.24
DUV_SWRMH459	106	15,254	22.23
DUV_SWRMH466	127	19,205	30.08

Table 2 summarizes manhole flow monitoring data provided in the 2023 *Duvall Washington Flow Monitoring Report* provided by ADS, attached in Appendix A. The following data was gathered during the study period between March 1, 2023, through August 10, 2023, , where the 5-minute flow depth (in), velocity (ft/s), and quantity (million gallons per day (MGD) – total MG) were observed. The rain gauge for the project measured a total of 10.23 inches of precipitation over the course of the monitoring period. Significant individual storm events are defined and summarized in the Rainfall Analysis section below.

Table 2. Summarized Flow Metering Data

Manhole ID	Item	Depth (inches)	Manhole ID	Item
DUV_SWRMH428	Average	1.870	0.740	0.031
	Minimum	0.800	0.140	0.002
	Maximum	3.990	2.720	0.225
DUV_SWRMH430	Average	1.020	4.750	0.082
	Minimum	0.720	1.210	0.015
	Maximum	1.570	7.840	0.211
DUV_SWRMH459	Average	1.620	1.270	0.045
	Minimum	0.610	0.080	0.002
	Maximum	4.980	2.810	0.222
DUV_SWRMH466	Average	3.100	2.610	0.289
	Minimum	1.290	0.870	0.034
	Maximum	14.350	3.710	0.914

It should be noted that the existing flow meter at the Duvall Sewage Treatment Plant (DSTP) was synchronized with the ADS flow meters to determine the proportionality of flows by area between the collection system to the north and south of the DSTP. This information has been extracted from the DSTP SCADA historian system; however, a full analysis has not been completed for the Draft report

due to the file formatting and extraction of the information into a usable format. A full analysis is anticipated for the Final version of the report.

JMT I/I Analysis

JMT utilized the data collected by ADS to conduct further I&I analysis including rainfall analysis, dry day analysis, wet weather analysis, RDII analysis, and I&I severity analysis. JMT’s findings were reported to Parametrix in the *Final Memorandum City of Duvall Infiltration and Inflow (I&I) Analysis*, attached in Appendix A Relevant descriptions and summary tables for corresponding analyses are provided below.

Dry Day Analysis

The dry day analysis defined the volumetric and temporal characteristics of the Average Dry Day Flow (ADDF) which consists of only sanitary flow from sewer service laterals and base infiltration (BI). The ADDF excludes RDII, which occurs only during and shortly after rainfall. The BI, unlike RDII, occurs even under low groundwater conditions and is not an immediate result of rainfall.

ADDF curves were calculated for weekdays, Monday through Friday, and for weekends, Saturday and Sunday. The curves which were generated for each day group by averaging the hourly flows for all selected dry days within the day group. From the generated curves and dry day analysis, the net weekday and weekend average dry day flows for each basin were determined and are shown in Table 3 below.

Table 3. Storm Event Rainfall Depths

Meter Basin ID	2023 Net Average Dry Day Flow (MGD)	
	Weekday	Weekend
DUV_SWRMH428	0.022	0.022
DUV_SWRMH430	0.072	0.067
DUV_SWRMH459	0.036	0.038
DUV_SWRMH466	0.101	0.120

MGD = million gallons a day

Base Infiltration

BI, as stated previously, is groundwater that enters the collection system independent of rainfall influence. BI can enter the collection system through multiple sources including:

- Structural defects within the sewer main such as:
 - Cracks, fractures, and breaks.
 - Offset or separated sewer main pipe joints.
- Service lateral pipe structural defects.
- Manhole structural defects.

JMT calculated the net BI values based on the weekday ADDF for each basin and then normalized the net BI values based on the net pipe length within each basin. This normalization of the net BI allows for an assessment of the severity of the BI in each basin and allows for a clear side-by-side comparison between the basins. Table 4 below provides the Net BI, BI percentage of the net ADDF, net total wastewater production (WWP), and the normalized net BI (gallons per day (gpd)/LF) for each basin. The WWP is the total wastewater contributed to the collection system exclusive of BI sources, i.e., Net WWP = Net ADDF – Net BI.

Table 4. Net Base Infiltration and Normalized Net Base Infiltration Values

Meter Basin ID	Net ADDF (MGD)	Net WWP (MGD)	Net BI (MGD)	BI Percentage of Net ADDF	Pipe Length (LF)	Normalized Net BI (gpd/LF) ¹
DUV_SWRMH428	0.022	0.013	0.009	41	11,080	0.8
DUV_SWRMH430	0.072	0.022	0.05	69	18,768	2.7
DUV_SWRMH459	0.036	0.025	0.011	31	15,254	0.7
DUV_SWRMH466	0.101	0.101	0.00	0	19,205	0.0

ADDF = average dry day flow; MGD = million gallons per day; WWP = wastewater production; BI = base infiltration; LF = linear feet; gpd = gallons per day.

1. Threshold for Excessive Net BI: Based on industry research and experience, in typical residential areas: Net BI less than 2 gpd/LF is likely not cost effective to try to remove through rehabilitation; Net BI between 2 to 5 gpd/LF should be investigated for possible sources of I/I; and Net BI greater than 5 gpd/LF is considered high and would warrant additional SSES investigations to identify sources of infiltration.

Rainfall Analysis

A storm event is defined, by the SII/Icer software used, as a minimum of 0.5-inches of rainfall within a 24-hour period. The rainfall analysis utilized the temporary rain gauge data to determine the number of storm events to be used for the evaluation of the flow meter data. A total of six storm events were identified and are summarized in Table 5 below.

Table 5. Rainfall Depths for the Captured Storm Events

Storm Date/Time	DUV_RG Rainfall Depth (inches)
3/12/2023 16:00	1.05
4/2/2023 16:00	1.17
4/6/2023 8:00	0.89
4/10/2023 7:00	0.71
4/22/2023 20:00	0.88
6/20/2023 3:00	0.59

Wet Weather Analysis

JMT generated hydrographs for each of the four meter basins for each storm event including Pre-compensation, Rain, and the Recovery Period. Pre-compensation is a calculated value used to adjust the ADDF curve used in the wet weather analysis. It is calculated based on the dry weather flow observed during the 24-hour period immediately preceding the storm event. It compensates for unidentified random and systematic variations in flow between the ADDF curve and dry weather flow just prior to the storm event. The Rain Period begins when rain starts and extends to capture all rainfall that falls during the storm event. The Recovery Period represents the influence of RFI that is

present in the sewer system after the rainfall has ended. There can be multiple Recovery Periods for a single storm which are important for hydraulic modeling, however, they are viewed as the same in an I/I analysis. The resulting storm event hydrographs can be found in the JMT report in Attachment A.

RDII Analysis

One important purpose of the I/I analysis is to establish a relationship between the amount of rainfall and the RDII for a specific part of the collection system. For each meter basin, a storm event will produce a different RDII response. JMT used the graphical technique known as the “Q versus i” diagram to evaluate and compare the net RDII generated in each meter basin during storm events of varying rainfall depths and intensities. JMT generated two types of Q versus i diagrams for this analysis:

- Total Event Net RDII Volume (in MG) versus. Rainfall Depth (in inches).
- Peak Net RDII (in MGD) versus. Rain Volume to Peak I/I Time (in inches).

The graphs generated through JMT’s analysis can be found in Attachment A. Table 6 and Table 7 summarize the Normalized RDII Severity by Volume and Normalized Peak RDII Severity completed through JMT’s analysis.

Table 6. Normalized Rainfall Derived Infiltration and Inflow Severity by Volume

Meter Basin ID	Net RDII Severity by Volume (MG/in)	R-Squared (Coefficient of Determination) ¹	Pipe Length (LF)	Normalized Net RDII Severity by Volume (gal/in/LF) ²	Net RDII Severity by Volume Ranking
DUV_SWRMH428	0.03	0.00	11,080	2.7	4
DUV_SWRMH430	0.73	0.92	18,768	38.9	1
DUV_SWRMH459	0.06	0.42	15,254	3.9	2
DUV_SWRMH466	0.06	0.00	19,205	3.1	3

MG/in = million gallons per inch; LF = linear feet; gal/in/LF = _____.

- 1 R-Squared (Coefficient of Determination): The R-squared value is a statistical measure of the regression analysis that determines the proportion of variance in the dependent variable that can be explained by the independent variable (i.e., the R-squared value shows how well the data fit the regression analysis). In the RDII Severity by Volume regression analysis, the independent variable is rainfall (measured in inches) and the dependent variable is the volume of RDII (measured in MG).
- 2 Thresholds for Excessive Net RDII Volume: Based on industry research and experience, in typical residential areas: Net RDII Volume less than 7 gal/in/LF may not be cost effective to try to remove through sewer rehabilitation; Net RDII Volume between 8 to 10 gal/in/LF should be investigated for possible sources of I/I; Net RDII Volume greater than 10 gal/in/LF is considered high and would warrant additional SSES investigations to identify sources of I/I; and Net RDII Volume greater than 15 gal/in/LF is considered excessive and should be prioritized for additional SSES investigations to identify sources of I/I.

Table 7. Normalized Peak RDII Severity

Meter Basin ID	Peak Net RDII Severity (MGD/in)	R-Squared (Coefficient of Determination)	Pipe Length (LF)	Normalized Peak Net RDII Severity (gpd/in/LF)	Peak Net RDII ³ Severity Ranking
DUV_SWRMH428	0.05	0.00	11,080	4.5	3
DUV_SWRMH430	0.36	0.61	18,768	19.2	1
DUV_SWRMH459	0.05	0.47	15,254	3.3	4
DUV_SWRMH466	0.14	0.00	19,205	7.3	2

MGD/in = million gallons per day per inch; LF = linear feet; gpd/in/LF = _____; and RDII = rainfall derived inflow and infiltration.

Capture Coefficients

The final analysis completed as part of JMT’s reporting was the capture coefficient for each meter basin, which is the percentage of the volume of the rain that falls on a meter basin and finds its way into the collection system. Table 8 summarizes the results of the complete capture coefficient calculations.

Table 8. RDII Capture Coefficients

Meter Basin ID	Net RDII Severity by Volume (MG/in)	Basin Area (acres)	Net Capture Coefficient ¹
DUV_SWRMH428	0.03	60.3	1.8%
DUV_SWRMH430	0.73	116.8	23.0%
DUV_SWRMH459	0.06	106.4	2.1%
DUV_SWRMH466	0.06	127.0	1.7%

RDII = rainfall derived inflow and infiltration; MG/in = million gallons per inch.

¹ Thresholds for Excessive RDII based on Capture Coefficients: Based on industry research and experience, in typical residential areas: Capture Coefficients greater than 5% suggest high Inflow and Infiltration (I/I) within a basin and would warrant additional SSES investigations to identify sources of Inflow and Infiltration (I/I).

I/I Conclusions and Recommendations

Based on the completed I/I analysis, JMT concluded that the basin with the most severe I/I response is meter basin DUV_SWRMH430 and recommended additional evaluation surveys focused on this specific basin.

Bravo Smoke Test

Based on the recommendation from JMT’s I/I analysis, Parametrix requested Bravo to conduct smoke testing in basin 430. Figure 2 below highlights and numbers the locations where smoke testing was conducted within the meter basin area. City representatives were present during smoke testing for photo documentation, and Table 9 below summarizes the notes recorded for locations with further I/I concern. Bravo smoke testing results are included in Attachment B.

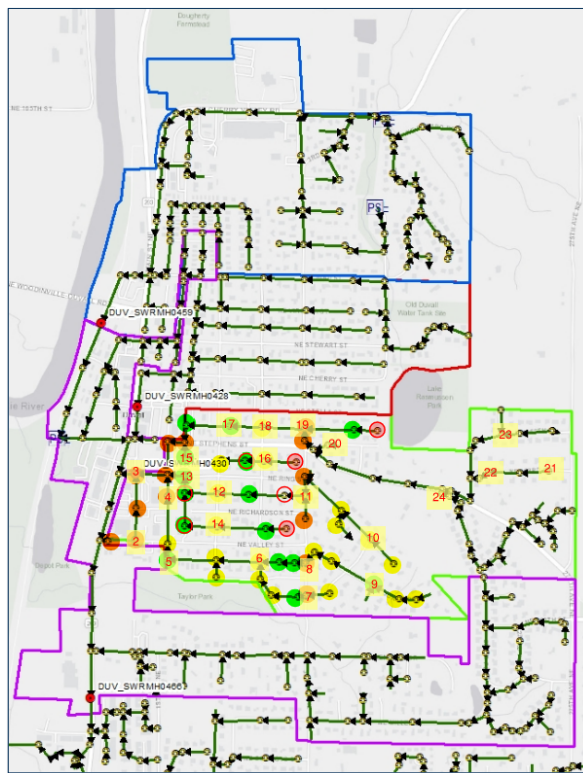


Figure 2. Smoke Testing Locations within Meter Basin DUV_SWRMH430, Setup Locations are Highlighted and Numbered

Table 9. Potential Defect Locations Identified during Smoke Testing

Smoke Testing Potential Defect Location ¹	Smoke Testing Notes
5	Smoke from crawl space
11, 12	Smoke from crawl space and sewer manhole (MH) leaking groundwater into structure
13	Smoke from Apartment Catch Basin
16	Light smoke from French drain/footing drain along garage wall
23	Smoke side of house (either from cleanout or gutter drain)

¹ Location numbers in Table 10 correspond to location numbers shown in Figure 2 within meter basin DUV_SWRMH430. All locations listed here suggest further Inflow and Infiltration (I/I) concerns.

Recommendations for next steps and/or repairs for the defects found during smoke testing can be found in the Recommendations section later in the report.

Bravo CCTV

Bravo performed closed circuit television (video) inspections within five sewer main lines within basin 430. The five sewers were split between three “runs” or setups for the CCTV crew. Table 10 summarizes the location (address), length of pipe surveyed, the National Association of Sewer Service Companies (NASSCO) structural pipe rating, and NASSCO operational and maintenance (O&M) rating. NASSCO is a North American trade organization that provides training and education on underground infrastructure including sewer pipes and manholes and sets industry standards for the definition, categorization of, and rating system for defects within pipelines. The NASSCO structural rating is based on defects that impact the structural integrity of the pipeline including cracks, fractures, breaks, surface damage, and joint offsets and separations. NASSCO O&M ratings are based on settled deposits, grease buildup, root intrusion into the pipe, and other nonstructural items that can impact the flow through the pipe. Ratings for both structural and O&M defects are from 1 to 5 with 5 being the worst. The CCTV reports from Bravo can be found in Attachment C.

Table 10. Closed Circuit Television (CCTV) Inspection Summary

Run Number	Bravo Pipe Designation ¹	Address	Length (LF)	Diameter (in)	NASSCO Structural Rating	NASSCO O&M Rating
1	RUN1 E_S	Behind 15320 1st Ave NE	132.4	8	2	2
2	RUN2 M_S	Area behind homes between 3rd Ave NE and Broadway Ave NE	297.4	8	2	2
2	RUN2 M_E	Area behind homes between Broadway Ave NE and 1st Ave NE	246.4	8	2	1
3	RUN3 S_M	Area behind 27302 NE 153rd Pl to Bruett Rd	223.3	8	1	2
3	RUN3 M_E	Area behind 27302 NE 153rd Pl to Bruett Rd	184.7	8	2	1

LF = linear feet; in = inches; NASSCO = National Association of Sewer Service Companies; O&M = operational and maintenance.

1. Designations for each run are for Start (S), Middle (M), and End (E) for each pipe run.

Parametrix reviewed the videos completed by Bravo and agreed with the initial scoring provided by Bravo. The videos showed slight signs of surface damage with aggregate visible, surface spalling, and several cracks. The defects are generally considered the start of degradation of the pipe; however, they are not severe enough to warrant immediate actions. The O&M defects included roots and deposits attached (encrustation). Due to the location at the back of homes or within an easement area with large trees and bushes nearby, these types of defects are common. Root treatments and periodic cleaning can be used to keep the flow within the pipes flowing properly.

Recommendation

Recommendations Based on Flow Monitoring Results

The ADS flow monitoring and subsequent JMT I/I Analysis Report determined that the 430 basin had a Net Capture Coefficient of 23% which is a very higher capture coefficient (as noted earlier in the report a capture coefficient above 5% suggest high I/I within a basin). While the SSES investigations identified several potential issues through smoke testing, the video completed under this scope of

work did not identify defects in the nearby sewers. It is recommended that additional flow monitoring be completed in basin 430 to narrow down the location of the I/I into the system. Parametrix however, recommends that flow monitoring be conducted within the City's other sewer basins to determine if other basins are contributing equal or higher amounts of I/I into the system compared to the 430 basin.

Recommendations Based on Smoke Testing Results

The six Bravo identified defects require differing approaches and are listed below with recommended repairs or next steps.

1. Location 5 had smoke witnessed coming from a crawl space.
 - a. Further inspection through dye testing can confirm if a direct connection from the drain to the sewer is present. If a direct connection is discovered the storm and sewer should be separated.
2. Location 11 had smoke witnessed coming from a crawl space.
 - a. Further inspection through dye testing can confirm if a direct connection from the drain to the sewer is present. If a direct connection is discovered the storm and sewer should be separated.
3. Location 12 identified a leak within the wall of the MH allowing groundwater into the system.
 - a. Based on the weather conditions (no recent rain event) during the smoke testing this infiltration was assumed to be consistent and would be included under the BI of basin 430.
 - b. As basin 430 was determined to have 69% of its ADDF derived from BI it is recommended that this hole be sealed. A combination of grout and surface repair (a cementitious coating) is recommended.
4. Location 13 had smoke witnessed from a catch basin near an apartment building.
 - a. Further investigation into the as-builts by the City have differing slopes which would make a direct connection unlikely, however, with the presence of smoke from the catch basin means a connection exists somewhere along the line.
 - b. Additional inspection of the catch basin line through videoing or dye testing may reveal the location of the connection. Once the connection is discovered the connection point should be separated.
5. Location 16 has smoke witnessed coming from a French Drain / footing drain for a garage.
 - a. Further inspection through dye testing can confirm if a direct connection from the drain to the sewer is present. If a direct connection is discovered the storm and sewer should be separated.
6. Location 23 had smoke witnessed coming from a cleanout or gutter drain in the driveway of a home.
 - a. The pipe that is at grade currently should be determined to be either the cleanout or gutter drain and sealed with a removable cap if it is confirmed to be the sewer cleanout.

Recommendations Based on CCTV

There were no defects within the inspected pipelines through CCTV that require immediate action or rehabilitation. The majority of defects were operation and maintenance issues (roots or debris within the pipe) or low severity (per NASSCO standards) structural defects such as cracks and surface roughness increase of the pipelines. While it is recommended to perform routine CCTV investigations to confirm conditions have not worsened, the recommended frequency is a 5- or 10-years cycle with

Recommendations for Future Flow Monitoring

Parametrix recommends the flow monitoring of other basins throughout the existing sewer system. Figure 3 below shows the proposed location of 7 potential meters. A brief description for the location selection is also provided.

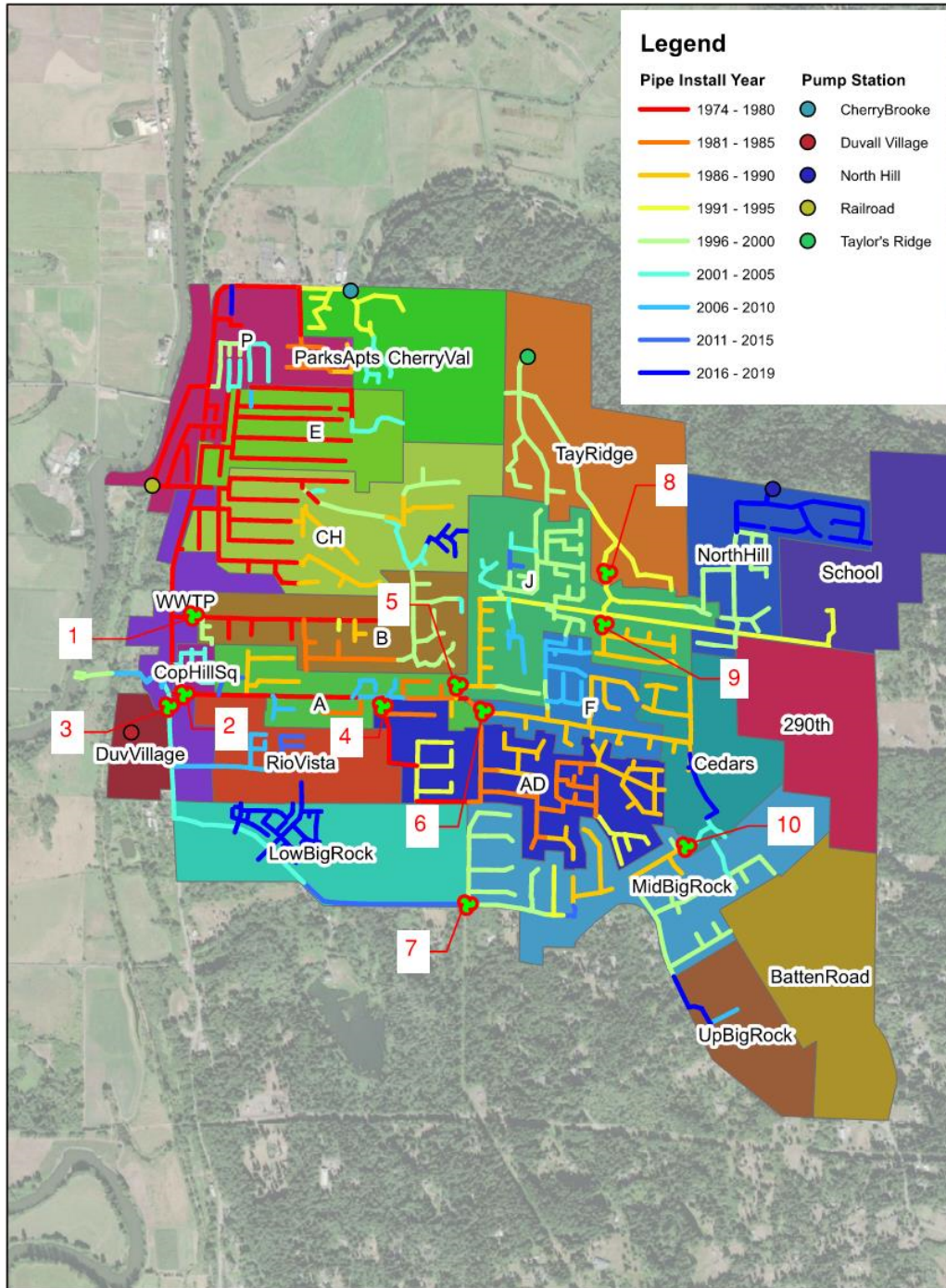


Figure 3. Suggested Flow Monitoring Locations

The locations of the flow meters considered the upstream area and the age of the upstream pipelines.

1. Location 1 would monitor Basin B which has a large amount of older pipe (1974 to 1985) and is a self-contained basin (no other basin drains into it)
2. Location 2 would capture the total flow from Basins A, AD, F, Cedars, east Mid Big Rock, Up Big Rock, J, Tay Ridge, School, and North Hill.
 - a. This location would allow for isolation of Basin A from the totalized flow from the combined basins.
3. Location 3 would capture flow from the southern WWTP, Low Big Rock and the west Mid Big Rock.
4. Location 4 would isolate Basin AD which has a large amount of older pipe comprising of pipe installed from 1091 to 1995.
5. Location 5 isolates Basins J, Tay Ridge, North Hills, and School.
6. Location 6 isolates Basins F, Cedars, east Mid Big Rock, and Up Big Rock
7. Location 7 isolates the west Mid Big Rock from Location 3's meter which would allow for computation of the flow contributed from west Mid Big Rock and Low Big Rock.
 - a. As the age of pipe in Low Big Rock and west Big Rock are overall relatively new it is recommended that only location 3 be installed at this time with future metering possible to separate basins further.
8. Location 8 isolates Basin Tay Ridge which would allow for computation of the flow contributed from J, North Hill, and School.
9. Location 9 isolates an older portion of Basin.
10. Location 10 isolates east Mid Big Rock and Up Big Rock from Location 6's meter.
 - a. Similarly to Location 7, east Mid Big Rock and Up Big Rock are overall rather new pipe and could be metered later.

Locations 1 through 6 are the recommended priority meter locations, however, the number and location of the meters installed can be adjusted for the duration of metering and the number of meters the City would like installed at any time.

Cost Estimate

A high-level cost estimate for additional monitoring and SSES investigations is shown in Table 11 below. The rates and estimates provided are based on invoices and quotes received from Bravo, JMT, and ADS.

Table 11. Flow Monitoring and SSES Investigation Cost Estimate

Metering or SSES Investigation	Unit Cost	Unit	Quantity	Total	Notes / Assumptions
Flow Metering	\$8,500	Month	9	\$76,500	<ul style="list-style-type: none"> • 3 meter sites and 1 rain gauge • \$2,500 per month per meter • \$1,000 per month per rain gauge
Flow Analysis	\$10,000	EA	1	\$10,000	<ul style="list-style-type: none"> • Flow analysis report provided by either metering company or 3rd party such as JMT
Smoke Testing	\$3,000	Day	3	\$9,000	<ul style="list-style-type: none"> • 3 days of smoke testing • 10 -15 setups per day • Approximately 15,000 LF could be testes
CCTV	\$5.00	LF	2,000	\$10,000	<ul style="list-style-type: none"> • Bravo investigation at approximately 1,000 LF / Day

The total cost for 9 months of additional flow monitoring and subsequent analysis and SSES investigations would be approximately \$105,500 which is in-line with the City’s anticipated yearly spending as part of their Capital Improvement Plan. While the estimated total includes only 3 meters it would encompass the majority of the year and seasons. The number of sites and total duration can further be discussed with the City to provide comprehensive results and direct the SSES investigations to priority areas.

Attachment A

Johnson, Mirmiran & Thompson
(JMT) Analysis



FINAL MEMORANDUM

CITY OF DUVALL INFILTRATION AND INFLOW (I&I) ANALYSIS

TO: Mr. Brandon Moss, P.E.
 DATE: January 31, 2024
 FROM: Matthew Smith, P.E.
 PROJECT: City of Duvall Infiltration and Inflow (I&I) Analysis
 JMT JOB NO.: 23-04112-001
 RE: Final Technical Memorandum - City of Duvall I&I Analysis

PROJECT BACKGROUND

ADS Environmental Services, LLC (ADS), under contract with Parametrix, completed flow monitoring at four (4) locations within the City of Duvall sanitary sewer system from March 2023 through July 2023. One (1) rain gauge was installed to collect rainfall depth during storm events for the same time period. A flow monitoring summary report prepared by ADS, dated August 31, 2023, is included in Attachment A. Johnson, Mirmiran, & Thompson, Inc. (JMT) contracted with Parametrix to complete an infiltration and inflow (I&I) analysis on the flow data collected by ADS and provided to JMT for use in the analysis. The goal of the I&I analysis was to quantify dry weather flows, base infiltration (BI) values, and rainfall derived infiltration and inflow (RDII) values for the captured storm events.

JMT utilized ADS’ Sli/icer.com™ (Sli/icer) software to analyze the flow data. The I&I Analysis consisted of the following sub-tasks: Rainfall Analysis, Dry Day Analysis, Wet Weather Analysis, RDII Analysis and I&I Severity Analysis. This technical memorandum provides an overview of the analysis performed and presents the results of the I&I Analysis for the four (4) meter basins.

METER BASIN CHARACTERISTICS

Flow meters were at four (4) locations within the City of Duvall sanitary sewer system. These locations are summarized in Table 1 and shown in Figure 1 below.

Table 1: Flow Monitor Locations

Site ID	MH ID	Pipe Dimensions (H x W in inches)
DUV_SWRMH428	SWRMH466	7.88 x 8.00
DUV_SWRMH430	SWRMH466	8.13 x 8.00
DUV_SWRMH459	SWRMH466	8.13 x 8.00
DUV_SWRMH466	SWRMH466	11.25 x 12.00

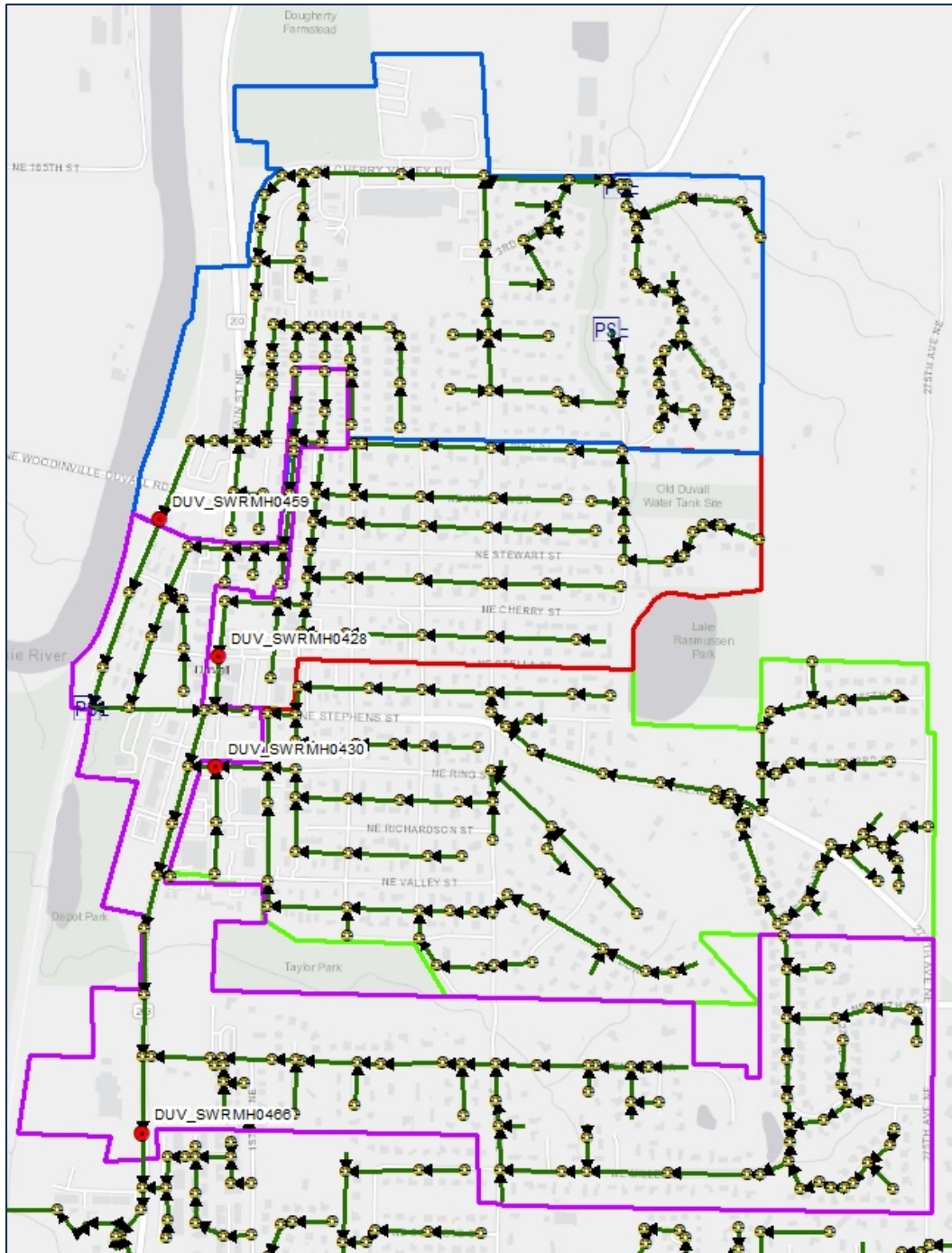


Figure 1: Meter Location with Meter Basin Boundaries

Using GIS data provided by Parametrix, JMT pulled sanitary sewer system characteristics for each of the four (4) meter basins. These system characteristics include the net basin area (in acres), the net linear footage of sanitary sewer pipe (LF), and the net sewer footprint (inch-diameter-mile) tributary to the meter.

Table 2: Meter Basin Sewer System Characteristics

Meter Basin ID	Net Basin Area (AC)	Length of Net Sewer (LF)	Net Sewer Footprint (IDM)
DUV_SWRMH428	60	11,080	16.73
DUV_SWRMH430	117	18,768	28.24
DUV_SWRMH459	106	15,254	22.23
DUV_SWRMH466	127	19,205	30.08

RAINFALL ANALYSIS

For the I&I analysis, JMT utilized rainfall data collected by the temporary rain gauge, DUV_RG, installed by ADS during their flow monitoring period.

For the I&I analysis, the standard Sli/icer software definition for determining a storm event was used, which defines a Storm Event as a minimum of 0.5-inches of rainfall within a 24-hour period. The rainfall threshold of 0.5-inches must be reached during a time interval without a break in rainfall of more than 300-minutes (5-hours). Analysis of the rainfall data collected by the temporary rain gauge resulted in six (6) Storm Events being used for evaluation. Table 3 provides the rainfall depth recorded during each Storm Event by rain gauge DUV_RG.

Table 3: Rainfall Depths for the Captured Storm Events

Storm Date/Time	DUV_RG Rainfall Depth (in)
3/12/2023 16:00	1.05
4/2/2023 16:00	1.17
4/6/2023 8:00	0.89
4/10/2023 7:00	0.71
4/22/2023 20:00	0.88
6/20/2023 3:00	0.59

DRY DAY ANALYSIS

The purpose of the dry day analysis is to define the volumetric and temporal characteristics of the Average Dry Day Flow (ADDF), shown by the green (weekday) and blue (weekend) curves in Figure 2. The hourly values of the ADDF curve are used with the gross flow during storm events to calculate hourly and total rainfall derived infiltration and

inflow (RDII). ADDF consists of only sanitary flow from sewer service laterals (wastewater production) and base infiltration (BI), shown by the grey horizontal line in Figure 2. It excludes RDII, which occurs only during and shortly after rainfall. Unlike RDII, BI occurs even under low groundwater conditions and is not an immediate result of rainfall.

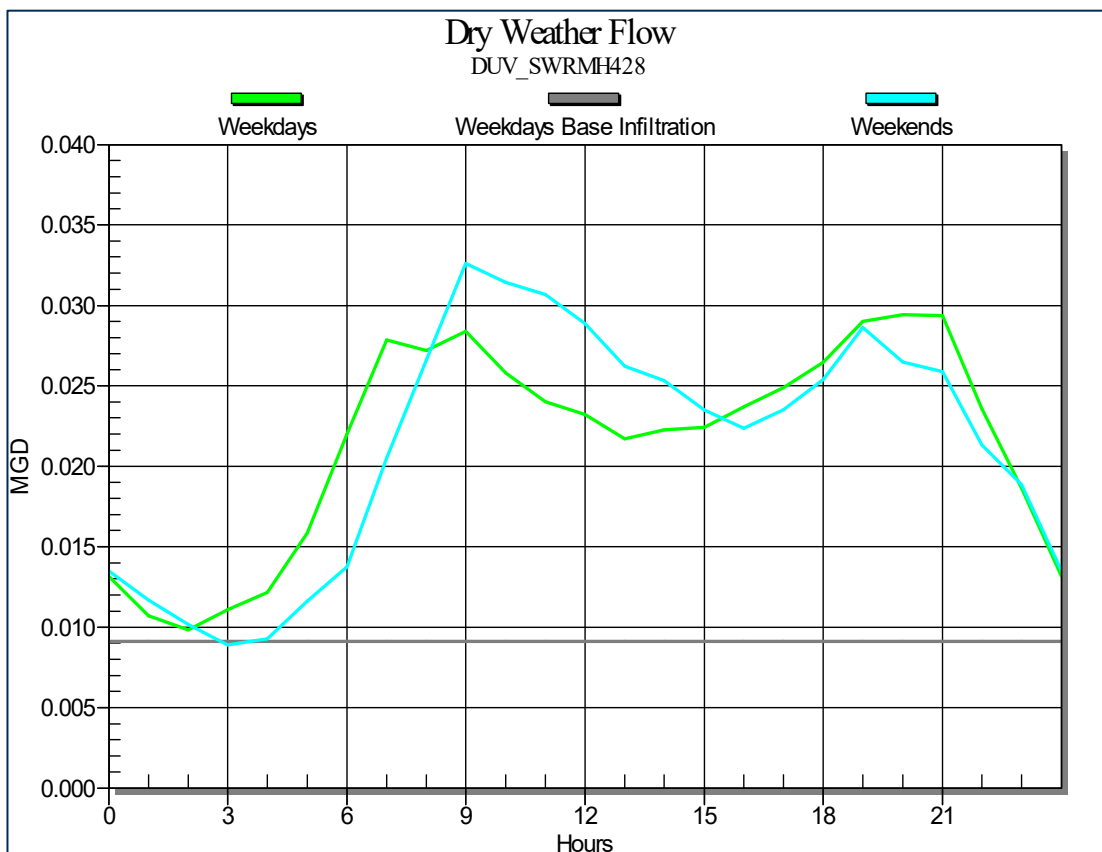


Figure 2: Components of the Average Dry Day Flow

The ADDF curve is calculated by averaging all selected dry days during a given time period, such as weekdays or weekend days. The calculated ADDF curve represents graphically the flow quantity and temporal variation that would have occurred during a storm event had there been no rainfall influence. It is crucial to calculate the ADDF curve from a dataset that contains the fewest possible anomalies. JMT uses a three-step process to ensure acceptable dry day selection. This process is made up of the following steps:

- An antecedent rainfall test,
- A random variation exclusion test, and
- A holiday exclusion step

The antecedent rainfall test applied rainfall thresholds for the one-, three-, and five-day periods prior to each candidate dry day. Only days which passed the antecedent rainfall test at these thresholds (shown in Table 4) were used in the dry day analysis. For example, if the total amount of rainfall in the three (3) days prior to a candidate dry day exceeded 0.4-inches, it was removed as a candidate dry day.

Table 4: Rainfall Thresholds for the Antecedent Rainfall Test

No. of Days Prior to Candidate Dry Day	Rainfall Threshold (in)
1	0.2
3	0.4
5	1.0

In addition, JMT removed any candidate dry day from the analysis if its total flow was more than 15 percent lower or higher than the ADDF total for the basin. Each time a candidate dry day was removed, the ADDF total was recalculated, and the test was performed again for all remaining dry days. Any day during the monitoring period that passed the tests described above was designated as a selected dry day.

JMT then divided the dry days into two day groups: Weekdays and Weekends. For the purpose of this analysis, weekdays are defined as Monday through Friday, and weekends were defined as Saturday and Sunday. JMT generated an ADDF curve for each day group by averaging the hourly flows for all selected dry days within the day group. Figure 3 below shows the gross ADDF curves for weekdays and weekends for Basin DUV_SWRMH459.

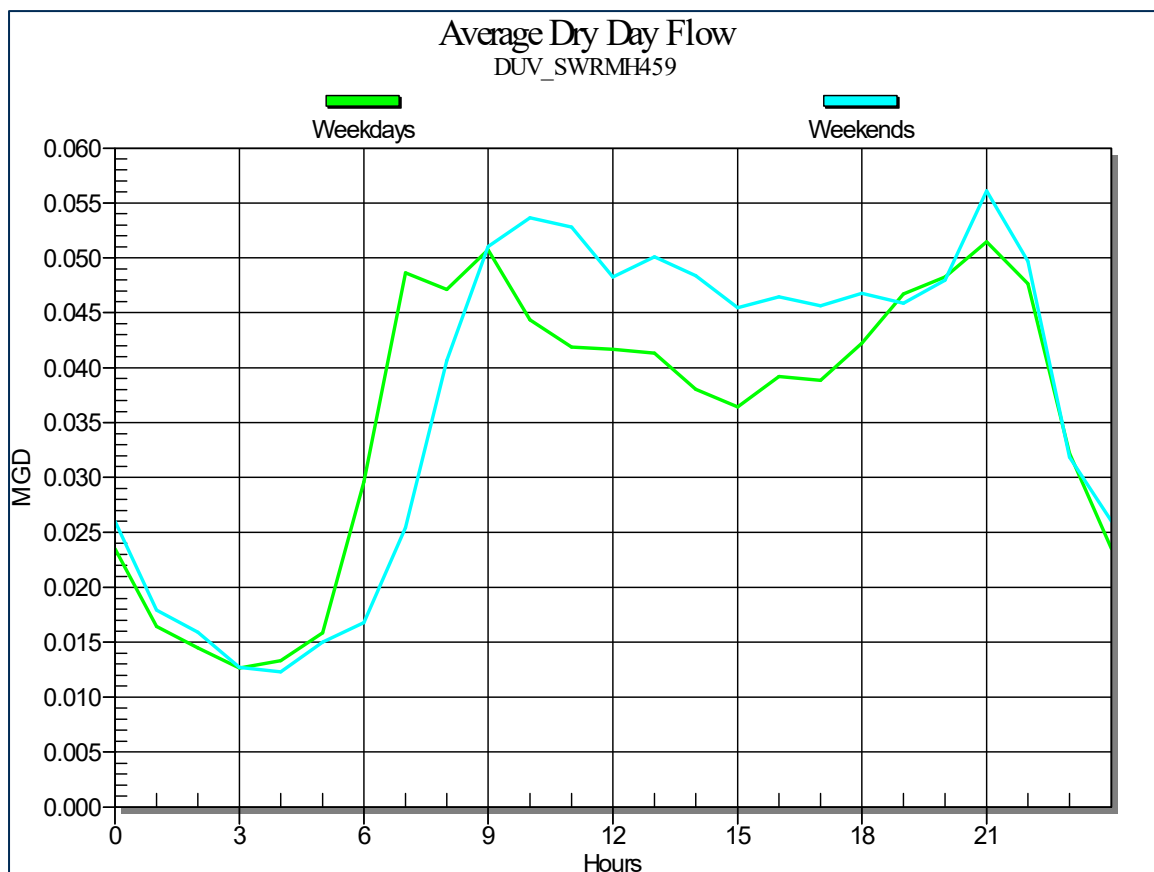


Figure 3: ADDF Curves for Basin DUV_SWRMH459

The results of the dry day analysis, the net weekday and weekend average dry day flows for each basin are presented in Table 5.

Table 5: Net Average Dry Day Flows

Meter Basin ID	2023 Net Average Dry Day Flow (MGD)	
	Weekday	Weekend
DUV_SWRMH428	0.022	0.022
DUV_SWRMH430	0.072	0.067
DUV_SWRMH459	0.036	0.038
DUV_SWRMH466	0.101	0.120

BASE INFILTRATION

Base infiltration (BI) is groundwater that enters the sanitary system independent of rainfall influence. BI can enter the sanitary sewer system through the following sources:

- Sewer main pipe cracks, fractures, and breaks
- Offset or separated sewer main pipe joints
- Service lateral pipe structural defects
- Manhole structural defects

One of the methods for calculating BI is the Stevens/Schutzbach method, which JMT used for this analysis. The Stevens/Schutzbach method calculates BI using the following equation:

$$BI = \frac{0.4 \times MDF}{[1 - (0.6 \times (MDF/ADF)^{(MDF)^{0.7}})]}$$

Where: BI = Base Infiltration

MDF = Minimum Daily Flow rate

ADF = Average Daily Flow Rate

JMT used the weekday ADDF curves for use in calculating BI. Table 6 provides the net BI for each basin, along with the net ADDF from the weekday ADDF curve used to calculate the BI, and the net total wastewater production (WWP) rate. The table also provides the percentage of the ADDF that is attributable to BI.

Table 6: Net Base Infiltration Values

Meter Basin ID	Net ADDF (MGD)	Net WWP (MGD)	Net BI (MGD)	BI Percentage of Net ADDF
DUV_SWRMH428	0.022	0.013	0.009	41%
DUV_SWRMH430	0.072	0.022	0.05	69%
DUV_SWRMH459	0.036	0.025	0.011	31%
DUV_SWRMH466	0.101	0.101	0.000	0%

JMT normalized the net BI values in order to determine the relative severity of BI in each meter basin, which helps with comparison between basins. Table 7 provides net BI values normalized based on net pipe length. A full summary table of BI results is included in Attachment B.

