Flow Monitoring Implementation Plan

CSO REMEDIAL MEASURES PROGRAM

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Revision Summary

May 2023

Table 1	Updated to replace surcharge level indicators with non-transmitting level monitors.
Table 2	Updated to reflect that Sanger Street is an orifice type regulator based on information provided in Appendix D.
Section 3.0	Added references to Appendix C and Appendix D, both new appendices.
Section 4.0 & Table 3	Updated to replace surcharge level indicators with non-transmitting level monitors.
Section 6.0	Updated to reflect eight rain gauges instead of seven rain gauges.
Figure 1	Added Prospect rain gauge.
Figure 2	Updated to replace surcharge level indicators with non-transmitting level monitors. Updated location of level meter leaders to indicate meter is located on upstream (dry weather flow) side of regulators.

Appendix C	New Appendix with 2015 Greeley and Hansen Regulator Details.
Appendix D	New appendix with CSO Regulator Photos and Descriptions.

March 2025

Section 3.2 & Appendix A	Updated text and appendix graphs for the Eaton and Fayette swirl concentrators to reflect the revised level-flow relationships.

1.0 Introduction

1.1 Background

The City of Peoria (City) owns a sewer system comprised of both combined and separate sewers that convey flow to the Riverfront Interceptor (RFI). The RFI sewer runs parallel to the Illinois River and transports flow to the wastewater treatment plant (WWTP). There are 21 regulator structures (including two swirl concentrators) that control the flow from the combined sewer area to the RFI. During rainfall events, excess flow is diverted from the regulator structures and discharged to the Illinois River via 16 combined sewer overflow (CSO) outfalls. Twelve of the CSO outfalls are considered “active” while the other four are “emergency” CSO outfalls that rarely, if ever, overflow. The Greater Peoria Sanitary District (GPSD) owns and operates the regulator structures, RFI, WWTP, and some of the separate sewers. The City of Peoria owns the CSO outfalls, combined sewers, and some of the separate sewers.

1.2 Purpose

Over the next 18 years, the City is implementing CSO Remedial Measures to reduce both the frequency (CSO Individual Events) and volume (CSO Evaluation Volume) of CSO discharges to the river and meet the Final Performance Criteria defined in paragraph 9.u. of the Consent Decree (CD). The CSO Individual Event reduction and CSO Evaluation Volume reduction, described in paragraphs 33 and 34 of the CD, are key indicators of the effectiveness of the CSO Remedial Measures implemented by the City. The City will report the reductions annually and evaluate progress at the Interim Performance Criteria Milestones in accordance with paragraphs 77.a.vii and 31 of the CD. This Flow Monitoring Implementation Plan defines the flow monitoring locations and approaches to collect the meter data necessary at each active CSO outfall for the City to calculate the CSO Evaluation Volume and CSO Individual Event reductions. Also included in this plan are the backup approach for CSO discharge volume calculations; the approach for estimating CSO discharge volumes for emergency CSO outfalls; information on system rain gauges; and an operation, maintenance, and repair program for monitoring equipment.

2.0 Summary of Flow Monitoring Plan

A summary of the types and purpose of the City's planned rain gauges and flow monitors is provided in the table below. This includes the rain gauges and flow monitors needed to meet the requirements of the CD. The locations of the rain gauges and flow monitors are shown in Figures 1 and 2, respectively.

Table 1 also summarizes additional flow meters that the City may use to track the progress of its CSO Remedial Measures Program implementation and inform its adaptive management approach for green infrastructure projects. The subsequent sections contain detailed information regarding CSO flow rate meters, other CSO flow monitors, backup CSO discharge volume approach, rain gauges, and the operation, maintenance, and repair plan.

Table 1 | Summary of Rain Gauges and Flow Monitors

ITEM / TYPE	PURPOSE	NUMBER OF MONITORS
Rain Gauges (Required by CD)	• Determine if any given rainfall event is an Interim Performance Criteria Event or Final Performance Criteria Event, per Appendix A and B of the CD. • Use as rainfall input in the Starting Conditions Hydrologic and Hydraulic (H&H) Model and Final Conditions H&H Model to demonstrate progress towards meeting CSO Evaluation Volume and CSO Individual Event reduction goals.	7 gauges
CSO Flow Rate and Occurrence Determination (Required by CD)	• Demonstrate CSO Evaluation Volume and CSO Individual Event reduction at active outfalls. • Evaluate progress toward Interim Performance Milestones. • Must be capable of determining CSO discharge volume.	10 level 3 area velocity (AV)
CSO Overflow Occurrence Determination (Required by CD)	• Record overflow occurrence and estimate overflow volume at emergency outfalls.	4 non-transmitting level monitors
Regulator / Swirl Concentrator Inflow Pipe Flow Rate	• Track changes to total collection system flows over time for installed project performance assessment and adaptive management. • Planned for regulators that regularly overflow and swirl concentrators	As Needed (12 AV estimated)

ITEM / TYPE	PURPOSE	NUMBER OF MONITORS
CSO Remedial Measure Project Specific Flow Data	• Planned to be relocated annually for pre- and post-construction monitoring of annual CSO Remedial Measures projects. • Confirm project design assumptions to allow for adaptive management. • Analyze project performance to evaluate progress towards CSO reduction goals.	As Needed (8-16 AV estimated)
RFI Flow Rate	• Evaluate interceptor performance and confirm direct inflow assumptions to allow for adaptive management.	As Needed (4 AV estimated)
RFI Flow Level	• Existing GPSD level meters in the RFI used to control the position of gates on throttle pipes. • Used to verify modeled interceptor levels.	As Needed (4 level currently)
Throttle Pipe Flow Rate	• Used to verify modeled regulator performance. • Might be needed to evaluate upgraded regulator/throttle performance.	As Needed
Throttle Pipe Gate Position Data	• Existing GPSD throttle pipe gate position data. • Used to verify modeled gate performance. • More will likely be added as regulators and throttle pipes are improved.	As Needed (Position data for 4 gates currently)

Note that this Flow Monitoring Implementation Plan will need to be updated over time as GPSD completes its CD combined sewer system projects improving regulator structures and throttle pipes. Some or all of these GPSD projects will change the configuration and/or overflow elevation of existing regulator structures and, as a result, monitoring locations, approaches, and/or level-flow rate relationships may need to be revised. Other updates to this plan may also be warranted as improved metering technologies or other innovations become available.

The Post Construction Compliance Monitoring will occur for two years following the final completion of CSO Remedial Measures projects (December 31, 2039). A separate Post Construction Compliance Monitoring Plan will be developed for this flow monitoring, as additional meters will be required to calibrate the Final Conditions H&H Model.

3.0 CSO Flow Rate Meters

CSO outfall flow metering is critical to evaluate the reduction of both frequency (CSO Individual Events) and volume (CSO Evaluation Volume) of CSO discharges to the river as the City's CSO Remedial Measures projects are completed. To evaluate these reductions, the flow meters must be capable of recording CSO discharge occurrence, duration, and flow rate. The City will use the flow metering locations and approaches shown in Table 2 to obtain the data necessary to perform CSO reduction evaluations for the 12 active CSO outfalls. The following subsections provide information about the types of meters that will be used, details regarding the approaches, and how the approach for each outfall was selected. The monitoring locations and approaches for emergency outfalls are presented in Section 4.

The metering locations and approach to determine CSO discharge volume discussed in this document, and listed in Tables 1, 2, and 3, will be updated as necessary as GPSD completes its CD combined sewer system projects improving regulator structures and throttle pipes.

Table 2 | Active CSO Outfall Flow Metering Plan to Determine CSO Discharge Volume

OUTFALL ID	REGULATOR		METER ID	FLOW METERING PLAN TO DETERMINE CSO DISCHARGE VOLUME
	NAME	TYPE		
001	Green Street	Weir	001-01L	Level meter in regulator structure.
003	Spring Street	Weir	003-01L	Level meter in regulator structure.
A06 / B06	Old Eaton Street/ New Eaton Street[1]	Swirl Concentrator	006-01L	Level meter in swirl concentrator.
		Weir	006-02L	Level meter in regulator structure.
A07	Fayette Street	Swirl Concentrator	007-01L	Level meter in swirl concentrator.
		Weir	007-02L	Level meter in regulator structure.
008	Hamilton Street	Offset Pipe	008-01L	Level meter in regulator structure.
009	Fulton Street	Weir	009-01L	Level meter in regulator structure.
016	Water Street	Orifice	016-00F	AV meter in outfall pipe to record overflow for both regulators.
	Cedar Street	Orifice		
017	South Street	Weir	017-02L	Level meter in regulator structure.