Table 7: Normalized Net Base Infiltration Values

Meter Basin ID	Net BI (MGD)	Pipe Length (LF)	Normalized Net BI (gpd/LF) ¹
DUV_SWRMH428	0.009	11,080	0.8
DUV_SWRMH430	0.050	18,768	2.7
DUV_SWRMH459	0.011	15,254	0.7
DUV_SWRMH466	0.000	19,205	0.0

¹Threshold for Excessive Net BI: Based on industry research and experience, in typical residential areas: Net BI less than 2 gpd/LF is likely not cost effective to try to remove through rehabilitation; Net BI between 2-5 gpd/LF should be investigated for possible sources of I&I; and Net BI greater than 5 gpd/LF is considered high and would warrant additional SSES investigations to identify sources of infiltration.

WET WEATHER ANALYSIS

RDII is the observable increase in sanitary sewer flow attributable to rainfall. Rainfall derived infiltration is infiltration that occurs under the saturated groundwater conditions caused by rainfall. Rainfall derived inflow can be defined as stormwater that enters the sanitary sewer system through direct connections to the system. Inflow may enter the sanitary sewer system through private sources, such as roof leaders, area drains, or broken service lateral cleanout, or from public sources such as cross-connections between the storm and sanitary sewer systems, low lying manholes subject to ponding, or manholes with missing covers.

Using the rainfall data collected by rain gauge DUV_RG, and the storm event criteria defined in the Rainfall Analysis Section resulted in six (6) storm events being generated during the monitoring period.

JMT generated storm event hydrographs for each meter basin for each storm event. Storm event hydrographs can be divided into four time periods: Pre-compensation, Rain, Recovery 1, and Recovery 2. Pre-compensation is a

calculated value used to adjust the ADDF curve used in the wet weather analysis. Its value is calculated based on the dry weather flow observed during the 24-hour period immediately preceding the storm event. It compensates for unidentified random and systematic variations in flow between the ADDF curve and the dry weather flow just prior to the storm event. The Rain Period begins when rain starts and extends to capture all rainfall that falls during the storm event. The Recovery 1 and Recovery 2 Periods capture RDII that is present in the sewer system after the rainfall has ended. The two recovery periods represent the same influence: RDII response that occurs after rainfall has stopped.

JMT generated and reviewed storm event hydrographs for each meter basin for each storm event. JMT made two types of adjustments during the wet weather analysis based on the storm event hydrographs: Global Adjustments and Local Adjustments. Global adjustments are modifications to storm events that impact all the meter basins included in this analysis. These adjustments include setting storm start and end times, as well as adjustments to the length of the storm period and two recovery periods. JMT also evaluated globally removing specific storm events from the analysis if no response was observed in any of the meter basins. Following the global adjustments, JMT evaluated each storm event on a local level, meaning for each meter basin. Local storm event adjustments only affect the meter basin for which the adjustment is made. The most significant local adjustment that can be performed was reviewing and modifying the pre-compensation values for each storm, for each meter basin. JMT also reviewed and considered removing storm events on a local level if flow data during the storm period was missing or determined to be unreliable.

An example of a storm event hydrograph for the 4/22/2023 storm event in meter basin DUV_SWRMH459 is shown in Figure 4 below. The graph shows the gross weekday ADDF curve (in green), the gross weekend ADDF curve (in light blue), the gross flow curve recorded by the meter (in blue), the gross RDII curve (in gold), the pre-compensation adjustment (represented by the horizontal dark green bar), and the rainfall hyetograph (represented by the vertical purple bars). The horizontal bars located at the bottom of the storm event hydrograph represent the Pre-compensation (shown in grey), Storm (shown in pink), Recovery 1 (shown in purple) and Recovery 2 (shown in dark purple) Periods as described above.

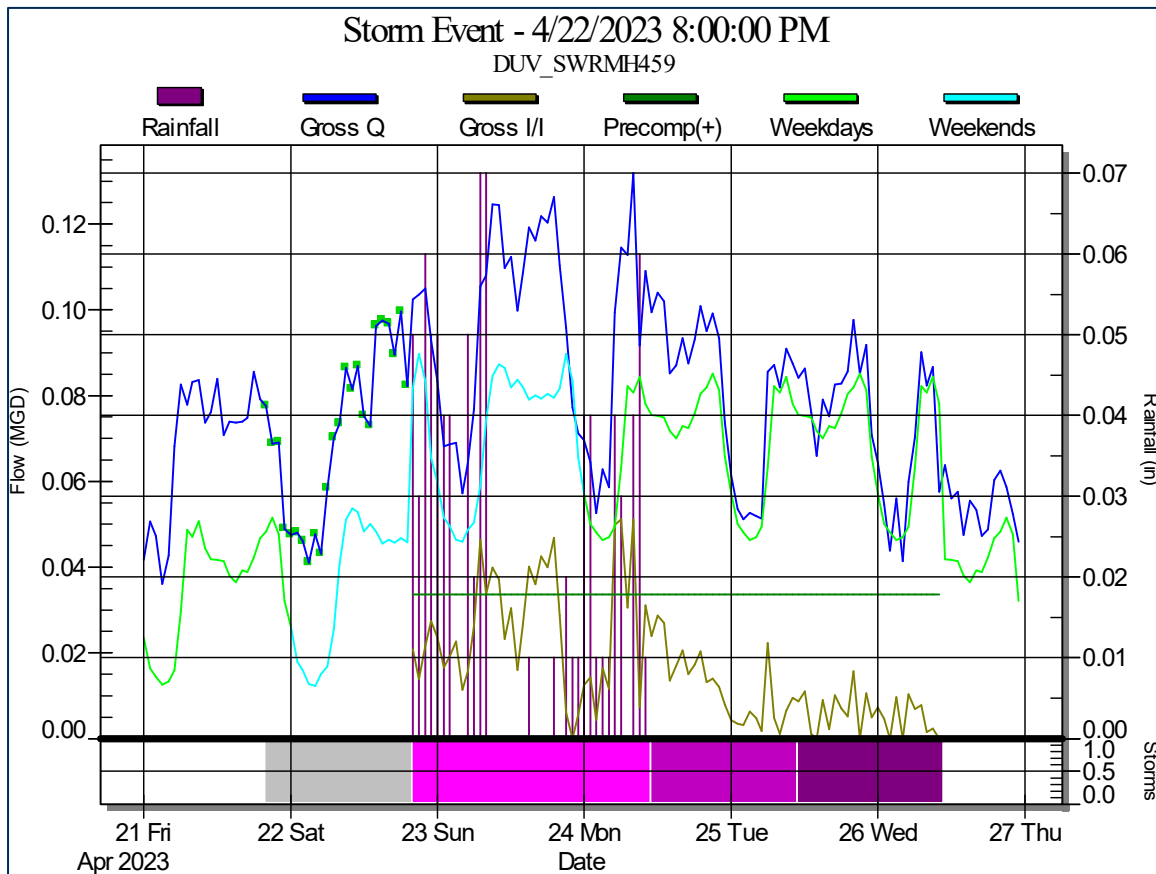


Figure 4: Storm Event Hydrograph - 4/22/2023 Storm Event - Meter Basin DUV_SWRMH459

RDII ANALYSIS

One important purpose of the I/I analysis is to establish a relationship between the amount of rainfall and the RDII for a specific part of the collection system. For each meter basin, a storm event will produce a different RDII response. JMT used the graphical technique known as the “Q versus i” diagram to evaluate and compare the net RDII generated in each meter basin during storm events of varying rainfall depths and intensities. JMT generated two (2) types of Q versus i diagrams for this analysis:

- Total Event Net RDII Volume (in MG) vs. Rainfall Depth (in inches)
- Peak Net RDII (in MGD) vs. Rain Volume to Peak I/I Time (in inches)

RDII Volume:

The ratio of net RDII volume (Q, in million gallons) to rainfall depth (i, in inches) is typically used to assess the severity of a meter basin’s reaction to a storm event. The relationship between RDII volume and rainfall depth can be plotted on a scatterplot, with each point representing a storm event. JMT generated this scatterplot for each catchment and developed a linear regression through the storm event points that relates the quantity of RDII entering the sewer system in the basin and the amount of rainfall. The slope of the linear regression line represents

the RDII severity by volume of the basin. The steeper the slope, the more severe the RDII is within the basin. Figure 5 shows the Volume Q versus i graph for meter basin DUV_SWRMH428. The RDII Volume Q versus i graphs for all the meter basins are included in Attachment C.

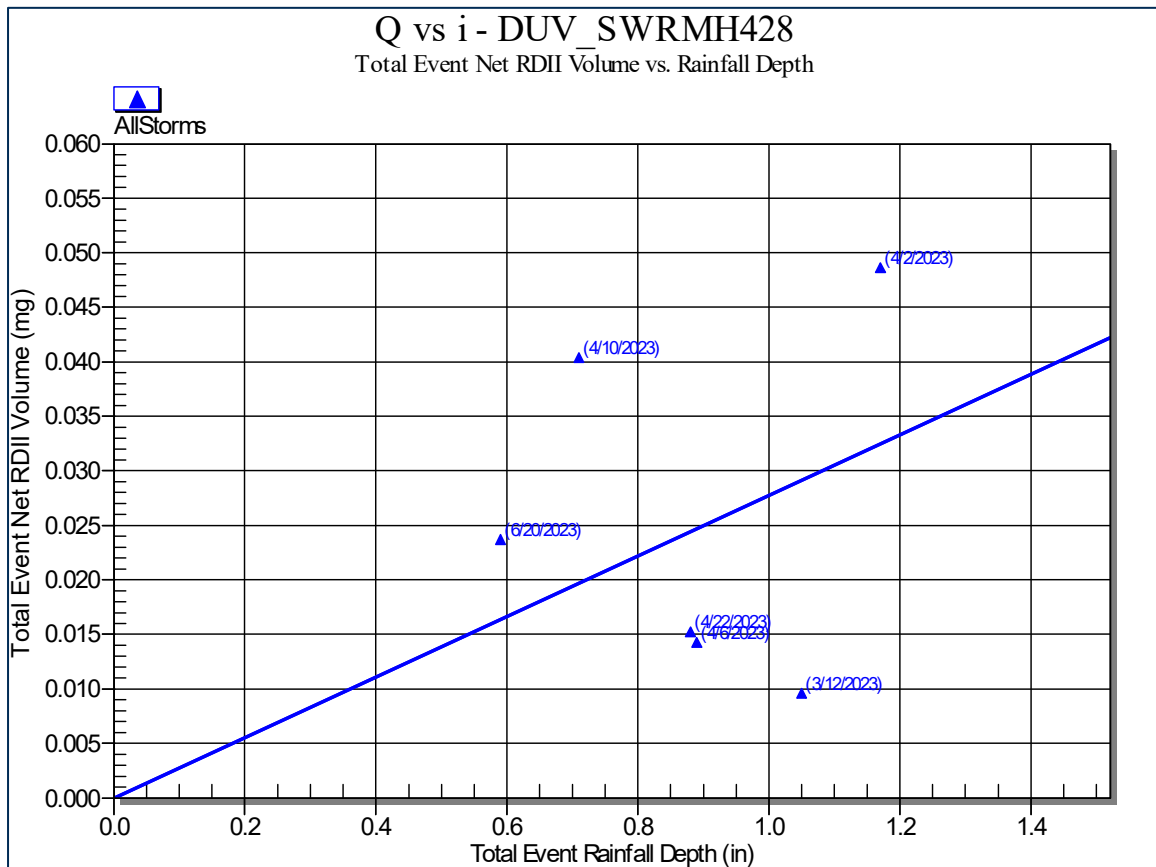


Figure 5: RDII Volume Q versus i Diagram – DUV_SWRMH428

Peak RDII Rate:

In addition to the volumetric analysis, JMT completed a Q versus i analysis for peak net RDII rate because long term capacity management strategies must consider the peak flow that a meter basin contributes to the overall peak RDII in the sewer system. Peak gross RDII is defined as the maximum difference in flow between the gross flow curve during the storm event and the gross ADDF curve, or the maximum value on the gross RDII rate curve. Peak net RDII is the maximum value on the net RDII rate curve. In the Peak Q versus i analysis, the ratio of peak net RDII rate (Q, in MGD) to rainfall (i, in inches) is used, where the rainfall depth includes all the rain that fell prior to the time of the peak net RDII rate. The slope of the linear regression line represents the peak RDII rate of the basin. The steeper the slope, the more severe the RDII is within the basin. Figure 6 shows the Peak Q versus i graph for meter basin DUV_SWRMH428. The Peak RDII Q versus i graphs for all the meter basins are included in Attachment D.

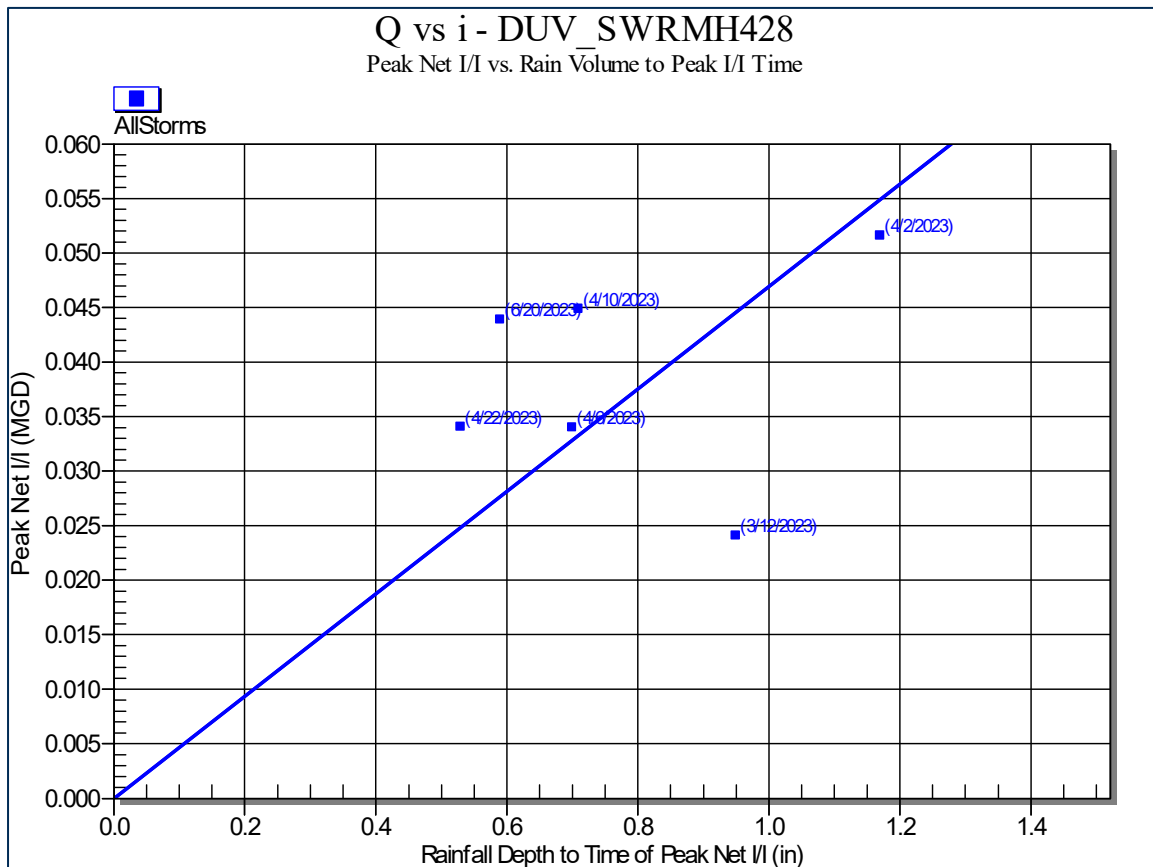


Figure 6: Peak RDII Rate versus i Diagram - DUV_SWRMH428

RDII RESULTS

As described above, the I/I analysis established a relationship between the amount of rainfall and the RDII for a specific part of the collection system. JMT generated two types of Q versus i diagrams for this analysis: RDII Volume versus rainfall depth and Peak RDII Rate versus rainfall depth. The results of the I/I analysis are the RDII severity (both volume and peak rate) and the calculated capture coefficient for each meter basin.

RDII Severity by Volume Rankings:

As described above, the Volume Q versus i graph can be used to determine the net RDII severity by volume for each meter basin. JMT normalized these RDII values in order to determine the relative severity of RDII in each basin. Table 8 provides the net RDII volumes normalized based on pipe length. A full summary table of RDII severity by volume results is included in Attachment B. The table also ranks the basins in terms of severity, with a ranking of one (1) representing the most sever and a ranking of four (4) representing the least severity.

Table 8: Normalized RDII Severity by Volume

Meter Basin ID	Net RDII Severity by Volume (MG/in)	R-Squared (Coefficient of Determination) ¹	Pipe Length (LF)	Normalized Net RDII Severity by Volume (gal/in/LF) ²	Net RDII Severity by Volume Ranking
DUV_SWRMH428	0.03	0.00	11,080	2.7	4
DUV_SWRMH430	0.73	0.92	18,768	38.9	1
DUV_SWRMH459	0.06	0.42	15,254	3.9	2
DUV_SWRMH466	0.06	0.00	19,205	3.1	3

¹R-Squared (Coefficient of Determination): The R-squared value is a statistical measure of the regression analysis that determines the proportion of variance in the dependent variable that can be explained by the independent variable (i.e. the r-squared value shows how well the data fit the regression analysis). In the RDII Severity by Volume regression analysis, the independent variable is rainfall (measured in inches) and the dependent variable is the volume of RDII (measured in MG).

²Thresholds for Excessive Net RDII Volume: Based on industry research and experience, in typical residential areas: Net RDII Volume less than 7 gal/in/LF may not be cost effective to try to remove through sewer rehabilitation; Net RDII Volume between 8-10 gal/in/LF should be investigated for possible sources of I&I; Net RDII Volume greater than 10 gal/in/LF is considered high and would warrant additional SSES investigations to identify sources of I&I; and Net RDII Volume greater than 15 gal/in/LF is considered excessive and should be prioritized for additional SSES investigations to identify sources of I&I.

Peak RDII Severity Rankings:

As described above, the Peak Q versus i graph can be used to determine the peak net RDII rate severity for each meter basin. JMT normalized these RDII values in order to determine the relative severity of RDII in each basin. Table 9 provides the peak net RDII rates normalized based on pipe length. A full summary table of peak net RDII severity results is included in Attachment B. The table also ranks the basins in terms of severity, with a ranking of one (1) representing the most sever and a ranking of four (4) representing the least severity.

Table 9: Normalized Peak RDII Severity

Meter Basin ID	Peak Net RDII Severity (MGD/in)	R-Squared (Coefficient of Determination) ¹	Pipe Length (LF)	Normalized Peak Net RDII Severity (gpd/in/LF)	Peak Net RDII Severity Ranking
DUV_SWRMH428	0.05	0.00	11,080	4.5	3
DUV_SWRMH430	0.36	0.61	18,768	19.2	1
DUV_SWRMH459	0.05	0.47	15,254	3.3	4
DUV_SWRMH466	0.14	0.00	19,205	7.3	2

¹R-Squared (Coefficient of Determination): The R-squared value is a statistical measure of the regression analysis that determines the proportion of variance in the dependent variable that can be explained by the independent variable (i.e. the r-squared value shows how well the data fit the regression analysis). In the Peak RDII Severity regression analysis, the independent variable is rainfall (measured in inches) and the dependent variable is the Peak RDII rate (measured in MGD).

Capture Coefficients:

The volume Q versus i diagram can be used to determine the capture coefficient for each meter basin. The capture coefficient (R) is the percentage of the volume of the rain that falls on a meter basin and finds its way into the collection system. It is given by the following equation:

$$R = \frac{(36.83 \left(Acres \times \frac{in}{MG} \right) \times S \left(\frac{MG}{in} \right))}{A \text{ (Acres)}}$$

Where: R = capture coefficient

S = slope of the regression line on the RDII volume Q versus i graph

A = basin area

The capture coefficients for the meter basins evaluated in this study are presented in Table 10.

Table 10: RDII Capture Coefficients

Meter Basin ID	Net RDII Severity by Volume (MG/in)	Basin Area (ac)	Net Capture Coefficient ¹
DUV_SWRMH428	0.03	60.3	1.8%
DUV_SWRMH430	0.73	116.8	23.0%
DUV_SWRMH459	0.06	106.4	2.1%
DUV_SWRMH466	0.06	127.0	1.7%

¹ Thresholds for Excessive RDII based on Capture Coefficients: Based on industry research and experience, in typical residential areas: Capture Coefficients greater than 5% suggest high I&I within a basin and would warrant additional SSES investigations to identify sources of I&I.



CONCLUSIONS

JMT utilized ADS' Sli/icer.com™ (Sli/icer) software to analyze the flow data captured at four (4) locations within the City of Duvall sanitary sewer system from March 2023 through July 2023. The analysis also utilized data collected by one (1) rain gauge that captured data for the same time period. All data utilized in the analysis was provided by Parametrix. JMT assumes that the flow and rainfall data provided was complete and of sufficient quality to obtain accurate I&I analysis results. JMT provides no guarantee of the quality of the flow and rainfall data provided by Parametrix for use in the analysis.

The I&I Analysis consisted of the following sub-tasks: Rainfall Analysis, Dry Day Analysis, Wet Weather Analysis, RDII Analysis and I&I Severity Analysis. These sub-tasks were described and detailed in the previous sections of this technical memorandum.

Based on the analysis completed, the meter basin with the most severe I&I response is meter basin DUV_SWRMH430. Should the City desire to complete additional sanitary sewer evaluation survey (SSES) activities to locate and eliminate sources of I&I, we recommend those efforts be focused within meter basin DUV_SWRMH430. However, it should be noted that only six (6) storm events were captured during the flow monitoring period, with the most severe storm event totaling 1.17 inches of rainfall. No significant storm events were captured during the temporary flow monitoring period. Were more severe storm events captured, it is possible the results of the I&I analysis would differ.

If you have any questions or need further information, please do not hesitate to contact me at 410-316-2329 or msmith@jmt.com

Very truly yours,

Johnson, Mirmiran, and Thompson, Inc.

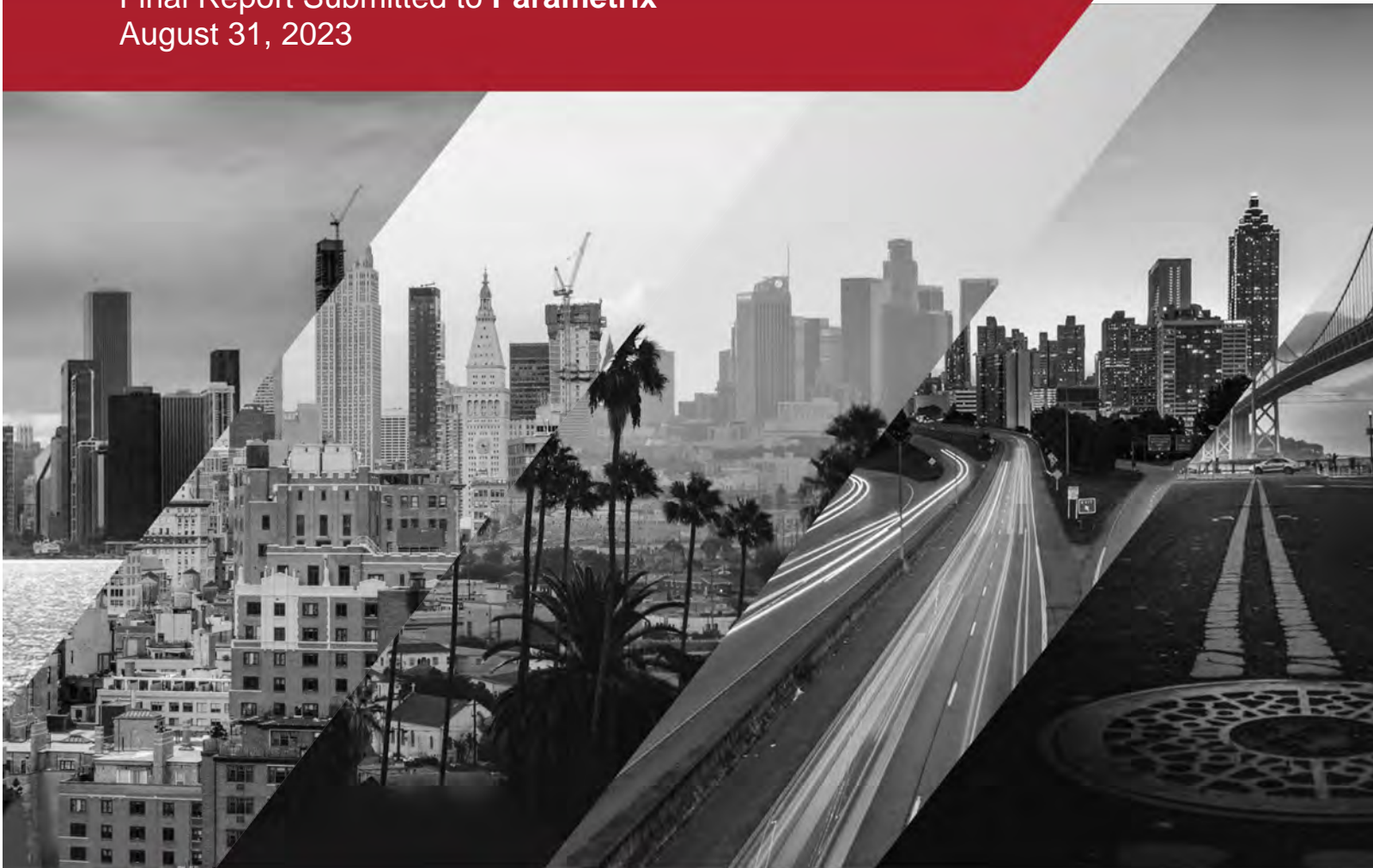


Matthew D. Smith, P.E.
Senior Associate | Project Manager

Attachment A: ADS 2023 Duvall Washington Flow Monitoring Report

2023 Duvall Washington Flow Monitoring

Final Report Submitted to **Parametrix**
August 31, 2023



ADS ENVIRONMENTAL SERVICES

2023 Duvall Washington Flow Monitoring

Prepared For:

Randy Raymond, P.E.
Parametrix
14525 Main Street NE
Duvall, WA, 98019

Prepared By:



ADS, LLC
846 Industry Dr.
Tukwila, WA, 98188



August 31, 2023

Randy Raymond, P.E.
Parametrix
14525 Main Street NE
Duvall, WA, 98019

SUBJECT: 2023 Duvall Washington Flow Monitoring

Dear Randy Raymond,

ADS is pleased to submit the report for the **2023 Duvall Washington Flow Monitoring** completed on behalf of Parametrix. The metering was conducted at four (4) locations and one (1) rain gauge. The study was conducted during the period of Wednesday, 01 March 2023 to Thursday, 10 August 2023.

The report contains depth, velocity, and quantity hydrographs as well as daily long tables for the metering period. An Excel file containing depth, quantity, and velocity entities for the monitoring location in 5-minute format is also provided.

In addition, we would be happy to further explain any details about the report that may seem unclear. Should you have any questions or comments, you may contact the Project Manager, Samuel Reash at 206.458.8423.

It has been our pleasure to be of service to you in the performance of this project. Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,
ADS ENVIRONMENTAL SERVICES

Tyler Bui
Data Analyst

Scope and Methodology

Introduction

Parametrix entered into an agreement with ADS Environmental Services to conduct flow monitoring at (4) four locations and (1) rain gauge in the Duvall Sanitary Collection System. The study was scheduled for a period of (5) five months. Once in place, the flow monitoring equipment was to be used to measure depth, velocity, and to quantify flows. The objective of this study was for general flow study.

Project Scope

The scope of this study involved using a flow monitor to quantify wastewater flow at the designated locations for the study period. Specifically, the study included the following key components.

- Investigate the proposed flow-monitoring site for adequate hydraulic conditions
- Flow monitor installation
- Flow monitor confirmations and data collections
- Flow data analysis

Equipment installation was completed on March 01, 2023. The monitoring period began on March 02, 2023, and was completed on August 02, 2023. Upon completion of the study, equipment was removed from the system.

Flow Monitoring Equipment



The **ADS FlowShark Triton** monitor was selected for this project. This flow monitor is an area velocity flow monitor that uses both the Continuity and Manning's equations to measure flow.

The ADS FlowShark Triton monitor consists of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. The monitor was programmed to acquire and store depth of flow and velocity readings at 5-minute intervals.

The FS Triton monitor features cross-checking using multiple technologies in each sensor for continuous running of comparisons and tolerances. The FS Triton monitor can support two (2) sets of sensors. The sensor option used for this project was:

The Peak Combo Sensor installed at the bottom of the pipe includes three types of data acquisition technologies.

The **up looking ultrasonic depth** uses sound waves from two independent transceivers to measure the distance from the sensor upward toward the flow surface; applying the speed of sound in the water and the temperature measured by sensor to calculate depth.

The **pressure depth** is calculated by using a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a desiccant filled breather tube.

To obtain **peak velocity**, the sensor sends an ultrasonic signal at an angle upward through the widest cross-section of the oncoming flow. The signal is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity.

Installation

Installation of flow monitoring equipment typically proceeds in four steps. First, the site is investigated for safety and to determine physical and hydraulic suitability for the flow monitoring equipment. Second, the equipment is physically installed at the selected location. Third, the monitor is tested to assure proper operation of the velocity and depth of flow sensors and verify that the monitor clock is operational and synchronized to the master computer clock. Fourth, the depth and velocity sensors are confirmed and line confirmations are performed.

In pipes up to 42 inches in diameter, the sensors were mounted on expandable stainless-steel rings, inserted at least a foot upstream into influent pipes and tightened against the inside walls of the pipes. Influent pipe installations reduce the influences of turbulence and backwater often caused by changes in channel geometry in manholes.





Data Collection, Confirmation, and Quality Assurance

Data collects were done remotely via wireless connect on a weekly basis. As needed, during the monitoring period, field crews visit each monitoring location to verify proper monitor operation and document field conditions. The following quality assurance steps are taken to assure the integrity of the collected data:

Measure power supplies: monitors were powered by dry cell battery packs. Voltages were recorded and battery packs replaced, as necessary. Separate batteries provided back-up power to memory allowing primary batteries to be replaced without loss of data.

Clock synchronization: Field crews synchronized monitor clocks to master clocks.

Confirm depth and velocity readings: Field crews descended into meter manholes to manually measure depths and velocities and compare the meter readings to confirm that they agreed. The site met the criteria for confirmation for depth and velocity unless noted otherwise in the site commentary section. They also measured silt levels, if any, in the inverts of the pipes. Silt areas were subtracted from flow areas to compute true areas of flow.

Confirm average velocities through cross-sectional velocity profiles: Since ADS velocity sensors measure peak velocity, field crews collected cross-sectional velocity profiles in order to develop a relationship between peak and average velocity in lines that meet the hydraulic criteria.

Upload and Review Data: Data collected from the monitors were uploaded and reviewed by a Data Analyst for completeness, outliers and deviations in the flow patterns, which indicate system anomalies or equipment failure.

Flow Quantification Methods

There are two main equations used to measure open channel flow: the **Continuity Equation** and the **Manning Equation**. The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available. In cases where velocity measurements are not available or not practical to obtain, the Manning Equation can be used to estimate velocity from the depth data based on certain physical characteristics of the pipe (i.e. the slope and roughness of the pipe being measured). However, the Manning equation assumes uniform, steady flow hydraulic conditions with non-varying roughness, which are typically invalid assumptions in most sanitary sewers. The Continuity Equation was used exclusively for this study.

Continuity Equation

The Continuity Equation states that the flow quantity (Q) is equal to the wetted area (A) multiplied by the average velocity (V) of the flow.

$$Q = A * V$$

This equation is applicable in a variety of conditions including backwater, surcharge, and reverse flow.

Data Analysis and Presentation

Data Analysis

A flow monitor is typically programmed to collect data at 5-minute intervals throughout the monitoring period. The monitor stores raw data consisting of (1) the ultrasonic depth, (2) the peak velocity and (3) the pressure depth. The data is imported into ADS's proprietary software and is examined by a data analyst to verify its integrity. The data analyst also reviews the daily field reports and site visit records to identify conditions that would affect the collected data.

Velocity profiles and the line confirmation data developed by the field personnel are reviewed by the data analyst to identify inconsistencies and verify data integrity. Velocity profiles are reviewed and an average to peak velocity ratio is calculated for the site. This ratio is used in converting the peak velocity measured by the sensor to the average velocity used in the Continuity equation. The data analyst selects which depth sensor entity will be used to calculate the final depth information. Silt levels present at each site visit are reviewed and representative silt levels established.

Occasionally the velocity sensor's performance may be compromised resulting in invalid readings sporadically during the monitoring period. This is generally caused by excessive debris (silt) blocking the sensor's crystals, shallow flows (~< 1") that may drop below the top of the sensor or very clear flows lacking the particles needed to measure rate. In order to use the Continuity equation to quantify the flow during these periods, a Data Analyst and/or Engineer will use the site's historical pipe curve (depth vs. velocity) data along with valid field confirmations to reconstitute and replace the false velocity recordings with expected velocity readings for a given historical depth along the curve.

Selections for the above parameters can be constant or can change during the monitoring period. While the data analysis process is described in a linear manner, it often requires an iterative approach to accurately complete.

Data Presentation

This type of flow monitoring project generates a large volume of data. To facilitate review of the data, results have been provided in graphical and tabular formats. The flow data is presented graphically in the form of scattergraphs and hydrographs. Hydrographs are based on 15-minute averaging. Tables are provided in 5-minute format. These tables show the flow rate for each day, along with the daily minimum and maximums, the times they were observed, the total daily flow, and total flow for the month (or monitoring period). The following explanation of terms may aid in interpretation of the flow data table and hydrograph.

DEPTH - Final calculated depth measurement (in inches)

QUANTITY - Final calculated flow rate (in MGD)

VELOCITY - Final calculated flow velocity (in feet per second)

REPORT TOTAL - Total volume of flow recorded for the indicated time period (in MG)

DUV_SWRMH428

Site Commentary

SITE INFORMATION

Pipe	Elliptical (7.88 in H x 8 in W)
Silt	0.00 (in)

OBSERVATIONS

This site functioned under normal conditions during the study period. No surcharge conditions were experienced at this location.

5-min flow depth, velocity, and quantity data observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Average	1.87	0.74	0.031
Minimum	0.80	0.14	0.002
Maximum	3.99	2.72	0.225
Min Time	06/15/2023 2:50:00 AM	06/17/2023 4:40:00 AM	06/17/2023 4:40:00 AM
Max Time	04/11/2023 6:50:00 PM	04/26/2023 8:20:00 PM	04/11/2023 7:40:00 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions are based on the five minutes intervals.

Values in the graphical reports are based on the fifteen minutes average.

Values in the tabular report are based on the five minutes intervals.

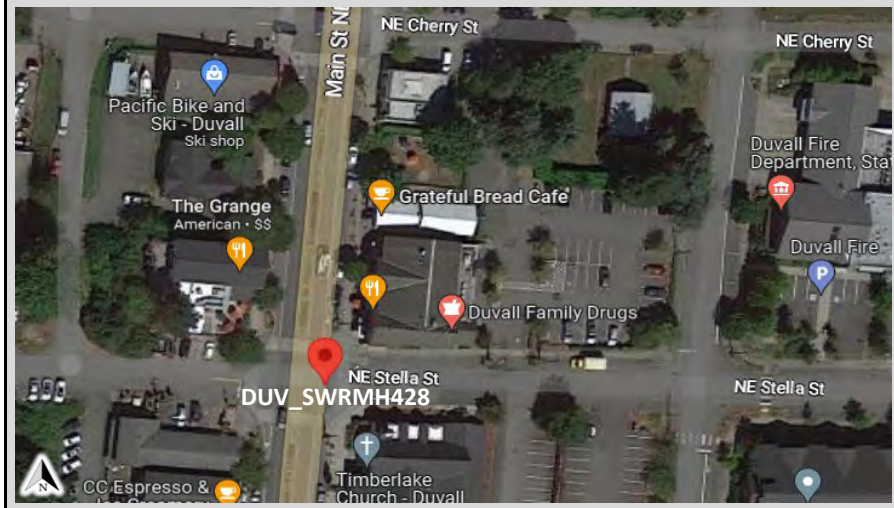
DATA UPTIME

Data uptime observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023** is provided in the following table:

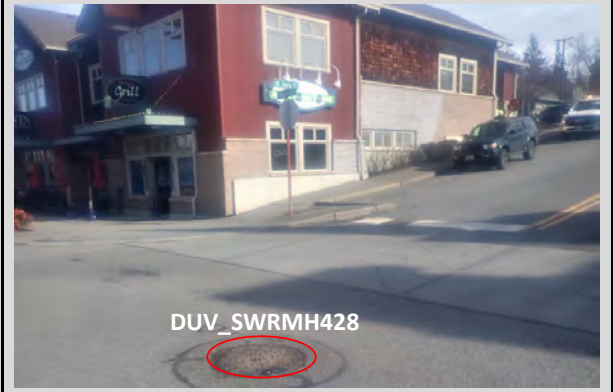
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100

Duvall.Parametrix.TFM.WA23		Site Name
Flow Monitoring Site Report		DUV_SWRMH428

Site Address /Location:	Main St NE, Duvall, WA		Monitor Series	TRITON+	Location Type	Temporary
Site Access Details:	Main St NE and NE Stella St SW Intersection	Latitude:	47.739361	Pipe Size (H x W)	Pipe Shape	
		Longitude:	-121.986000	7.88 x 8.00	Elliptical	



Manhole #	SWRMH428	System Characteristics	Commercial
Access	Drive		Traffic
			Medium



Installation Information	
Installation Date:	Wednesday, March 1, 2023
Installation Type:	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Upstream 0-5 FT
Sensors / Devices:	Peak Combo (CS4), Smart Depth (CS5)
Monitor Location:	Manhole
Pressure Sensor Range (psi)	0 - 5 psi

Installation Confirmation:	
Time	10:51:00 AM
Depth of Flow (Wet DOF) (in)	2.13
CS5 Physical Offset (in)	1.38
Measurement Confidence (in)	0.25"
Peak Velocity (fps)	1.41
Velocity Sensor Offset (in)	N/A
Silt (in)	0
Silt Type	







Manhole / Pipe Information:	
Manhole Depth (Approx. FT):	8
Manhole Configuration	Single
Manhole Material:	Concrete
Manhole Condition:	Good
Manhole Opening Diameter (in)	24
Manhole Diameter (Approx.):	26
Manhole Cover	Steel
Manhole Frame	Normal
Active Connections	No
Air Quality:	Normal
Pipe Material	PVC
Pipe Condition:	Good

Communication Information:	
Communication Type	Wireless
Antenna Location	Manhole Pick / Vent Hole

ADS Project Name:	Duvall.Parametrix.TFM.WA23
ADS Project Number:	22905.11 .325

Additional Site Info. / Comments:	

Additional Photos

Monitoring Point Inlet	Outlet	
		
Top Down	Location	
		
KEY		
<p style="text-align: center;">→ Flow Direction</p> <p style="text-align: center;">⊗ Monitoring Point</p>		

Hydrograph Report

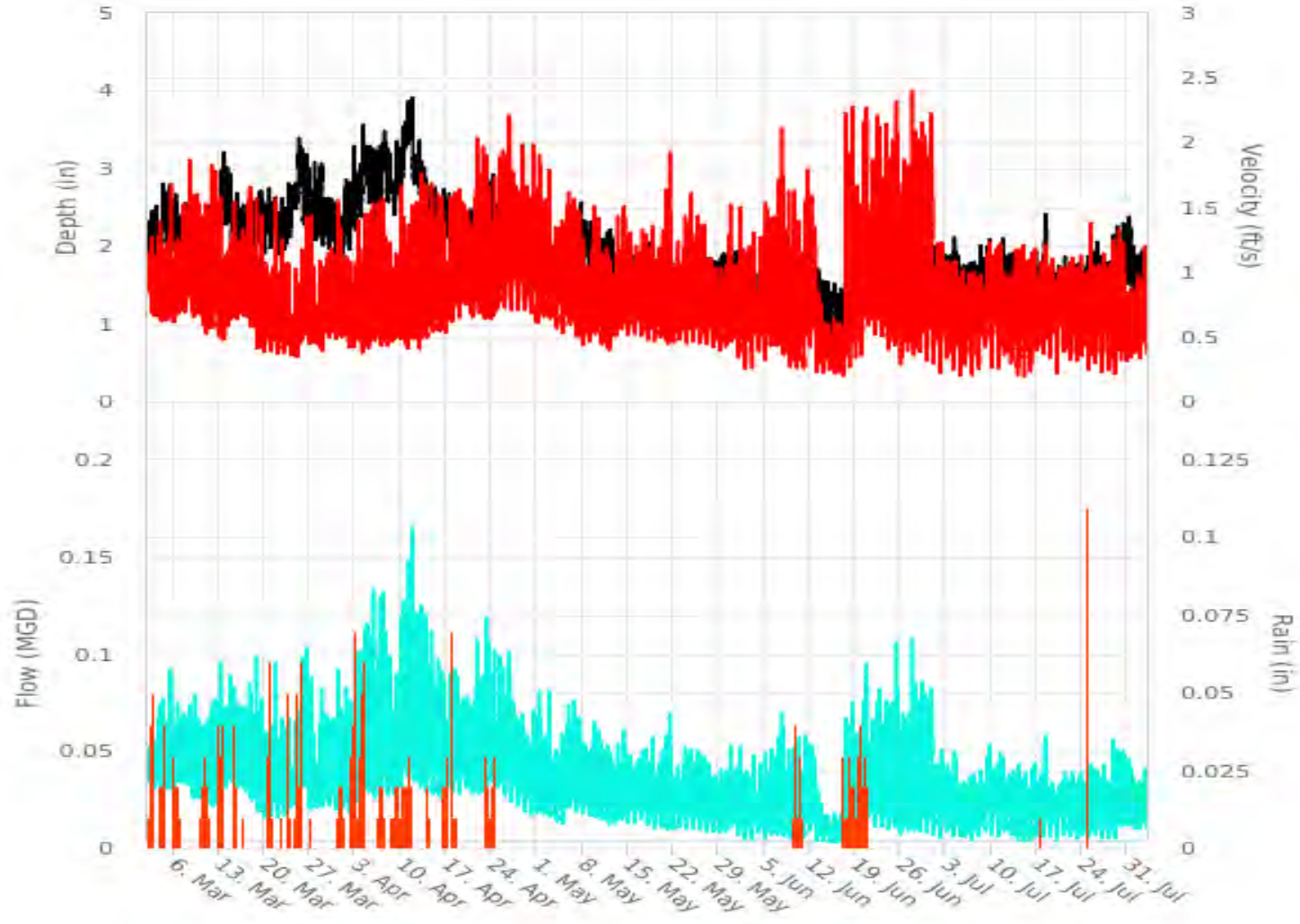
DUV_SWRMH428

Flow Monitor
DUV_SWRMH428

Pipe Height
7.88
in

Report Period
03/02/2023
To
08/02/2023

Legend
— DFINAL
— Rain
— VFINAL
— QFINAL



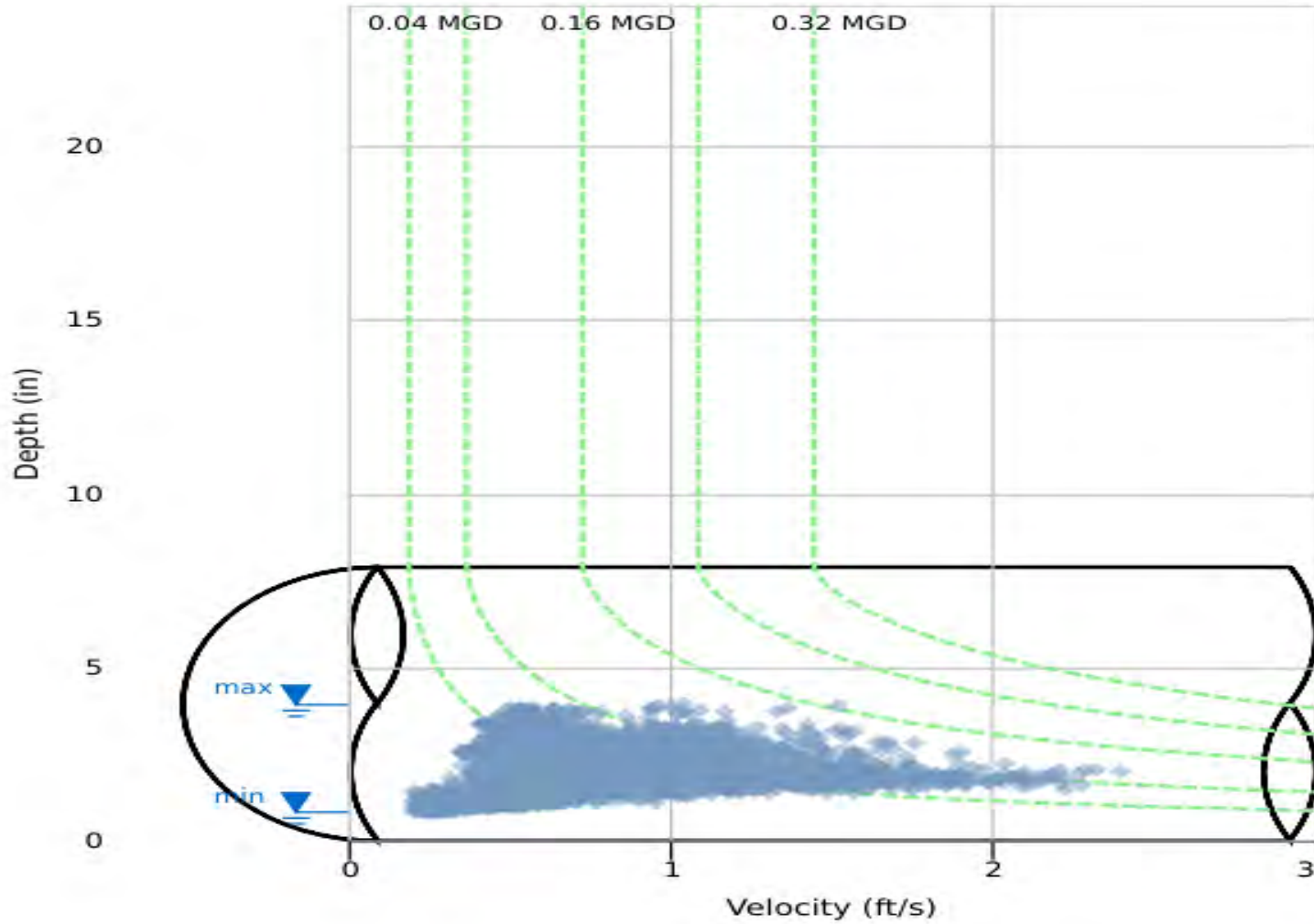
Scattergraph Report DUV_SWRMH428

Flow Monitor
DUV_SWRMH428

Pipe Height
7.88
in

Report Period
03/02/2023
To
08/02/2023

Legend
◇ DFINAL - VFINAL
- - Iso-Q™
▾ Min-Max Depth



Daily Tabular Report

03/02/2023 00:00 - 08/02/2023 23:59

DUV_SWRMH428Pipe: Elliptical (7.88 in H x 8 in W), Silt0.00 in

Date	Time	DFINAL (in)				VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
		Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
03/02/2023	01:10	1.72	17:15	2.58	2.03	20:45	0.60	17:30	2.18	0.90	03:50	0.030	17:30	0.108	0.040	0.040	0.30
03/03/2023	02:50	1.89	10:05	2.58	2.13	21:30	0.60	18:50	2.26	0.86	22:45	0.028	22:25	0.123	0.042	0.042	0.11
03/04/2023	04:00	1.99	14:20	3.15	2.34	20:40	0.56	09:00	2.06	0.73	06:25	0.027	08:50	0.137	0.041	0.041	0.29
03/05/2023	03:05	2.00	10:00	2.88	2.25	23:10	0.58	15:35	2.33	0.80	23:10	0.027	10:00	0.162	0.042	0.042	0.17
03/06/2023	01:50	1.95	08:45	3.09	2.18	05:25	0.54	16:00	2.14	0.76	05:25	0.025	16:00	0.140	0.038	0.038	0.05
03/07/2023	03:20	1.86	19:25	2.69	2.11	07:00	0.62	16:05	2.34	0.90	04:20	0.032	07:05	0.127	0.043	0.043	-
03/08/2023	08:55	1.69	20:30	2.71	1.98	20:30	0.62	08:55	2.57	0.96	23:35	0.024	09:00	0.108	0.042	0.042	-
03/09/2023	12:10	1.68	09:35	2.73	1.87	04:05	0.61	12:50	2.51	1.01	04:05	0.024	09:40	0.125	0.041	0.041	-
03/10/2023	00:40	1.75	19:15	2.44	1.91	17:15	0.54	19:55	2.27	0.89	13:35	0.023	16:40	0.101	0.037	0.037	0.19
03/11/2023	13:55	1.77	09:35	2.92	1.97	00:40	0.47	18:35	2.54	0.89	02:40	0.020	19:55	0.120	0.039	0.039	0.04
03/12/2023	04:35	1.76	09:00	2.43	1.95	23:40	0.48	07:00	2.30	0.86	23:40	0.019	12:55	0.119	0.037	0.037	0.41
03/13/2023	00:50	1.84	20:05	3.36	2.60	14:25	0.45	07:00	2.07	0.59	02:35	0.020	07:00	0.127	0.038	0.038	0.54
03/14/2023	23:30	2.06	07:35	3.09	2.52	01:10	0.54	20:00	2.23	0.72	01:55	0.029	20:25	0.160	0.044	0.044	-
03/15/2023	23:30	1.88	18:15	2.94	2.24	11:30	0.59	08:50	2.38	0.79	23:30	0.029	08:50	0.128	0.041	0.041	0.10
03/16/2023	03:05	1.92	13:25	2.58	2.18	11:30	0.61	19:55	2.28	0.83	11:30	0.029	05:55	0.130	0.042	0.042	0.01
03/17/2023	02:40	1.88	18:40	2.72	2.12	20:00	0.51	12:55	2.21	0.78	21:30	0.024	18:10	0.111	0.038	0.038	-
03/18/2023	01:20	1.86	16:40	2.77	2.22	23:25	0.38	08:50	2.23	0.70	23:25	0.019	19:15	0.135	0.036	0.036	-
03/19/2023	23:50	1.97	12:15	2.81	2.32	23:15	0.37	07:35	1.96	0.59	23:15	0.017	13:45	0.121	0.033	0.033	-
03/20/2023	03:30	1.90	19:15	2.91	2.25	00:05	0.36	11:35	1.91	0.57	00:05	0.015	06:55	0.111	0.030	0.030	0.30
03/21/2023	01:20	1.97	18:35	2.73	2.29	02:35	0.37	20:10	2.11	0.57	02:35	0.016	20:10	0.130	0.031	0.031	0.04
03/22/2023	01:20	1.86	18:55	2.73	2.22	00:45	0.35	15:55	1.95	0.57	01:35	0.015	17:35	0.120	0.030	0.030	0.01
03/23/2023	03:55	1.95	17:10	2.87	2.25	02:20	0.35	13:40	1.97	0.59	03:55	0.015	13:40	0.123	0.032	0.032	0.09
03/24/2023	00:00	2.10	22:05	2.88	2.55	00:25	0.34	21:15	1.69	0.51	00:00	0.019	21:15	0.116	0.032	0.032	0.44
03/25/2023	00:00	2.53	08:55	3.48	2.89	00:30	0.33	16:25	1.60	0.53	00:00	0.021	20:55	0.135	0.039	0.039	0.21
03/26/2023	23:35	2.09	12:00	3.32	2.63	17:55	0.44	14:25	2.10	0.63	23:10	0.022	13:20	0.150	0.041	0.041	0.02
03/27/2023	03:15	2.03	19:00	3.37	2.37	23:55	0.41	14:05	2.11	0.55	23:55	0.019	08:25	0.122	0.031	0.031	-
03/28/2023	23:55	2.02	20:05	3.19	2.40	21:00	0.37	15:25	1.98	0.55	02:05	0.020	20:10	0.161	0.032	0.032	-
03/29/2023	23:25	1.96	10:15	2.76	2.27	00:45	0.44	20:35	2.13	0.64	00:45	0.020	19:40	0.131	0.035	0.035	-
03/30/2023	23:55	1.91	06:30	2.64	2.23	06:25	0.48	16:20	2.13	0.64	02:35	0.021	16:20	0.127	0.033	0.033	-
03/31/2023	03:35	1.83	08:50	2.59	2.18	00:30	0.44	08:40	2.05	0.64	01:35	0.018	08:40	0.122	0.032	0.032	0.26
04/01/2023	04:35	1.88	09:35	3.02	2.23	23:50	0.42	14:30	2.10	0.64	23:50	0.019	15:30	0.158	0.033	0.033	-
04/02/2023	04:15	1.96	21:45	3.36	2.49	20:05	0.39	08:25	1.83	0.54	04:20	0.017	08:25	0.126	0.033	0.033	0.63
04/03/2023	02:15	2.20	18:05	3.10	2.67	02:25	0.44	11:00	2.05	0.60	02:25	0.022	18:05	0.162	0.040	0.040	0.26
04/04/2023	00:00	2.45	18:10	3.63	3.05	02:50	0.35	20:15	1.98	0.62	02:50	0.023	18:10	0.183	0.050	0.050	0.43
04/05/2023	23:55	2.36	19:15	3.53	2.82	01:50	0.40	21:15	2.17	0.71	02:50	0.026	19:15	0.194	0.051	0.051	-
04/06/2023	01:40	2.32	20:15	3.38	2.70	00:40	0.44	20:15	2.05	0.68	01:45	0.024	20:15	0.187	0.047	0.047	0.48
04/07/2023	01:00	2.50	12:55	3.60	3.06	08:20	0.41	21:05	2.16	0.70	01:00	0.026	18:40	0.184	0.057	0.057	0.23
04/08/2023	04:25	2.56	09:05	3.31	2.74	14:15	0.41	08:40	2.24	0.57	01:40	0.026	08:40	0.180	0.040	0.040	0.08
04/09/2023	03:00	2.36	18:45	3.56	2.77	03:00	0.45	12:55	2.26	0.62	03:00	0.025	12:10	0.167	0.044	0.044	0.52
04/10/2023	01:15	2.59	19:10	3.79	3.17	23:20	0.40	05:10	2.21	0.63	01:20	0.030	11:50	0.185	0.053	0.053	0.53
04/11/2023	23:55	2.89	18:50	3.99	3.58	02:40	0.39	19:55	2.07	0.66	23:40	0.034	19:40	0.225	0.065	0.065	0.20
04/12/2023	20:50	2.75	23:15	3.42	2.93	23:35	0.39	08:55	2.25	0.74	00:35	0.032	08:55	0.193	0.055	0.055	-
04/13/2023	23:55	2.56	07:20	3.16	2.80	02:05	0.46	17:10	2.41	0.75	02:05	0.030	08:25	0.177	0.053	0.053	0.02
04/14/2023	23:50	2.31	08:05	2.85	2.57	00:20	0.46	18:30	2.50	0.80	02:25	0.027	21:00	0.163	0.051	0.051	0.01
04/15/2023	23:35	2.15	08:35	2.97	2.42	01:50	0.49	20:35	2.56	0.81	01:50	0.026	19:40	0.160	0.047	0.047	-
04/16/2023	02:05	2.11	10:40	2.98	2.39	02:35	0.52	08:05	2.56	0.83	02:35	0.025	11:35	0.152	0.048	0.048	0.23
04/17/2023	22:50	2.10	12:15	3.15	2.31	01:40	0.50	17:25	2.54	0.86	02:05	0.025	17:25	0.152	0.047	0.047	0.12
04/18/2023	02:30	2.00	20:05	2.82	2.20	00:50	0.59	08:25	2.57	0.98	00:50	0.027	08:25	0.158	0.050	0.050	0.05
04/19/2023	02:15	1.92	20:35	2.54	2.17	03:15	0.62	17:50	2.55	1.01	03:15	0.026	14:25	0.128	0.051	0.051	-
04/20/2023	03:20	1.91	20:05	2.54	2.10	23:00	0.66	13:20	2.15	1.02	03:20	0.029	13:20	0.098	0.049	0.049	-
04/21/2023	23:55	1.94	06:15	2.43	2.10	07:00	0.58	18:30	2.56	1.05	01:20	0.027	18:30	0.140	0.050	0.050	-
04/22/2023	02:30	1.86	15:50	2.46	2.04	13:10	0.57	18:15	2.64	1.05	12:55	0.027	07:20	0.129	0.048	0.048	0.19
04/23/2023	01:20	2.02	10:10	3.03	2.48	05:35	0.59	12:05	2.49	0.94	02:50	0.027	12:05	0.168	0.058	0.058	0.40
04/24/2023	08:40	2.08	06:50	2.96	2.39	02:45	0.58	05:00	2.41	0.85	02:45	0.032	07:00	0.154	0.048	0.048	0.29
04/25/2023	23:40	1.84	07:05	2.43	2.10	02:05	0.60	19:30	2.53	1.02	02:05	0.026	07:50	0.131	0.049	0.049	-
04/26/2023	23:40	1.71	08:50	2.16	1.88	02:45	0.66	20:20	2.72	1.17	02:45	0.024	17:35	0.127	0.048	0.048	-
04/27/2023	23:35	1.60	20:55	2.13	1.76	04:10	0.65	20:50	2.66	1.13	04:10	0.022	08:20	0.111	0.042	0.042	-
04/28/2023	23:40	1.50	08:20	2.25	1.65	02:30	0.63	07:30	2.70	1.08	02:30	0.020	07:30	0.114	0.037	0.037	-
04/29/2023	04:40	1.38	09:25	1.89	1.59	07:35	0.66	12:30	2.60	1.01	04:30	0.018	12:30	0.091	0.033	0.033	-
04/30/2023	04:15	1.33	10:15	2.22	1.61	23:10	0.58	15:00	2.60	1.04	02:35	0.016	10:15	0.123	0.035	0.035	-
05/01/2023	23:20	1.51	09:50	2.12	1.73	00:35	0.56	07:10	2.55	1.00	03:45	0.018	07:10	0.106	0.037	0.037	-
05/02/2023	02:35	1.39	21:05	2.15	1.64	01:50	0.61	19:25	2.52	0.98	02:35	0.016	21:05	0.103	0.034	0.034	-
05/03/2023	03:30	1.33	21:05	2.12	1.63	03:35	0.58	12:55	1.79	0.92	03:35	0.015	20:45	0.068	0.031	0.031	-
05/04/2023	04:05	1.30	20:40	1.98	1.60	03:10	0.54	21:20	2.09	0.88	03:10	0.013	21:20	0.090	0.029	0.029	-
05/05/2023	03:00	1.28	19:50	2.15	1.75	02:50	0.50	21:50	2.21	0.84	02:50	0.012	21:50	0.100	0.032	0.032	-
05/06/2023	04:55	1.67	20:20	2.53	1.95	02:30	0.55	18:30	2.14	0.76	04:55	0.019	18:30				

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
05/12/2023	03:40	1.57	08:25	2.28	1.86	03:15	0.38	09:15	1.96	0.64	03:15	0.012	09:15	0.090	0.026	0.026	-
05/13/2023	03:40	1.36	10:55	1.88	1.69	05:10	0.47	12:00	2.23	0.78	03:35	0.012	12:00	0.084	0.028	0.028	-
05/14/2023	03:35	1.35	09:20	2.20	1.69	03:00	0.54	10:55	2.49	0.85	03:35	0.014	11:20	0.102	0.031	0.031	-
05/15/2023	03:45	1.34	23:10	1.94	1.67	01:30	0.49	12:20	1.87	0.77	01:30	0.013	12:20	0.069	0.027	0.027	-
05/16/2023	03:40	1.29	20:35	1.98	1.67	03:40	0.48	23:15	2.03	0.81	03:40	0.012	23:15	0.075	0.028	0.028	-
05/17/2023	03:30	1.33	20:50	1.91	1.66	01:10	0.49	21:15	2.24	0.76	02:00	0.014	21:15	0.088	0.027	0.027	-
05/18/2023	03:20	1.25	11:30	2.78	1.65	01:40	0.45	17:00	2.09	0.76	01:40	0.011	21:15	0.092	0.026	0.026	-
05/19/2023	03:10	1.23	23:15	2.26	1.60	04:00	0.46	18:45	2.07	0.73	04:00	0.010	18:45	0.072	0.024	0.024	-
05/20/2023	04:25	1.19	09:55	1.89	1.60	01:25	0.46	21:20	2.47	0.77	03:35	0.010	21:20	0.088	0.026	0.026	-
05/21/2023	03:10	1.21	21:40	1.80	1.57	05:05	0.42	12:15	2.47	0.80	04:55	0.009	12:15	0.087	0.026	0.026	-
05/22/2023	03:20	1.20	15:45	1.80	1.58	03:35	0.42	02:10	1.66	0.74	01:45	0.010	02:10	0.055	0.024	0.024	-
05/23/2023	03:00	1.20	19:50	1.80	1.58	02:30	0.46	21:20	2.31	0.75	02:40	0.010	21:20	0.084	0.024	0.024	-
05/24/2023	03:05	1.20	07:10	1.83	1.55	02:15	0.44	19:55	2.39	0.74	02:25	0.010	09:10	0.075	0.024	0.024	-
05/25/2023	02:10	1.21	22:15	1.88	1.56	02:35	0.43	21:10	2.40	0.77	02:35	0.009	21:10	0.077	0.025	0.025	-
05/26/2023	02:45	1.20	09:10	1.81	1.54	02:40	0.43	06:00	2.29	0.74	02:40	0.009	06:00	0.081	0.024	0.024	-
05/27/2023	04:55	1.09	09:55	1.98	1.51	05:05	0.39	20:10	1.82	0.71	05:05	0.008	20:10	0.062	0.022	0.022	-
05/28/2023	04:35	1.13	09:45	1.87	1.50	05:10	0.40	07:15	1.48	0.68	05:10	0.008	14:30	0.049	0.021	0.021	-
05/29/2023	03:15	1.09	19:15	2.01	1.54	05:05	0.38	19:10	1.21	0.69	04:20	0.007	19:10	0.051	0.022	0.022	-
05/30/2023	03:10	1.09	19:55	1.93	1.52	02:40	0.38	20:40	1.97	0.67	02:40	0.008	20:30	0.068	0.021	0.021	-
05/31/2023	02:10	1.17	20:35	2.19	1.53	00:05	0.38	16:40	1.84	0.66	02:10	0.010	21:10	0.065	0.021	0.021	-
06/01/2023	03:55	1.06	20:25	1.93	1.43	04:35	0.22	10:10	2.01	0.66	04:35	0.004	10:10	0.069	0.019	0.019	-
06/02/2023	04:25	1.02	07:00	1.76	1.39	02:40	0.21	20:30	1.98	0.63	02:40	0.004	07:05	0.068	0.017	0.017	-
06/03/2023	05:25	0.93	09:40	1.86	1.39	05:40	0.19	10:10	1.98	0.65	05:40	0.003	10:10	0.073	0.018	0.018	-
06/04/2023	05:50	1.10	12:00	1.82	1.41	06:45	0.29	09:45	2.23	0.72	06:45	0.006	09:45	0.079	0.020	0.020	-
06/05/2023	04:10	0.96	09:30	1.67	1.33	04:20	0.28	10:15	2.13	0.67	04:20	0.004	07:20	0.063	0.017	0.017	-
06/06/2023	03:55	1.00	07:30	1.75	1.40	02:25	0.36	07:20	2.34	0.71	02:25	0.006	21:20	0.085	0.020	0.020	-
06/07/2023	02:15	1.01	19:55	1.80	1.38	00:40	0.32	07:00	2.24	0.74	03:30	0.007	19:55	0.084	0.021	0.021	-
06/08/2023	03:05	1.02	08:15	1.76	1.43	04:35	0.33	13:50	2.35	0.69	02:35	0.006	13:50	0.081	0.020	0.020	-
06/09/2023	05:25	1.03	10:40	2.12	1.48	04:20	0.19	18:50	2.12	0.66	04:20	0.003	18:00	0.071	0.020	0.020	0.20
06/10/2023	02:30	1.12	11:00	1.94	1.50	02:55	0.23	11:05	2.35	0.65	02:25	0.005	11:05	0.097	0.020	0.020	0.20
06/11/2023	03:20	1.24	09:35	1.97	1.54	04:30	0.23	10:35	2.38	0.75	04:30	0.006	10:35	0.093	0.024	0.024	-
06/12/2023	04:45	1.13	21:20	1.77	1.42	04:45	0.35	14:40	2.40	0.75	04:45	0.007	21:15	0.078	0.021	0.021	-
06/13/2023	03:55	0.99	08:30	1.81	1.30	03:25	0.17	20:00	1.49	0.47	03:25	0.003	20:00	0.046	0.012	0.012	-
06/14/2023	03:20	0.95	07:15	1.68	1.24	02:10	0.19	08:35	1.11	0.38	02:10	0.003	08:35	0.031	0.009	0.009	-
06/15/2023	02:50	0.80	20:30	1.54	1.21	02:40	0.21	18:15	1.20	0.40	02:40	0.003	18:15	0.031	0.009	0.009	-
06/16/2023	04:05	0.85	21:15	1.56	1.17	00:30	0.19	17:15	0.68	0.37	00:35	0.003	19:40	0.020	0.008	0.008	0.10
06/17/2023	04:05	0.82	12:55	1.75	1.26	04:40	0.14	15:05	2.33	0.58	04:40	0.002	20:55	0.076	0.015	0.015	0.11
06/18/2023	05:15	1.02	10:25	1.72	1.37	04:50	0.18	10:30	2.44	0.86	04:50	0.003	10:25	0.085	0.024	0.024	0.22
06/19/2023	04:10	1.00	19:55	1.87	1.43	04:35	0.30	19:50	2.41	0.83	04:40	0.005	19:50	0.096	0.024	0.024	0.16
06/20/2023	01:40	1.07	11:50	1.98	1.59	02:25	0.28	19:40	2.49	1.00	02:25	0.005	19:40	0.106	0.034	0.034	0.60
06/21/2023	01:10	1.38	21:10	1.83	1.58	00:35	0.52	08:40	2.44	0.91	00:35	0.014	08:40	0.094	0.030	0.030	-
06/22/2023	03:15	1.23	20:25	1.95	1.55	02:45	0.49	20:25	2.51	0.97	03:25	0.011	20:25	0.108	0.032	0.032	-
06/23/2023	03:25	1.22	18:10	1.84	1.54	03:15	0.49	20:50	2.37	0.89	03:15	0.011	18:10	0.091	0.029	0.029	-
06/24/2023	04:15	1.17	11:45	1.98	1.60	04:45	0.37	21:35	2.35	0.84	04:20	0.009	11:45	0.100	0.029	0.029	-
06/25/2023	02:40	1.34	10:15	2.16	1.70	04:50	0.41	10:10	2.51	0.87	04:50	0.010	10:10	0.118	0.033	0.033	-
06/26/2023	03:20	1.28	18:50	2.02	1.65	02:50	0.22	18:50	2.23	0.75	02:50	0.006	18:50	0.100	0.027	0.027	-
06/27/2023	02:00	1.28	20:25	2.11	1.62	04:10	0.39	20:25	2.50	0.90	04:10	0.009	20:25	0.119	0.031	0.031	-
06/28/2023	03:05	1.27	21:35	2.07	1.66	03:15	0.33	11:20	2.37	0.87	03:05	0.008	09:05	0.099	0.031	0.031	-
06/29/2023	04:50	1.24	19:50	2.13	1.63	04:10	0.31	17:45	2.30	0.90	04:10	0.008	10:00	0.093	0.031	0.031	-
06/30/2023	02:10	1.30	08:50	2.02	1.64	02:30	0.22	19:10	2.41	0.91	02:30	0.005	08:40	0.102	0.032	0.032	-
07/01/2023	03:20	1.26	12:00	2.05	1.62	04:55	0.22	11:25	1.57	0.65	04:55	0.005	11:25	0.066	0.023	0.023	-
07/02/2023	04:55	1.25	11:10	2.03	1.63	04:00	0.21	10:10	1.59	0.68	04:00	0.005	10:10	0.060	0.024	0.024	-
07/03/2023	04:05	1.28	00:00	2.11	1.67	14:35	0.26	08:10	1.59	0.67	02:25	0.008	08:10	0.064	0.024	0.024	-
07/04/2023	04:05	1.27	09:00	2.19	1.67	05:35	0.18	14:30	1.55	0.67	05:35	0.004	14:30	0.059	0.024	0.024	-
07/05/2023	11:55	1.09	18:50	1.94	1.41	06:25	0.19	17:50	1.48	0.66	06:25	0.005	18:50	0.048	0.018	0.018	-
07/06/2023	02:45	1.02	19:50	1.86	1.49	01:50	0.25	18:50	1.60	0.68	01:50	0.005	19:15	0.050	0.020	0.020	-
07/07/2023	03:10	1.11	10:15	1.86	1.50	03:05	0.16	16:20	1.46	0.66	03:05	0.003	21:25	0.049	0.020	0.020	-
07/08/2023	02:25	1.13	10:45	2.07	1.57	03:55	0.22	10:20	1.34	0.66	03:10	0.005	10:20	0.058	0.022	0.022	-
07/09/2023	03:50	1.12	19:15	2.13	1.62	05:20	0.34	19:05	1.56	0.72	05:20	0.007	19:05	0.068	0.025	0.025	-
07/10/2023	04:10	1.23	16:10	1.96	1.64	04:40	0.18	07:25	1.60	0.71	04:40	0.005	18:35	0.057	0.024	0.024	-
07/11/2023	02:35	1.21	21:15	2.21	1.60	03:30	0.23	07:15	1.57	0.69	03:30	0.006	09:40	0.063	0.023	0.023	-
07/12/2023	02:10	1.19	18:35	2.02	1.59	04:50	0.19	13:35	1.60	0.69	04:50	0.004	13:35	0.054	0.023	0.023	-
07/13/2023	04:15	1.14	09:20	1.98	1.58	01:30	0.18	19:20	1.60	0.67	01:45	0.004	10:05	0.056	0.022	0.022	-
07/14/2023	01:40	1.07	13:05	1.88	1.51	03:05	0.16	23:05	1.57	0.68	03:05	0.003	11:30	0.059	0.021	0.021	-
07/15/2023	03:00	0.95	10:30	2.23	1.40	03:25	0.18	18:30	1.56	0.69	03:10	0.003	09:25	0.049	0.019	0.019	-
07/16/2023	06:10	0.98	21:35	2.15	1.43	04:40	0.19	19:05	1.58	0.69	04:40	0.004	19:05	0.053	0.020	0.020	-
07/17/2023	02:00	1.00	09:05	1.80	1.43	04:00	0.18	22:35	1.58	0.71	04:00	0.003	18:40	0.053	0.020	0.020	0.01
07/18/2023	03:15	0.92	09:55	2.56	1.62	03:20	0.24</										

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
07/25/2023	03:15	1.15	08:30	2.05	1.58	02:00	0.22	20:20	1.60	0.68	03:15	0.005	21:50	0.062	0.022	0.022	-
07/26/2023	03:30	1.23	09:45	2.29	1.60	00:25	0.22	09:35	1.59	0.67	02:50	0.005	19:35	0.056	0.022	0.022	-
07/27/2023	03:25	1.17	08:25	1.91	1.51	02:50	0.20	08:55	1.54	0.66	03:25	0.004	08:40	0.055	0.020	0.020	-
07/28/2023	01:45	1.16	20:35	2.29	1.58	04:25	0.19	14:10	1.58	0.63	02:35	0.004	19:20	0.065	0.021	0.021	-
07/29/2023	05:35	1.22	09:20	2.30	1.77	00:35	0.19	19:15	1.60	0.65	05:30	0.004	10:30	0.071	0.026	0.026	-
07/30/2023	02:50	1.34	10:50	2.43	1.73	02:50	0.18	08:35	1.46	0.64	02:50	0.004	10:05	0.067	0.024	0.024	-
07/31/2023	13:15	1.46	08:05	2.44	1.81	14:50	0.28	09:50	1.19	0.64	14:50	0.010	09:50	0.059	0.025	0.025	-
08/01/2023	05:55	1.39	20:55	1.93	1.65	04:55	0.32	16:15	1.51	0.63	05:55	0.009	22:05	0.052	0.021	0.021	-
08/02/2023	02:00	1.15	20:40	2.05	1.59	00:35	0.25	18:55	1.49	0.63	00:35	0.007	09:15	0.050	0.020	0.020	-

03/02/2023 00:00 - 08/02/2023 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			4.755	10.23
Average	1.87	0.74	0.031	



DUV_SWRMH430

Site Commentary

SITE INFORMATION

Pipe	Elliptical (8.13 in H x 8 in W)
Silt	0.00 (in)

OBSERVATIONS

This site functioned under poor hydraulic conditions during the study period. The flow conditions were shallow and very fast; therefore, lower confidence level in this data set. No surcharge conditions were experienced at this location.

5-min flow depth, velocity, and quantity data observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Average	1.02	4.75	0.082
Minimum	0.72	1.21	0.015
Maximum	1.57	7.84	0.211
Min Time	05/12/2023 3:40:00 AM	07/12/2023 3:10:00 AM	07/14/2023 12:35:00 AM
Max Time	03/02/2023 7:05:00 PM	04/11/2023 10:05:00 AM	04/24/2023 7:05:00 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions are based on the five minutes intervals.

Values in the graphical reports are based on the fifteen minutes average.

Values in the tabular report are based on the five minutes intervals.

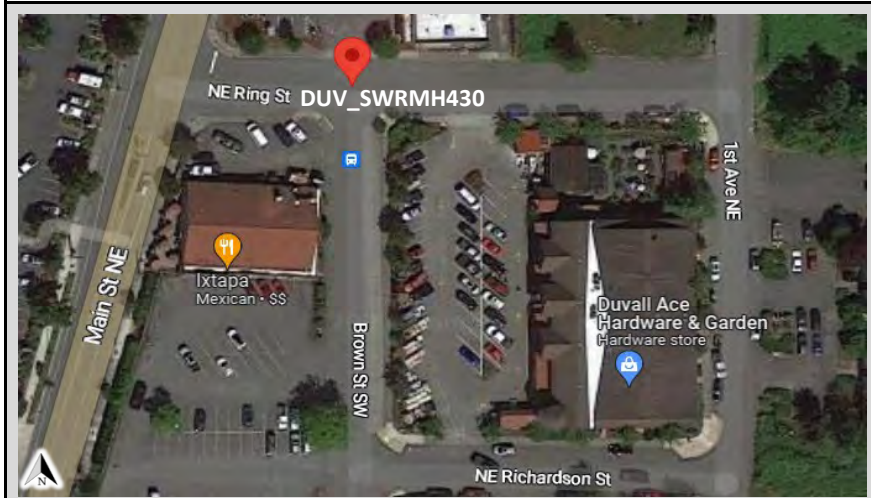
DATA UPTIME

Data uptime observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023** is provided in the following table:

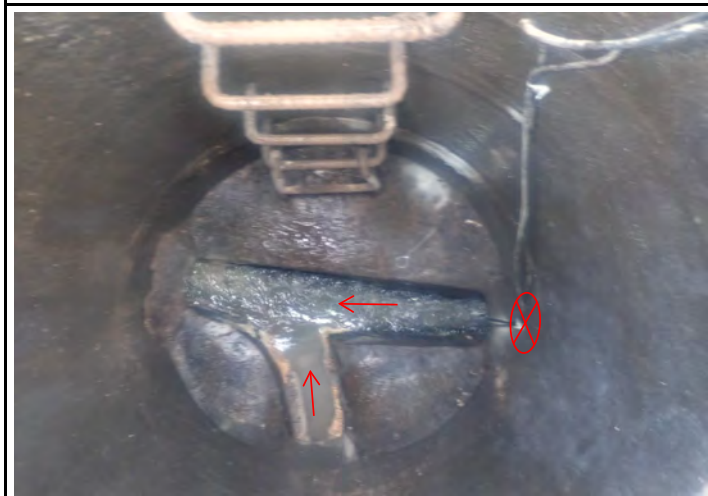
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100

Duvall.Parametrix.TFM.WA23		Site Name
Flow Monitoring Site Report		DUV_SWRMH430

Site Address /Location:	NE Ring St, Duvall, WA		Monitor Series	Location Type
Site Access Details:	NE Ring St and Brown St SW Intersection	Latitude:	TRITON+	Temporary
		Longitude:	Pipe Size (H x W)	Pipe Shape
			8.13 x 8.00	Elliptical



Manhole #	System Characteristics
SWRMH430	Commercial
Access	Traffic
Drive	Medium



Installation Information	
Installation Date:	Installation Type:
Wednesday, March 1, 2023	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4), Smart Depth (CS5)	0 - 5 psi

Installation Confirmation:	
Time	
9:16:00 AM	
Depth of Flow (Wet DOF) (in)	
1.00	
CS5 Physical Offset (in)	Measurement Confidence (in)
1.38	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
6.34	N/A
Silt (in)	Silt Type
0	








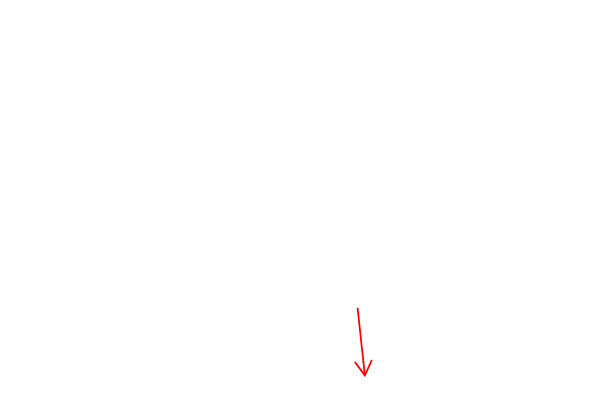
Manhole / Pipe Information:	
Manhole Depth (Approx. FT):	Manhole Configuration
8	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
24	26
Manhole Cover	Manhole Frame
Steel	Normal
Active Connections	Air Quality:
Yes, Inside	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:	
Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

ADS Project Name:	Duvall.Parametrix.TFM.WA23
ADS Project Number:	22905.11 .325

Additional Site Info. / Comments:

Additional Photos

Monitoring Point Inlet	Outlet	Side Connection
		
Top Down	Location	
		
	KEY	
	<p>→ Flow Direction</p> <p>⊗ Monitoring Point</p>	

Hydrograph Report

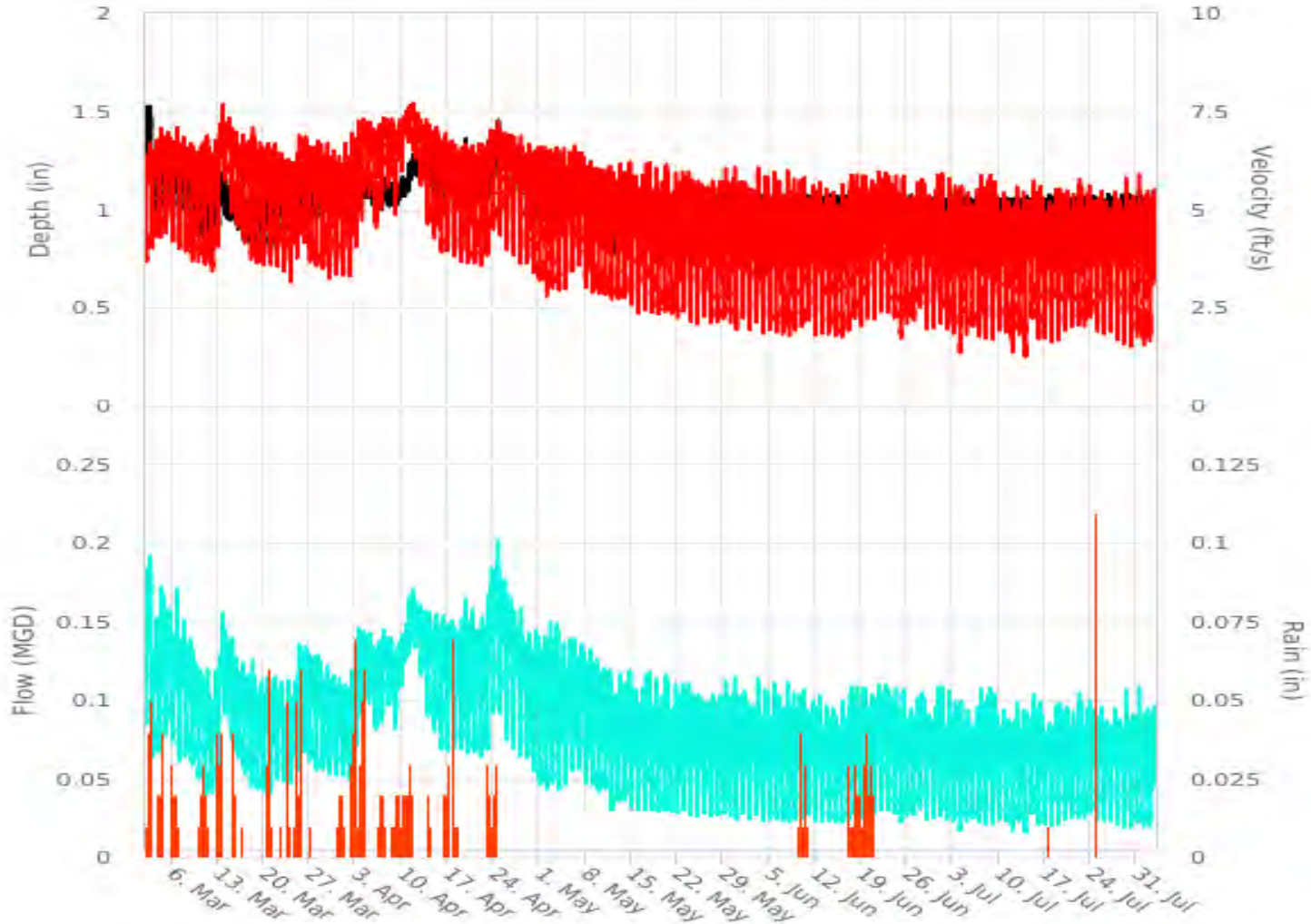
DUV_SWRMH430

Flow Monitor
DUV_SWRMH430



Report Period
03/02/2023
To
08/02/2023

Legend
— DFINAL
— Rain
— VFINAL
— QFINAL



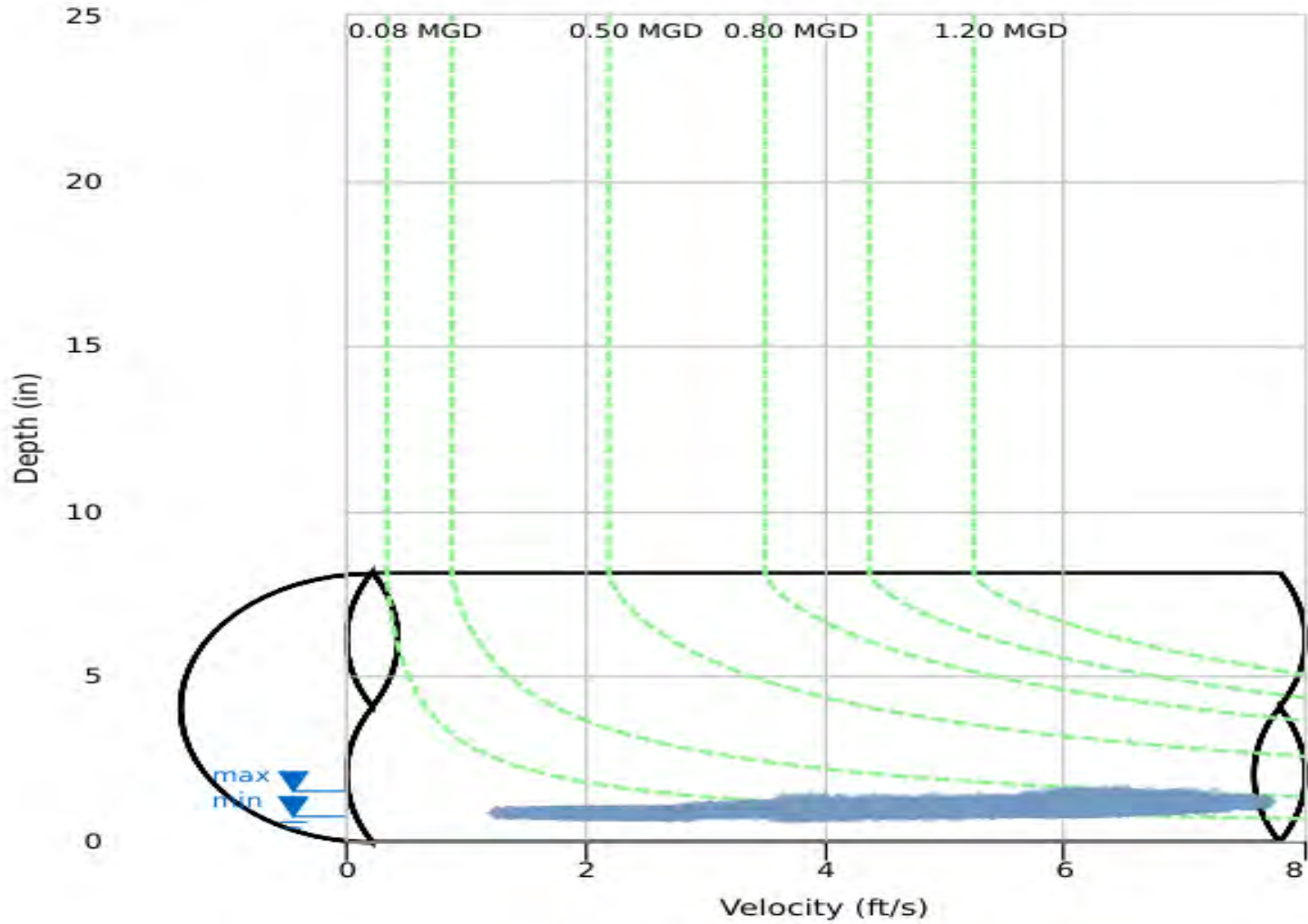
Scattergraph Report DUV_SWRMH430

Flow Monitor
DUV_SWRMH430

Pipe Height
8.13
in

Report Period
03/02/2023
To
08/02/2023

Legend
◇ DFINAL - VFINAL
- - Iso-Q™
Min-Max Depth



Daily Tabular Report

03/02/2023 00:00 - 08/02/2023 23:59

DUV_SWRMH430Pipe: Elliptical (8.13 in H x 8 in W), Silt0.00 in

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
03/02/2023	23:40	1.04	19:05	1.57	1.35	03:55	3.51	18:45	6.79	5.56	23:25	0.078	19:05	0.203	0.141	0.141	0.30
03/03/2023	04:40	0.94	19:30	1.29	1.12	01:55	3.91	17:55	6.88	5.78	01:55	0.061	19:30	0.160	0.112	0.112	0.11
03/04/2023	05:55	0.92	12:35	1.38	1.16	05:55	4.02	11:55	7.30	6.02	05:55	0.058	11:55	0.186	0.122	0.122	0.29
03/05/2023	00:50	1.02	13:55	1.34	1.16	03:35	4.13	16:40	7.24	5.97	03:35	0.073	13:55	0.174	0.122	0.122	0.17
03/06/2023	03:40	0.99	20:00	1.38	1.14	01:40	4.10	20:00	7.37	5.98	01:35	0.073	20:00	0.190	0.118	0.118	0.05
03/07/2023	03:05	0.92	20:35	1.28	1.10	02:50	3.91	20:30	7.11	5.88	03:05	0.058	20:35	0.159	0.111	0.111	-
03/08/2023	05:20	0.98	07:05	1.21	1.09	03:05	3.82	19:30	6.88	5.72	00:45	0.064	19:30	0.143	0.106	0.106	-
03/09/2023	23:45	0.93	18:30	1.18	1.03	05:10	3.46	18:30	6.80	5.51	05:10	0.053	18:30	0.140	0.094	0.094	-
03/10/2023	02:05	0.82	10:25	1.13	0.98	02:25	3.47	19:50	6.96	5.61	02:15	0.047	12:55	0.129	0.089	0.089	0.19
03/11/2023	03:40	0.75	12:05	1.10	0.91	03:20	3.48	10:05	7.06	5.50	03:40	0.038	12:05	0.126	0.079	0.079	0.04
03/12/2023	03:35	0.79	18:50	1.07	0.91	04:50	3.33	20:20	6.97	5.41	04:50	0.040	18:50	0.122	0.078	0.078	0.41
03/13/2023	02:35	0.81	17:05	1.21	1.03	02:35	3.85	20:25	7.81	6.39	02:35	0.046	20:25	0.161	0.111	0.111	0.54
03/14/2023	11:55	0.93	06:05	1.21	1.05	03:40	5.39	19:40	7.52	6.65	23:55	0.080	06:05	0.154	0.115	0.115	-
03/15/2023	00:20	0.93	06:50	1.20	1.02	02:30	4.47	19:55	7.30	6.22	02:30	0.069	06:50	0.151	0.103	0.103	0.10
03/16/2023	23:50	0.87	19:20	1.10	0.98	01:05	4.12	20:00	7.02	5.96	01:05	0.060	19:20	0.128	0.094	0.094	0.01
03/17/2023	01:55	0.82	17:05	1.09	0.95	01:10	3.95	06:30	7.17	5.78	01:10	0.050	17:05	0.125	0.087	0.087	-
03/18/2023	05:35	0.81	12:55	1.12	0.92	02:40	3.53	09:50	7.25	5.58	02:40	0.043	09:50	0.135	0.081	0.081	-
03/19/2023	04:05	0.79	12:00	1.07	0.92	00:40	3.54	16:50	6.93	5.30	05:20	0.042	16:50	0.119	0.077	0.077	-
03/20/2023	02:50	0.79	18:10	1.07	0.93	02:25	3.32	20:30	6.95	5.39	02:40	0.040	17:55	0.120	0.079	0.079	0.30
03/21/2023	00:40	0.79	08:55	1.11	0.93	03:10	3.47	20:20	6.75	5.38	03:15	0.041	19:50	0.117	0.080	0.080	0.04
03/22/2023	01:45	0.87	20:15	1.08	0.98	02:35	3.38	15:55	6.88	5.36	01:55	0.047	18:30	0.116	0.085	0.085	0.01
03/23/2023	05:00	0.84	19:25	1.10	0.95	01:40	3.31	19:25	6.83	5.10	04:10	0.046	19:25	0.127	0.078	0.078	0.09
03/24/2023	00:00	0.87	19:40	1.10	0.98	02:35	3.02	06:15	6.54	5.06	00:50	0.045	19:40	0.119	0.080	0.080	0.44
03/25/2023	01:30	0.89	13:35	1.17	1.05	02:25	3.60	09:40	6.99	5.71	01:30	0.052	13:35	0.142	0.100	0.100	0.21
03/26/2023	01:50	0.96	17:00	1.18	1.07	23:00	3.82	12:00	7.13	5.64	04:40	0.063	17:00	0.145	0.102	0.102	0.02
03/27/2023	00:00	1.00	06:05	1.17	1.07	03:55	3.37	20:25	6.84	5.55	03:55	0.056	06:05	0.137	0.099	0.099	-
03/28/2023	03:15	0.96	06:05	1.14	1.04	02:50	3.33	19:40	7.00	5.38	02:50	0.051	06:05	0.131	0.093	0.093	-
03/29/2023	08:20	0.96	19:00	1.12	1.04	00:05	3.29	19:10	7.06	5.26	00:05	0.053	19:10	0.131	0.091	0.091	-
03/30/2023	14:25	0.95	05:25	1.09	1.03	02:15	3.14	18:55	6.80	5.16	01:55	0.050	18:55	0.123	0.087	0.087	-
03/31/2023	23:55	0.92	06:25	1.09	1.03	01:50	3.16	13:25	6.76	5.08	03:00	0.048	13:25	0.122	0.086	0.086	0.26
04/01/2023	15:15	0.92	08:10	1.06	0.99	03:50	3.16	10:15	6.91	5.30	00:40	0.049	13:25	0.118	0.085	0.085	-
04/02/2023	01:10	0.91	17:55	1.11	1.01	01:10	3.10	10:40	7.33	5.25	01:10	0.042	10:40	0.124	0.087	0.087	0.63
04/03/2023	12:00	1.01	10:55	1.17	1.09	03:05	3.75	10:55	7.33	5.98	03:05	0.065	10:55	0.149	0.110	0.110	0.26
04/04/2023	09:40	1.04	05:55	1.18	1.10	00:30	4.35	06:10	7.49	6.58	00:30	0.083	05:55	0.153	0.122	0.122	0.43
04/05/2023	11:00	1.02	05:55	1.16	1.09	23:40	4.69	06:25	7.38	6.43	23:40	0.081	05:55	0.146	0.118	0.118	-
04/06/2023	12:35	1.00	18:20	1.14	1.06	03:30	4.03	18:45	7.38	6.18	02:55	0.072	19:30	0.143	0.110	0.110	0.48
04/07/2023	00:55	0.97	07:35	1.21	1.08	00:20	4.71	07:15	7.59	6.67	00:20	0.082	07:35	0.154	0.122	0.122	0.23
04/08/2023	05:00	1.00	09:00	1.15	1.06	23:50	5.19	13:05	7.56	6.55	23:50	0.085	09:00	0.144	0.115	0.115	0.08
04/09/2023	01:20	0.99	22:15	1.15	1.08	01:50	4.40	14:35	7.71	6.47	01:50	0.073	14:35	0.151	0.117	0.117	0.52
04/10/2023	01:20	1.06	05:35	1.19	1.11	01:30	5.67	20:00	7.77	6.95	01:30	0.101	19:35	0.157	0.131	0.131	0.53
04/11/2023	02:15	1.06	17:30	1.30	1.19	22:50	6.56	10:05	7.84	7.32	02:15	0.121	12:45	0.173	0.152	0.152	0.20
04/12/2023	23:15	1.14	17:15	1.29	1.22	23:05	5.82	10:10	7.59	6.90	23:15	0.114	07:55	0.166	0.148	0.148	-
04/13/2023	05:20	1.13	06:55	1.27	1.20	23:55	4.91	18:40	7.49	6.49	23:55	0.097	09:15	0.167	0.136	0.136	0.02
04/14/2023	23:55	1.09	17:30	1.27	1.19	23:55	4.36	08:35	7.52	6.11	23:55	0.080	08:35	0.162	0.127	0.127	0.01
04/15/2023	00:30	1.06	10:35	1.25	1.17	02:10	4.08	08:30	7.52	5.94	02:10	0.076	10:35	0.163	0.121	0.121	-
04/16/2023	23:50	0.99	10:40	1.28	1.15	04:05	3.72	17:00	7.30	5.76	04:00	0.066	10:40	0.164	0.115	0.115	0.23
04/17/2023	00:05	1.02	18:45	1.29	1.16	03:10	3.77	19:25	7.08	5.65	03:10	0.064	20:05	0.160	0.115	0.115	0.12
04/18/2023	05:05	1.06	18:20	1.27	1.19	03:25	3.62	21:20	6.82	5.45	01:35	0.067	20:05	0.151	0.114	0.114	0.05
04/19/2023	05:10	1.07	18:25	1.40	1.21	02:05	3.46	19:45	6.99	5.47	02:05	0.065	19:00	0.178	0.119	0.119	-
04/20/2023	04:15	1.06	20:50	1.35	1.18	00:20	3.46	20:35	6.97	5.40	00:20	0.063	20:35	0.167	0.112	0.112	-
04/21/2023	23:45	1.04	06:45	1.30	1.17	02:15	3.44	15:30	6.87	5.47	02:15	0.063	06:40	0.152	0.113	0.113	-
04/22/2023	01:50	1.05	08:55	1.30	1.17	03:00	3.42	08:55	6.92	5.41	01:40	0.062	08:55	0.164	0.111	0.111	0.19
04/23/2023	00:20	1.03	17:00	1.40	1.23	02:35	3.56	17:35	7.37	5.84	04:30	0.063	17:35	0.192	0.130	0.130	0.40
04/24/2023	00:10	1.14	19:05	1.48	1.30	03:25	4.22	19:05	7.41	6.25	03:25	0.087	19:05	0.211	0.150	0.150	0.29
04/25/2023	22:45	1.16	05:55	1.39	1.27	23:55	4.10	06:45	7.25	6.10	23:55	0.083	06:45	0.187	0.141	0.141	-
04/26/2023	02:30	1.07	06:55	1.37	1.22	04:05	3.86	17:40	7.18	5.83	02:30	0.072	20:10	0.181	0.127	0.127	-
04/27/2023	02:45	1.06	20:55	1.30	1.19	02:20	3.68	18:10	6.94	5.74	02:20	0.067	18:10	0.162	0.120	0.120	-
04/28/2023	02:50	1.04	06:20	1.30	1.15	03:25	3.35	07:40	7.20	5.58	03:25	0.059	06:05	0.165	0.112	0.112	-
04/29/2023	22:05	1.00	11:20	1.27	1.11	02:55	3.46	11:20	7.12	5.32	02:55	0.061	11:20	0.163	0.101	0.101	-
04/30/2023	04:10	0.97	11:00	1.27	1.12	02:35	3.28	19:35	7.02	5.19	04:10	0.051	19:35	0.155	0.101	0.101	-
05/01/2023	02:40	0.92	18:10	1.23	1.07	03:20	3.07	05:55	6.91	5.10	02:40	0.044	18:10	0.148	0.093	0.093	-
05/02/2023	03:35	0.93	18:20	1.30	1.10	03:35	2.58	17:55	6.86	5.01	03:35	0.038	18:20	0.159	0.095	0.095	-
05/03/2023	23:55	0.94	18:15	1.31	1.07	01:45	2.91	18:10	6.99	4.86	23:55	0.045	18:15	0.163	0.089	0.089	-
05/04/2023	00:55	0.90	19:55	1.23	1.06	01:45	2.84	19:50	6.99	4.91	00:55	0.041	19:50	0.151	0.088	0.088	-
05/05/2023	01:45	0.96	17:50	1.23	1.08	01:40	2.81	17:30	6.72	5.02	01:40	0.043	17:30	0.145	0.092	0.092	-
05/06/2023	03:30	0.97	11:10	1.22	1.08	01:45	3.22	11:10	6.72	5.14	03:40	0.052	11:10	0.14			

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
05/12/2023	02:10	0.72	12:30	1.11	0.96	02:10	2.57	06:10	6.43	4.52	02:10	0.026	06:10	0.115	0.070	0.070	-
05/13/2023	02:25	0.84	09:25	1.13	1.00	02:25	2.56	09:25	6.38	4.56	02:25	0.032	09:25	0.123	0.076	0.076	-
05/14/2023	02:20	0.84	08:25	1.13	0.99	05:00	2.57	20:00	6.40	4.38	02:20	0.032	20:00	0.124	0.071	0.071	-
05/15/2023	01:30	0.84	07:45	1.13	0.98	04:10	2.47	07:45	6.33	4.47	02:20	0.031	07:45	0.122	0.072	0.072	-
05/16/2023	00:15	0.84	20:25	1.13	0.98	03:00	2.24	20:25	6.27	4.26	03:00	0.028	20:25	0.121	0.069	0.069	-
05/17/2023	00:30	0.84	16:00	1.14	0.98	03:45	2.32	20:00	6.58	4.37	03:45	0.029	20:00	0.129	0.070	0.070	-
05/18/2023	00:20	0.84	19:15	1.13	0.97	03:30	2.27	19:15	6.33	4.13	03:30	0.028	19:15	0.122	0.066	0.066	-
05/19/2023	00:30	0.84	09:55	1.11	0.97	02:10	2.22	09:55	6.03	4.07	02:10	0.028	09:55	0.113	0.065	0.065	-
05/20/2023	00:20	0.84	08:40	1.15	0.97	01:50	2.29	08:40	6.68	4.12	01:50	0.029	08:40	0.132	0.066	0.066	-
05/21/2023	00:15	0.84	19:30	1.13	0.97	05:05	2.17	19:30	6.36	4.06	05:05	0.027	19:30	0.123	0.065	0.065	-
05/22/2023	00:05	0.84	19:30	1.13	0.97	03:25	2.12	19:30	6.40	4.15	03:25	0.027	19:30	0.124	0.066	0.066	-
05/23/2023	00:30	0.84	20:15	1.14	0.97	01:35	2.34	20:15	6.47	4.17	01:35	0.029	20:15	0.127	0.066	0.066	-
05/24/2023	00:20	0.84	07:30	1.13	0.97	03:50	2.02	07:30	6.43	4.13	03:50	0.025	07:30	0.124	0.066	0.066	-
05/25/2023	00:00	0.84	19:55	1.13	0.97	03:35	2.01	19:55	6.34	4.01	01:55	0.025	19:55	0.123	0.064	0.064	-
05/26/2023	00:45	0.84	15:10	1.13	0.97	04:00	2.12	17:30	6.42	4.11	02:50	0.027	17:30	0.124	0.066	0.066	-
05/27/2023	00:20	0.84	08:45	1.13	0.96	03:00	1.92	08:45	6.43	3.94	03:00	0.024	08:45	0.124	0.062	0.062	-
05/28/2023	00:25	0.84	11:55	1.11	0.96	02:40	1.92	12:10	6.12	3.82	02:40	0.024	12:10	0.115	0.060	0.060	-
05/29/2023	00:20	0.84	09:45	1.14	0.96	02:15	2.10	10:15	6.56	4.02	00:55	0.026	10:15	0.128	0.064	0.064	-
05/30/2023	00:20	0.84	07:25	1.13	0.97	03:40	1.88	14:50	6.42	4.00	03:40	0.024	14:50	0.124	0.063	0.063	-
05/31/2023	00:10	0.84	05:50	1.12	0.97	02:20	1.87	05:50	6.20	4.09	02:20	0.023	05:50	0.118	0.065	0.065	-
06/01/2023	00:30	0.84	06:10	1.13	0.97	01:40	2.02	06:10	6.41	4.05	01:40	0.025	06:10	0.124	0.064	0.064	-
06/02/2023	00:10	0.84	19:05	1.13	0.97	02:30	1.88	19:05	6.28	4.05	02:30	0.024	19:05	0.121	0.065	0.065	-
06/03/2023	00:20	0.84	08:25	1.13	0.97	02:50	2.00	08:25	6.42	3.88	02:50	0.025	08:25	0.124	0.062	0.062	-
06/04/2023	00:50	0.84	08:55	1.13	0.97	04:05	1.75	08:55	6.43	4.03	04:05	0.022	08:55	0.124	0.064	0.064	-
06/05/2023	00:00	0.84	18:00	1.12	0.96	02:35	1.84	18:30	6.26	3.96	02:35	0.023	18:30	0.119	0.063	0.063	-
06/06/2023	00:00	0.84	16:25	1.11	0.97	02:30	1.73	16:25	6.07	3.86	02:30	0.022	16:25	0.114	0.061	0.061	-
06/07/2023	00:05	0.84	20:00	1.13	0.97	03:20	1.58	20:00	6.34	4.02	03:20	0.020	20:00	0.123	0.064	0.064	-
06/08/2023	00:10	0.84	20:00	1.14	0.97	03:15	1.31	20:00	6.43	3.98	03:15	0.016	20:00	0.126	0.063	0.063	-
06/09/2023	00:05	0.84	16:40	1.10	0.96	01:35	1.83	18:55	5.95	3.89	01:25	0.023	18:55	0.110	0.061	0.061	0.20
06/10/2023	00:05	0.84	10:20	1.12	0.96	03:10	1.93	10:20	6.18	3.92	02:10	0.024	10:20	0.118	0.062	0.062	0.20
06/11/2023	00:45	0.84	20:05	1.11	0.96	04:40	1.83	20:05	6.02	3.96	04:40	0.023	20:05	0.113	0.062	0.062	-
06/12/2023	00:00	0.84	07:15	1.12	0.96	01:55	1.72	07:15	6.16	3.95	01:50	0.022	07:15	0.118	0.062	0.062	-
06/13/2023	00:00	0.84	17:25	1.11	0.96	02:50	1.77	17:25	6.11	3.85	02:50	0.022	17:25	0.115	0.060	0.060	-
06/14/2023	00:00	0.84	06:55	1.10	0.97	01:40	1.73	18:20	5.96	3.88	01:40	0.022	18:20	0.111	0.061	0.061	-
06/15/2023	00:15	0.84	21:15	1.12	0.96	03:05	1.71	21:15	6.15	3.74	03:05	0.021	21:15	0.117	0.058	0.058	-
06/16/2023	00:10	0.84	07:15	1.12	0.96	04:00	1.57	07:15	6.13	3.84	04:00	0.020	07:15	0.117	0.060	0.060	0.10
06/17/2023	00:05	0.84	08:10	1.12	0.96	04:05	1.77	08:10	6.19	3.95	04:05	0.022	08:10	0.118	0.062	0.062	0.11
06/18/2023	00:00	0.84	08:40	1.13	0.97	04:15	1.92	08:40	6.34	3.94	04:15	0.024	08:40	0.122	0.063	0.063	0.22
06/19/2023	00:20	0.84	10:10	1.13	0.97	02:50	1.90	10:10	6.37	4.10	02:50	0.024	10:10	0.123	0.065	0.065	0.16
06/20/2023	00:05	0.84	18:50	1.14	0.98	00:45	2.14	18:50	6.54	4.28	00:45	0.027	18:50	0.128	0.069	0.069	0.60
06/21/2023	00:40	0.84	19:00	1.15	0.98	03:00	2.20	19:00	6.76	4.42	03:00	0.028	19:00	0.134	0.072	0.072	-
06/22/2023	00:40	0.84	11:05	1.13	0.98	03:10	2.32	11:05	6.43	4.35	03:10	0.029	11:05	0.124	0.070	0.070	-
06/23/2023	01:15	0.84	07:25	1.12	0.98	02:00	2.28	07:25	6.21	4.24	02:00	0.029	07:25	0.118	0.068	0.068	-
06/24/2023	00:00	0.84	10:45	1.12	0.97	03:30	2.08	10:45	6.15	3.98	02:50	0.026	10:45	0.117	0.063	0.063	-
06/25/2023	00:00	0.84	13:35	1.11	0.96	03:20	1.59	13:35	6.12	3.73	03:20	0.020	13:35	0.115	0.058	0.058	-
06/26/2023	00:00	0.84	06:50	1.11	0.96	02:00	1.86	14:30	6.09	4.00	02:00	0.023	14:30	0.115	0.063	0.063	-
06/27/2023	00:00	0.84	19:00	1.12	0.97	03:45	1.87	19:00	6.24	3.98	03:45	0.023	19:00	0.119	0.063	0.063	-
06/28/2023	01:40	0.84	08:30	1.13	0.98	03:00	2.40	08:30	6.35	4.21	01:40	0.030	08:30	0.123	0.067	0.067	-
06/29/2023	00:15	0.84	08:45	1.09	0.96	02:50	1.84	08:45	5.86	3.98	02:50	0.023	08:45	0.107	0.062	0.062	-
06/30/2023	00:00	0.84	17:55	1.11	0.97	02:20	1.80	17:55	6.03	3.99	02:20	0.023	17:55	0.113	0.064	0.064	-
07/01/2023	00:10	0.84	09:35	1.13	0.96	05:10	1.98	09:35	6.42	3.87	05:10	0.025	09:35	0.124	0.061	0.061	-
07/02/2023	00:00	0.84	10:15	1.11	0.96	03:55	1.78	10:25	6.07	3.65	03:55	0.022	10:25	0.114	0.057	0.057	-
07/03/2023	00:00	0.84	08:10	1.11	0.97	02:40	1.70	09:55	6.10	3.80	02:40	0.021	09:55	0.115	0.060	0.060	-
07/04/2023	00:15	0.84	08:40	1.11	0.96	03:30	1.25	08:40	6.10	3.57	02:00	0.016	08:40	0.115	0.056	0.056	-
07/05/2023	00:25	0.84	09:45	1.10	0.96	03:05	1.67	09:45	5.96	3.72	03:05	0.021	09:45	0.111	0.058	0.058	-
07/06/2023	00:00	0.84	18:55	1.12	0.96	03:30	1.73	18:55	6.21	3.74	03:25	0.022	18:55	0.118	0.059	0.059	-
07/07/2023	00:05	0.84	08:00	1.12	0.96	03:30	1.57	08:00	6.17	3.92	02:55	0.020	08:00	0.118	0.062	0.062	-
07/08/2023	01:00	0.84	17:45	1.13	0.97	02:45	1.39	17:55	6.41	4.03	02:45	0.017	17:55	0.124	0.064	0.064	-
07/09/2023	00:00	0.84	09:35	1.11	0.96	04:05	1.60	09:35	6.09	3.77	04:05	0.020	09:35	0.115	0.059	0.059	-
07/10/2023	00:20	0.84	08:40	1.11	0.96	03:35	1.77	08:40	6.02	3.77	03:35	0.022	08:40	0.113	0.059	0.059	-
07/11/2023	00:00	0.84	10:05	1.08	0.96	02:05	1.80	10:05	5.69	3.63	00:40	0.023	10:05	0.103	0.057	0.057	-
07/12/2023	00:10	0.84	18:55	1.10	0.97	03:10	1.21	18:55	5.98	3.73	03:10	0.015	18:55	0.111	0.059	0.059	-
07/13/2023	00:05	0.84	18:50	1.10	0.95	23:10	1.45	18:50	5.94	3.59	23:10	0.018	18:50	0.110	0.056	0.056	-
07/14/2023	00:00	0.84	07:05	1.12	0.96	00:35	1.22	07:05	6.16	3.75	00:00	0.015	07:05	0.117	0.059	0.059	-
07/15/2023	00:25	0.84	10:15	1.11	0.96	04:35	2.11	10:15	6.03	3.93	04:35	0.026	10:15	0.113	0.061	0.061	-
07/16/2023	00:05	0.84	10:40	1.09	0.96	03:20	1.51	16:40	5.88	3.70	03:20	0.019	16:40	0.108	0.058	0.058	-
07/17/2023	00:05	0.84	19:05	1.12	0.96	02:55	1.51	19:05	6.21	3.77	02:55	0.019	19:05	0.118	0.059	0.059	0.01
07/18/2023	00:00	0.84	18:35	1.11	0.96	03:30	1.46										

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
07/25/2023	00:00	0.84	08:25	1.11	0.96	03:35	1.40	08:25	6.03	3.89	03:35	0.018	08:25	0.113	0.061	0.061	-
07/26/2023	00:00	0.84	08:55	1.08	0.96	01:40	1.52	10:30	5.71	3.78	01:40	0.019	10:30	0.103	0.059	0.059	-
07/27/2023	00:00	0.84	05:40	1.08	0.96	03:25	1.54	18:10	5.70	3.93	03:25	0.019	10:30	0.103	0.061	0.061	-
07/28/2023	00:00	0.84	09:15	1.11	0.96	02:10	1.59	09:15	6.06	3.82	02:10	0.020	09:15	0.114	0.060	0.060	-
07/29/2023	00:00	0.84	08:40	1.13	0.96	01:50	1.48	08:40	6.27	3.88	01:50	0.018	08:40	0.121	0.061	0.061	-
07/30/2023	00:25	0.84	09:35	1.11	0.96	03:20	1.49	09:35	6.08	3.83	03:15	0.019	09:35	0.114	0.060	0.060	-
07/31/2023	00:05	0.84	10:15	1.12	0.96	02:30	1.69	10:15	6.13	3.96	02:30	0.021	10:15	0.117	0.062	0.062	-
08/01/2023	00:10	0.84	10:20	1.08	0.96	03:40	1.50	11:35	5.75	3.91	02:20	0.019	11:35	0.104	0.062	0.062	-
08/02/2023	00:25	0.84	13:15	1.10	0.96	03:45	1.50	13:15	5.90	3.90	02:20	0.019	13:15	0.110	0.061	0.061	-

03/02/2023 00:00 - 08/02/2023 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			12.672	10.23
Average	1.02	4.75	0.082	

DUV_SWRMH459

Site Commentary

SITE INFORMATION

Pipe	Elliptical (8.13 in H x 8 in W)
Silt	0.00 (in)

OBSERVATIONS

This site functioned under poor hydraulic conditions during the study period. The flow conditions were shallow and slow; therefore, lower confidence level in this data set. No surcharge conditions were experienced at this location.

5-min flow depth, velocity, and quantity data observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Average	1.62	1.27	0.045
Minimum	0.61	0.08	0.002
Maximum	4.98	2.81	0.222
Min Time	06/06/2023 3:40:00 AM	08/02/2023 12:55:00 PM	07/31/2023 5:40:00 AM
Max Time	05/09/2023 9:45:00 AM	03/30/2023 11:45:00 AM	03/30/2023 11:45:00 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions are based on the five minutes intervals.

Values in the graphical reports are based on the fifteen minutes average.

Values in the tabular report are based on the five minutes intervals.

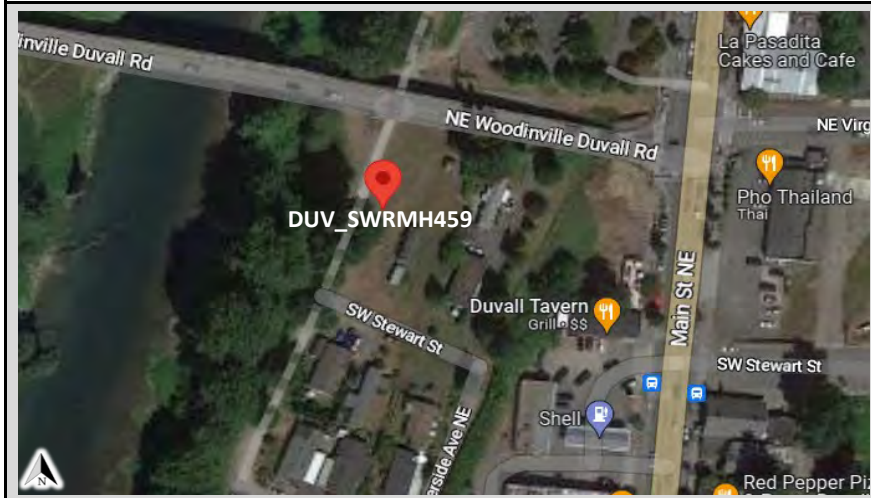
DATA UPTIME

Data uptime observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023** is provided in the following table:

Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100

Duvall.Parametrix.TFM.WA23		Site Name
Flow Monitoring Site Report		DUV_SWRMH459

Site Address /Location:	NE Ring St NE, Duvall, WA		Monitor Series	Location Type
Site Access Details:	NE Ring St and Brown St SW Intersection	Latitude:	TRITON+	Temporary
		Longitude:	Pipe Size (H x W)	Pipe Shape
			8.13 x 8.00	Elliptical



Manhole #	System Characteristics
SWRMH459	Commercial
Access	Traffic
Drive	Medium



Installation Information	
Installation Date:	Installation Type:
Wednesday, March 1, 2023	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4), Smart Depth (CS5)	0 - 5 psi

Installation Confirmation:	
Time	
1:52:00 PM	
Depth of Flow (Wet DOF) (in)	
1.75	
CS5 Physical Offset (in)	Measurement Confidence (in)
1.38	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
1.83	N/A
Silt (in)	Silt Type
0	



Manhole / Pipe Information:	
Manhole Depth (Approx. FT):	Manhole Configuration
8	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
24	26
Manhole Cover	Manhole Frame
Steel	Normal
Active Connections	Air Quality:
No	Normal
Pipe Material	Pipe Condition:
Concrete	Good

Communication Information:	
Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

ADS Project Name:	Duvall.Parametrix.TFM.WA23
ADS Project Number:	22905.11 .325

Additional Site Info. / Comments:

Additional Photos

<p>Monitoring Point Inlet</p>	<p>Outlet</p>	
		
<p>Top Down</p>	<p>Location</p>	
		
	<p>KEY</p>	
	<p>→ Flow Direction</p> <p>⊗ Monitoring Point</p>	

Hydrograph Report

DUV_SWRMH459

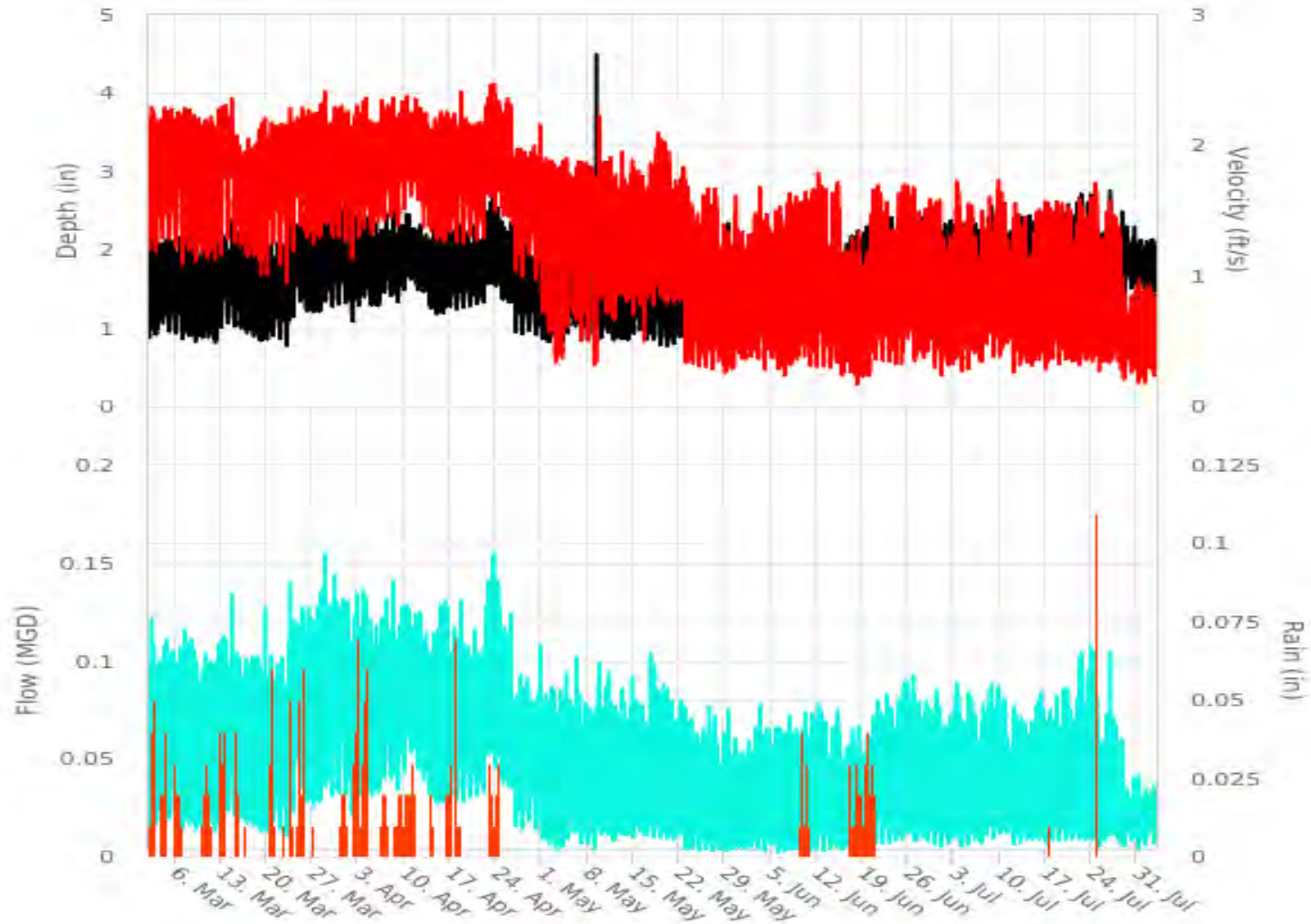
Flow Monitor
DUV_SWRMH459

Pipe Height
8.13
in

Report Period
03/02/2023
To
08/02/2023

Legend

- DFINAL
- Rain
- VFINAL
- QFINAL



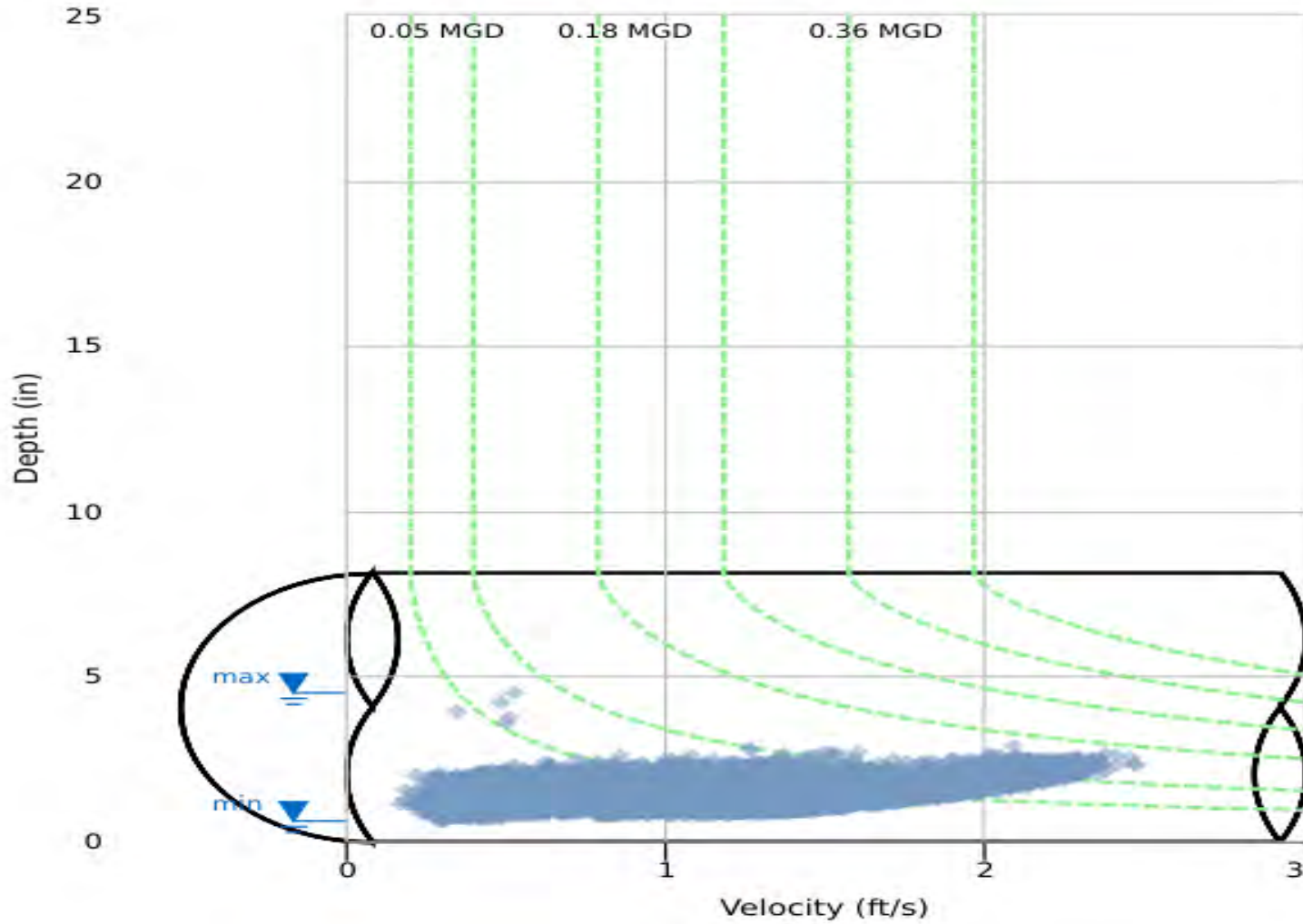
Scattergraph Report DUV_SWRMH459

Flow Monitor
DUV_SWRMH459

Pipe Height
8.13
in

Report Period
03/02/2023
To
08/02/2023

Legend
◇ DFINAL - VFINAL
- - - Iso-Q™
▲ Min-Max Depth



Daily Tabular Report

03/02/2023 00:00 - 08/02/2023 23:59

DUV_SWRMH459Pipe: Elliptical (8.13 in H x 8 in W), Silt0.00 in

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
03/02/2023	03:50	0.87	12:05	2.86	1.49	04:20	1.17	12:05	2.70	1.84	04:20	0.016	12:05	0.194	0.057	0.057	0.30
03/03/2023	05:10	0.91	18:30	2.56	1.48	04:35	1.02	21:25	2.50	1.80	04:35	0.015	17:45	0.144	0.055	0.055	0.11
03/04/2023	05:05	1.04	15:00	2.45	1.57	03:55	1.22	20:50	2.51	1.88	04:50	0.022	17:00	0.144	0.062	0.062	0.29
03/05/2023	05:05	0.94	18:00	2.67	1.54	02:20	0.99	19:10	2.56	1.85	02:20	0.016	18:00	0.162	0.060	0.060	0.17
03/06/2023	04:45	0.92	18:40	2.46	1.48	04:05	1.03	13:45	2.52	1.83	04:05	0.015	09:05	0.141	0.056	0.056	0.05
03/07/2023	04:50	0.86	12:15	2.61	1.45	03:10	1.02	12:15	2.53	1.78	03:05	0.014	12:15	0.161	0.054	0.054	-
03/08/2023	02:20	0.88	12:25	2.88	1.57	03:25	1.04	21:30	2.54	1.80	03:25	0.014	09:50	0.169	0.061	0.061	-
03/09/2023	04:15	0.82	08:35	2.50	1.41	03:25	0.95	09:30	2.48	1.73	03:25	0.012	07:05	0.145	0.051	0.051	-
03/10/2023	03:25	0.87	18:35	2.75	1.44	02:45	1.08	18:35	2.47	1.76	05:05	0.015	18:35	0.169	0.052	0.052	0.19
03/11/2023	03:10	0.87	12:45	2.37	1.46	02:40	1.05	12:20	2.47	1.75	03:15	0.014	12:20	0.134	0.054	0.054	0.04
03/12/2023	05:10	0.80	09:25	2.81	1.46	04:50	0.94	22:55	2.57	1.78	04:50	0.011	09:25	0.174	0.055	0.055	0.41
03/13/2023	01:25	1.00	20:15	2.79	1.63	03:05	1.02	11:35	2.56	1.94	03:05	0.017	11:35	0.177	0.068	0.068	0.54
03/14/2023	02:15	1.06	20:20	2.68	1.59	01:15	1.22	21:20	2.58	1.89	03:20	0.022	20:20	0.153	0.063	0.063	-
03/15/2023	03:25	1.01	20:40	2.64	1.63	03:35	1.16	12:15	2.47	1.68	03:35	0.019	12:15	0.144	0.058	0.058	0.10
03/16/2023	02:35	0.98	21:00	2.77	1.58	00:40	1.05	22:30	2.55	1.65	02:40	0.018	21:00	0.144	0.055	0.055	0.01
03/17/2023	01:05	0.92	07:45	2.80	1.57	01:10	1.07	07:20	2.33	1.63	01:10	0.016	18:45	0.160	0.054	0.054	-
03/18/2023	01:40	0.89	12:10	2.65	1.51	03:55	1.06	22:40	2.36	1.62	03:55	0.015	18:15	0.151	0.052	0.052	-
03/19/2023	03:45	0.83	19:30	2.86	1.44	05:25	0.76	13:35	2.48	1.74	05:25	0.009	19:30	0.171	0.053	0.053	-
03/20/2023	02:55	0.85	19:15	2.55	1.50	03:40	0.95	19:15	2.38	1.79	03:40	0.013	19:15	0.146	0.056	0.056	0.30
03/21/2023	02:00	0.88	10:40	2.58	1.45	00:25	1.04	17:25	2.42	1.80	02:05	0.016	10:40	0.138	0.054	0.054	0.04
03/22/2023	03:35	0.83	08:10	2.90	1.44	03:05	0.94	16:30	2.54	1.78	03:05	0.012	08:10	0.178	0.053	0.053	0.01
03/23/2023	03:40	0.77	15:15	2.78	1.54	02:30	0.85	14:55	2.62	1.72	03:55	0.009	14:55	0.179	0.058	0.058	0.09
03/24/2023	02:45	1.14	18:35	2.79	1.73	00:45	1.10	18:35	2.56	1.76	02:55	0.022	18:35	0.178	0.067	0.067	0.44
03/25/2023	04:35	1.33	11:35	2.81	1.84	03:45	1.27	11:15	2.53	1.88	03:45	0.032	11:35	0.177	0.076	0.076	0.21
03/26/2023	03:55	1.20	12:40	3.11	1.81	03:50	1.16	10:15	2.56	1.84	03:50	0.025	12:40	0.192	0.075	0.075	0.02
03/27/2023	03:40	1.20	20:25	3.00	1.78	03:50	1.09	19:45	2.59	1.84	03:50	0.023	20:25	0.188	0.073	0.073	-
03/28/2023	01:35	1.20	18:25	2.90	1.87	02:15	1.18	17:20	2.59	1.85	03:35	0.026	16:15	0.180	0.078	0.078	-
03/29/2023	02:30	1.34	19:10	2.98	1.88	01:05	1.30	06:25	2.48	1.86	01:05	0.033	19:10	0.180	0.078	0.078	-
03/30/2023	03:40	1.26	11:45	3.07	1.87	03:10	1.18	11:45	2.81	1.84	03:10	0.027	11:45	0.222	0.077	0.077	-
03/31/2023	03:50	1.29	17:20	3.15	1.89	04:35	1.25	20:50	2.64	1.83	02:45	0.030	20:50	0.206	0.077	0.077	0.26
04/01/2023	23:20	1.30	09:55	2.89	1.80	03:45	1.18	11:05	2.51	1.78	05:40	0.029	11:05	0.184	0.071	0.071	-
04/02/2023	04:10	1.08	20:50	2.89	1.78	03:20	1.00	21:40	2.57	1.82	03:20	0.018	20:50	0.176	0.073	0.073	0.63
04/03/2023	03:45	1.27	18:10	2.76	1.83	01:30	1.19	18:05	2.58	1.88	01:30	0.029	18:05	0.169	0.076	0.076	0.26
04/04/2023	00:05	1.36	12:45	2.92	1.88	03:20	1.29	08:15	2.49	1.92	00:05	0.033	07:45	0.161	0.080	0.080	0.43
04/05/2023	02:30	1.28	18:50	2.85	1.74	02:40	1.12	10:15	2.45	1.84	02:40	0.027	18:50	0.162	0.069	0.069	-
04/06/2023	02:50	1.28	19:15	2.67	1.79	03:20	1.15	08:05	2.56	1.88	03:20	0.027	18:00	0.162	0.074	0.074	0.48
04/07/2023	01:20	1.45	08:30	2.83	1.86	02:05	1.26	06:10	2.53	1.91	02:05	0.035	19:55	0.162	0.078	0.078	0.23
04/08/2023	02:55	1.41	09:10	3.01	1.82	03:00	1.21	10:00	2.64	1.89	03:00	0.032	09:10	0.187	0.075	0.075	0.08
04/09/2023	03:05	1.33	19:55	2.90	1.84	03:55	1.21	13:15	2.58	1.89	03:55	0.029	19:55	0.178	0.077	0.077	0.52
04/10/2023	03:15	1.48	08:30	2.82	1.91	03:40	1.31	16:50	2.55	1.94	03:40	0.038	16:50	0.173	0.082	0.082	0.53
04/11/2023	23:50	1.56	09:55	2.74	1.92	16:00	1.45	18:00	2.58	1.95	02:15	0.049	08:25	0.165	0.083	0.083	0.20
04/12/2023	03:25	1.48	09:05	2.72	1.77	23:45	1.46	09:45	2.50	1.87	03:05	0.043	09:45	0.161	0.071	0.071	-
04/13/2023	23:35	1.34	08:40	2.74	1.74	01:25	1.34	09:15	2.50	1.84	23:35	0.034	20:25	0.155	0.068	0.068	0.02
04/14/2023	02:40	1.24	13:00	2.78	1.70	02:55	1.15	17:05	2.61	1.80	02:55	0.026	06:45	0.153	0.066	0.066	0.01
04/15/2023	01:25	1.17	13:05	2.92	1.69	01:20	1.11	07:10	2.51	1.78	01:20	0.023	13:05	0.181	0.065	0.065	-
04/16/2023	01:55	1.18	10:15	2.86	1.74	05:50	1.06	19:15	2.55	1.81	02:00	0.024	14:25	0.162	0.069	0.069	0.23
04/17/2023	03:50	1.27	10:35	2.78	1.72	03:50	1.17	07:55	2.61	1.82	03:50	0.027	20:00	0.152	0.067	0.067	0.12
04/18/2023	01:20	1.23	09:50	2.95	1.68	02:50	1.18	18:40	2.56	1.82	02:50	0.027	09:50	0.178	0.066	0.066	0.05
04/19/2023	03:15	1.26	21:35	2.93	1.69	04:35	1.12	19:25	2.57	1.81	03:30	0.026	21:35	0.156	0.065	0.065	-
04/20/2023	02:55	1.28	18:15	2.68	1.71	03:05	1.15	08:35	2.55	1.81	03:05	0.027	18:15	0.158	0.067	0.067	-
04/21/2023	02:25	1.31	16:40	2.97	1.74	03:50	1.16	16:40	2.57	1.83	03:50	0.029	16:40	0.195	0.069	0.069	-
04/22/2023	03:55	1.30	18:40	2.93	1.85	03:50	1.18	16:15	2.69	1.87	03:50	0.029	22:15	0.181	0.077	0.077	0.19
04/23/2023	04:45	1.56	15:45	3.24	2.11	05:45	1.48	19:30	2.66	2.02	05:45	0.048	18:30	0.197	0.097	0.097	0.40
04/24/2023	03:35	1.52	07:40	3.00	1.99	02:50	1.41	11:20	2.72	2.02	02:50	0.043	11:20	0.193	0.090	0.090	0.29
04/25/2023	04:20	1.35	21:20	2.86	1.82	04:20	1.33	21:20	2.67	1.92	04:20	0.033	21:20	0.193	0.076	0.076	-
04/26/2023	23:55	1.16	09:15	2.80	1.62	23:50	1.25	07:20	2.50	1.75	23:50	0.027	09:15	0.161	0.059	0.059	-
04/27/2023	02:45	0.94	21:05	2.44	1.45	02:45	0.89	21:05	2.47	1.59	02:45	0.013	21:05	0.143	0.047	0.047	-
04/28/2023	03:20	0.92	09:25	2.52	1.46	04:05	0.85	08:55	2.51	1.53	03:20	0.013	08:55	0.139	0.046	0.046	-
04/29/2023	04:00	0.95	10:40	2.27	1.45	03:45	0.94	23:05	2.31	1.59	03:45	0.015	10:40	0.105	0.046	0.046	-
04/30/2023	05:20	0.91	19:20	2.52	1.50	03:50	0.84	19:25	2.53	1.60	03:50	0.012	19:20	0.145	0.051	0.051	-
05/01/2023	04:25	0.86	19:15	2.38	1.48	04:05	0.65	19:50	2.12	1.50	04:05	0.009	19:50	0.112	0.047	0.047	-
05/02/2023	04:25	0.81	19:20	2.59	1.46	04:20	0.55	15:40	2.15	1.45	04:20	0.007	15:40	0.129	0.046	0.046	-
05/03/2023	04:25	0.85	20:45	2.54	1.41	04:20	0.33	22:55	1.98	1.29	04:25	0.004	20:45	0.110	0.039	0.039	-
05/04/2023	02:25	0.82	11:55	2.68	1.38	04:00	0.36	06:05	2.01	1.25	02:10	0.004	20:20	0.109	0.038	0.038	-
05/05/2023	03:35	0.91	17:55	2.52	1.56	03:05	0.58	13:25	1.96	1.39	03:10	0.009	17:55	0.105	0.046	0.046	-
05/06/2023	06:15	0.98	11:00	2.62	1.49	07:00	0.62	17:35	1.97	1.42	06:05	0.010	11:00	0.118	0.044	0.044	-</