OUTFALL ID	REGULATOR		METER ID	FLOW METERING PLAN TO DETERMINE CSO DISCHARGE VOLUME
	NAME	TYPE		
018	Washington Street East	Orifice	018-00F	AV meter in outfall pipe to record overflow for all three regulators.
	Sanger Street	Orifice		
	Washington Street West	Orifice		
019	Darst Street	Orifice	019-00F	AV meter in outfall pipe.
020	Main Street	Weir	020-01L	Level meter in regulator structure.
[1]Outfalls A06 and B06 are two separate, but parallel outfalls that both carry overflows from the Eaton Swirl Concentrator and Eaton Regulator.				

A schematic showing the flow monitoring locations, regulators, and CSO outfalls is presented in Figure 2. The level-flow relationships for locations using a flow level meter are provided in Appendix A. Greeley and Hansen's 2015 regulator details are included in Appendix C. A brief description, estimated construction date, and photos of each CSO regulating control structure can be found in Appendix D.

Figure 1 shows the sewershed area tributary to each CSO outfall. The Updated Starting Conditions H&H Model Report contains more details about the collection system components and configuration, including how each regulator structure operates.

3.1 CSO Overflow Volume Monitoring Approaches

The types of meters that can be used to determine CSO volume are dictated by the CD. The definition for a flow meter in the CD is as follows:

> [A] device used to continuously record both flow activation and volume discharged at a specific point within the Combined Sewer System or Sanitary Sewer System. Flow data recorded to calculate flow volume discharged shall be (i) flow level and velocity or (ii) flow level only if a reliable level-flow rate relationship has been demonstrated and approved by EPA and Illinois EPA.

The two types of meters and associated monitoring approaches, including their suitability, are described below.

3.1.1 Flow Level and Velocity Meter (AV Meter) in Outfall Pipe

The flow level and velocity meter approach consists of installing a flow meter equipped with both level and velocity sensors directly in the CSO outfall pipe to calculate CSO discharge volumes. The flow level and velocity meter, commonly referred to as an area velocity meter (AV meter), measures both the depth and velocity of flow in a pipe. The depth measurement is converted to a cross-sectional area using the geometry of the pipe. Then the cross-sectional area and velocity of the flow are multiplied together to calculate the flow rate. The main limitation of this approach is it is notoriously difficult to obtain accurate reliable AV meter data from CSO outfall pipes. CSO outfall pipes are dry unless actively overflowing, making it very difficult to field calibrate the depth and velocity sensors for the AV meters. Additionally, it can be challenging to obtain accurate flow velocity data as the velocity sensors typically record either the measured peak velocity or surface velocity and then a multiplier is applied to estimate an average velocity. The flow profile in outfall pipes is chaotic and the peak velocity or surface velocity recorded may be very different than the average velocity. For these reasons, using an AV meter located directly in the CSO outfall pipe to calculate CSO discharge volume is not the preferred approach, but will be considered for locations where a reliable level-flow rate relationship has not been developed.

3.1.2 Flow Level Only Meter with Level-Flow Rate Relationship

The level-flow rate relationship approach consists of using a flow level only meter to record the depth in a regulator structure and then using that depth to calculate the CSO discharge volumes. The relationship between the depth above the restriction (weir, offset pipe, etc.) in the regulator structure and the CSO flow rate in the outfall must be defined, generally, as an equation, to use this approach. Typically, a weir equation is used for the level-flow rate relationship; however, regulators without weirs may use different equations. For example, if the regulator consists of an offset overflow pipe without a weir, Manning's equation may be used to define the relationship.

The level-flow relationship approach is most suitable for weir regulators. It is more challenging to determine the level-flow relationship for orifice and offset pipe regulators. The advantage of this method is that it relies only on a depth measurement, which tends to be more accurate than measuring velocity.

3.2 Selected Approaches

Each regulator and outfall have unique hydraulic conditions and configuration. Therefore, each location was considered on a case-by-case basis to select the most appropriate metering approach to determine CSO discharge volumes. The City's metering plan to ensure that CSO discharge activation and volume are continuously recorded at each active CSO outfall is outlined in Table 2. A schematic showing the flow monitoring locations, regulators, and CSO outfalls is presented in Figure 2.

The level-flow relationships for locations using a flow level meter only are provided in Appendix A. For most locations, the City developed relationships for the regulator level and CSO discharge flow rates using modeled flow depth in the regulator and the modeled CSO overflow rate in the outfall pipe from the City's Starting Conditions H&H Model. The City used model data instead of meter data to develop the relationships because the outfall AV meter data at these locations were generally not accurate enough to develop reliable level-flow relationships due to the challenges with CSO outfall flow monitoring described in Section 3.1.1 above. The relationships developed using the model depths and flows provide a reliable approach to determining the observed CSO discharge flow rates using flow level only meter data.

The swirl concentrators, upstream of CSO outfalls A06 / B06 and A07, have more complex hydraulics than the weir regulators and, therefore, required additional analysis to refine the level-flow relationships. The relationships for the swirl concentrators are derived from published curves, provided to the City by GPSD, and modified based on structure geometry, record drawings, and swirl concentrator flow level meter data and inflow AV meter data. An evaluation of the swirl concentrator level and inflow meter data indicated that the CSO discharge curve transitions from weir equations to orifice equations at high depths in the structures. An assessment of swirl concentrator inflow meter data and calculated CSO discharge flow was conducted to verify that the level-flow relationships produced CSO discharge flow rates less than the metered swirl concentrator inflow rates. Descriptions of the swirl concentrator level-flow relationships are included in Appendix A.

4.0 Other CSO Flow Monitors

In addition to the 12 active outfalls described in Table 2, the City has four emergency outfalls listed in Table 3. The sewers upstream of the emergency outfalls were historically combined but the sewers tributary to these outfalls have since been separated as part of a past CSO remediation project. As a result, these emergency outfalls rarely, if ever, overflow.

The City will install and maintain non-transmitting level monitors in the regulators for each emergency outfall. The non-transmitting level monitors in these structures will record the flow depth, but do not transmit data in real time like the flow meters installed at active CSO locations. Data will be manually collected and reviewed monthly, until a large storm event has occurred. For the purposes of this review, a large storm event is a rainfall event with a 2-hour, 3-hour, and/or 6-hour peak larger than the Six-Month Design Storm’s 2-hour, 3-hour, and/or 6-hour peak. Appendix A of the Consent Decree provides examples of this evaluation. If no overflows occur at the emergency outfalls during the large storm event, manual data collection and review will occur quarterly instead of monthly.

Overflows are unlikely at these emergency outfalls; however, in the event the level meter records flow depths indicating an overflow, the CSO discharge volume will be calculated using a level-flow relationship. The flow monitoring locations and volume determination approaches are listed below in Table 3, and the level-flow relationships are provided in Appendix A. A schematic showing the flow monitoring locations, regulators, and CSO outfalls is presented in Figure 2. A brief description, estimated construction date, and photos of each CSO regulating control structure can be found in Appendix D.

Table 3 | Flow Monitoring Plan to Determine Emergency CSO Volume

OUTFALL ID	REGULATOR		METER ID	FLOW MONITORING PLAN TO DETERMINE CSO DISCHARGE VOLUME
	NAME	TYPE		
010	Liberty Street	Weir	010-01L	Non-transmitting level monitor in regulator structure.
011	Harrison Street	Weir	011-01L	Non-transmitting level monitor in regulator structure.
013	Walnut Street	Weir	013-01L	Non-transmitting level monitor in regulator structure.
014	State Street	Weir	014-01L	Non-transmitting level monitor in regulator structure.

5.0 Backup CSO Volume Calculation

In the event that a meter is inoperable or malfunctioning during the time that a CSO discharge occurs, the City needs a backup method to calculate CSO volume. The City will use its Starting Conditions H&H Model as the backup approach should the primary approach be unavailable during a CSO event. Using the Starting Conditions modeled CSO discharge volume is a conservative approach that will overestimate the CSO volumes.