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
05/12/2023	02:05	0.84	17:40	2.64	1.32	05:40	0.66	17:40	2.06	1.15	02:05	0.008	17:40	0.133	0.032	0.032	-
05/13/2023	04:55	0.86	13:35	2.51	1.37	23:55	0.77	10:20	2.07	1.25	05:40	0.011	22:25	0.116	0.036	0.036	-
05/14/2023	05:25	0.84	21:40	2.48	1.43	08:15	0.75	23:00	2.10	1.26	05:25	0.010	22:30	0.106	0.039	0.039	-
05/15/2023	04:30	0.91	11:30	2.39	1.42	02:30	0.70	22:45	2.15	1.23	04:30	0.010	11:30	0.116	0.037	0.037	-
05/16/2023	01:10	0.95	09:05	2.62	1.46	16:20	0.37	05:05	2.05	1.25	16:20	0.008	09:05	0.114	0.038	0.038	-
05/17/2023	03:15	0.84	16:15	2.88	1.39	04:10	0.80	20:45	2.01	1.30	04:10	0.011	16:15	0.143	0.038	0.038	-
05/18/2023	03:25	0.84	07:25	2.44	1.40	01:25	0.76	13:10	2.36	1.30	02:55	0.010	21:50	0.127	0.039	0.039	-
05/19/2023	04:30	0.76	09:55	2.50	1.36	06:25	0.80	09:55	2.36	1.34	04:05	0.009	09:55	0.141	0.039	0.039	-
05/20/2023	05:20	0.75	22:45	2.67	1.43	05:10	0.77	21:55	2.43	1.27	05:20	0.008	22:45	0.147	0.039	0.039	-
05/21/2023	04:45	0.79	12:40	2.41	1.39	05:15	0.76	11:35	2.10	1.18	05:15	0.009	13:40	0.110	0.034	0.034	-
05/22/2023	04:50	0.88	15:10	2.50	1.43	03:30	0.80	21:40	2.26	1.25	03:30	0.011	15:10	0.132	0.038	0.038	-
05/23/2023	03:10	0.77	18:10	2.67	1.34	05:55	0.28	00:25	2.00	0.94	03:10	0.003	15:20	0.110	0.028	0.028	-
05/24/2023	04:35	0.74	20:25	2.43	1.39	05:10	0.31	22:50	1.75	0.82	02:00	0.004	19:35	0.096	0.026	0.026	-
05/25/2023	04:10	0.75	20:30	2.45	1.41	16:30	0.26	17:30	1.73	0.75	04:00	0.003	20:30	0.094	0.024	0.024	-
05/26/2023	03:40	0.80	10:15	2.47	1.40	11:05	0.25	13:55	1.84	0.82	03:00	0.003	07:30	0.094	0.026	0.026	-
05/27/2023	04:55	0.72	14:45	2.60	1.30	04:20	0.27	12:00	1.85	0.85	04:20	0.003	14:45	0.106	0.025	0.025	-
05/28/2023	04:20	0.65	22:20	2.59	1.30	22:35	0.28	01:00	1.81	0.74	04:20	0.003	22:20	0.100	0.021	0.021	-
05/29/2023	05:35	0.72	13:00	2.91	1.42	02:00	0.21	18:00	1.63	0.76	02:00	0.002	13:00	0.117	0.024	0.024	-
05/30/2023	04:05	0.84	22:30	2.27	1.32	03:30	0.26	17:35	1.86	0.72	04:30	0.004	19:55	0.084	0.021	0.021	-
05/31/2023	04:50	0.76	17:40	2.36	1.34	14:50	0.27	10:40	1.79	0.76	04:40	0.004	12:05	0.083	0.022	0.022	-
06/01/2023	05:00	0.73	17:50	2.68	1.32	06:35	0.26	14:55	1.81	0.71	03:50	0.004	17:50	0.110	0.020	0.020	-
06/02/2023	05:05	0.84	16:10	2.47	1.32	03:10	0.27	23:05	1.87	0.80	04:15	0.005	16:45	0.098	0.022	0.022	-
06/03/2023	05:25	0.80	12:45	2.66	1.36	15:30	0.17	08:30	1.84	0.92	15:30	0.003	12:45	0.114	0.028	0.028	-
06/04/2023	05:30	0.77	12:55	2.47	1.47	05:20	0.28	10:00	1.86	0.79	05:20	0.003	10:00	0.104	0.026	0.026	-
06/05/2023	04:15	0.85	14:00	2.39	1.39	07:10	0.32	16:20	1.81	0.79	04:15	0.005	20:35	0.098	0.024	0.024	-
06/06/2023	03:40	0.61	09:45	2.42	1.41	00:50	0.25	10:15	1.74	0.76	03:35	0.002	08:20	0.096	0.024	0.024	-
06/07/2023	04:30	0.84	08:00	2.56	1.44	03:50	0.22	18:55	1.83	0.83	03:55	0.003	17:40	0.095	0.027	0.027	-
06/08/2023	04:00	0.74	10:05	2.41	1.39	02:15	0.29	18:25	1.85	0.83	02:15	0.003	10:05	0.101	0.026	0.026	-
06/09/2023	05:00	0.69	10:05	2.40	1.38	10:10	0.27	19:35	1.84	0.89	02:40	0.003	09:35	0.093	0.027	0.027	0.20
06/10/2023	03:40	0.82	18:35	2.42	1.45	22:10	0.35	14:10	1.92	1.00	04:55	0.005	11:30	0.094	0.032	0.032	0.20
06/11/2023	03:50	0.72	14:00	2.37	1.43	02:50	0.30	10:55	1.97	1.03	02:50	0.003	12:55	0.100	0.034	0.034	-
06/12/2023	02:55	0.79	07:25	2.58	1.48	02:45	0.29	08:55	1.94	0.96	02:45	0.003	08:25	0.108	0.032	0.032	-
06/13/2023	04:30	0.67	07:40	2.31	1.42	03:40	0.27	09:30	1.89	0.85	03:50	0.003	07:40	0.097	0.027	0.027	-
06/14/2023	05:50	0.85	07:10	2.45	1.47	03:35	0.27	13:25	1.87	0.82	05:55	0.004	13:25	0.098	0.027	0.027	-
06/15/2023	02:00	0.87	08:20	2.31	1.42	05:20	0.30	10:55	1.88	0.82	05:20	0.005	08:20	0.099	0.026	0.026	-
06/16/2023	03:35	0.88	20:25	2.30	1.44	00:20	0.23	17:15	1.52	0.62	03:30	0.004	17:15	0.078	0.020	0.020	0.10
06/17/2023	03:55	0.90	12:05	2.38	1.60	14:35	0.25	12:25	1.88	0.66	05:55	0.004	12:25	0.100	0.024	0.024	0.11
06/18/2023	03:30	1.10	10:00	2.68	1.59	05:45	0.12	13:05	1.58	0.65	05:45	0.002	12:15	0.088	0.024	0.024	0.22
06/19/2023	04:55	1.05	08:05	2.82	1.61	05:25	0.21	21:25	1.61	0.66	05:25	0.004	08:05	0.102	0.024	0.024	0.16
06/20/2023	01:00	1.00	09:20	2.48	1.64	02:00	0.21	19:40	1.70	0.90	02:20	0.004	19:40	0.097	0.033	0.033	0.60
06/21/2023	04:05	1.07	08:50	2.70	1.60	14:25	0.27	23:40	1.87	1.05	03:50	0.006	08:50	0.121	0.037	0.037	-
06/22/2023	00:30	1.05	19:40	2.64	1.68	03:10	0.32	13:40	1.88	0.98	03:10	0.006	21:45	0.111	0.037	0.037	-
06/23/2023	05:40	1.12	12:20	2.84	1.79	21:35	0.27	17:55	1.87	0.77	05:40	0.006	11:15	0.123	0.033	0.033	-
06/24/2023	06:00	1.25	12:05	2.78	1.75	03:40	0.30	16:15	1.86	0.85	01:55	0.008	13:25	0.119	0.034	0.034	-
06/25/2023	06:35	1.25	12:45	2.70	1.77	01:25	0.27	14:20	1.88	1.13	01:25	0.007	09:25	0.112	0.046	0.046	-
06/26/2023	03:15	1.24	19:35	2.58	1.75	23:25	0.32	16:50	1.83	1.09	05:00	0.011	22:15	0.110	0.043	0.043	-
06/27/2023	04:05	1.25	11:20	2.74	1.80	14:10	0.27	02:45	1.79	0.83	03:45	0.007	08:50	0.107	0.034	0.034	-
06/28/2023	03:10	1.25	22:10	2.87	1.75	12:05	0.31	17:15	1.96	0.88	04:25	0.009	20:50	0.108	0.036	0.036	-
06/29/2023	04:00	1.15	12:20	2.99	1.76	14:30	0.33	01:10	1.77	0.87	03:50	0.008	22:50	0.107	0.036	0.036	-
06/30/2023	04:55	1.14	11:45	2.76	1.71	04:55	0.28	14:25	1.92	0.90	04:55	0.005	11:45	0.118	0.036	0.036	-
07/01/2023	05:05	1.12	16:35	2.89	1.72	04:15	0.23	09:35	1.72	0.71	04:15	0.005	09:35	0.107	0.028	0.028	-
07/02/2023	03:50	1.25	21:25	2.84	1.75	20:30	0.24	09:30	1.60	0.63	05:30	0.007	09:30	0.108	0.026	0.026	-
07/03/2023	22:30	1.36	15:25	2.69	1.76	00:30	0.26	08:40	1.82	0.84	01:35	0.009	08:40	0.116	0.034	0.034	-
07/04/2023	06:00	1.07	10:25	2.61	1.65	05:35	0.26	13:40	1.77	0.76	06:00	0.005	13:40	0.102	0.029	0.029	-
07/05/2023	03:55	1.16	20:05	2.70	1.76	03:25	0.27	19:05	1.70	0.89	04:00	0.006	07:30	0.103	0.036	0.036	-
07/06/2023	03:30	1.22	08:45	2.64	1.78	23:45	0.26	01:45	1.56	0.75	05:15	0.008	07:15	0.095	0.030	0.030	-
07/07/2023	07:10	1.13	16:45	2.82	1.74	22:15	0.28	22:10	1.64	0.81	07:10	0.006	16:45	0.116	0.033	0.033	-
07/08/2023	04:30	1.28	21:00	3.00	1.85	20:10	0.35	08:30	1.88	0.89	05:30	0.011	21:00	0.128	0.038	0.038	-
07/09/2023	02:35	1.30	19:40	2.61	1.86	12:40	0.31	22:55	1.89	0.93	02:20	0.008	23:25	0.113	0.040	0.040	-
07/10/2023	05:50	1.32	17:20	3.00	1.79	12:45	0.31	09:40	1.83	0.91	06:35	0.009	17:20	0.134	0.037	0.037	-
07/11/2023	01:35	1.30	15:45	2.90	1.70	11:35	0.29	11:30	1.83	0.81	00:15	0.009	08:05	0.109	0.030	0.030	-
07/12/2023	04:40	1.21	14:15	2.61	1.70	03:30	0.24	13:45	1.64	0.89	03:30	0.005	14:15	0.099	0.034	0.034	-
07/13/2023	02:40	1.27	08:50	2.74	1.78	02:20	0.27	12:45	1.74	0.86	02:20	0.006	20:40	0.103	0.035	0.035	-
07/14/2023	07:05	1.31	20:35	2.74	1.88	04:30	0.29	20:35	1.64	0.65	04:30	0.008	20:35	0.111	0.028	0.028	-
07/15/2023	03:05	1.36	10:35	2.81	1.82	00:40	0.23	20:55	1.74	0.85	01:35	0.008	14:40	0.104	0.036	0.036	-
07/16/2023	04:40	1.29	10:35	2.62	1.78	03:25	0.30	22:50	1.74	0.96	03:25	0.008	10:35	0.108	0.039	0.039	-
07/17/2023	04:20	1.22	20:05	2.71	1.75	03:50	0.27	08:40	1.71	0.92	03:50	0.007	20:05	0.103	0.037	0.037	0.01
07/18/2023	04:40	1.22	18:10	3.04	1.76	02:00	0.33	13:									

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
07/25/2023	05:25	1.10	12:10	2.63	1.68	05:30	0.25	10:10	1.61	0.78	05:30	0.005	10:10	0.092	0.029	0.029	-
07/26/2023	06:25	1.16	22:10	3.81	1.67	00:20	0.28	22:10	1.93	0.81	03:50	0.007	22:10	0.203	0.031	0.031	-
07/27/2023	04:20	1.24	09:05	2.55	1.74	00:25	0.30	07:40	1.84	0.91	01:25	0.008	09:05	0.101	0.036	0.036	-
07/28/2023	05:00	1.23	17:15	2.73	1.64	23:45	0.21	01:10	1.54	0.64	23:45	0.005	10:10	0.084	0.023	0.023	-
07/29/2023	00:25	1.24	15:10	2.54	1.79	05:10	0.13	13:00	1.13	0.47	05:10	0.004	09:50	0.043	0.018	0.018	-
07/30/2023	23:10	1.47	17:00	2.59	1.82	20:20	0.10	07:15	1.33	0.52	02:40	0.004	17:00	0.056	0.020	0.020	-
07/31/2023	04:15	1.23	14:30	2.37	1.76	05:40	0.09	08:35	1.36	0.48	05:40	0.002	08:35	0.062	0.018	0.018	-
08/01/2023	02:30	1.49	12:50	2.48	1.77	06:20	0.09	10:45	1.32	0.52	06:20	0.003	10:45	0.055	0.019	0.019	-
08/02/2023	16:00	1.40	21:10	2.28	1.78	12:55	0.08	20:40	1.28	0.49	12:55	0.003	12:30	0.056	0.018	0.018	-

03/02/2023 00:00 - 08/02/2023 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			6.969	10.23
Average	1.62	1.27	0.045	

DUV_SWRMH466

Site Commentary

SITE INFORMATION

Pipe	Elliptical (11.25 in H x 12 in W)
Silt	0.00 (in)

OBSERVATIONS

This site functioned under normal conditions during the study period. Daily backwater conditions were observed. Surge conditions were recorded at this location.

5-min flow depth, velocity, and quantity data observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)
Average	3.10	2.61	0.289
Minimum	1.29	0.87	0.034
Maximum	14.35	3.71	0.914
Min Time	06/08/2023 2:20:00 AM	07/16/2023 3:35:00 AM	07/04/2023 4:10:00 AM
Max Time	04/11/2023 7:45:00 AM	03/27/2023 11:05:00 PM	04/11/2023 7:45:00 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions are based on the five minutes intervals.

Values in the graphical reports are based on the fifteen minutes average.

Values in the tabular report are based on the five minutes.

DATA UPTIME

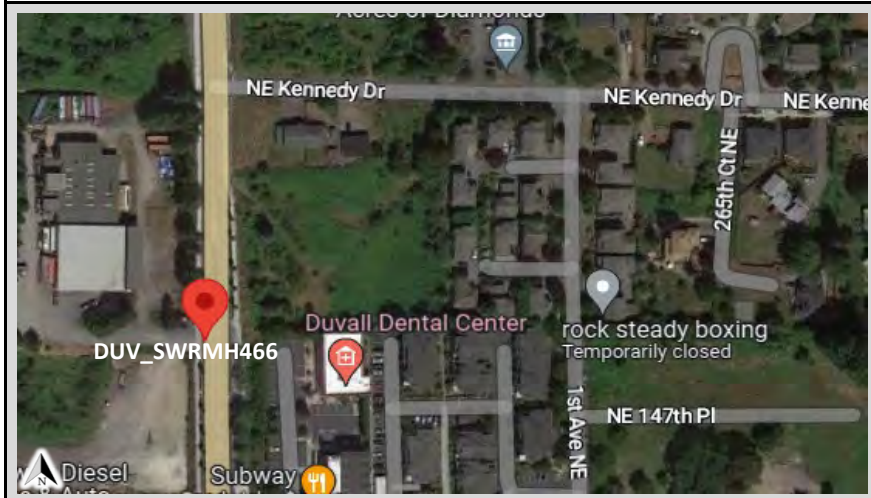
Data uptime observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023** is provided in the following table:

Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100



Duvall.Parametrix.TFM.WA23		Site Name
Flow Monitoring Site Report		DUV_SWRMH466

Site Address /Location:	14849-14755 Carnation Duvall Rd, Duvall,WA		Monitor Series	Location Type
Site Access Details:	Located on road edge	Latitude: 47.734303 Longitude: -121.987404	TRITON+ Pipe Size (H x W) 11.25 x 12.00	Temporary Pipe Shape Elliptical



Manhole #	System Characteristics
SWRMH466	Commercial
Access	Traffic
Drive	Medium



Installation Information	
Installation Date:	Installation Type:
Wednesday, March 1, 2023	Doppler Standard Ring and Crank
Monitoring Location (Sensors):	Monitor Location:
Upstream 0-5 FT	Manhole
Sensors / Devices:	Pressure Sensor Range (psi)
Peak Combo (CS4), Smart Depth (CS5)	0 - 5 psi

Installation Confirmation:	
Time	
12:30:00 PM	
Depth of Flow (Wet DOF) (in)	
2.88	
CS5 Physical Offset (in)	Measurement Confidence (in)
1.38	0.25"
Peak Velocity (fps)	Velocity Sensor Offset (in)
2.5	N/A
Silt (in)	Silt Type
0	



Manhole / Pipe Information:	
Manhole Depth (Approx. FT):	Manhole Configuration
12	Single
Manhole Material:	Manhole Condition:
Concrete	Good
Manhole Opening Diameter (in)	Manhole Diameter (Approx.):
24	26
Manhole Cover	Manhole Frame
Steel	Normal
Active Connections	Air Quality:
Yes, Inside	Normal
Pipe Material	Pipe Condition:
PVC	Good

Communication Information:	
Communication Type	Antenna Location
Wireless	Manhole Pick / Vent Hole

ADS Project Name:	Duvall.Parametrix.TFM.WA23
ADS Project Number:	22905.11 .325

Additional Site Info. / Comments:

Additional Photos

Monitoring Point Inlet	Outlet	Side Connection
		
<p>Top Down</p>	<p>Location</p>	
		
	<p>KEY</p>	
	<p>→ Flow Direction</p> <p>⊗ Monitoring Point</p>	

Hydrograph Report

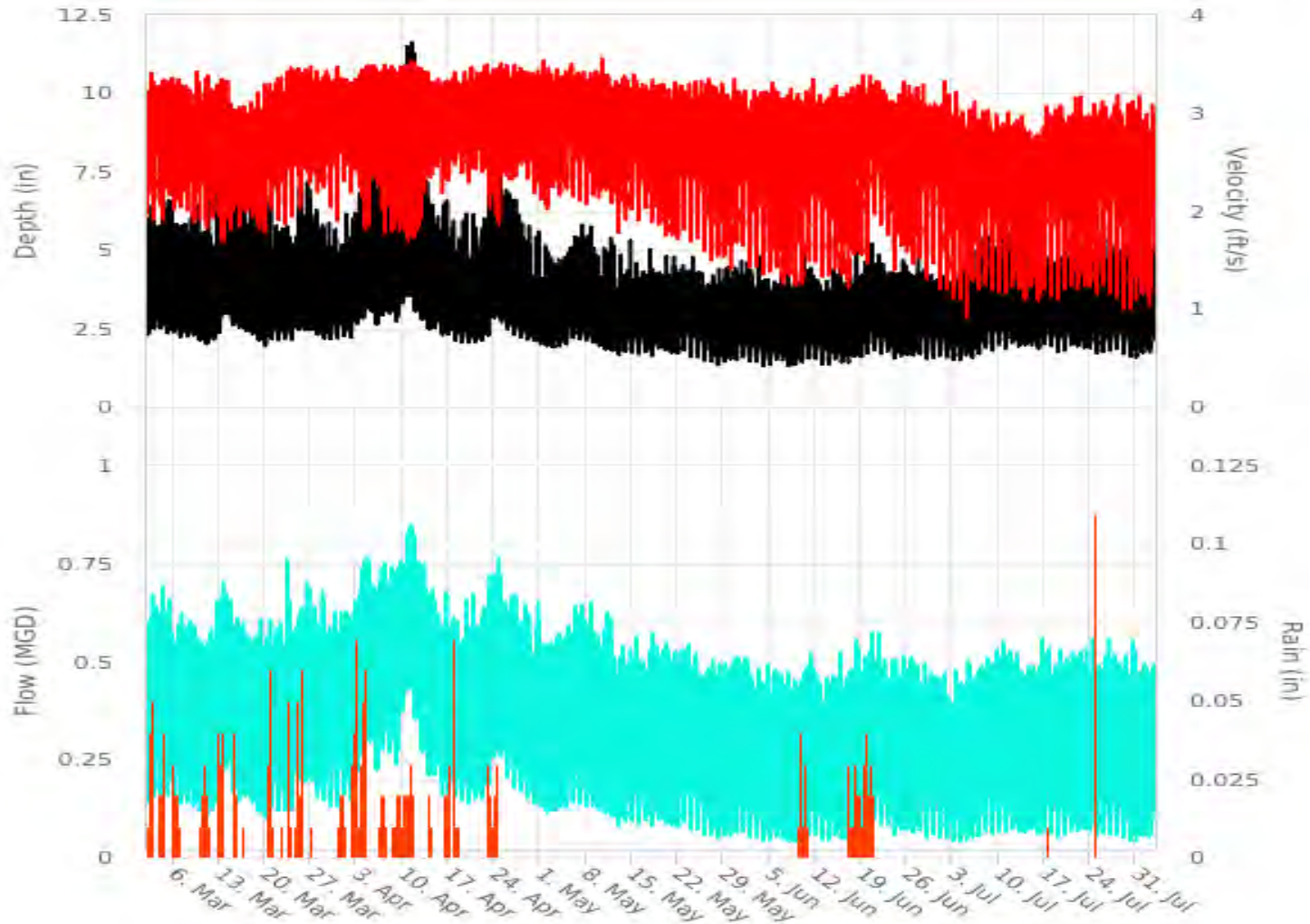
DUV_SWRMH466

Flow Monitor
DUV_SWRMH466

Pipe Height
11.25
in

Report Period
03/02/2023
To
08/02/2023

Legend
— DFINAL
— Rain
— VFINAL
— QFINAL



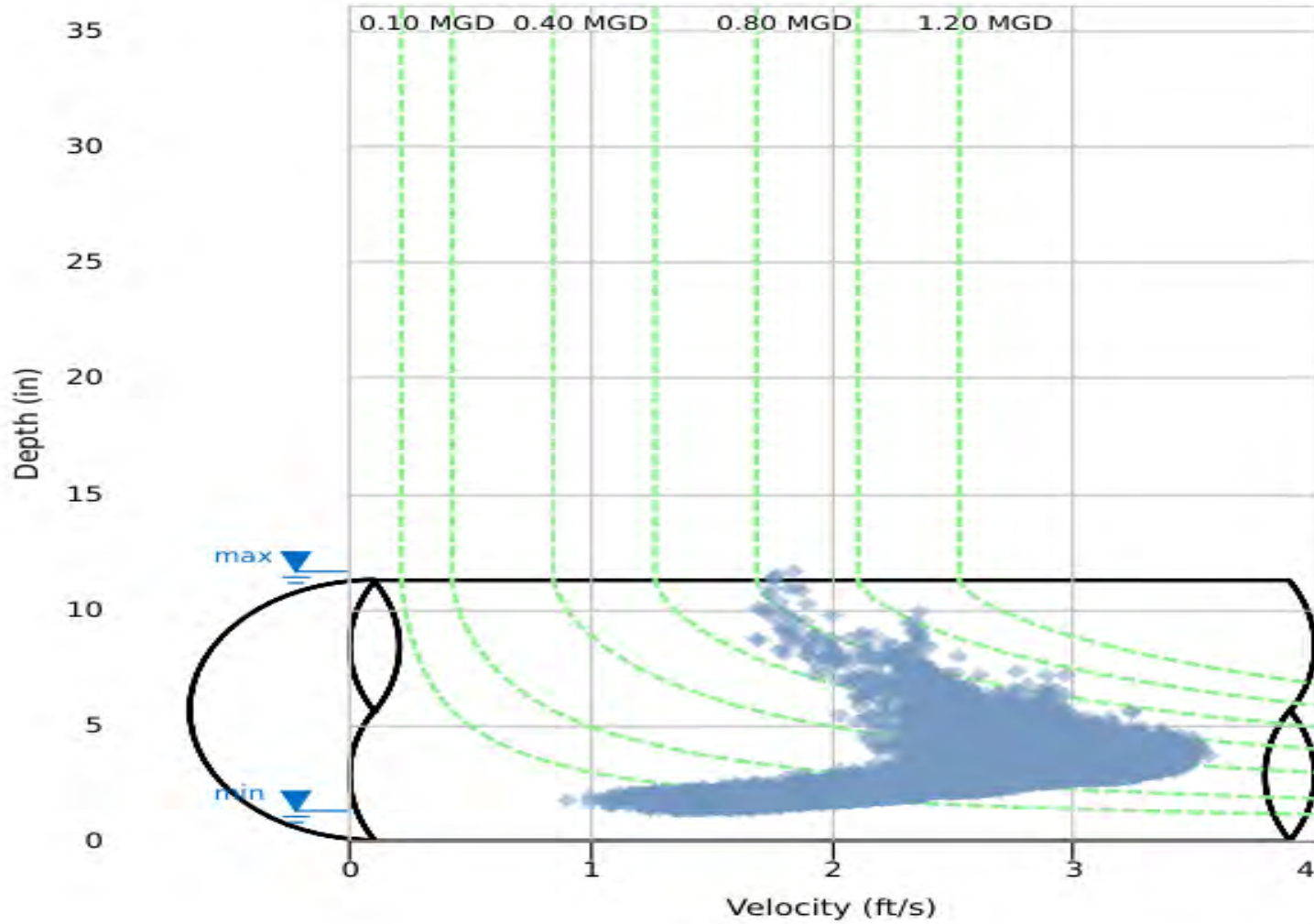
Scattergraph Report DUV_SWRMH466

Flow Monitor
DUV_SWRMH466

Pipe Height
11.25
in

Report Period
03/02/2023
To
08/02/2023

Legend
◇ DFINAL - VFINAL
--- Iso-Q™
▼ Min-Max Depth



Daily Tabular Report

03/02/2023 00:00 - 08/02/2023 23:59

DUV_SWRMH466Pipe: Elliptical (11.25 in H x 12 in W), Silt0.00 in

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
03/02/2023	03:10	2.29	20:40	8.06	3.53	22:05	1.85	22:55	3.46	2.74	01:50	0.135	09:35	0.777	0.355	0.355	0.30
03/03/2023	03:50	2.47	19:00	7.80	3.53	01:30	1.74	09:55	3.44	2.77	01:30	0.143	12:15	0.768	0.360	0.360	0.11
03/04/2023	03:10	2.50	10:40	9.60	3.81	13:15	1.60	01:20	3.46	2.81	03:05	0.155	10:00	0.756	0.383	0.383	0.29
03/05/2023	06:05	2.32	11:45	9.00	3.55	20:05	1.73	23:40	3.50	2.85	05:50	0.154	20:40	0.757	0.350	0.350	0.17
03/06/2023	02:15	2.37	19:55	7.82	3.42	08:25	1.55	02:35	3.50	2.80	03:55	0.125	22:35	0.722	0.337	0.337	0.05
03/07/2023	03:35	2.21	20:45	8.52	3.31	19:25	1.79	00:25	3.49	2.79	03:25	0.130	14:45	0.735	0.329	0.329	-
03/08/2023	04:05	2.23	18:20	7.70	3.38	23:40	1.68	02:00	3.45	2.68	02:40	0.135	13:35	0.715	0.326	0.326	-
03/09/2023	04:35	2.23	19:45	8.26	3.12	02:20	1.61	00:25	3.57	2.67	02:20	0.114	09:15	0.700	0.292	0.292	-
03/10/2023	02:05	2.09	11:15	7.89	3.07	02:50	1.82	18:20	3.44	2.70	02:50	0.113	15:10	0.703	0.289	0.289	0.19
03/11/2023	03:20	1.98	09:55	9.26	3.11	09:55	1.54	22:45	3.50	2.66	03:40	0.096	23:35	0.732	0.291	0.291	0.04
03/12/2023	05:30	2.12	19:00	10.30	3.28	19:05	1.58	11:05	3.45	2.66	03:00	0.116	19:00	0.756	0.310	0.310	0.41
03/13/2023	01:10	2.35	19:30	11.62	4.51	20:05	1.53	02:40	3.45	2.67	00:55	0.140	19:30	0.786	0.422	0.422	0.54
03/14/2023	23:55	2.80	19:00	11.56	4.40	19:45	1.55	05:40	3.51	2.63	01:00	0.211	19:00	0.817	0.412	0.412	-
03/15/2023	01:45	2.57	06:20	9.24	3.84	07:00	1.57	00:35	3.41	2.60	01:20	0.164	06:15	0.723	0.358	0.358	0.10
03/16/2023	01:45	2.52	18:30	8.79	3.66	01:50	1.62	15:35	3.37	2.56	01:50	0.130	11:20	0.717	0.337	0.337	0.01
03/17/2023	03:15	2.41	19:10	8.30	3.53	01:30	1.75	01:20	3.48	2.59	02:15	0.142	02:25	0.710	0.330	0.330	-
03/18/2023	03:05	2.30	09:05	9.31	3.38	09:05	1.57	01:00	3.43	2.54	00:50	0.129	09:00	0.684	0.301	0.301	-
03/19/2023	04:00	2.10	12:10	9.10	3.29	12:10	1.59	01:25	3.52	2.52	02:10	0.110	19:05	0.661	0.290	0.290	-
03/20/2023	02:55	1.93	20:35	8.85	3.17	06:25	1.71	08:30	3.49	2.65	02:25	0.099	20:35	0.707	0.296	0.296	0.30
03/21/2023	02:50	2.14	20:35	7.74	3.21	03:10	1.87	00:45	3.51	2.69	03:10	0.122	21:15	0.684	0.308	0.308	0.04
03/22/2023	02:40	2.11	20:15	8.26	3.16	01:10	1.77	09:00	3.53	2.63	02:50	0.113	10:20	0.683	0.296	0.296	0.01
03/23/2023	01:20	2.16	08:00	8.32	3.21	01:50	1.63	23:50	3.63	2.78	01:50	0.109	20:45	0.765	0.324	0.324	0.09
03/24/2023	02:50	2.12	20:25	7.18	3.08	02:40	1.82	01:25	3.63	2.84	02:40	0.115	19:35	0.759	0.309	0.309	0.44
03/25/2023	03:05	2.44	10:00	10.62	3.75	10:00	1.63	04:40	3.58	2.96	01:50	0.186	21:05	0.764	0.390	0.390	0.21
03/26/2023	01:40	2.43	09:55	9.18	3.68	10:00	1.66	02:15	3.69	2.96	01:35	0.187	11:15	0.751	0.384	0.384	0.02
03/27/2023	23:50	2.40	19:15	8.90	3.45	19:15	1.79	23:05	3.71	2.98	03:30	0.189	14:20	0.770	0.361	0.361	-
03/28/2023	02:25	2.29	20:05	7.87	3.25	16:10	1.78	04:30	3.69	2.91	02:05	0.145	20:55	0.747	0.333	0.333	-
03/29/2023	02:20	2.18	07:15	8.42	3.13	00:10	1.96	11:20	3.65	2.90	00:10	0.131	18:40	0.795	0.319	0.319	-
03/30/2023	01:50	2.15	20:05	7.14	3.19	03:20	1.73	00:25	3.63	2.86	03:20	0.111	09:45	0.733	0.324	0.324	-
03/31/2023	03:10	2.18	20:40	6.79	3.18	01:35	1.64	19:50	3.68	2.86	00:35	0.114	18:20	0.754	0.326	0.326	0.26
04/01/2023	02:45	2.24	11:30	7.88	3.35	11:30	1.98	03:35	3.61	2.85	01:30	0.144	10:40	0.759	0.341	0.341	-
04/02/2023	01:40	2.21	19:15	8.62	3.53	10:15	1.78	02:15	3.52	2.83	04:20	0.139	19:15	0.783	0.359	0.359	0.63
04/03/2023	02:40	2.64	18:30	9.97	4.01	18:35	1.69	23:40	3.56	2.94	01:35	0.212	18:30	0.794	0.420	0.420	0.26
04/04/2023	01:05	2.79	18:20	11.60	4.71	19:30	1.66	06:45	3.53	2.98	00:40	0.248	18:20	0.847	0.500	0.500	0.43
04/05/2023	23:55	2.76	06:00	9.15	4.18	07:25	1.82	08:00	3.53	3.02	23:50	0.253	01:50	0.781	0.452	0.452	-
04/06/2023	02:35	2.61	20:00	10.52	3.97	20:00	1.69	21:45	3.56	3.00	03:05	0.214	19:55	0.784	0.424	0.424	0.48
04/07/2023	01:30	2.93	10:10	11.21	4.81	18:55	1.66	23:50	3.62	2.91	01:40	0.264	10:10	0.875	0.498	0.498	0.23
04/08/2023	02:25	2.96	09:35	11.57	4.45	14:45	1.64	08:45	3.53	2.93	02:20	0.260	09:35	0.842	0.462	0.462	0.08
04/09/2023	03:05	2.72	19:35	10.77	4.66	17:00	1.59	18:10	3.53	2.92	03:40	0.221	16:55	0.801	0.484	0.484	0.52
04/10/2023	02:10	3.29	18:05	13.01	5.56	11:05	1.56	08:30	3.54	2.88	01:05	0.370	18:05	0.871	0.561	0.561	0.53
04/11/2023	23:50	3.07	07:45	14.35	6.21	08:30	1.66	06:20	3.61	2.85	23:45	0.348	07:45	0.914	0.601	0.601	0.20
04/12/2023	23:50	2.86	07:40	11.03	4.83	18:30	1.64	18:20	3.55	3.00	23:50	0.307	07:40	0.815	0.507	0.507	-
04/13/2023	23:50	2.58	08:50	9.93	4.21	08:50	1.69	11:30	3.55	3.04	23:50	0.233	08:05	0.790	0.459	0.459	0.02
04/14/2023	01:40	2.46	08:45	9.80	3.70	08:45	1.62	20:25	3.52	3.01	02:55	0.202	10:05	0.782	0.398	0.398	0.01
04/15/2023	23:45	2.45	09:40	8.52	3.62	09:45	1.85	02:55	3.55	2.91	01:15	0.207	06:30	0.762	0.379	0.379	-
04/16/2023	03:30	2.27	10:25	8.23	3.62	10:25	1.78	02:25	3.48	2.85	03:00	0.151	13:45	0.730	0.367	0.367	0.23
04/17/2023	02:55	2.30	19:15	8.07	3.32	19:15	1.94	01:10	3.50	2.91	02:55	0.156	20:35	0.747	0.341	0.341	0.12
04/18/2023	02:45	2.10	20:15	7.94	3.15	20:10	1.91	00:55	3.53	2.91	02:45	0.147	14:20	0.707	0.319	0.319	0.05
04/19/2023	03:25	2.06	06:45	7.70	3.15	06:45	1.99	15:25	3.56	2.91	03:20	0.143	20:35	0.724	0.319	0.319	-
04/20/2023	02:35	2.03	20:45	7.72	3.10	20:50	1.95	23:15	3.61	2.92	02:25	0.128	07:55	0.746	0.317	0.317	-
04/21/2023	02:05	2.06	06:55	7.55	3.11	06:55	1.98	16:25	3.58	3.00	02:00	0.139	13:25	0.694	0.327	0.327	-
04/22/2023	03:30	2.11	09:55	8.65	3.25	09:55	1.73	01:40	3.63	2.96	03:25	0.141	11:50	0.766	0.340	0.340	0.19
04/23/2023	03:00	2.26	19:25	9.69	4.00	19:25	1.72	04:25	3.56	2.97	04:40	0.174	21:15	0.783	0.427	0.427	0.40
04/24/2023	02:10	2.82	18:45	10.17	4.45	07:00	1.64	21:45	3.57	2.97	02:25	0.251	18:00	0.816	0.476	0.476	0.29
04/25/2023	23:35	2.61	19:30	8.98	3.98	20:15	1.80	21:20	3.63	3.04	23:35	0.238	14:35	0.829	0.432	0.432	-
04/26/2023	23:55	2.40	07:05	8.68	3.56	07:05	1.78	00:40	3.65	3.02	02:05	0.193	06:20	0.757	0.379	0.379	-
04/27/2023	02:50	2.29	07:20	7.83	3.28	07:20	1.98	00:05	3.64	3.02	00:50	0.172	10:55	0.756	0.347	0.347	-
04/28/2023	02:50	2.20	07:05	7.38	3.18	07:05	2.03	02:20	3.65	2.98	03:30	0.156	08:30	0.787	0.331	0.331	-
04/29/2023	02:55	2.13	08:20	6.91	3.05	09:05	2.16	19:55	3.64	2.92	01:35	0.143	11:10	0.759	0.313	0.313	-
04/30/2023	04:25	2.10	18:30	7.10	3.08	09:40	1.97	21:10	3.59	2.91	02:50	0.125	19:05	0.723	0.315	0.315	-
05/01/2023	02:50	1.98	19:20	6.48	2.85	04:05	2.07	15:35	3.64	2.87	02:05	0.124	17:10	0.704	0.285	0.285	-
05/02/2023	01:55	1.93	06:30	6.27	2.77	03:05	1.84	19:40	3.59	2.83	03:05	0.101	20:25	0.714	0.270	0.270	-
05/03/2023	01:40	1.89	07:25	6.57	2.81	01:15	2.16	19:00	3.54	2.80	01:15	0.115	19:45	0.711	0.274	0.274	-
05/04/2023	01:00	1.91	18:15	6.06	2.87	03:50	1.88	14:10	3.54	2.79	03:50	0.107	19:45	0.710	0.281	0.281	-
05/05/2023	02:05	1.97	20:15	6.76	3.10	18:10	1.99	21:00	3.57	2.91	03:10	0.124	08:00	0.731	0.322	0.322	-
05/06/2023	04:10	2.18	10:00	6.90	3.21	12:30	2.02	02:05	3.59	2.93	02:40	0.138	13:55	0.728	0.338</		

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
05/12/2023	03:35	1.78	06:20	6.66	2.57	04:05	1.92	02:40	3.48	2.72	04:05	0.097	11:05	0.682	0.237	0.237	-
05/13/2023	02:50	1.64	09:30	5.86	2.77	01:05	1.67	22:10	3.52	2.71	01:05	0.076	17:15	0.726	0.267	0.267	-
05/14/2023	02:35	1.76	20:50	6.56	2.67	03:40	1.72	13:30	3.48	2.70	03:40	0.082	14:20	0.694	0.248	0.248	-
05/15/2023	03:05	1.72	19:35	5.86	2.62	02:00	1.90	18:45	3.52	2.68	03:05	0.089	08:55	0.689	0.241	0.241	-
05/16/2023	03:05	1.66	20:15	6.00	2.64	02:25	1.74	09:35	3.45	2.66	03:00	0.082	19:30	0.689	0.242	0.242	-
05/17/2023	03:30	1.70	20:00	6.08	2.65	23:30	1.85	17:35	3.46	2.63	03:30	0.090	19:20	0.659	0.239	0.239	-
05/18/2023	02:45	1.61	19:45	5.68	2.74	02:25	1.75	17:25	3.42	2.62	01:25	0.075	21:20	0.707	0.253	0.253	-
05/19/2023	02:35	1.86	14:00	7.35	2.73	02:45	1.80	21:05	3.63	2.58	02:45	0.094	14:00	0.751	0.246	0.246	-
05/20/2023	04:05	1.80	08:50	5.97	2.72	04:10	1.68	14:05	3.45	2.56	04:10	0.082	08:45	0.726	0.246	0.246	-
05/21/2023	04:25	1.72	19:20	6.12	2.74	04:15	1.65	15:05	3.63	2.54	04:15	0.076	09:45	0.708	0.247	0.247	-
05/22/2023	02:25	1.69	19:00	6.74	2.76	03:40	1.61	10:55	3.43	2.57	02:15	0.074	20:35	0.702	0.249	0.249	-
05/23/2023	23:50	1.78	20:15	6.07	2.71	03:00	1.71	15:55	3.47	2.55	01:55	0.084	06:00	0.689	0.242	0.242	-
05/24/2023	01:40	1.59	07:40	5.98	2.61	01:15	1.50	08:30	3.41	2.52	01:15	0.064	21:05	0.676	0.229	0.229	-
05/25/2023	02:15	1.57	08:50	5.87	2.59	02:55	1.57	15:40	3.44	2.51	02:55	0.066	07:15	0.717	0.225	0.225	-
05/26/2023	03:00	1.42	10:10	5.46	2.52	03:00	1.34	19:10	3.42	2.50	03:00	0.047	15:05	0.694	0.219	0.219	-
05/27/2023	02:45	1.43	19:20	5.58	2.39	03:30	1.36	09:20	3.67	2.43	03:30	0.050	08:25	0.680	0.199	0.199	-
05/28/2023	02:25	1.32	10:40	6.04	2.31	02:10	1.40	10:00	3.59	2.41	02:10	0.047	13:55	0.709	0.190	0.190	-
05/29/2023	03:35	1.44	13:55	6.63	2.55	03:30	1.29	14:50	3.35	2.45	03:30	0.046	11:45	0.677	0.219	0.219	-
05/30/2023	03:35	1.51	20:35	6.41	2.45	03:55	1.34	18:00	3.57	2.47	03:55	0.051	11:20	0.699	0.208	0.208	-
05/31/2023	02:30	1.48	20:05	6.20	2.43	02:15	1.41	16:15	3.42	2.48	02:15	0.055	06:20	0.693	0.205	0.205	-
06/01/2023	02:00	1.58	19:50	6.22	2.46	02:45	1.29	18:15	3.38	2.46	02:45	0.054	06:50	0.644	0.205	0.205	-
06/02/2023	02:20	1.44	06:00	5.60	2.40	01:55	1.37	19:25	3.41	2.41	02:40	0.050	18:30	0.658	0.198	0.198	-
06/03/2023	02:15	1.43	09:20	6.63	2.48	02:40	1.21	11:40	3.40	2.41	02:40	0.044	17:25	0.705	0.209	0.209	-
06/04/2023	03:50	1.29	20:15	6.33	2.45	02:45	1.19	12:50	3.38	2.40	03:35	0.038	20:10	0.628	0.206	0.206	-
06/05/2023	03:30	1.32	20:10	5.99	2.39	01:25	1.12	12:05	3.39	2.42	03:25	0.040	16:50	0.643	0.198	0.198	-
06/06/2023	02:55	1.49	20:20	5.92	2.55	03:10	1.31	17:45	3.38	2.41	02:50	0.050	18:40	0.647	0.214	0.214	-
06/07/2023	02:05	1.48	21:55	6.07	2.56	01:50	1.14	09:25	3.41	2.39	01:50	0.043	07:25	0.637	0.214	0.214	-
06/08/2023	02:20	1.29	08:55	5.90	2.38	01:15	1.16	09:45	3.39	2.40	02:55	0.037	21:05	0.642	0.197	0.197	-
06/09/2023	01:45	1.34	18:45	5.82	2.40	03:20	1.10	20:15	3.37	2.38	02:00	0.036	18:45	0.635	0.197	0.197	0.20
06/10/2023	02:50	1.39	10:50	6.83	2.51	03:35	1.09	18:25	3.43	2.38	02:45	0.038	10:10	0.629	0.209	0.209	0.20
06/11/2023	04:55	1.50	20:10	6.56	2.52	04:15	1.26	16:10	3.42	2.48	04:15	0.050	15:25	0.684	0.217	0.217	-
06/12/2023	04:05	1.52	20:25	5.84	2.42	03:05	1.34	21:20	3.40	2.44	04:05	0.055	09:40	0.684	0.201	0.201	-
06/13/2023	01:45	1.34	06:25	5.73	2.37	03:30	1.14	07:10	3.44	2.40	03:30	0.038	19:40	0.636	0.195	0.195	-
06/14/2023	02:00	1.31	19:20	6.55	2.40	02:55	1.21	06:35	3.39	2.38	02:55	0.039	20:10	0.653	0.195	0.195	-
06/15/2023	02:10	1.48	20:40	6.24	2.43	01:15	1.20	18:15	3.41	2.44	02:10	0.046	19:45	0.694	0.202	0.202	-
06/16/2023	01:45	1.41	06:50	5.57	2.39	02:50	1.17	07:40	3.42	2.40	02:50	0.041	15:35	0.670	0.197	0.197	0.10
06/17/2023	03:00	1.40	09:45	5.66	2.45	02:55	1.08	20:25	3.45	2.37	02:55	0.037	19:30	0.676	0.204	0.204	0.11
06/18/2023	04:30	1.57	09:20	7.61	2.53	03:35	1.43	21:30	3.47	2.48	04:30	0.058	09:20	0.743	0.217	0.217	0.22
06/19/2023	03:05	1.57	20:25	6.52	2.62	03:50	1.35	06:45	3.47	2.51	03:50	0.058	18:15	0.689	0.230	0.230	0.16
06/20/2023	03:25	1.69	19:05	7.00	2.88	00:55	1.32	21:50	3.52	2.63	00:55	0.062	19:00	0.732	0.271	0.271	0.60
06/21/2023	02:15	1.80	20:05	7.29	2.82	02:55	1.62	13:45	3.47	2.70	02:55	0.080	12:10	0.683	0.264	0.264	-
06/22/2023	02:00	1.68	20:25	6.77	2.74	02:45	1.77	07:10	3.42	2.62	02:00	0.081	05:35	0.653	0.248	0.248	-
06/23/2023	02:15	1.74	12:40	6.22	2.71	02:55	1.56	11:55	3.43	2.57	02:15	0.073	21:00	0.734	0.240	0.240	-
06/24/2023	03:45	1.52	09:55	6.18	2.66	03:00	1.28	18:40	3.43	2.51	03:00	0.052	14:35	0.682	0.234	0.234	-
06/25/2023	04:10	1.59	10:35	7.11	2.72	04:25	1.53	20:30	3.39	2.52	04:20	0.065	15:15	0.687	0.242	0.242	-
06/26/2023	03:05	1.65	07:40	5.47	2.67	02:30	1.32	15:15	3.42	2.49	02:30	0.058	18:40	0.669	0.234	0.234	-
06/27/2023	02:30	1.63	19:35	5.83	2.69	02:05	1.30	20:25	3.37	2.44	02:35	0.056	18:05	0.698	0.231	0.231	-
06/28/2023	02:50	1.64	08:15	6.02	2.63	02:25	1.33	22:00	3.38	2.42	02:25	0.058	11:10	0.607	0.221	0.221	-
06/29/2023	02:55	1.51	09:00	6.13	2.56	02:55	1.20	20:25	3.43	2.37	02:55	0.046	18:40	0.666	0.211	0.211	-
06/30/2023	02:35	1.55	19:50	6.07	2.51	02:35	1.25	06:55	3.47	2.37	02:35	0.050	08:40	0.670	0.205	0.205	-
07/01/2023	02:45	1.59	11:15	5.66	2.57	01:30	1.16	20:20	3.41	2.31	01:30	0.049	09:35	0.601	0.207	0.207	-
07/02/2023	03:55	1.54	08:40	5.61	2.49	02:25	1.04	20:40	3.36	2.26	02:25	0.044	13:45	0.584	0.195	0.195	-
07/03/2023	03:35	1.49	09:55	6.73	2.56	02:15	0.93	19:25	3.39	2.26	02:15	0.037	08:55	0.604	0.202	0.202	-
07/04/2023	04:10	1.47	10:55	6.92	2.53	04:10	0.92	14:25	3.34	2.21	04:10	0.034	18:40	0.656	0.194	0.194	-
07/05/2023	02:25	1.61	21:00	7.03	2.73	03:50	0.88	21:45	3.37	2.29	03:50	0.041	08:00	0.663	0.219	0.219	-
07/06/2023	02:55	1.55	19:20	6.95	2.72	02:55	1.17	11:20	3.31	2.31	02:55	0.046	22:30	0.662	0.222	0.222	-
07/07/2023	02:25	1.64	13:50	6.72	2.89	01:25	1.01	19:30	3.30	2.28	02:25	0.046	21:05	0.670	0.238	0.238	-
07/08/2023	02:20	1.85	10:25	6.80	3.05	03:00	1.07	14:05	3.30	2.27	03:00	0.056	15:50	0.660	0.253	0.253	-
07/09/2023	04:25	1.77	09:40	7.85	3.14	02:15	1.05	14:25	3.35	2.24	04:25	0.055	17:45	0.671	0.262	0.262	-
07/10/2023	03:35	1.95	20:50	7.95	3.36	02:45	1.06	20:10	3.40	2.27	02:45	0.060	10:15	0.657	0.286	0.286	-
07/11/2023	02:00	1.84	10:25	7.23	3.13	03:00	1.02	09:40	3.35	2.26	03:00	0.058	16:15	0.643	0.260	0.260	-
07/12/2023	01:55	2.02	19:20	8.22	3.13	01:50	1.11	10:30	3.35	2.27	01:50	0.065	20:05	0.656	0.258	0.258	-
07/13/2023	02:55	1.90	09:40	6.91	3.05	02:55	1.10	19:35	3.34	2.23	02:55	0.058	07:25	0.645	0.246	0.246	-
07/14/2023	01:00	1.93	17:50	7.73	3.10	03:55	0.96	19:25	3.37	2.25	01:00	0.054	10:10	0.636	0.255	0.255	-
07/15/2023	03:45	1.88	11:30	7.75	3.06	02:15	1.04	13:05	3.39	2.25	02:15	0.060	09:05	0.648	0.249	0.249	-
07/16/2023	04:35	1.77	08:55	7.52	3.07	03:35	0.87	08:50	3.29	2.19	03:35	0.047	19:00	0.663	0.247	0.247	-
07/17/2023	02:40	1.97	17:05	6.34	2.97	02:40	0.96	09:25	3.30	2.30	02:40	0.053	18:45	0.641	0.248	0.248	0.01
07/18/2023	03:15	1.93	20:55	6.32	2.95	02:35	1.02</										

Date	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)					Rain (in)	
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
07/25/2023	03:25	1.69	18:55	6.40	2.84	02:25	1.04	17:10	3.34	2.26	02:25	0.049	08:50	0.610	0.231	0.231	-
07/26/2023	00:35	1.68	18:20	6.36	2.86	02:55	1.16	18:15	3.43	2.30	03:00	0.054	20:10	0.645	0.238	0.238	-
07/27/2023	03:00	1.74	20:30	6.81	2.87	03:10	1.09	14:25	3.37	2.29	02:10	0.053	07:20	0.661	0.238	0.238	-
07/28/2023	02:05	1.80	17:55	6.86	2.96	01:55	0.99	09:50	3.30	2.22	01:55	0.052	16:20	0.639	0.240	0.240	-
07/29/2023	02:30	1.66	08:50	7.54	2.91	02:10	0.88	11:45	3.38	2.21	02:30	0.042	08:00	0.654	0.236	0.236	-
07/30/2023	03:15	1.59	10:00	7.64	2.90	04:30	0.90	18:15	3.40	2.22	04:30	0.038	20:40	0.671	0.237	0.237	-
07/31/2023	01:30	1.54	10:25	7.17	2.86	00:20	0.91	19:20	3.35	2.26	01:35	0.037	13:00	0.655	0.234	0.234	-
08/01/2023	01:35	1.69	19:45	7.03	2.86	05:05	1.03	08:25	3.30	2.24	02:25	0.049	07:35	0.634	0.232	0.232	-
08/02/2023	03:30	1.73	10:05	7.10	2.87	02:35	1.00	13:40	3.34	2.17	02:45	0.050	06:40	0.638	0.223	0.223	-

03/02/2023 00:00 - 08/02/2023 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			44.487	10.23
Average	3.10	2.61	0.289	

DUV_RG

Site Commentary

SITE INFORMATION

RainGauge	8" tipping bucket type
Silt	0.00 (in)

OBSERVATIONS

A review of the hydrograph indicates DUV_RG functioned under normal conditions during the study period.

The total rainfall recorded during the study period was 10.23 in.

DATA UPTIME

Data uptime observed during **Thursday, 02 March 2023 to Wednesday, 02 August 2023** is provided in the following table:

Percent Uptime	
RAINFINAL (in)	100

Duvall.Parametrix.TFM.WA23		Site Name
Flow Monitoring Site Report		DUV_RG

Site Address /Location:	Snoqualmie Valley Trail, Duvall, WA		Monitor Series	Location Type
Site Access Details:	Located within pump station	Latitude: 47.74017 Longitude: -121.988540	Rain Alert III	Temporary
			Installation Date	3/1/2023



Location	
On Ground	
Access	Traffic
Walk (Commercial)	None

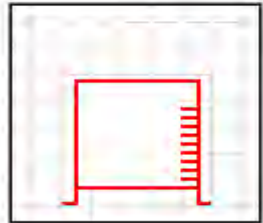


ADS Project Name:	Duvall.Parametrix.TFM.WA23
ADS Project Number:	22905.11 .325

Hydrograph Report

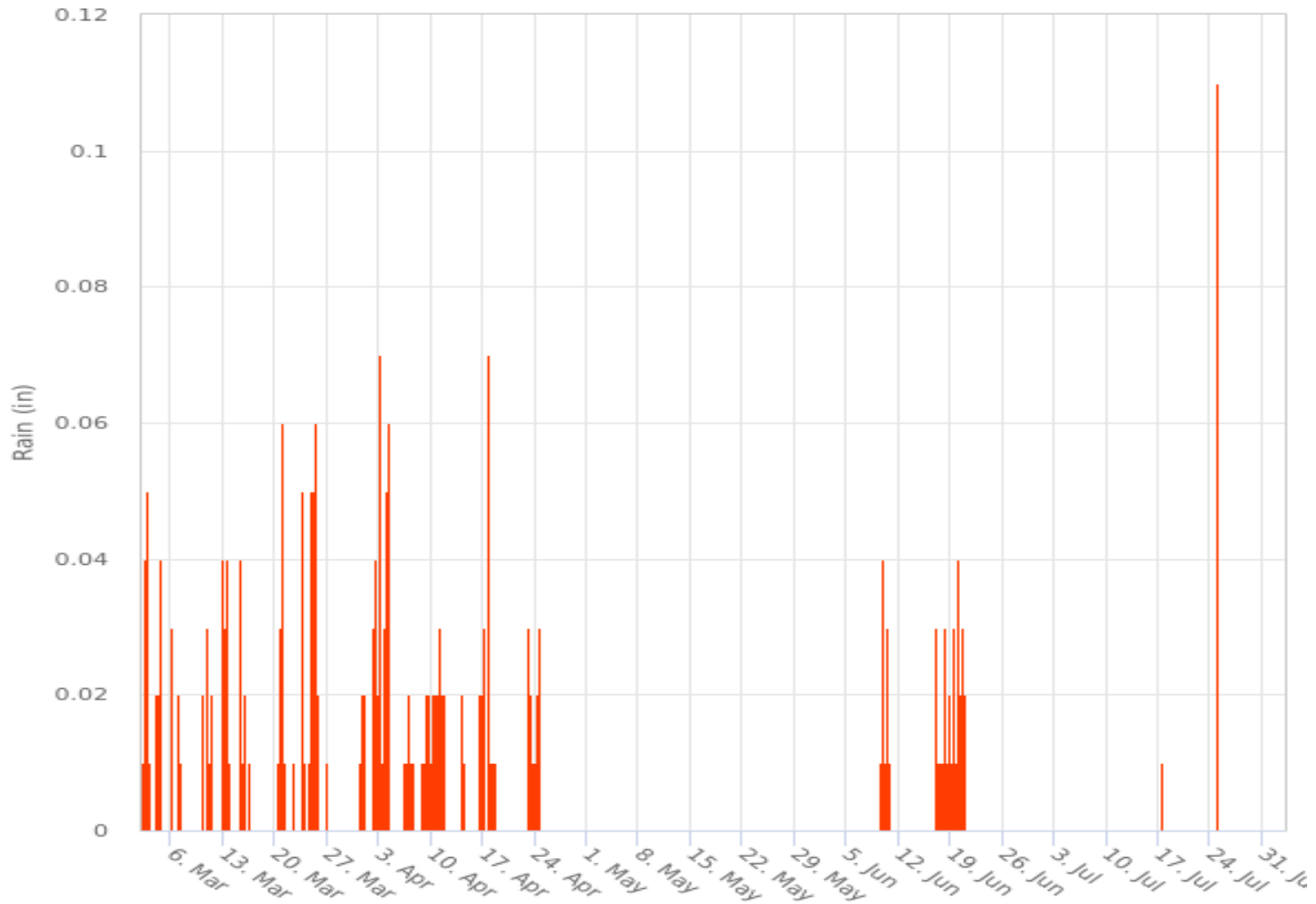
DUV_RG

Rain Gauge
DUV_RG



Report Period
03/02/2023
To
08/02/2023

Legend
— DFINAL
— Rain
— VFINAL
— OFINAL



Daily Tabular Report

03/02/2023 00:00 - 08/02/2023 23:59

DUV_RGRainGauge: Unknown (0 H x 0 W), Silt0.00

Date	Rain (in) Total
03/02/2023	0.30
03/03/2023	0.11
03/04/2023	0.29
03/05/2023	0.17
03/06/2023	0.05
03/07/2023	-
03/08/2023	-
03/09/2023	-
03/10/2023	0.19
03/11/2023	0.04
03/12/2023	0.41
03/13/2023	0.54
03/14/2023	-
03/15/2023	0.10
03/16/2023	0.01
03/17/2023	-
03/18/2023	-
03/19/2023	-
03/20/2023	0.30
03/21/2023	0.04
03/22/2023	0.01
03/23/2023	0.09
03/24/2023	0.44
03/25/2023	0.21
03/26/2023	0.02
03/27/2023	-
03/28/2023	-
03/29/2023	-
03/30/2023	-
03/31/2023	0.26
04/01/2023	-
04/02/2023	0.63
04/03/2023	0.26
04/04/2023	0.43
04/05/2023	-
04/06/2023	0.48
04/07/2023	0.23
04/08/2023	0.08
04/09/2023	0.52
04/10/2023	0.53
04/11/2023	0.20
04/12/2023	-
04/13/2023	0.02
04/14/2023	0.01
04/15/2023	-
04/16/2023	0.23
04/17/2023	0.12
04/18/2023	0.05
04/19/2023	-
04/20/2023	-
04/21/2023	-
04/22/2023	0.19
04/23/2023	0.40
04/24/2023	0.29
04/25/2023	-
04/26/2023	-
04/27/2023	-
04/28/2023	-
04/29/2023	-
04/30/2023	-
05/01/2023	-
05/02/2023	-
05/03/2023	-
05/04/2023	-
05/05/2023	-
05/06/2023	-
05/07/2023	-
05/08/2023	-
05/09/2023	-
05/10/2023	-
05/11/2023	-
05/12/2023	-
05/13/2023	-

Date	Rain (in) Total
05/14/2023	-
05/15/2023	-
05/16/2023	-
05/17/2023	-
05/18/2023	-
05/19/2023	-
05/20/2023	-
05/21/2023	-
05/22/2023	-
05/23/2023	-
05/24/2023	-
05/25/2023	-
05/26/2023	-
05/27/2023	-
05/28/2023	-
05/29/2023	-
05/30/2023	-
05/31/2023	-
06/01/2023	-
06/02/2023	-
06/03/2023	-
06/04/2023	-
06/05/2023	-
06/06/2023	-
06/07/2023	-
06/08/2023	-
06/09/2023	0.20
06/10/2023	0.20
06/11/2023	-
06/12/2023	-
06/13/2023	-
06/14/2023	-
06/15/2023	-
06/16/2023	0.10
06/17/2023	0.11
06/18/2023	0.22
06/19/2023	0.16
06/20/2023	0.60
06/21/2023	-
06/22/2023	-
06/23/2023	-
06/24/2023	-
06/25/2023	-
06/26/2023	-
06/27/2023	-
06/28/2023	-
06/29/2023	-
06/30/2023	-
07/01/2023	-
07/02/2023	-
07/03/2023	-
07/04/2023	-
07/05/2023	-
07/06/2023	-
07/07/2023	-
07/08/2023	-
07/09/2023	-
07/10/2023	-
07/11/2023	-
07/12/2023	-
07/13/2023	-
07/14/2023	-
07/15/2023	-
07/16/2023	-
07/17/2023	0.01
07/18/2023	-
07/19/2023	-
07/20/2023	-
07/21/2023	-
07/22/2023	-
07/23/2023	-
07/24/2023	0.38
07/25/2023	-
07/26/2023	-
07/27/2023	-



Date	Rain (in) Total
07/28/2023	-
07/29/2023	-
07/30/2023	-
07/31/2023	-
08/01/2023	-
08/02/2023	-

03/02/2023 00:00 - 08/02/2023 23:59

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total				10.23
Average				



Attachment B: RDII Result Summary Tables

Normalized Net Base Infiltration Values

Meter Basin ID	Net BI (MGD)	Pipe Length (LF)	Normalized Net BI (gpd/LF)	Basin Area (ac)	Normalized Net BI (gpd/ac)	Footprint (IDM)	Normalized Net BI (gpd/IDM)
DUV_SWRMH428	0.009	11,080	0.8	60.3	149	16.7	538
DUV_SWRMH430	0.050	18,768	2.7	116.8	428	28.2	1,771
DUV_SWRMH459	0.011	15,254	0.7	106.4	103	22.2	495
DUV_SWRMH466	0.000	19,205	0.0	127.0	0	30.1	0

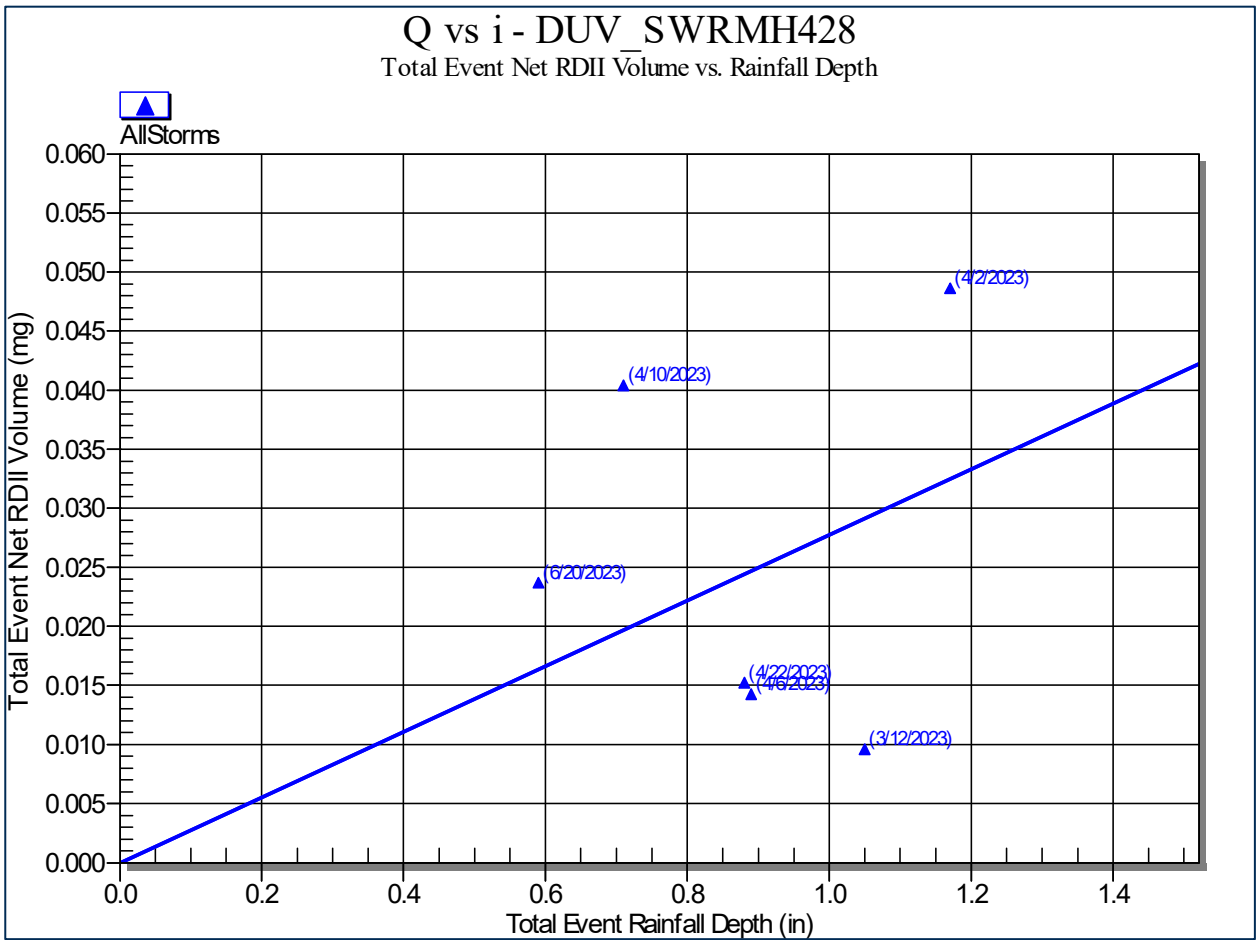
Normalized RDII Severity by Volume

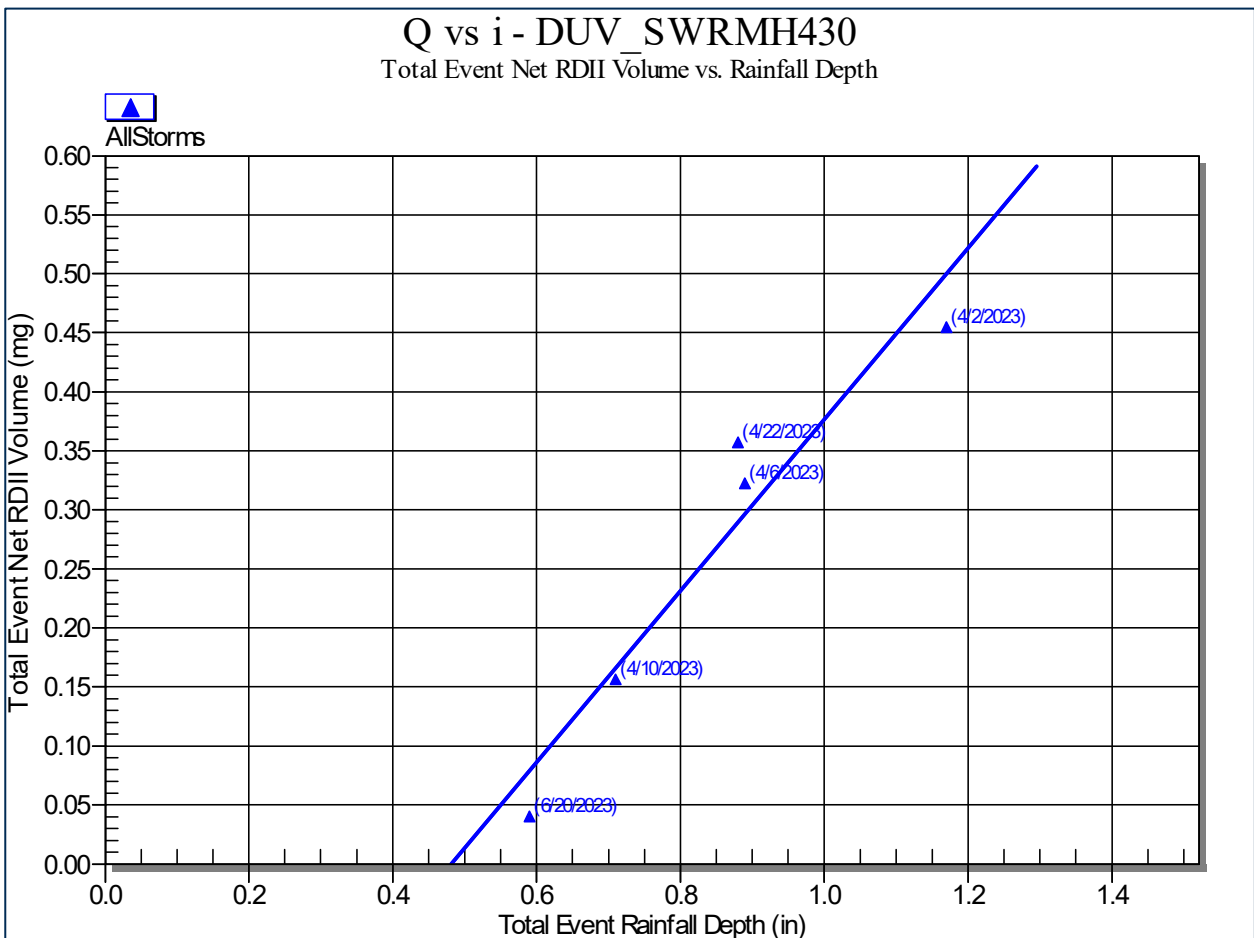
Meter Basin ID	Net RDII Severity by Volume (MG/in)	Pipe Length (LF)	Normalized Net RDII Severity by Volume (gal/in/LF)	Basin Area (ac)	Normalized Net RDII Severity by Volume (gal/in/ac)	Footprint (IDM)	Normalized Net RDII Severity by Volume (gal/in/IDM)
DUV_SWRMH428	0.03	11,080	2.7	60.3	497	16.7	1,793
DUV_SWRMH430	0.73	18,768	38.9	116.8	6,247	28.2	25,851
DUV_SWRMH459	0.06	15,254	3.9	106.4	564	22.2	2,699
DUV_SWRMH466	0.06	19,205	3.1	127.0	473	30.1	1,995

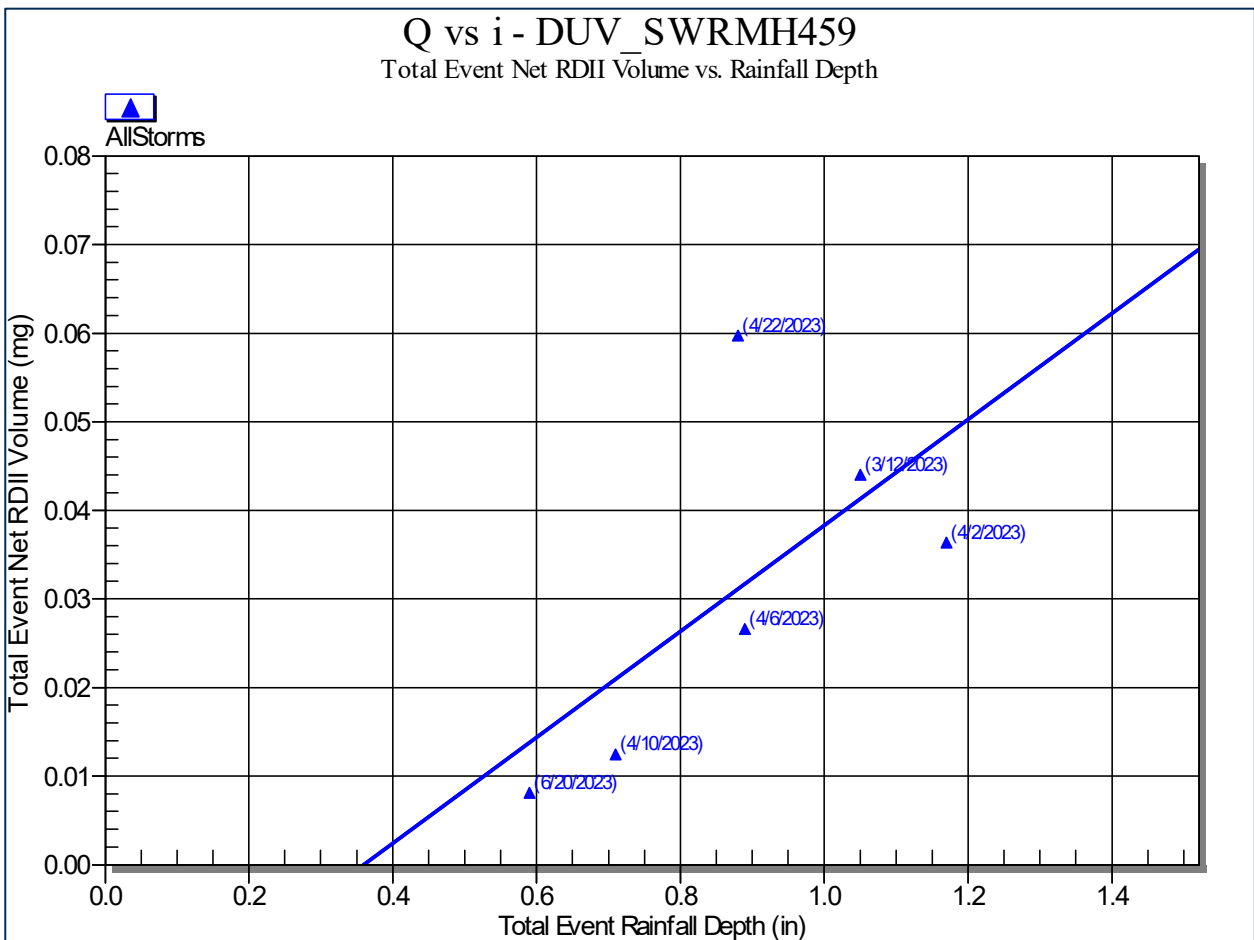
Normalized Peak RDII Severity

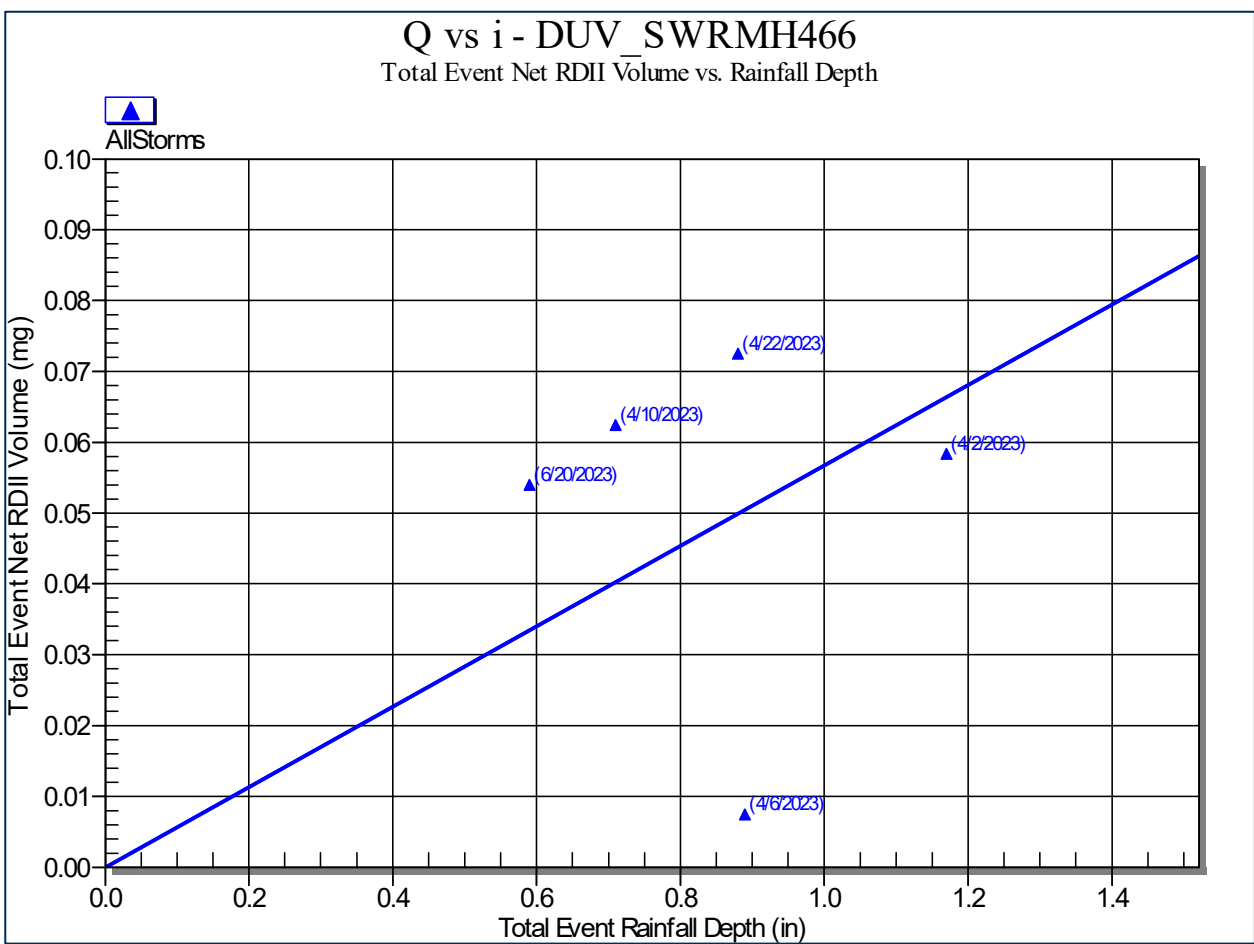
Meter Basin ID	Peak Net RDII Severity (MGD/in)	Pipe Length (LF)	Normalized Peak Net RDII Severity (gpd/in/LF)	Basin Area (ac)	Normalized Peak Net RDII Severity (gpd/in/ac)	Footprint (IDM)	Normalized Peak Net RDII Severity (gpd/in/IDM)
DUV_SWRMH428	0.05	11,080	4.5	60.3	829	16.7	2,988
DUV_SWRMH430	0.36	18,768	19.2	116.8	3,081	28.2	12,748
DUV_SWRMH459	0.05	15,254	3.3	106.4	470	22.2	2,249
DUV_SWRMH466	0.14	19,205	7.3	127.0	1,103	30.1	4,654