Early in the CSO Remedial Measures Program implementation, this backup approach will result in minimal difference from the volumes determined using the primary approach, as the system is still similar to its starting conditions. However, as the City's CSO Remedial Measures are implemented and overflow volumes are reduced, the Starting Conditions H&H Model will overestimate the CSO discharge volumes for current conditions.

6.0 Rain Gauges

The City has eight rain gauges located throughout the 12.2 square mile RFI sewer service area, of which 4.3 square miles are combined sewer areas and 7.9 square miles are separate sewer areas. The rain gauges are ADS RainAlert III wireless gauges that use tipping bucket technology and have a resolution of 0.01 inches. The rain gauges are programmed to record precipitation in 5-minute intervals. The locations of the rain gauges are shown in Figure 1. The City may add more rain gauges as needed during the implementation of the CSO Remedial Measures Program. If additional rain gauges are installed, they will be documented in the City's CSO Annual Reports.

The rain gauge data is used as the precipitation input for the City's Starting Conditions H&H Model. Throughout the implementation of the CSO Remedial Measures Program, the model will be run annually to determine the CSO Individual Event and CSO Evaluation Volume reductions as described in Paragraphs 33.d and 34.d of the CD. The rainfall data will also be used to determine whether or not each event is an Interim Performance Criteria Event, per Appendix A of the CD. The City will develop its Final Conditions H&H Model upon completion of the implementation of its CSO Remedial Measures Program. The rain gauge data will be used as the precipitation input to calibrate and validate the model and evaluate the Final Performance Criteria using the model. The rainfall data will also be used to determine which rainfall events qualify as Final Performance Criteria Events, per Appendix B of the CD.

7.0 Operation, Maintenance, and Repair

Routine maintenance is necessary to ensure the monitoring equipment is calibrated and operates as intended. The minimum maintenance requirements are as follows:

- Visually inspect flow meters at least twice per year.
- Conduct preventative maintenance and calibration service on meters and rain gauges in accordance with the manufacturer's recommended maintenance and calibration program.

Additional activities that may be performed to ensure monitoring equipment is functioning properly and providing reliable data include:

- Review of raw data time series for anomalies for AV meters, level meters, and rain gauges.
- Review depth and velocity scatter graphs for AV meters.
- Evaluation of flow volumes recorded by downstream AV meters compared to upstream AV meters.

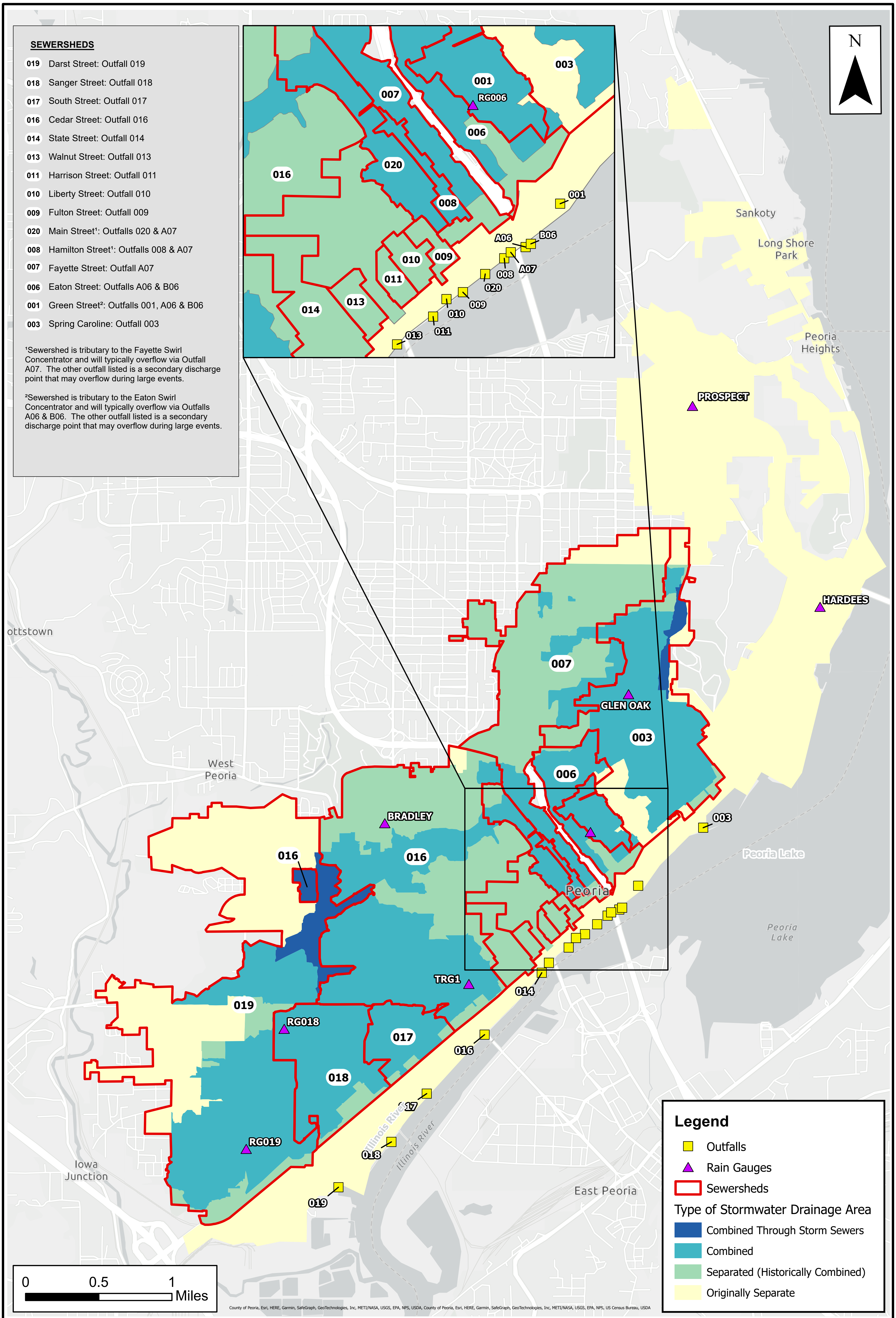
Equipment data sheets for examples of the flow monitoring equipment that may be used are provided in Appendix B. These are provided as examples only and flow monitoring equipment manufacturer and type may change as technologies are discontinued or advanced, or changes to the system require other flow monitoring equipment.

Flow meters will have the ability to automatically alert Peoria of a CSO event and allow for recorded data accessed instantaneously through telemetry. Flow meters will also have working malfunction alarms. If a malfunction is identified, the equipment will be repaired or replaced, as necessary. Repairs will be completed within 30 days of the City becoming aware of the malfunction if access to the meter is not prohibited by high river stage. If repairs are not possible, the equipment will be replaced within 60 days of the City becoming aware of the malfunction if access to the meter is not prohibited by high river stage. If high river stage prohibits access to the meter during these periods, the repair or replacement of equipment will be completed once access is feasible. If rain gauge equipment malfunctions, it will be repaired within 30 days or replaced within 60 days.

The City will retain records of meter maintenance and calibration services, as well as a log of meter malfunctions. At a minimum, the malfunction log will include the date of the meter malfunction, steps taken to resolve the malfunction, date the meter was returned to service or determined to be in need of replacement, and date the replacement was installed, if applicable.