Attachment C: RDII Volume Q vs. i Graphs

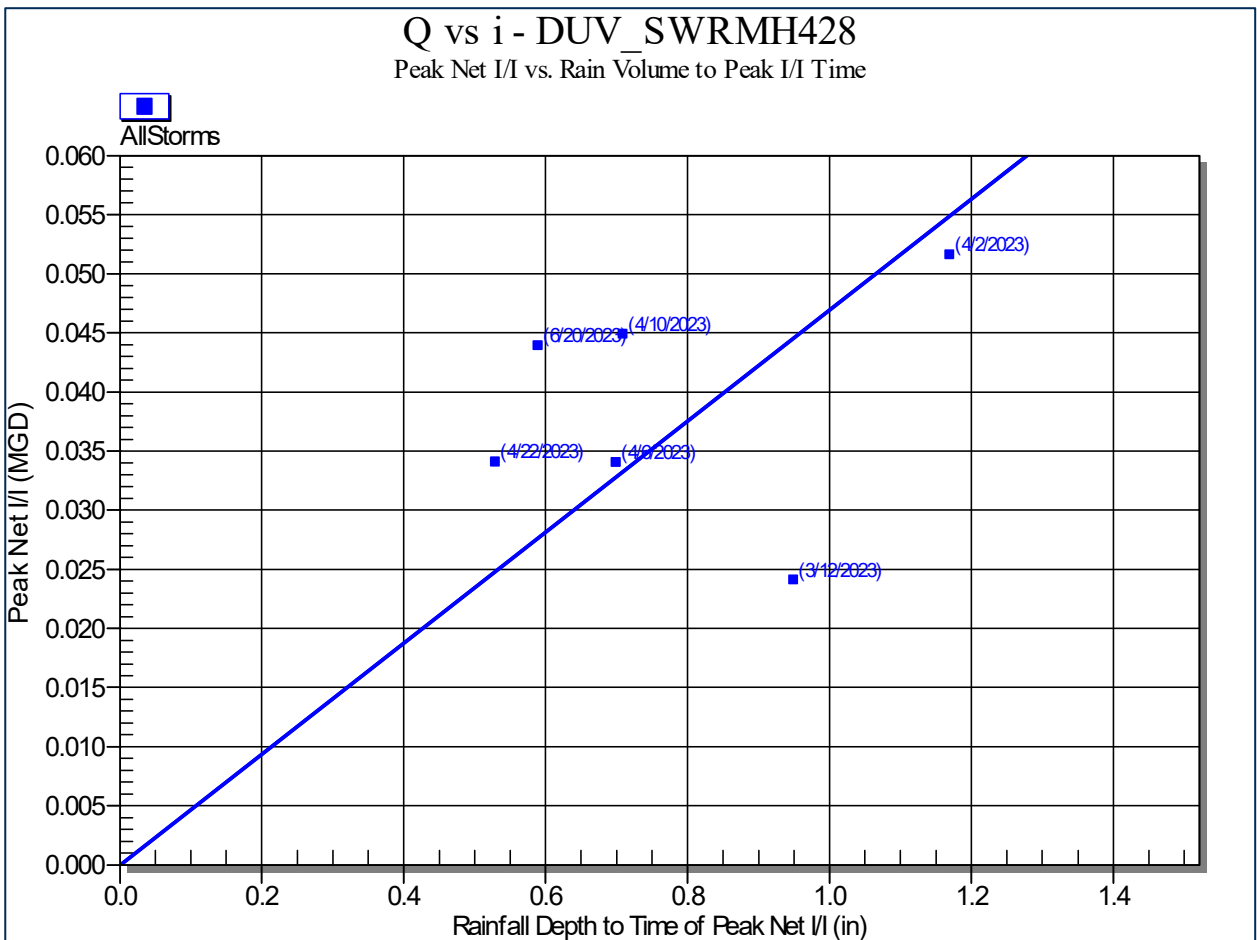


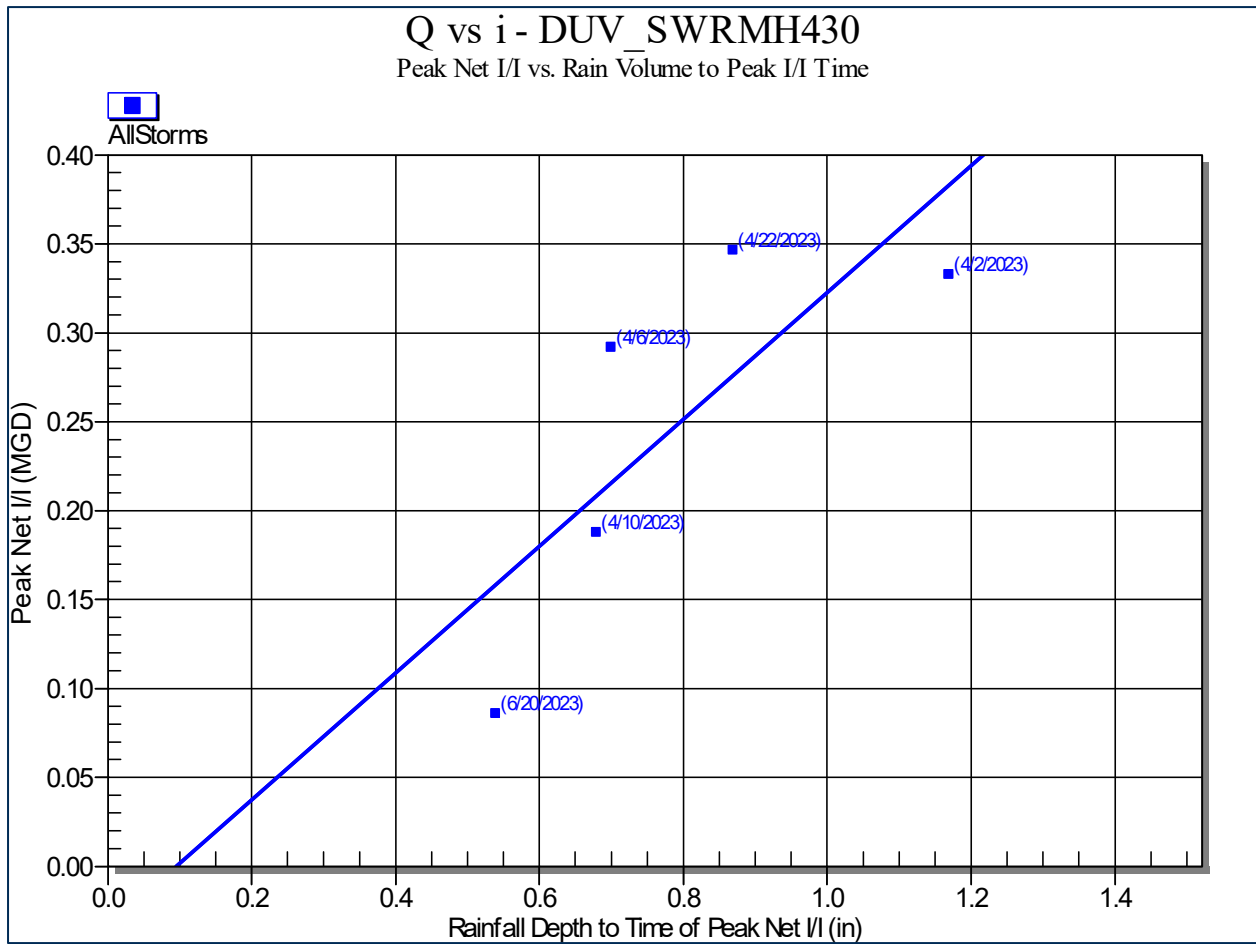


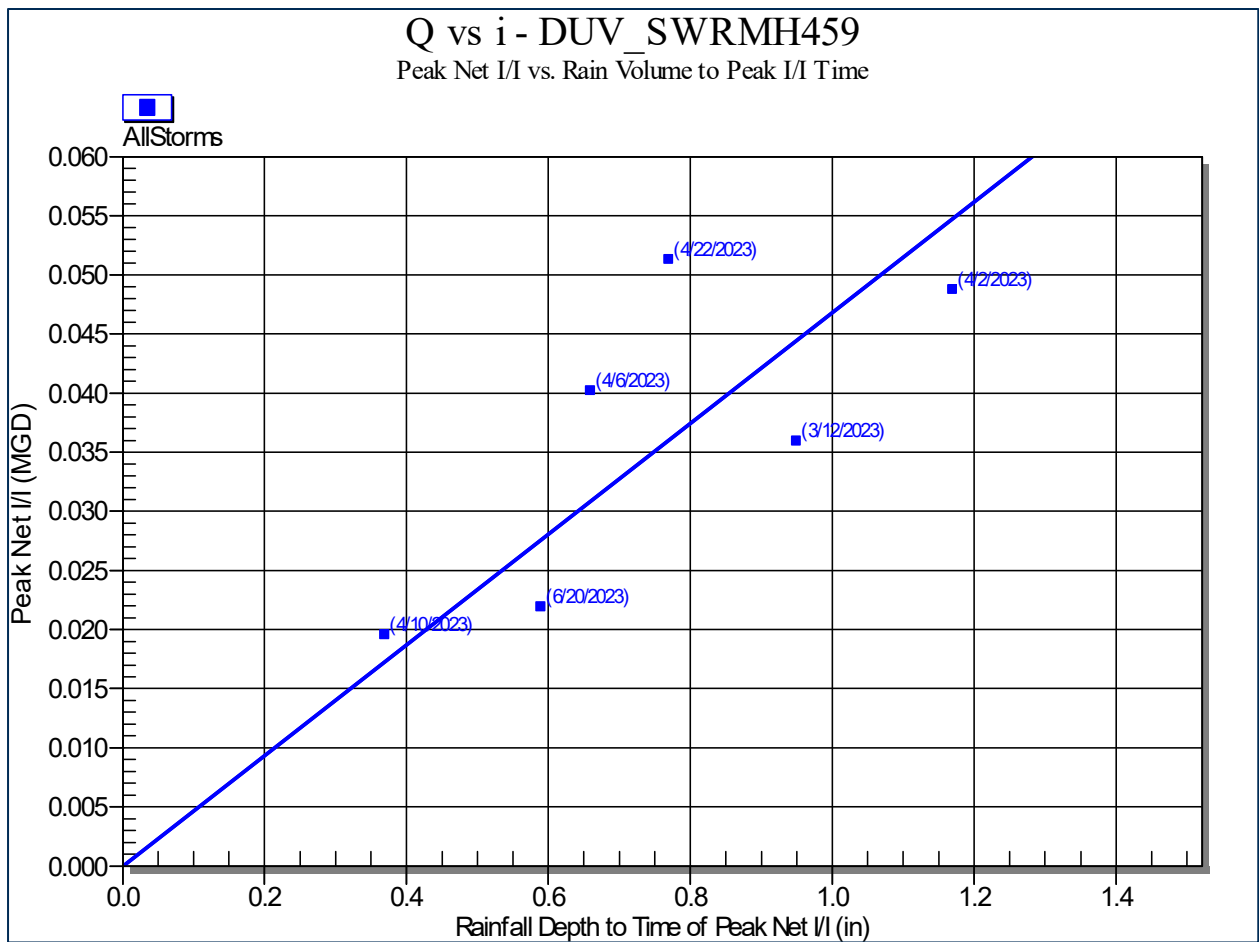


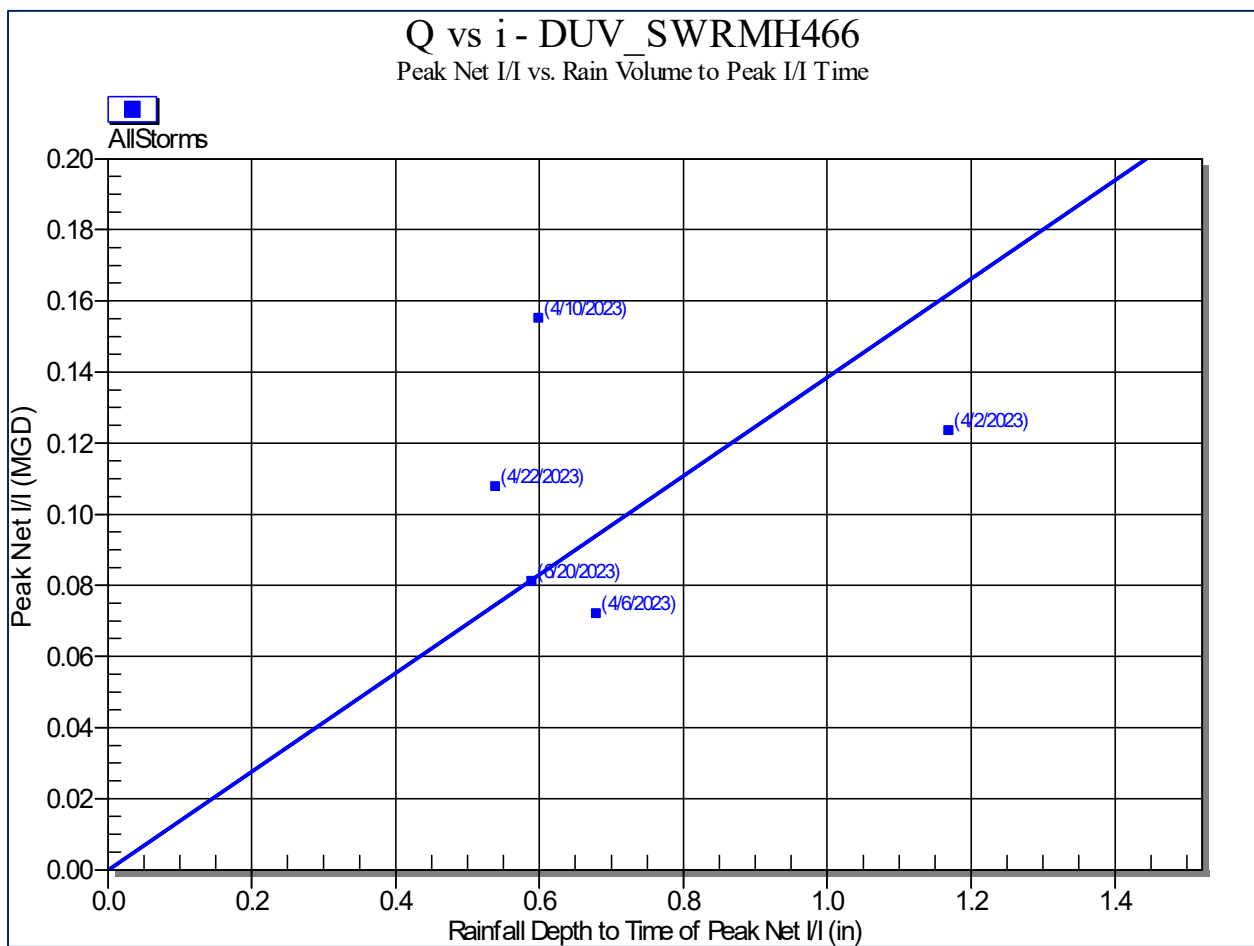


Attachment D: Peak RDII Q vs. i Graphs









Attachment B

Bravo Environmental
Smoke Test

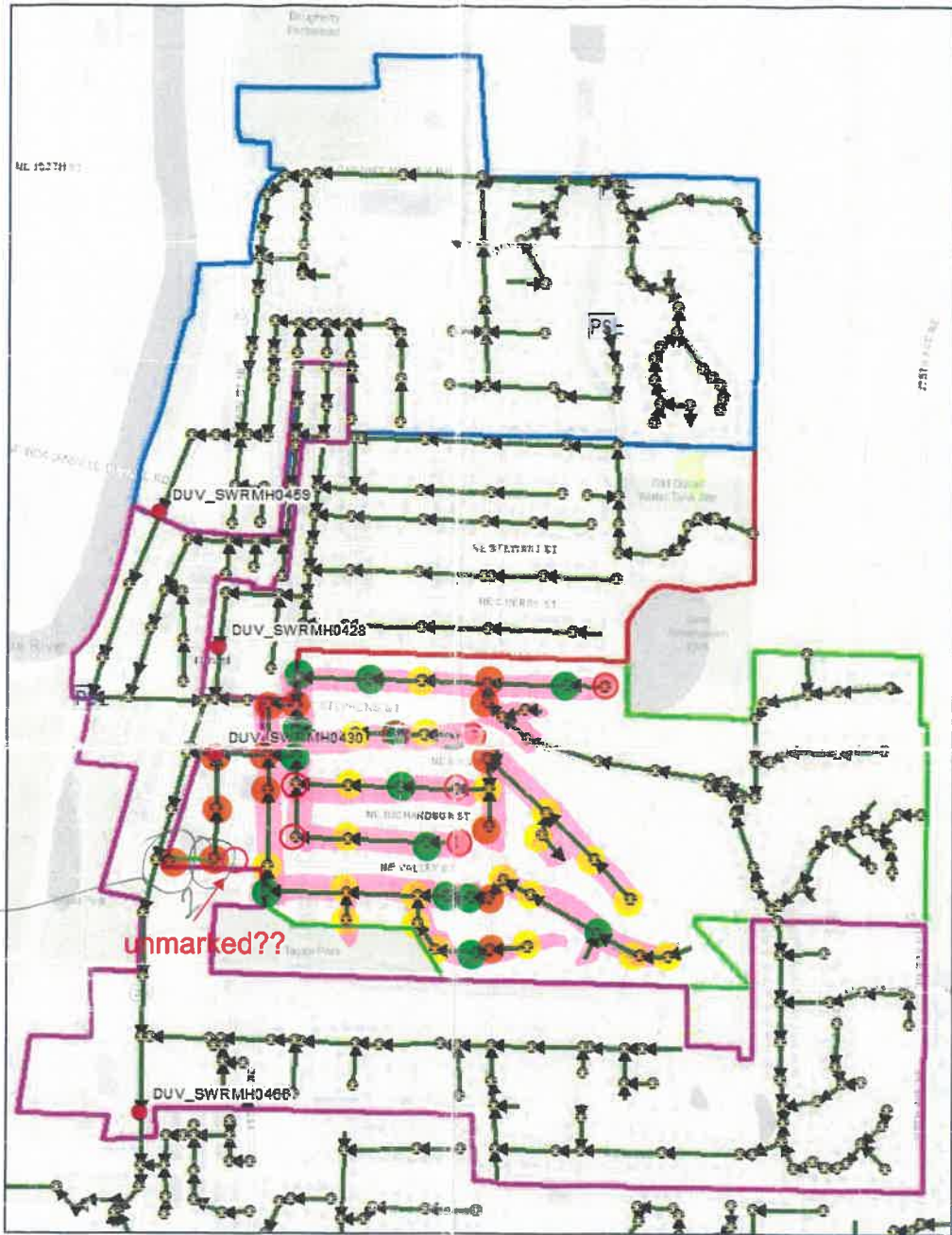


Figure 1: Meter Location with Meter Basin Boundaries

#5 Smoke from crawl space (older house)

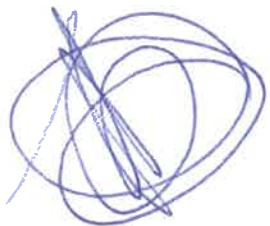
#11/12 Smoke from crawl space (newer house)

-> Sewer MH leaking ground water into structure

#13 smoke from Apt. CB.

#16 light smoke from french drain/footing drain along garage wall.

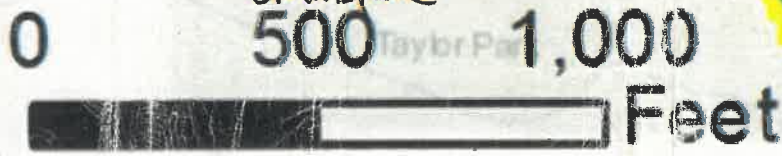
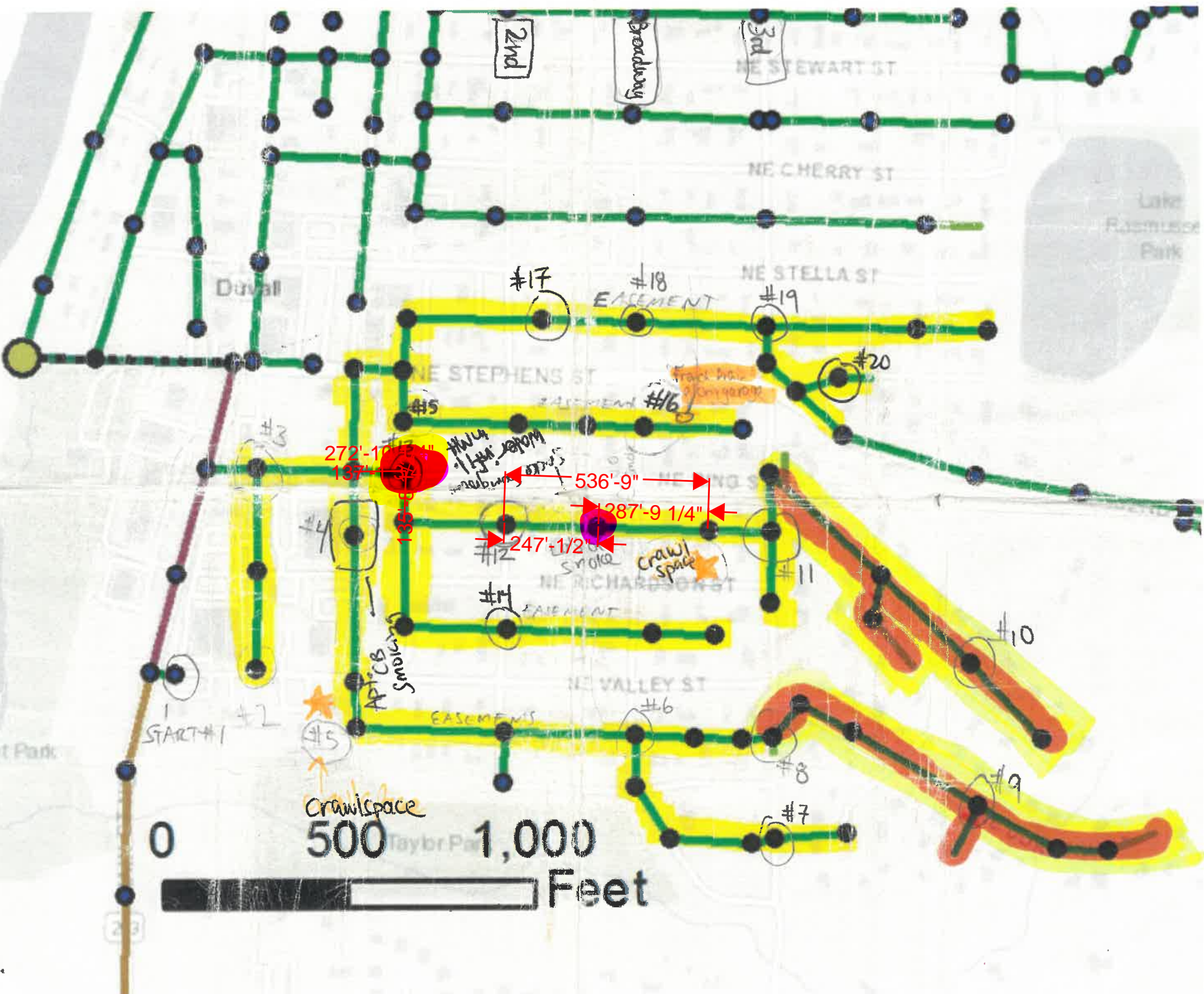
#23 smoke side of house (cleanout cover or gutter/drain?)



0815
0815 r

13215

Parame tox



START #1

Crawl space

500

1,000

Feet

2nd

Boundary

3rd

NE STEWART ST

NE CHERRY ST

NE STELLA ST

Duvall

#17

#18

EASEMENT

#19

#20

#15

#16

272'-10 1/2"

135'-4"

536'-9"

247'-1/2"

287'-9 1/4"

#12

#14

NE RICHARDSON ST

#11

APICB Smoking

NE VALLEY ST

#10

EASEMENT

#6

#8

#7

#9

Depot Park

23

Lake Rasmussen Park



#21

#23

#22

#21



Attachment C

Bravo Environmental Closed
Circuit Television Reports

Project:		Date/Time:	March 26 2024 - 09:04
Street and City:	1ST AVE NE - DUVALL, WA	Weather:	Unknown Weather
Owner:	DUVALL	Inspection Status:	Complete Inspection
Customer:	DUVALL	Segment:	RUN1 E_S
Surveyor Name and Certificate:	JAMES LEMAR 0000	Direction:	Upstream
Reviewer Name and Certificate:	BRUCE WEISKOTTEN U-0321-70401333	Up MH:	USMH-S
P.O. #		Down MH:	DSMH-E

Pipe Details and Measurements

Pipe Use:	SS	Material:	CP
Height:	8	Lining:	
Width:		Joint Length:	
Shape:	C	Purpose:	
Pre-Cleaning:	Heavy Cleaning	Additional Info:	

Pipe Ratings

Overall Quick Rating: 3122

Structural Quick Rating:	2200	O&M Quick Rating:	3111
Structural Pipe Rating Index:	2.0	O&M Pipe Rating Index:	2.0



Surveyed Length: 132.4

Total Length: 132.4

Inspection Technology Used:

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN1 E_S

Down MH: DSMH-E

Observations & Defects

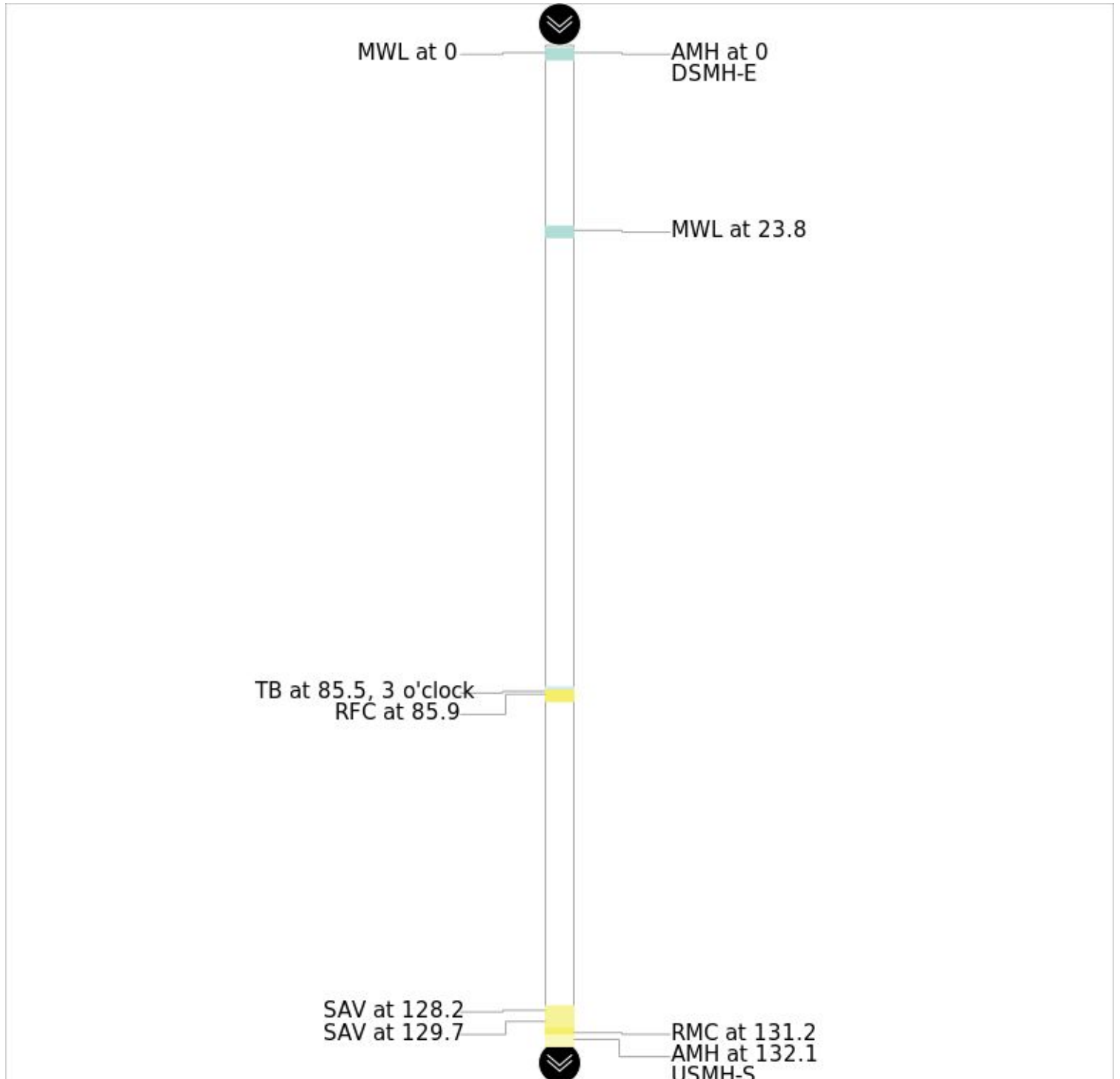
Surveyed Length: 132.4

Total Length: 132.4

Flow Direction:



Survey Direction:
Upstream

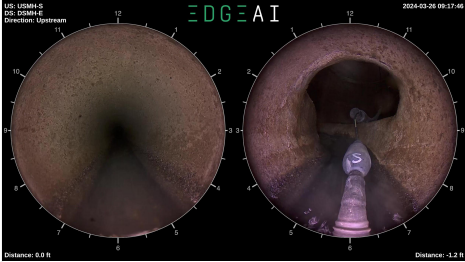
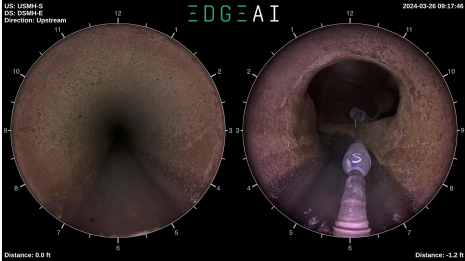
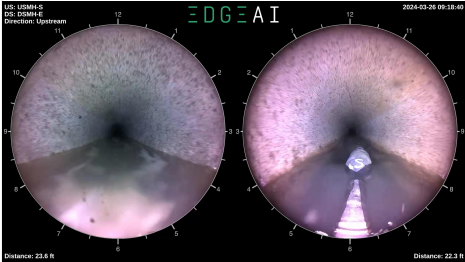
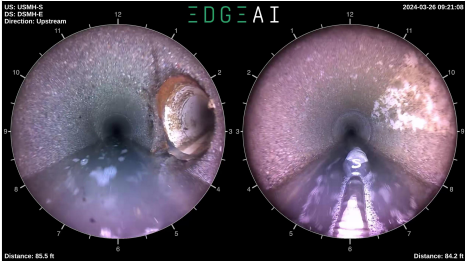


DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN1 E_S

Down MH: DSMH-E

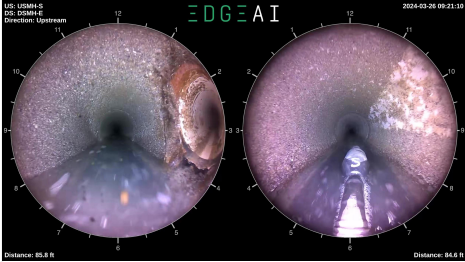
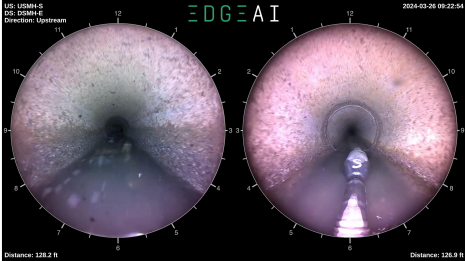
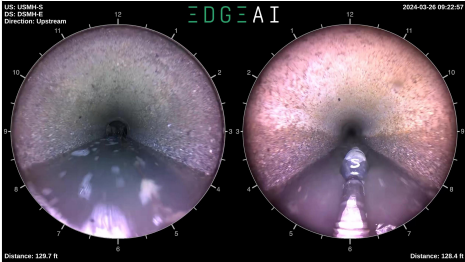
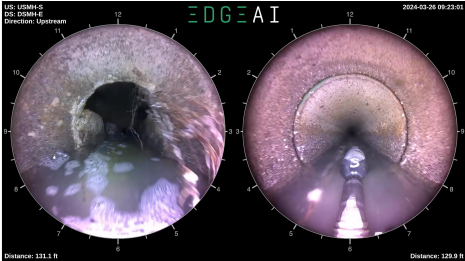
Photo	Distance	Description	Time
	0	AMH - Manhole Remark = DSMH-E	00:00:05
	0	MWL - Miscellaneous Water Level Percent: 10	00:00:05
	23.8	MWL - Miscellaneous Water Level Percent: 20	00:00:59
	85.5	TB - Tap Break-in/Hammer Measurement 1: 4 Clock At 3	00:03:27

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN1 E_S

Down MH: DSMH-E

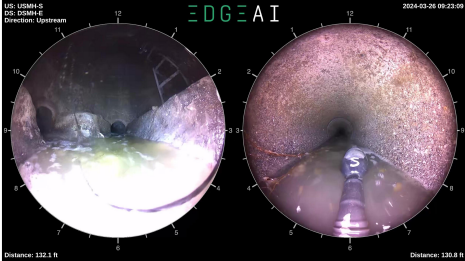
Photo	Distance	Description	Time
	85.9	RFC - Roots Fine Connection Clock from 1 to 4 Grade = 1	00:03:30
	128.2	SAV - Surface Damage Aggregate Visible Clock from 3 to 9 Grade = 2	00:05:13
	129.7	SAV - Surface Damage Aggregate Visible Joint: True Clock from 2 to 10 Grade = 2	00:05:16
	131.2	RMC - Roots Medium Connection Percent: 10 Clock from 12 to 5 Remark = FROM MH Grade = 3	00:05:20

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN1 E_S

Down MH: DSMH-E

Photo	Distance	Description	Time
	<p>132.1</p>	<p>AMH - Manhole Remark = USMH-S</p>	<p>00:05:28</p>

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN1 E_S

Down MH: DSMH-E

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:00:05	0	AMH								DSMH-E
00:00:05	0	MWL				10				
00:00:59	23.8	MWL				20				
00:03:27	85.5	TB		4				3		
00:03:30	85.9	RFC						1	4	
00:05:13	128.2	SAV					False	3	9	
00:05:13	129.7	SAV					True	2	10	
00:05:20	131.2	RMC				10		12	5	FROM MH
00:05:28	132.1	AMH								USMH-S

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN1 E_S

Down MH: DSMH-E

Additional PACP Header Information

Media Label:		Up Rim to Invert:	
Work Order:		Up Rim to Grade:	
Sheet Number:		Up Grade to Invert:	
Date Cleaned:	Unknown	Up Northing:	
Flow Control:		Up Easting:	
Consequence of Failure		Up Elevation:	
Pressure Value:		Down Rim to Invert:	
Drainage Area:		Down Rim to Grade:	
Location Code:		Down Grade to Invert:	
Location Details:		Down Northing:	
Coating Method:		Down Easting:	
Pipe Joint Length:		Down Elevation:	
Year Constructed:		Coordinate System:	
Year Renewed:		Vertical Datum:	
		GPS Accuracy:	
Reverse Setup:	0	Imperial?:	True

Project:		Date/Time:	March 26 2024 - 10:53
Street and City:	2ND AVE NE - DUVALL, WA	Weather:	Unknown Weather
Owner:	DUVALL	Inspection Status:	Complete Inspection
Customer:	DUVALL	Segment:	RUN2 M_E
Surveyor Name and Certificate:	JAMES LEMAR 0000	Direction:	Downstream
Reviewer Name and Certificate:	BRUCE WEISKOTTEN U-0321-70401333	Up MH:	USMH-M
P.O. #		Down MH:	DSMH-E

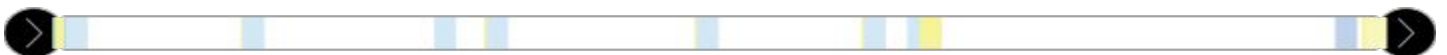
Pipe Details and Measurements

Pipe Use:	SS	Material:	CP
Height:	8	Lining:	
Width:		Joint Length:	
Shape:	C	Purpose:	
Pre-Cleaning:	Heavy Cleaning	Additional Info:	

Pipe Ratings

Overall Quick Rating: 2J11

Structural Quick Rating:	2J00	O&M Quick Rating:	1100
Structural Pipe Rating Index:	2.0	O&M Pipe Rating Index:	1.0



Surveyed Length: 246.4

Total Length: 246.4

Inspection Technology Used:

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

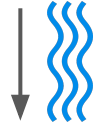
Down MH: DSMH-E

Observations & Defects

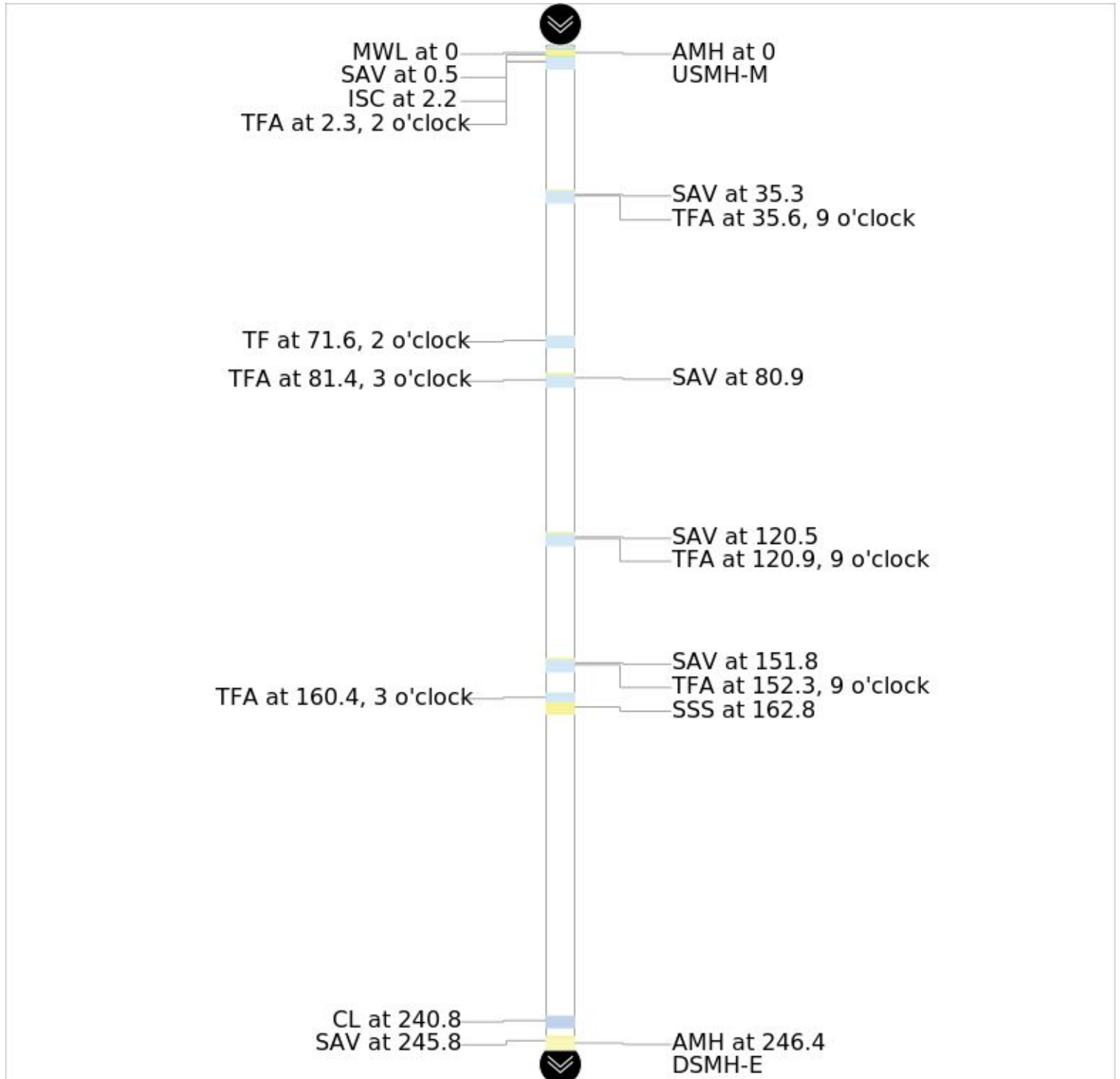
Surveyed Length: 246.4

Total Length: 246.4

Flow Direction:



Survey Direction:
Downstream

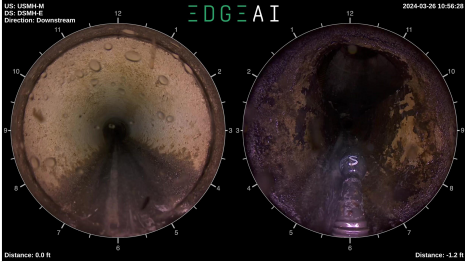
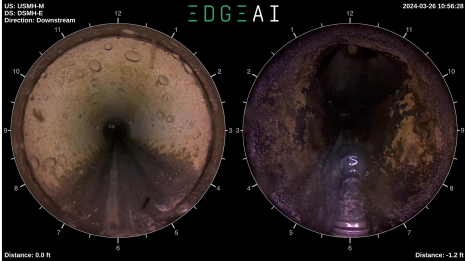
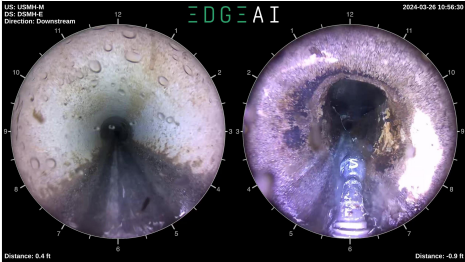
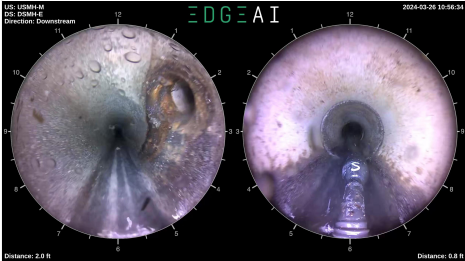


DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

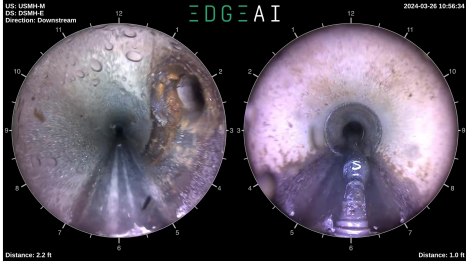
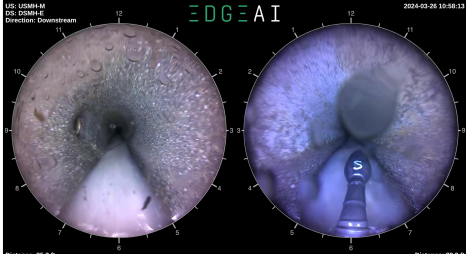
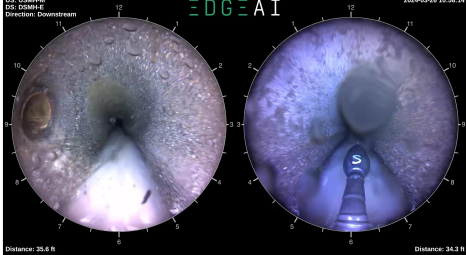
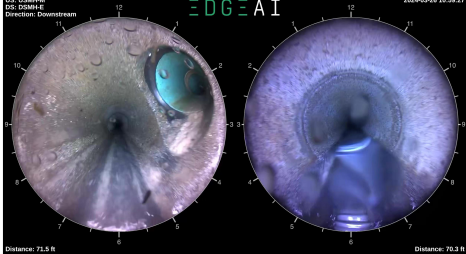
Photo	Distance	Description	Time
	0	AMH - Manhole Remark = USMH-M	00:00:05
	0	MWL - Miscellaneous Water Level Percent: 5	00:00:05
	0.5	SAV - Surface Damage Aggregate Visible Continuous: S01 Joint: True Clock from 4 to 8 Grade = 2	00:00:07
	2.2	ISC - Infiltration Stain Connection Clock from 1 to 5 Grade = 1	00:00:11

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

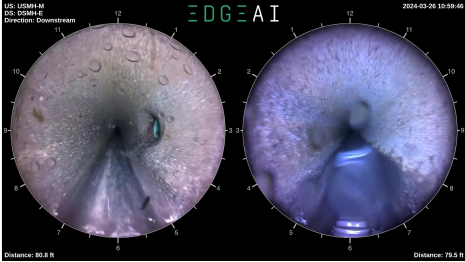
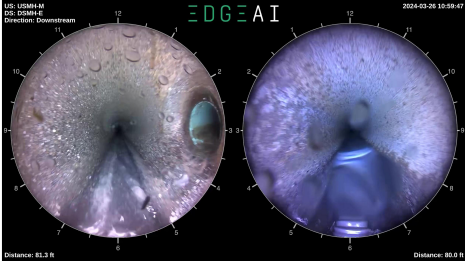
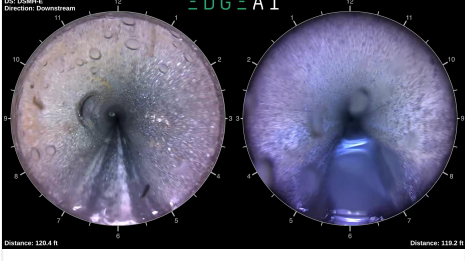
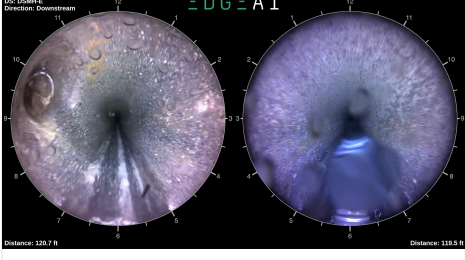
Photo	Distance	Description	Time
	2.3	TFA - Tap Factory Activity Measurement 1: 4 Clock At 2	00:00:11
	35.3	SAV - Surface Damage Aggregate Visible Joint: True Clock from 12 to 12 Grade = 2	00:01:50
	35.6	TFA - Tap Factory Activity Measurement 1: 4 Joint: True Clock At 9	00:01:51
	71.6	TF - Tap Factory Measurement 1: 4 Clock At 2	00:03:04

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

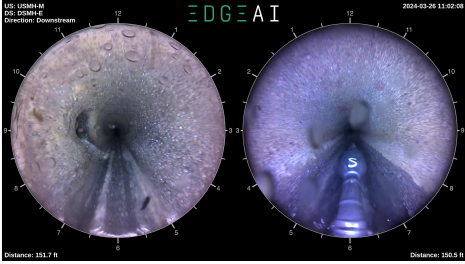
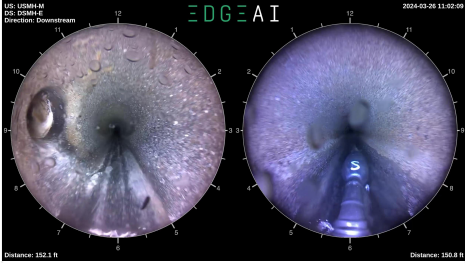
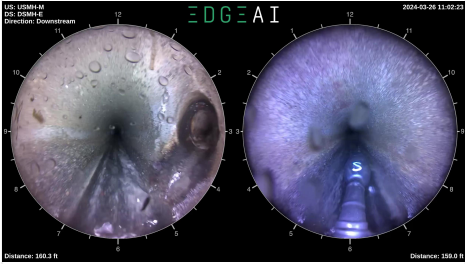
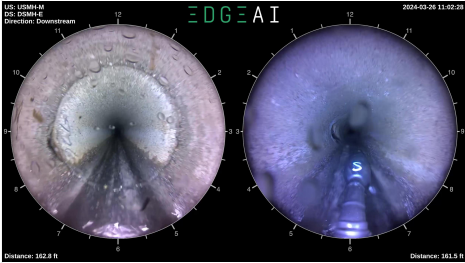
Photo	Distance	Description	Time
	80.9	SAV - Surface Damage Aggregate Visible Joint: True Clock from 12 to 12 Grade = 2	00:03:23
	81.4	TFA - Tap Factory Activity Measurement 1: 3 Joint: True Clock At 3	00:03:24
	120.5	SAV - Surface Damage Aggregate Visible Joint: True Clock from 12 to 12 Grade = 2	00:04:41
	120.9	TFA - Tap Factory Activity Measurement 1: 4 Joint: True Clock At 9	00:04:42

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

Photo	Distance	Description	Time
	151.8	SAV - Surface Damage Aggregate Visible Joint: True Clock from 12 to 12 Grade = 2	00:05:45
	152.3	TFA - Tap Factory Activity Measurement 1: 4 Joint: True Clock At 9	00:05:46
	160.4	TFA - Tap Factory Activity Measurement 1: 4 Joint: True Clock At 3 Remark = ISC IN LATERAL	00:06:00
	162.8	SSS - Surface Damage Surface Spalling Joint: True Clock from 8 to 9 Grade = 2	00:06:05

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

Photo	Distance	Description	Time
	240.8	CL - Crack Longitudinal Joint: True Clock At 2 Grade = 2	00:08:43
	245.8	SAV - Surface Damage Aggregate Visible Continuous: F01 Joint: True Clock from 4 to 8 Grade = 2	00:08:52
	246.4	AMH - Manhole Remark = DSMH-E	00:08:59

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:00:05	0	AMH								USMH-M
00:00:05	0	MWL				5				
00:00:07	0.5	SAV	S01				True	4	8	
00:00:11	2.2	ISC					False	1	5	
00:00:11	2.3	TFA		4			False	2		
00:01:50	35.3	SAV					True	12	12	
00:01:50	35.6	TFA		4			True	9		
00:03:04	71.6	TF		4			False	2		
00:03:23	80.9	SAV					True	12	12	

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:03:24	81.4	TFA		3			True	3		
00:04:41	120.5	SAV					True	12	12	
00:04:42	120.9	TFA		4			True	9		
00:05:45	151.8	SAV					True	12	12	
00:05:46	152.3	TFA		4			True	9		
00:06:00	160.4	TFA		4			True	3		ISC IN LATERAL
00:06:00	162.8	SSS					True	8	9	
00:08:43	240.8	CL					True	2		
00:08:52	245.8	SAV	F01				True	4	8	

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:08:59	246.4	AMH								DSMH-E

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN2 M_E

Down MH: DSMH-E

Additional PACP Header Information

Media Label:		Up Rim to Invert:	
Work Order:		Up Rim to Grade:	
Sheet Number:		Up Grade to Invert:	
Date Cleaned:	Unknown	Up Northing:	
Flow Control:		Up Easting:	
Consequence of Failure		Up Elevation:	
Pressure Value:		Down Rim to Invert:	
Drainage Area:		Down Rim to Grade:	
Location Code:		Down Grade to Invert:	
Location Details:		Down Northing:	
Coating Method:		Down Easting:	
Pipe Joint Length:		Down Elevation:	
Year Constructed:		Coordinate System:	
Year Renewed:		Vertical Datum:	
		GPS Accuracy:	
Reverse Setup:	0	Imperial?:	True

Project:		Date/Time:	March 26 2024 - 11:18
Street and City:	2ND AVE NE - DUVALL, WA	Weather:	Unknown Weather
Owner:	DUVALL	Inspection Status:	Complete Inspection
Customer:	DUVALL	Segment:	RUN2 M_S
Surveyor Name and Certificate:	JAMES LEMAR 0000	Direction:	Upstream
Reviewer Name and Certificate:	BRUCE WEISKOTTEN U-0321-70401333	Up MH:	USMH-S
P.O. #		Down MH:	DSMH-M

Pipe Details and Measurements

Pipe Use:	SS	Material:	CP
Height:	8	Lining:	
Width:		Joint Length:	
Shape:	C	Purpose:	
Pre-Cleaning:	Heavy Cleaning	Additional Info:	

Pipe Ratings

Overall Quick Rating: 312L

Structural Quick Rating:	2L00	O&M Quick Rating:	3111
Structural Pipe Rating Index:	2.0	O&M Pipe Rating Index:	2.0



Surveyed Length: 297.4

Total Length: 297.4

Inspection Technology Used:

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

Observations & Defects

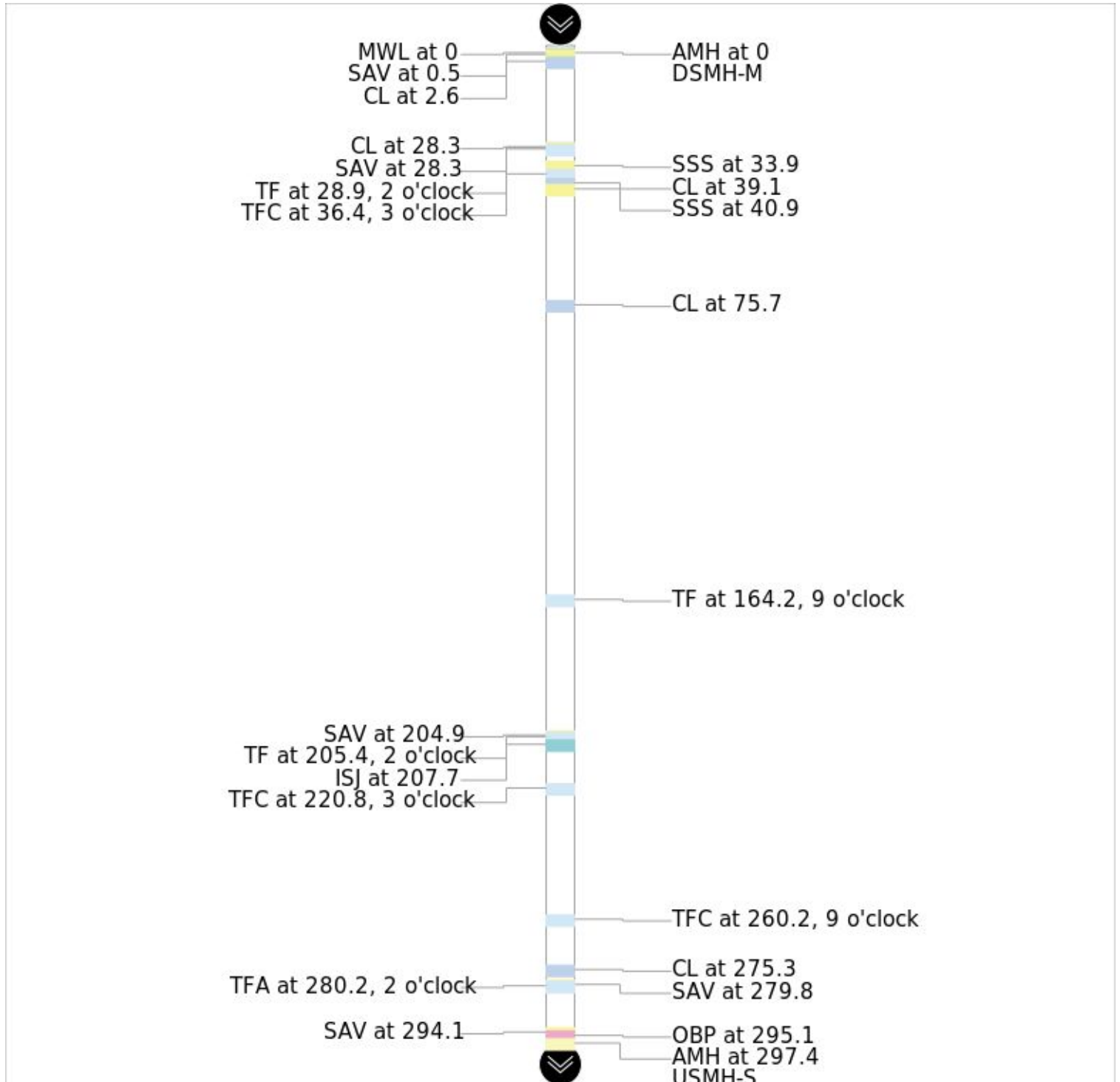
Surveyed Length: 297.4

Total Length: 297.4

Flow Direction:



Survey Direction:
Upstream

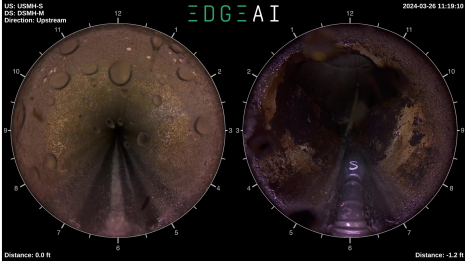
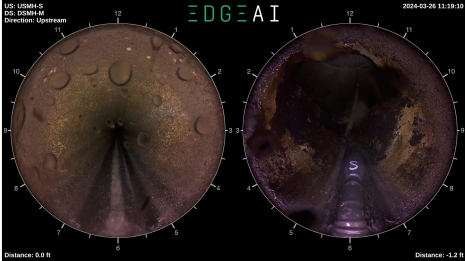
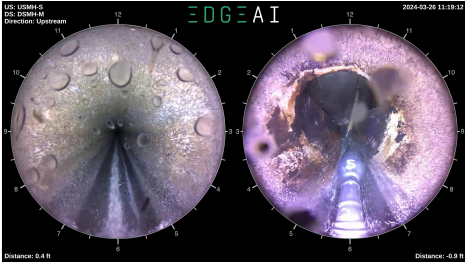
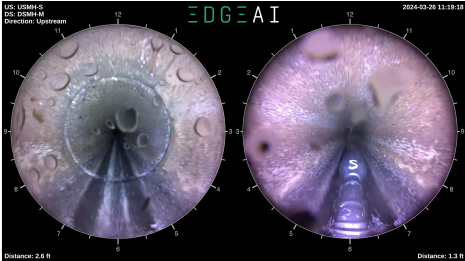


DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

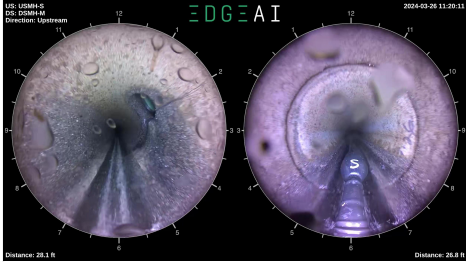
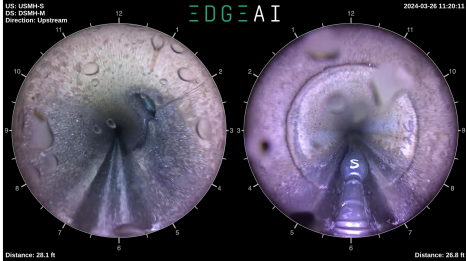
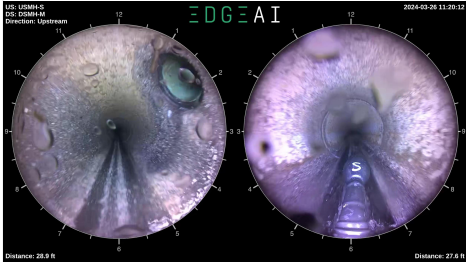
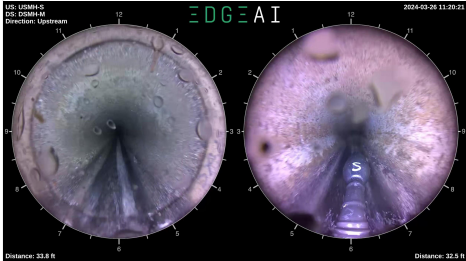
Photo	Distance	Description	Time
	0	AMH - Manhole Remark = DSMH-M	00:00:05
	0	MWL - Miscellaneous Water Level Percent: 5	00:00:05
	0.5	SAV - Surface Damage Aggregate Visible Continuous: S01 Clock from 5 to 7 Grade = 2	00:00:07
	2.6	CL - Crack Longitudinal Joint: True Clock At 1 Grade = 2	00:00:13

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

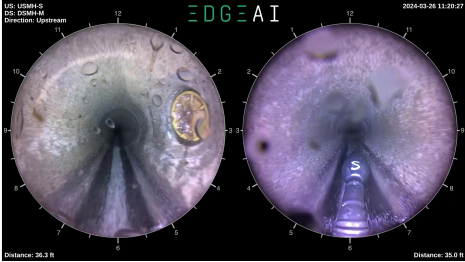
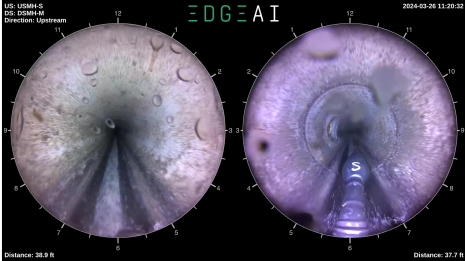
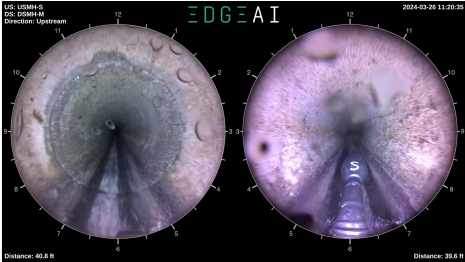
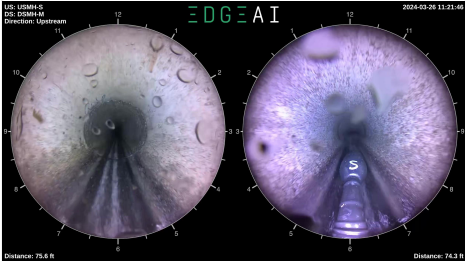
Photo	Distance	Description	Time
	28.3	CL - Crack Longitudinal Clock At 2 Grade = 2	00:01:06
	28.3	SAV - Surface Damage Aggregate Visible Clock from 2 to 10 Grade = 2	00:01:06
	28.9	TF - Tap Factory Measurement 1: 4 Clock At 2	00:01:07
	33.9	SSS - Surface Damage Surface Spalling Joint: True Clock from 11 to 12 Grade = 2	00:01:16

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

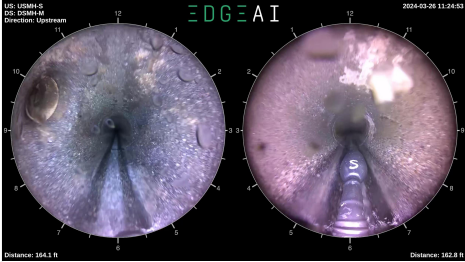
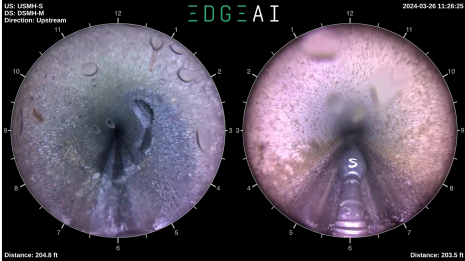
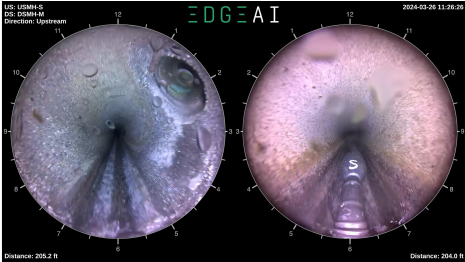
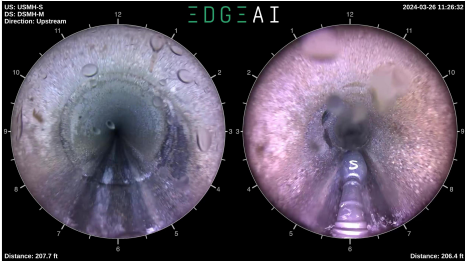
Photo	Distance	Description	Time
	36.4	TFC - Tap Factory Capped Measurement 1: 4 Clock At 3	00:01:22
	39.1	CL - Crack Longitudinal Clock At 10 Grade = 2	00:01:27
	40.9	SSS - Surface Damage Surface Spalling Joint: True Clock from 11 to 12 Grade = 2	00:01:30
	75.7	CL - Crack Longitudinal Clock At 10 Grade = 2	00:02:41

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

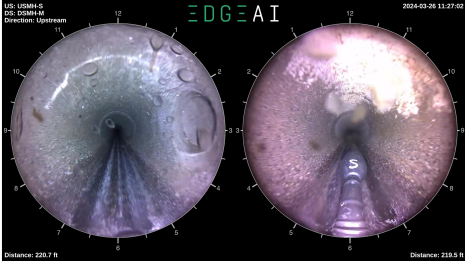
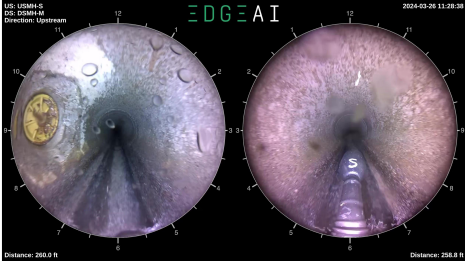
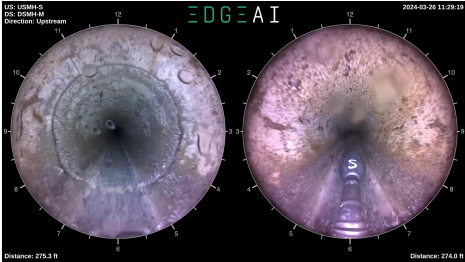
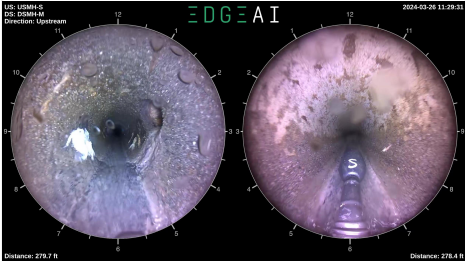
Photo	Distance	Description	Time
	164.2	TF - Tap Factory Measurement 1: 4 Clock At 9	00:05:48
	204.9	SAV - Surface Damage Aggregate Visible Joint: True Clock from 2 to 10 Grade = 2	00:07:20
	205.4	TF - Tap Factory Measurement 1: 4 Joint: True Clock At 2	00:07:21
	207.7	ISJ - Infiltration Stain Joint Joint: True Clock from 2 to 5 Grade = 1	00:07:27

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

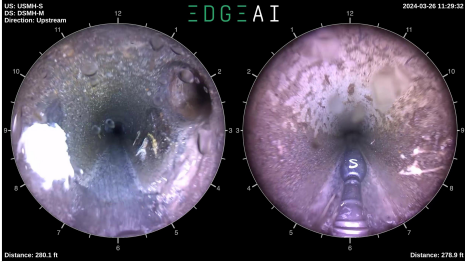
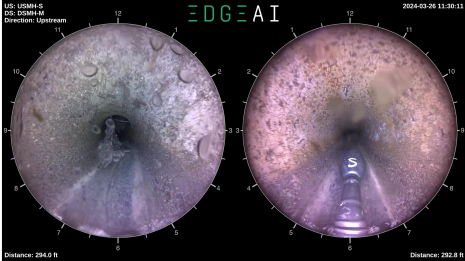
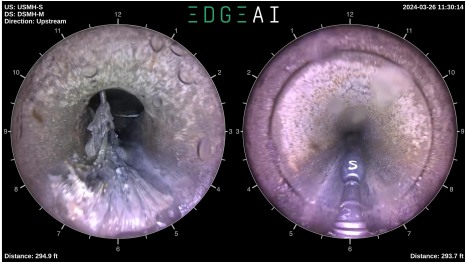
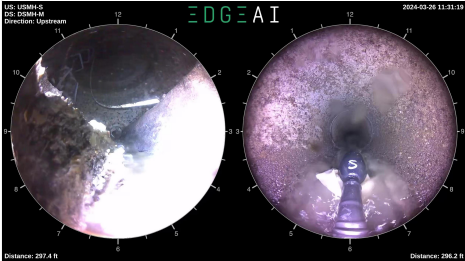
Photo	Distance	Description	Time
	220.8	TFC - Tap Factory Capped Measurement 1: 4 Clock At 3	00:07:57
	260.2	TFC - Tap Factory Capped Measurement 1: 4 Clock At 9	00:09:33
	275.3	CL - Crack Longitudinal Joint: True Clock At 11 Grade = 2	00:10:14
	279.8	SAV - Surface Damage Aggregate Visible Joint: True Clock from 12 to 12 Grade = 2	00:10:26

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

Photo	Distance	Description	Time
	280.2	TFA - Tap Factory Activity Measurement 1: 4 Joint: True Clock At 2	00:10:27
	294.1	SAV - Surface Damage Aggregate Visible Continuous: F01 Clock from 5 to 7 Grade = 2	00:11:07
	295.1	OBP - Obstruction External Pipe or Cable Percent: 15 Clock from 6 to 10 Remark = CABLE OR BAR INTRUDING FROM MH Grade = 3	00:11:09
	297.4	AMH - Manhole Remark = USMH-S	00:12:15

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:00:05	0	AMH								DSMH-M
00:00:05	0	MWL				5				
00:00:07	0.5	SAV	S01				False	5	7	
00:00:13	2.6	CL					True	1		
00:01:06	28.3	CL					False	2		
00:01:06	28.3	SAV					False	2	10	
00:01:06	28.9	TF		4			False	2		
00:01:16	33.9	SSS					True	11	12	
00:01:22	36.4	TFC		4			False	3		

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:01:27	39.1	CL					False	10		
00:01:30	40.9	SSS					True	11	12	
00:02:41	75.7	CL					False	10		
00:05:48	164.2	TF		4			False	9		
00:07:20	204.9	SAV					True	2	10	
00:07:21	205.4	TF		4			True	2		
00:07:21	207.7	ISJ					True	2	5	
00:07:57	220.8	TFC		4			False	3		
00:09:33	260.2	TFC		4			False	9		

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:10:14	275.3	CL					True	11		
00:10:26	279.8	SAV					True	12	12	
00:10:27	280.2	TFA		4			True	2		
00:11:07	294.1	SAV	F01				False	5	7	
00:11:09	295.1	OBP				15	False	6	10	CABLE OR BAR INTRUDING FROM MH
00:12:15	297.4	AMH								USMH-S

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN2 M_S

Down MH: DSMH-M

Additional PACP Header Information

Media Label:		Up Rim to Invert:	
Work Order:		Up Rim to Grade:	
Sheet Number:		Up Grade to Invert:	
Date Cleaned:	Unknown	Up Northing:	
Flow Control:		Up Easting:	
Consequence of Failure		Up Elevation:	
Pressure Value:		Down Rim to Invert:	
Drainage Area:		Down Rim to Grade:	
Location Code:		Down Grade to Invert:	
Location Details:		Down Northing:	
Coating Method:		Down Easting:	
Pipe Joint Length:		Down Elevation:	
Year Constructed:		Coordinate System:	
Year Renewed:		Vertical Datum:	
		GPS Accuracy:	
Reverse Setup:	0	Imperial?:	True

Project:		Date/Time:	March 26 2024 - 12:41
Street and City:	NE 155TH PL - DUVALL, WA	Weather:	Unknown Weather
Owner:	DUVALL	Inspection Status:	Complete Inspection
Customer:	DUVALL	Segment:	RUN3 M_E
Surveyor Name and Certificate:	JAMES LEMAR 0000	Direction:	Upstream
Reviewer Name and Certificate:	BRUCE WEISKOTTEN U-0321-70401333	Up MH:	USMH-M
P.O. #		Down MH:	DSMH-E

Pipe Details and Measurements

Pipe Use:	SS	Material:	CP
Height:	8	Lining:	
Width:		Joint Length:	
Shape:	C	Purpose:	
Pre-Cleaning:	Heavy Cleaning	Additional Info:	

Pipe Ratings

Overall Quick Rating: 2100

Structural Quick Rating:	2100	O&M Quick Rating:	0000
Structural Pipe Rating Index:	2.0	O&M Pipe Rating Index:	0.0



Surveyed Length: 184.7

Total Length: 184.7

Inspection Technology Used:

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN3 M_E

Down MH: DSMH-E

Observations & Defects

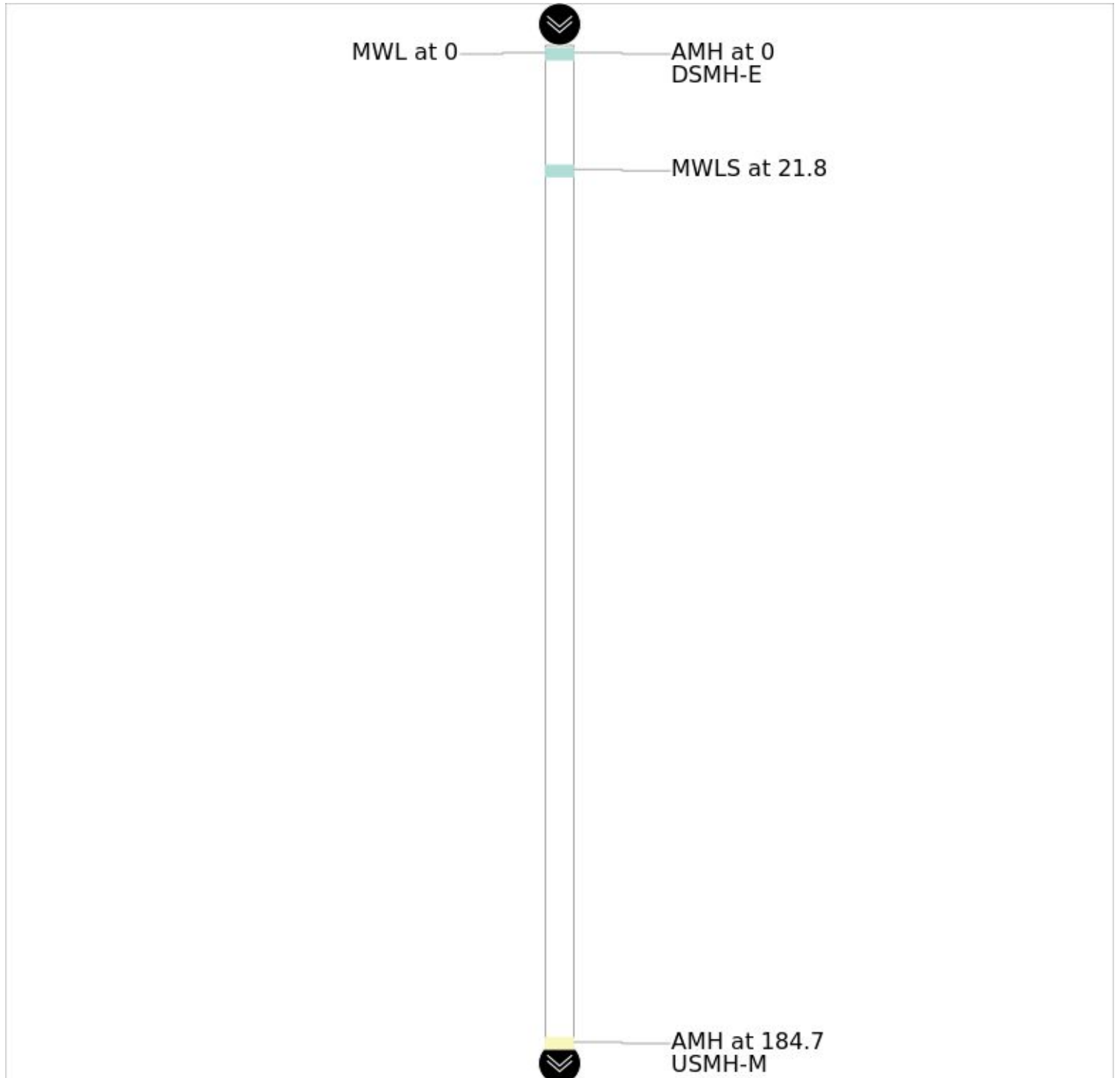
Surveyed Length: 184.7

Total Length: 184.7

Flow Direction:



Survey Direction:
Upstream

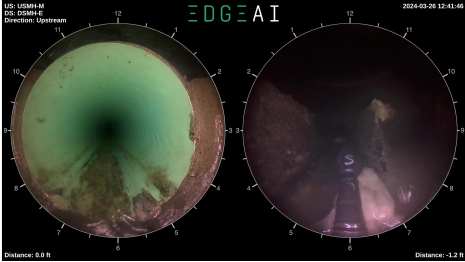
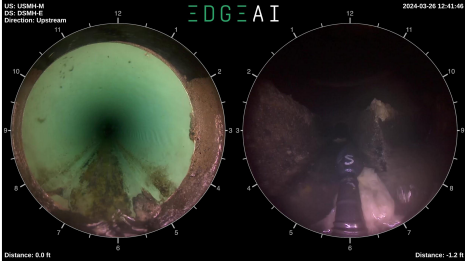
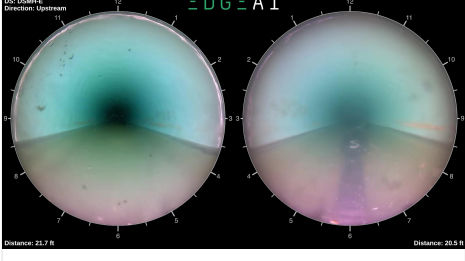
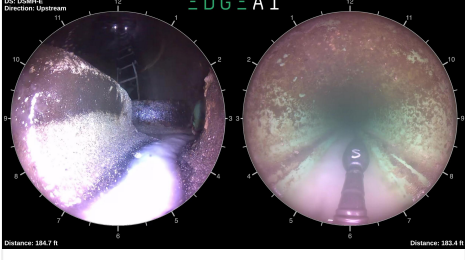


DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN3 M_E

Down MH: DSMH-E

Photo	Distance	Description	Time
	0	AMH - Manhole Remark = DSMH-E	00:00:05
	0	MWL - Miscellaneous Water Level Percent: 10	00:00:05
	21.8	MWLS - Miscellaneous Water Level Sag Percent: 20 Grade = 2	00:00:51
	184.7	AMH - Manhole Remark = USMH-M	00:06:38

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN3 M_E

Down MH: DSMH-E

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:00:05	0	AMH								DSMH-E
00:00:05	0	MWL				10				
00:00:51	21.8	MWL S				20				
00:06:38	184.7	AMH								USMH-M

DUVALL, WA — March 26 2024

Up MH: USMH-M

Pipe: RUN3 M_E

Down MH: DSMH-E

Additional PACP Header Information

Media Label:		Up Rim to Invert:	
Work Order:		Up Rim to Grade:	
Sheet Number:		Up Grade to Invert:	
Date Cleaned:	Unknown	Up Northing:	
Flow Control:		Up Easting:	
Consequence of Failure		Up Elevation:	
Pressure Value:		Down Rim to Invert:	
Drainage Area:		Down Rim to Grade:	
Location Code:		Down Grade to Invert:	
Location Details:		Down Northing:	
Coating Method:		Down Easting:	
Pipe Joint Length:		Down Elevation:	
Year Constructed:		Coordinate System:	
Year Renewed:		Vertical Datum:	
		GPS Accuracy:	
Reverse Setup:	0	Imperial?:	True

Project:		Date/Time:	March 26 2024 - 12:27
Street and City:	NE 155TH PL - DUVALL, WA	Weather:	Unknown Weather
Owner:	DUVALL	Inspection Status:	Complete Inspection
Customer:	DUVALL	Segment:	RUN3 S_M
Surveyor Name and Certificate:	JAMES LEMAR 0000	Direction:	Upstream
Reviewer Name and Certificate:	BRUCE WEISKOTTEN U-0321-70401333	Up MH:	USMH-S
P.O. #		Down MH:	DSMH-M

Pipe Details and Measurements

Pipe Use:	SS	Material:	CP
Height:	8	Lining:	
Width:		Joint Length:	
Shape:	C	Purpose:	
Pre-Cleaning:	Heavy Cleaning	Additional Info:	

Pipe Ratings

Overall Quick Rating: 2A00

Structural Quick Rating:	0000	O&M Quick Rating:	2A00
Structural Pipe Rating Index:	0.0	O&M Pipe Rating Index:	2.0



Surveyed Length: 223.3

Total Length: 223.3

Inspection Technology Used:

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

Observations & Defects

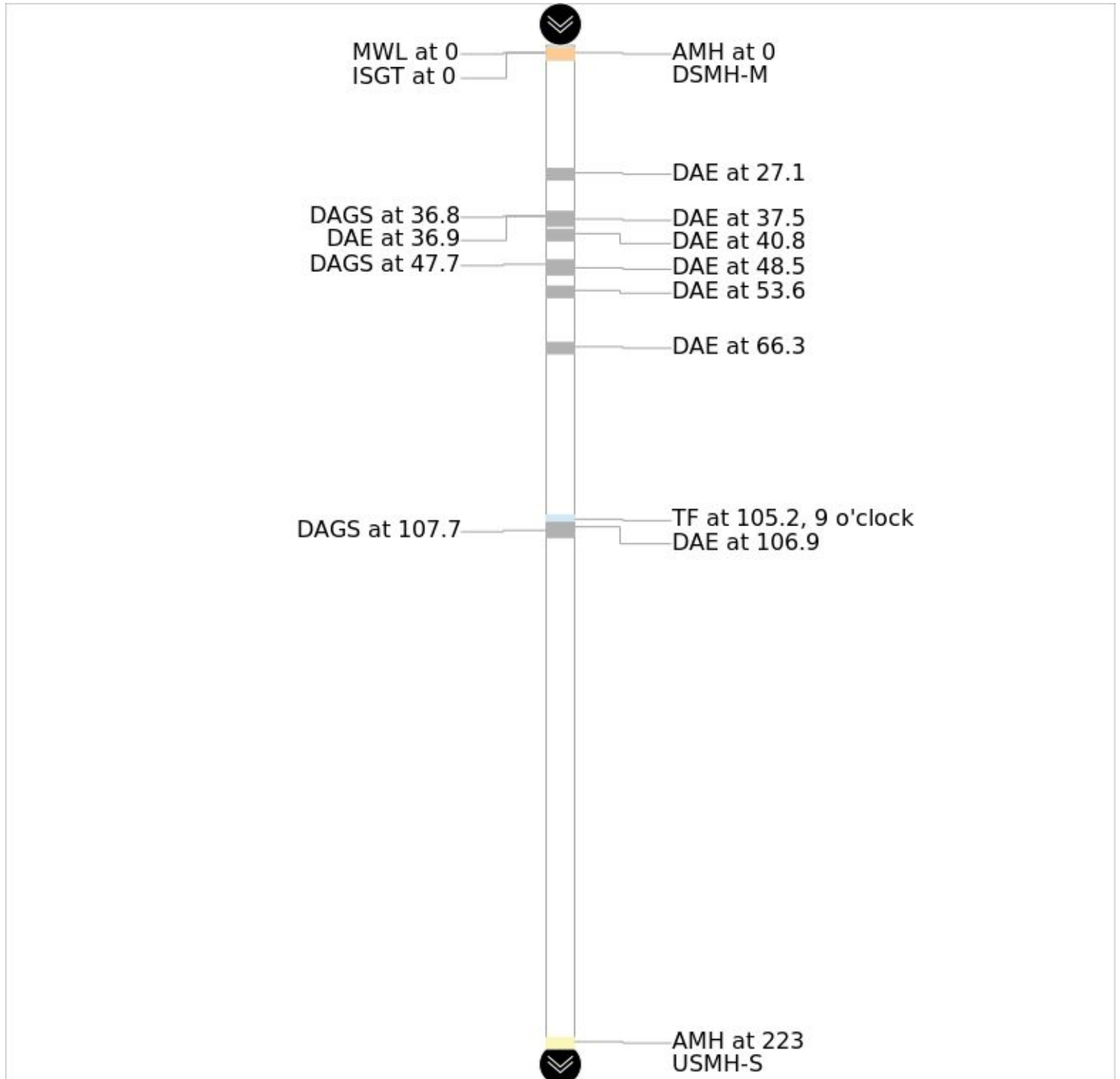
Surveyed Length: 223.3

Total Length: 223.3

Flow Direction:



Survey Direction:
Upstream

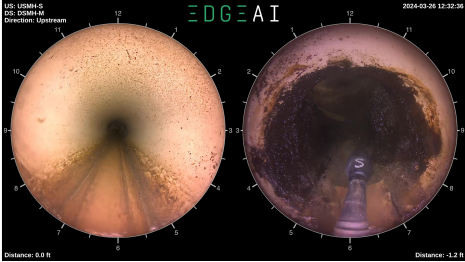
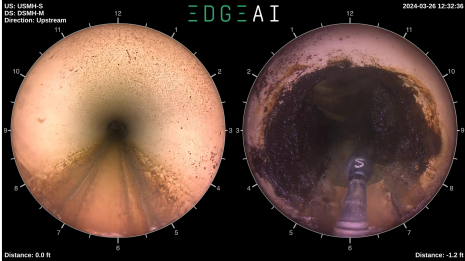
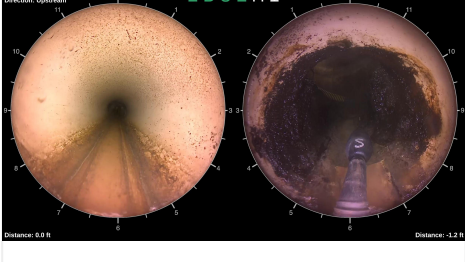
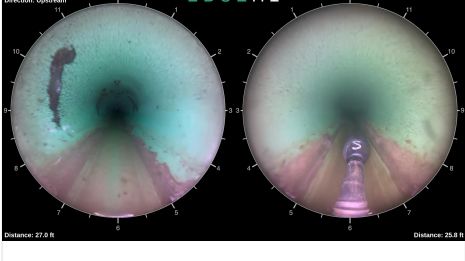


DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

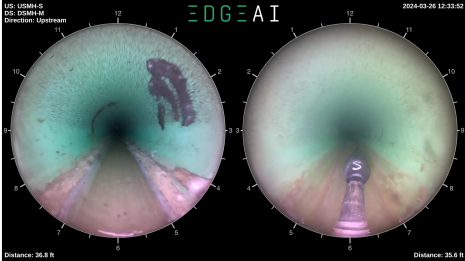
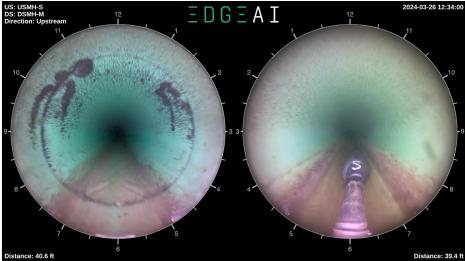
Photo	Distance	Description	Time
	0	AMH - Manhole Remark = DSMH-M	00:00:05
	0	MWL - Miscellaneous Water Level Percent: 10	00:00:05
	0	ISGT - Intruding Sealing Material Grout Percent: 5 Clock from 5 to 8 Remark = REAR CAM VIEW Grade = 2	00:00:05
	27.1	DAE - Deposits Attached Encrustation Percent: 5 Clock from 9 to 11 Grade = 2	00:01:02

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

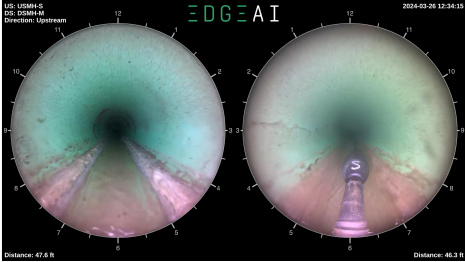
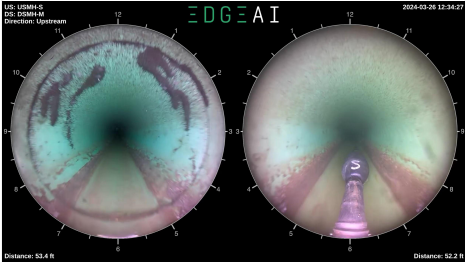
Photo	Distance	Description	Time
	36.8	<p>DAGS - Deposits Attached Grease Percent: 5 Clock from 4 to 8 Remark = SHELFING Grade = 2</p>	00:01:21
	36.9	<p>DAE - Deposits Attached Encrustation Percent: 5 Clock from 1 to 3 Grade = 2</p>	00:01:22
	37.5	<p>DAE - Deposits Attached Encrustation Percent: 5 Clock from 8 to 12 Grade = 2</p>	00:01:23
	40.8	<p>DAE - Deposits Attached Encrustation Percent: 5 Joint: True Clock from 8 to 3 Grade = 2</p>	00:01:29

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

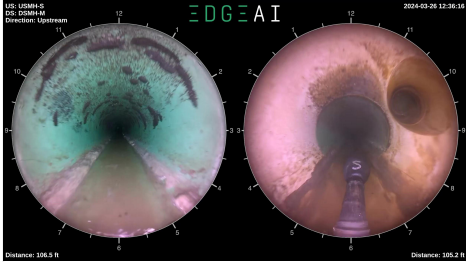
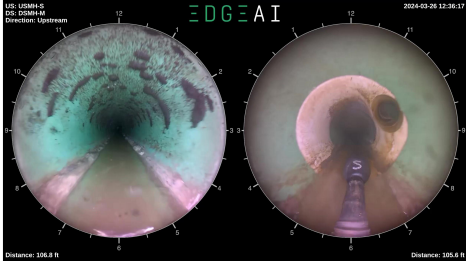
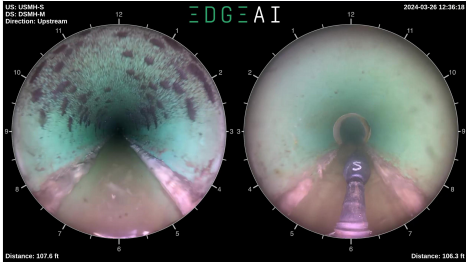
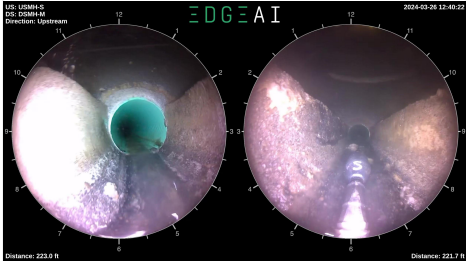
Photo	Distance	Description	Time
	47.7	DAGS - Deposits Attached Grease Percent: 5 Clock from 4 to 8 Remark = SHELFING Grade = 2	00:01:44
	48.5	DAE - Deposits Attached Encrustation Percent: 5 Clock from 8 to 3 Grade = 2	00:01:45
	53.6	DAE - Deposits Attached Encrustation Percent: 5 Joint: True Clock from 8 to 4 Grade = 2	00:01:56
	66.3	DAE - Deposits Attached Encrustation Percent: 5 Joint: True Clock from 9 to 3 Grade = 2	00:02:22

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

Photo	Distance	Description	Time
	105.2	TF - Tap Factory Measurement 1: 4 Joint: True Clock At 9 Remark = REAR CAM VIEW	00:03:45
	106.9	DAE - Deposits Attached Encrustation Percent: 5 Clock from 9 to 3 Grade = 2	00:03:46
	107.7	DAGS - Deposits Attached Grease Percent: 5 Clock from 4 to 8 Remark = SHELFING Grade = 2	00:03:47
	223	AMH - Manhole Remark = USMH-S	00:07:51

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:00:05	0	AMH								DSMH-M
00:00:05	0	MWL				10				
00:00:05	0	ISGT				5		5	8	REAR CAM VIEW
00:01:02	27.1	DAE				5	False	9	11	
00:01:21	36.8	DAG S				5	False	4	8	SHELFING
00:01:22	36.9	DAE				5	False	1	3	
00:01:22	37.5	DAE				5	False	8	12	
00:01:29	40.8	DAE				5	True	8	3	
00:01:44	47.7	DAG S				5	False	4	8	SHELFING

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

Time	Dist.	Code	Cont.	Dim. 1	Dim. 2	%	Joint	Clock From	Clock To	Remarks
00:01:45	48.5	DAE				5	False	8	3	
00:01:56	53.6	DAE				5	True	8	4	
00:02:22	66.3	DAE				5	True	9	3	
00:03:45	105.2	TF		4			True	9		REAR CAM VIEW
00:03:46	106.9	DAE				5	False	9	3	
00:03:47	107.7	DAG S				5	False	4	8	SHELFING
00:03:47	223	AMH								USMH-S

DUVALL, WA — March 26 2024

Up MH: USMH-S

Pipe: RUN3 S_M

Down MH: DSMH-M

Additional PACP Header Information

Media Label:		Up Rim to Invert:	
Work Order:		Up Rim to Grade:	
Sheet Number:		Up Grade to Invert:	
Date Cleaned:	Unknown	Up Northing:	
Flow Control:		Up Easting:	
Consequence of Failure		Up Elevation:	
Pressure Value:		Down Rim to Invert:	
Drainage Area:		Down Rim to Grade:	
Location Code:		Down Grade to Invert:	
Location Details:		Down Northing:	
Coating Method:		Down Easting:	
Pipe Joint Length:		Down Elevation:	
Year Constructed:		Coordinate System:	
Year Renewed:		Vertical Datum:	
		GPS Accuracy:	
Reverse Setup:	0	Imperial?:	True