FIGURE 1

Rain Gauge and Sewershed Locations



SYMBIONT
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DSGN: NT	CHK: KKD	SCALE	1 inch = 1 mile
DR: AS	APVD: KKD	DWG	1
PATH: L:\Projects\Peoria, City Of\PeoriaGPS42123.aprx		DATE	4/21/2023
		PROJ NO.	21PS35839

City of Peoria
CSO Remedial
Measures Program

Figure 1
Rain Gauge and
Sewershed Locations

FIGURE 2

Flow Monitoring Location Schematic

FIGURE 2: FLOW MONITORING LOCATION SCHEMATIC

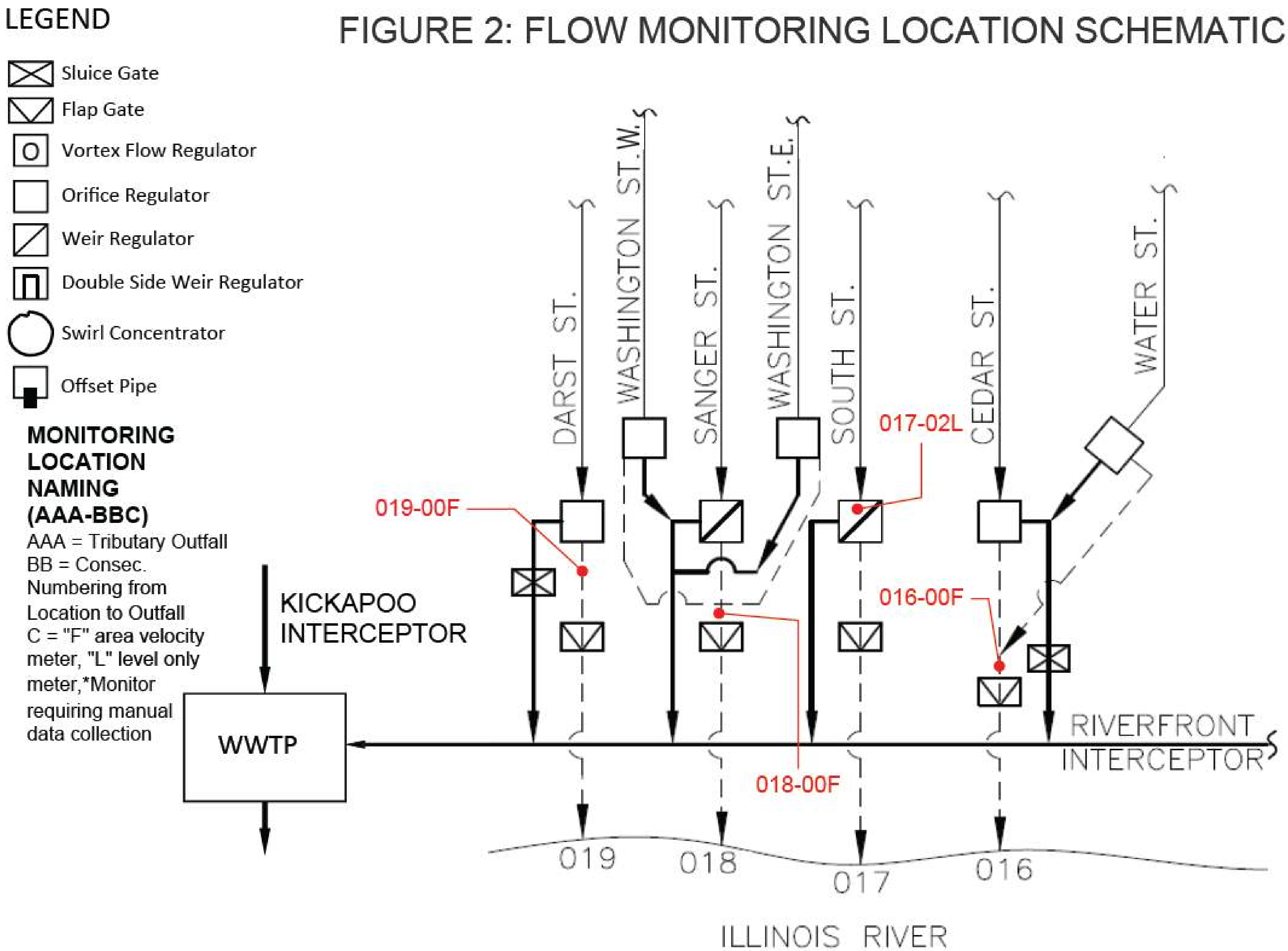


FIGURE 2: FLOW MONITORING LOCATION SCHEMATIC

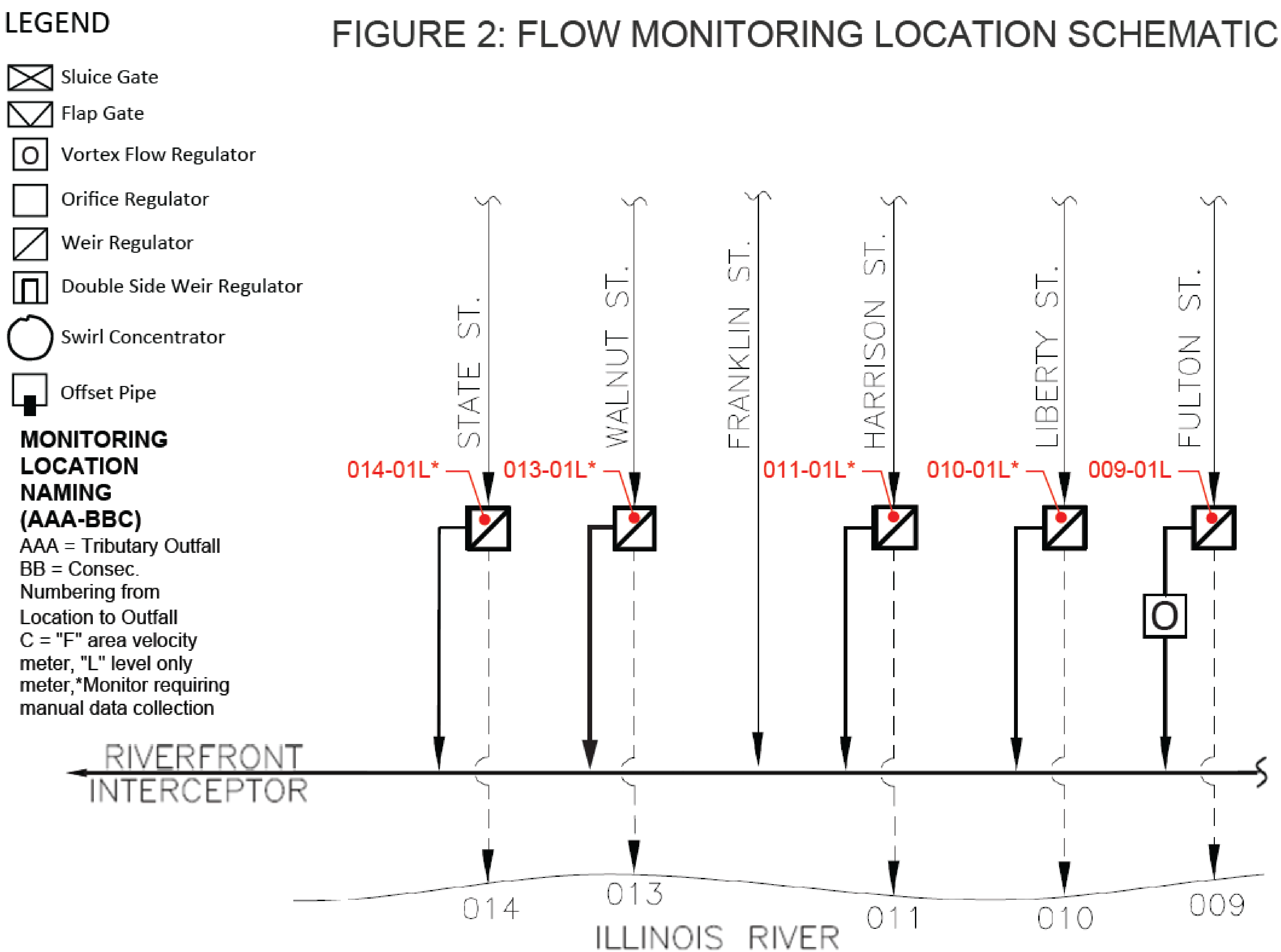
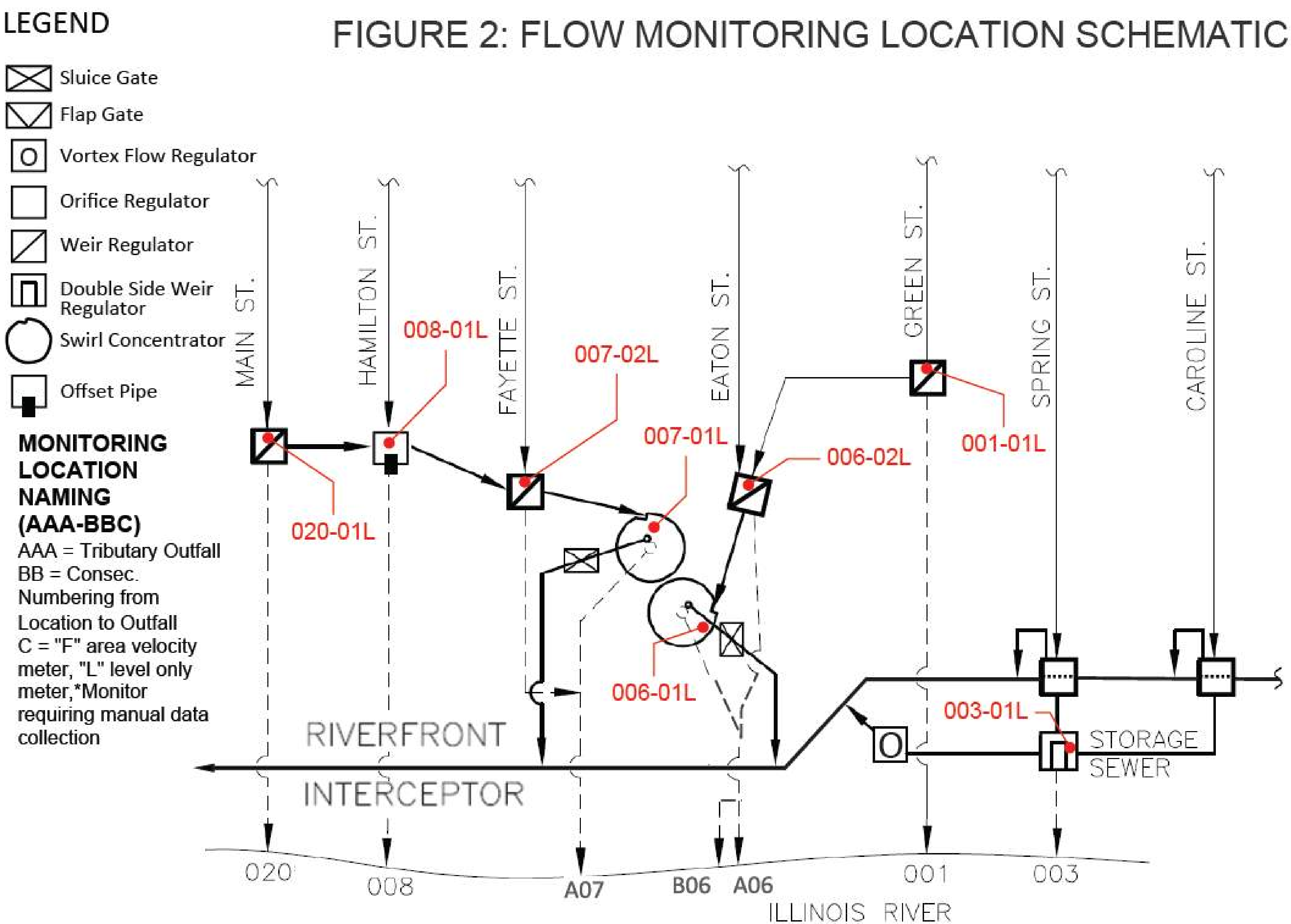


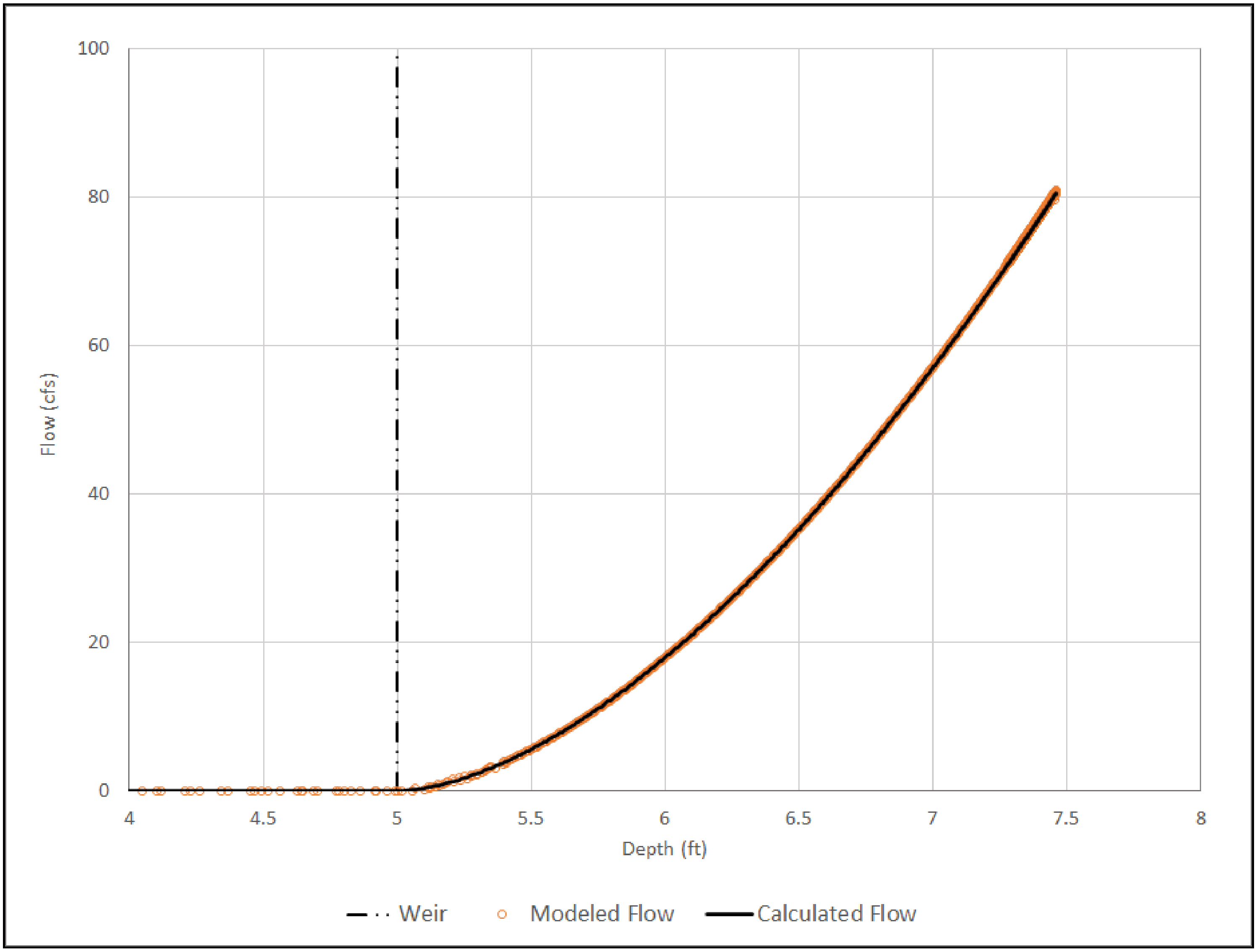
FIGURE 2: FLOW MONITORING LOCATION SCHEMATIC



APPENDIX A

Level-Flow Relationships

Appendix A
001 Regulator Level-Flow Relationship

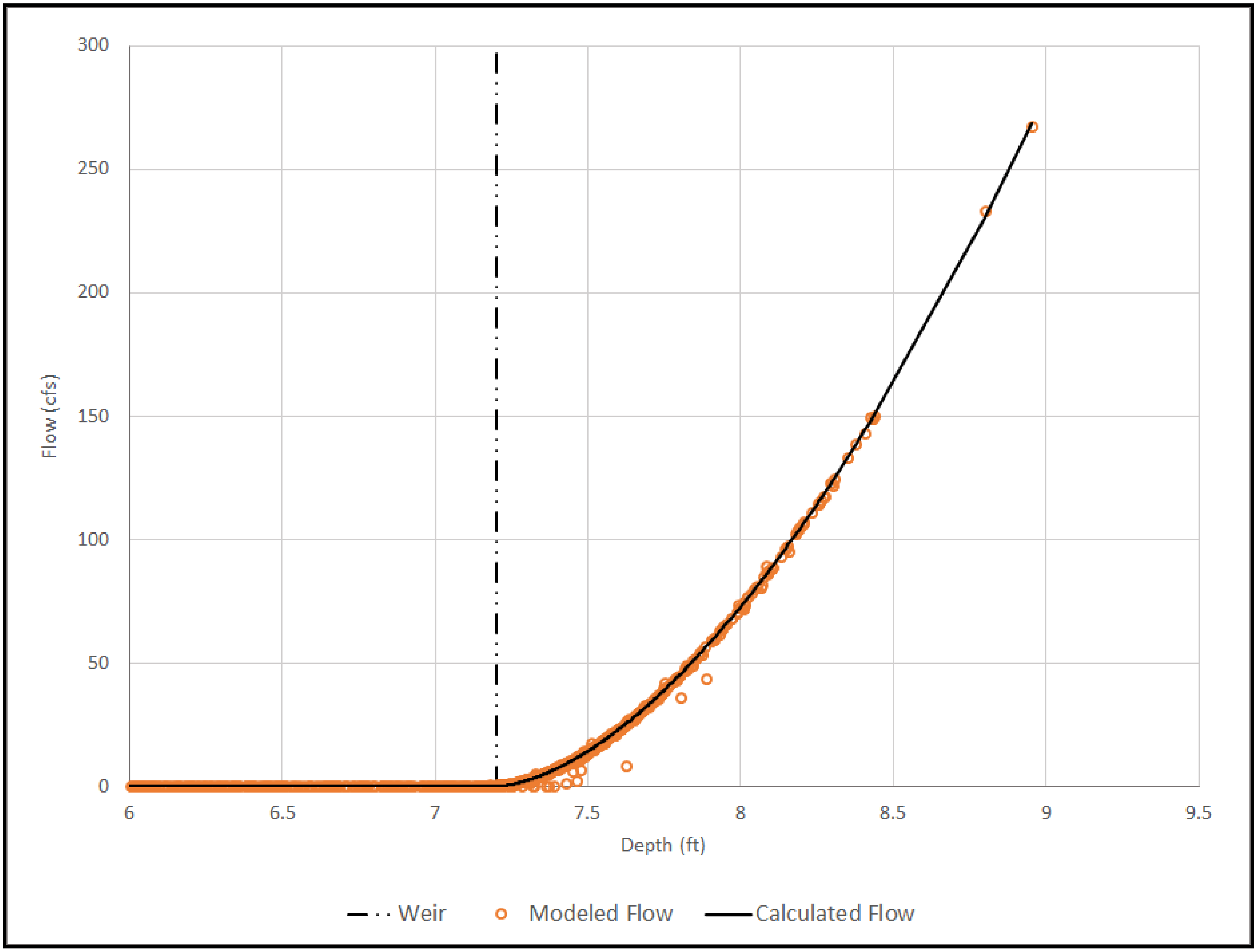


Sideflow Weir Equation to Calculate Flow: $Q = C_0 * L^{0.83} * h^{(5/3)}$	
d <= 5	Q = 0
5 < d	$Q = (2.9)(9)^{0.83}(d - 5)^{(5/3)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

Appendix A

003 Regulator Level-Flow Relationship

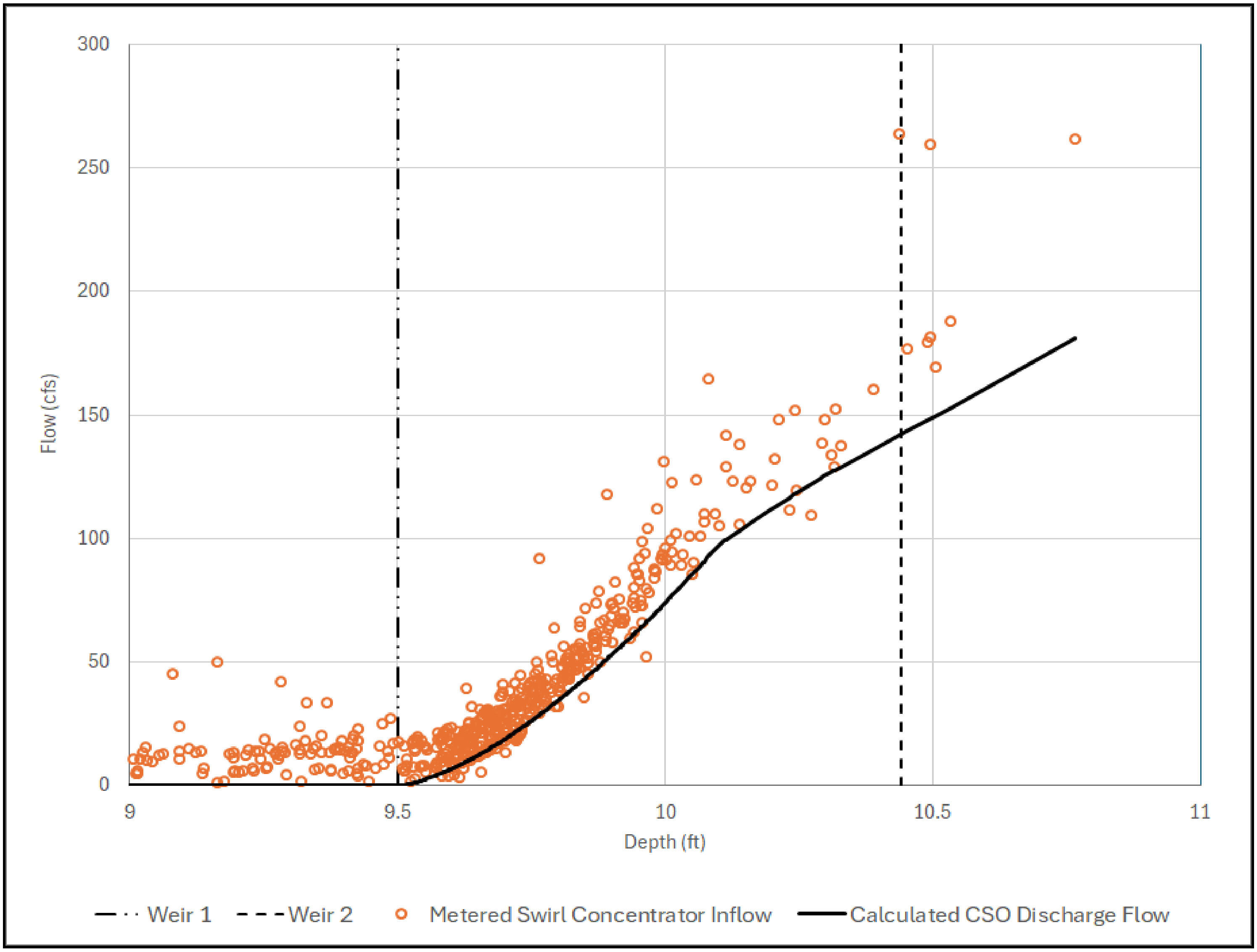


Sideflow Weir Equation to Calculate Flow: $Q = C_0 * L^{0.83} * h^{(5/3)}$	
d <= 7.2	Q = 0
7.2 < d	$Q = (4.1)(50)^{0.83}(d-7.2)^{(5/3)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using precipitation data collected by rain gauges from May 2021 through June 2022.

Appendix A

006 Swirl Concentrator Level-Flow Relationship



The graph uses meter data from January 2023 through December 2024. The difference between the metered swirl concentrator inflow and the calculated CSO discharge flow is the flow conveyed to the WWTP via the throttle pipe and RFI.

The relationship to calculate flow based on depth is provided on the next page.

Appendix A

006 Swirl Concentrator Level-Flow Relationship

Transverse Weir Equation to Calculate Flow: $Q = C_0 * L * h_0^{(3/2)}$ Sideflow Weir Equation to Calculate Flow: $Q = C_0 * L^{0.83} * h_0^{(5/3)}$ Orifice Equation to Calculate Flow: $Q = C * A * (2 * g * h)^{(1/2)}$	
$d \leq 9.5$	$Q = 0$
$9.5 < d \leq 10.1$	$Q_1 = (3.33)(73.33)(d - 9.5)^{(3/2)}$
$10.1 < d \leq 10.44$	$Q_2 = (0.587)(44)[(2)(32.2)\{(d-10.1)+(0.6/2)\}]^{(1/2)}$
$10.44 < d \leq 11.44$	$Q_3 = Q_2 + (2.9)(31)^{0.83}(d-10.44)^{(5/3)}$
$11.44 < d$	$Q_4 = Q_2 + (0.285)(31)[(2)(32.2)\{(d-11.44)+(1/2)\}]^{(1/2)}$

General Notes:

Q = Flow (cfs)
d = Metered depth within the structure (ft)
h_0 = Head difference across the weir (d - weir height) (ft)
h = Head difference across the orifice (d - top of orifice - orifice height/2) (ft)
L = Weir length (ft)
A = Area of orifice opening (ft^2)
g = Acceleration of gravity (ft/s^2)
C_0 = Weir discharge coefficient
C = Orifice discharge coefficient. The orifice discharge coefficient is calculated to achieve flow continuity at the depth where flow transitions from weir to orifice flow.

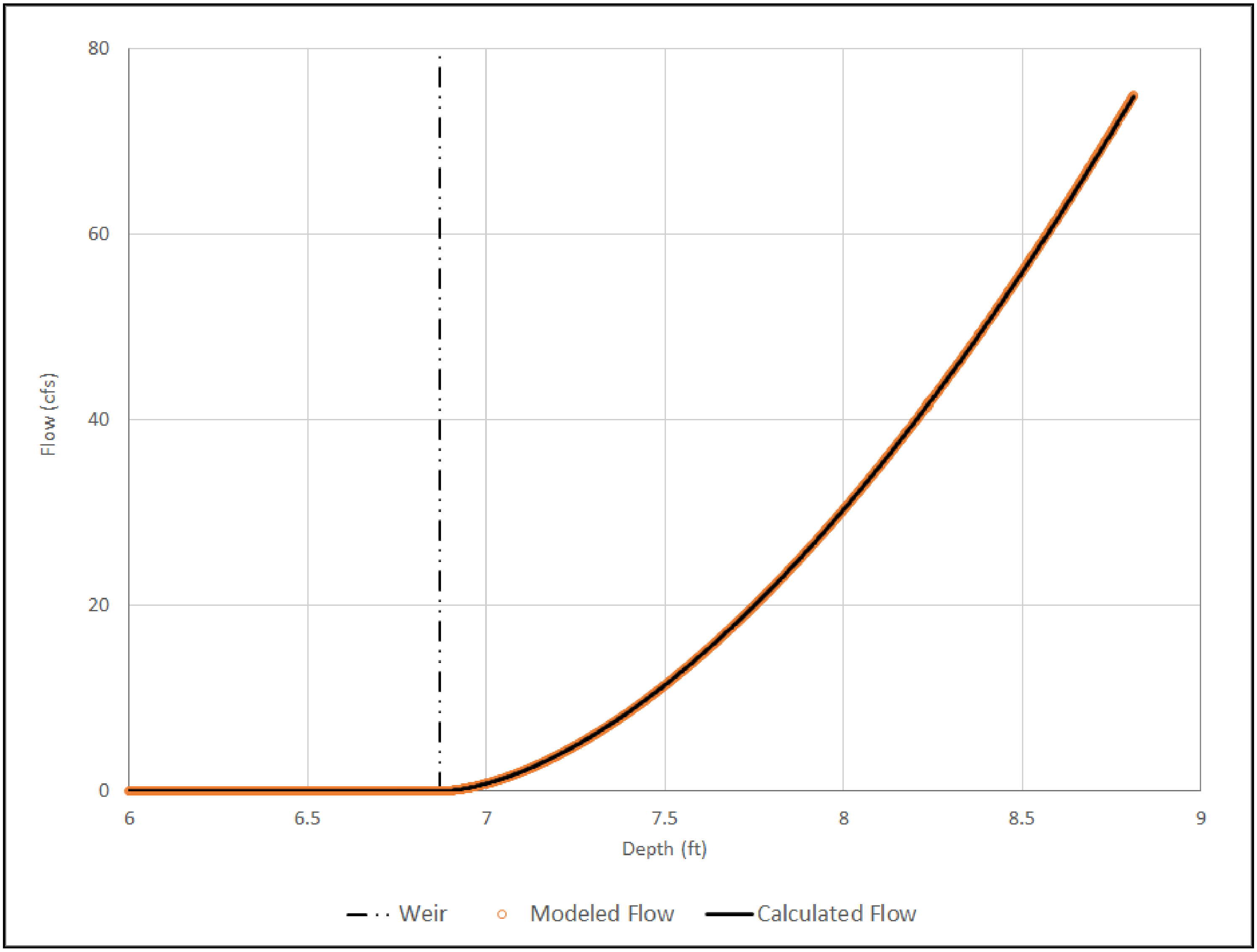
Weir 1 - Primary Overflow:

Equations Q_1 (transverse weir) and Q_2 (orifice)
Weir height = 9.5 ft (the depth in the structure where a CSO discharge starts)
Top of orifice = 10.1 ft (the depth where the primary overflow transitions from weir to orifice flow)
Orifice height = 0.6 ft
L = 73.33 ft
A = 44 ft^2
C_0 = 3.33
C = 0.587

Weir 2 - Secondary Overflow:

Equations Q_3 (Q_2 + sideflow weir) and Q_4 (Q_2 + orifice)
Weir height = 10.44 ft (the depth in the structure where a CSO discharge from secondary overflow starts)
Top of orifice = 11.44 ft (the depth where the secondary overflow transitions from weir to orifice flow)
Secondary orifice height = 1 ft
L = 31 ft
A = 31 ft^2
C_0 = 2.9
C = 0.285

Appendix A
006 Regulator Level-Flow Relationship

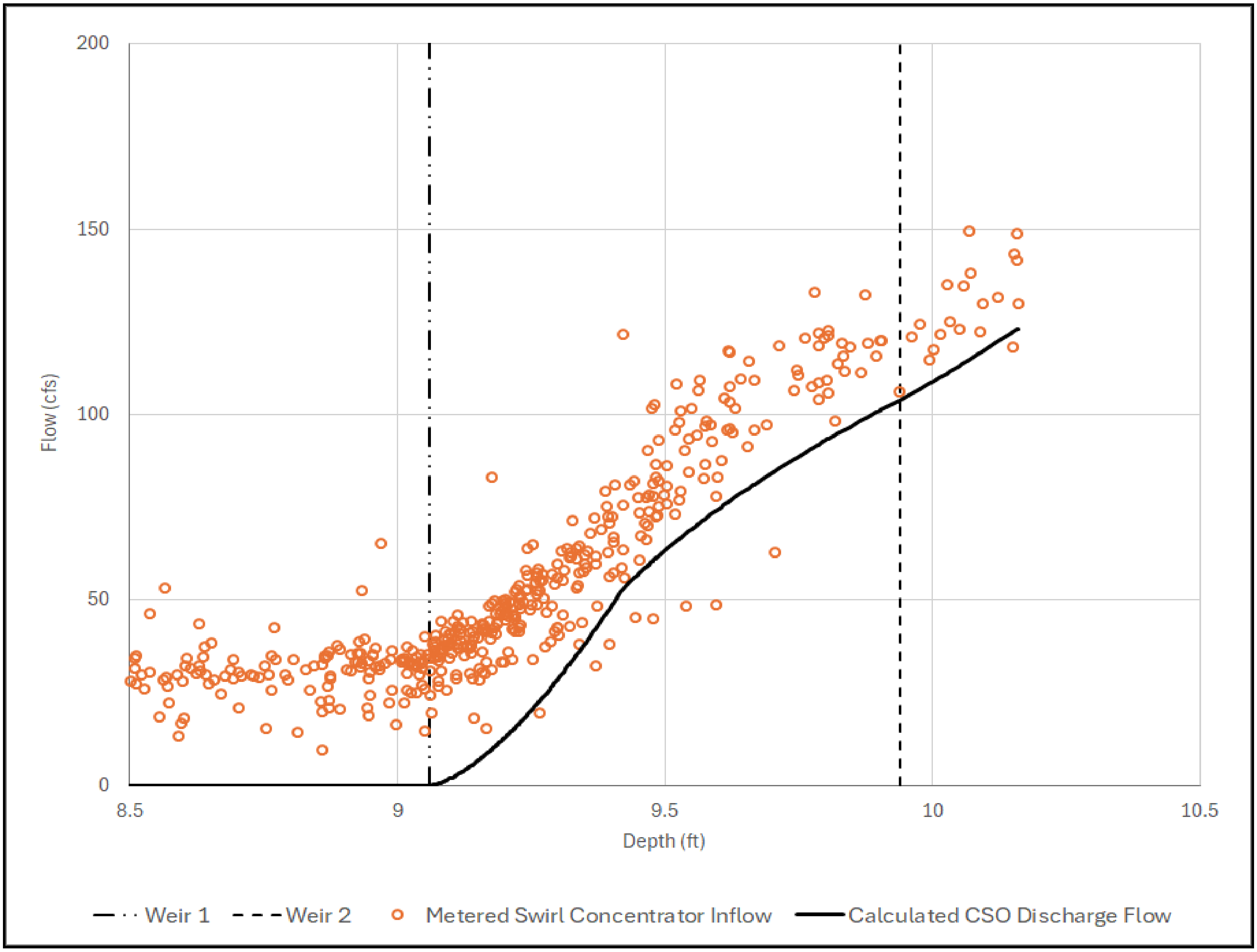


Sideflow Weir Equation to Calculate Flow: $Q = C_0 * L^{0.83} * h^{(5/3)}$	
d <= 6.87	Q = 0
6.87 < d	$Q = (2.9)(13.25)^{0.83}(d - 6.87)^{(5/3)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

Appendix A

007 Swirl Concentrator Level-Flow Relationship



The graph uses meter data from January 2023 through December 2024. The difference between the metered swirl concentrator inflow and the calculated CSO discharge flow is the flow conveyed to the WWTP via the throttle pipe and RFI.

The relationship to calculate flow based on depth is provided on the next page.

Appendix A

007 Swirl Concentrator Level-Flow Relationship

Transverse Weir Equation to Calculate Flow: $Q = C_0*L*h_0^{(3/2)}$ Sideflow Weir Equation to Calculate Flow: $Q=C_0*L^{0.83}*h_0^{(5/3)}$ Orifice Equation to Calculate Flow: $Q=C*A*(2*g*h)^{(1/2)}$	
$d \leq 9.06$	$Q = 0$
$9.06 < d \leq 9.42$	$Q_1 = (3.33)(73.33)(d -9.06)^{(3/2)}$
$9.42 \leq d \leq 9.94$	$Q_2 = (0.587)(26.4)[(2)(32.2)\{(d-9.42)+(0.36/2)\}]^{(1/2)}$
$9.94 < d \leq 10.94$	$Q_3 = Q_2+(2.9)(31)^{0.83}(d-9.94)^{(5/3)}$
$10.94 < d$	$Q_4 = Q_2+(0.285)(31)[(2)(32.2)\{(d-10.94)+(1/2)\}]^{(1/2)}$

General Notes:

Q = Flow (cfs)
d = Metered depth within the structure (ft)
h_0 = Head difference across the weir (d - weir height) (ft)
h = Head difference across the orifice (d - top of orifice - orifice height/2) (ft)
L = Weir length (ft)
A = Area of orifice opening (ft^2)
g = Acceleration of gravity (ft/s^2)
C_0 = Weir discharge coefficient
C = Orifice discharge coefficient. The orifice discharge coefficient is calculated to achieve flow continuity at the depth where flow transitions from weir to orifice flow.

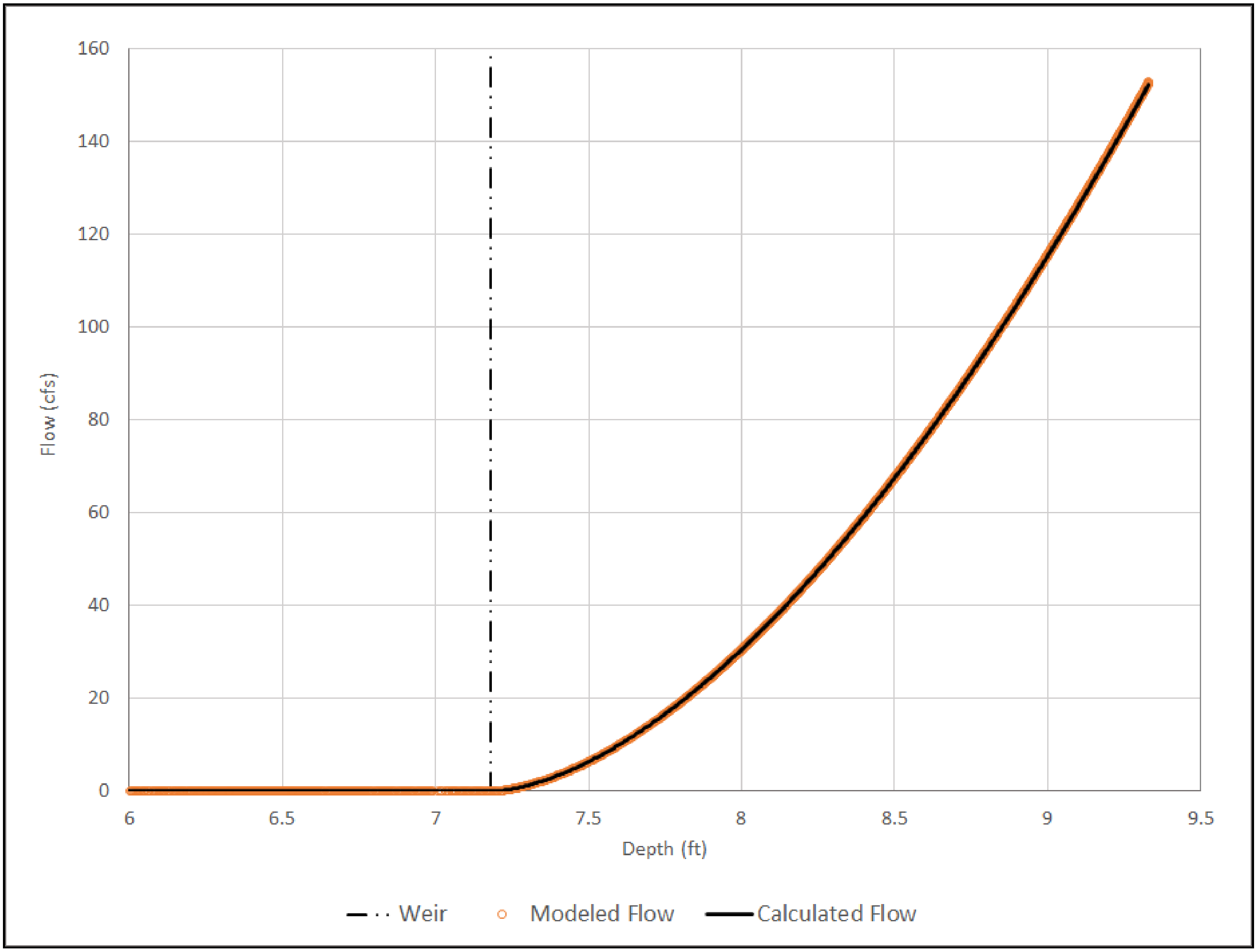
Weir 1 - Primary Overflow:

Equations Q_1 (transverse weir) and Q_2 (orifice)
Weir height = 9.06 ft (the depth in the structure where a CSO discharge starts)
Top of orifice = 9.42 ft (the depth where the primary overflow transitions from weir to orifice flow)
Orifice height = 0.36 ft
L = 73.33 ft
A = 26.4 ft^2
C_0 = 3.33
C = 0.587

Weir 2 - Secondary Overflow:

Equations Q_3 (Q_2 + sideflow weir) and Q_4 (Q_2 + orifice)
Weir height = 9.94 ft (the depth in the structure where a CSO discharge from secondary overflow starts)
Top of orifice = 10.94 ft (the depth where the secondary overflow transitions from weir to orifice flow)
Secondary orifice height = 1 ft
L = 31 ft
A = 31 ft^2
C_0 = 2.9
C = 0.285

Appendix A
007 Regulator Level-Flow Relationship

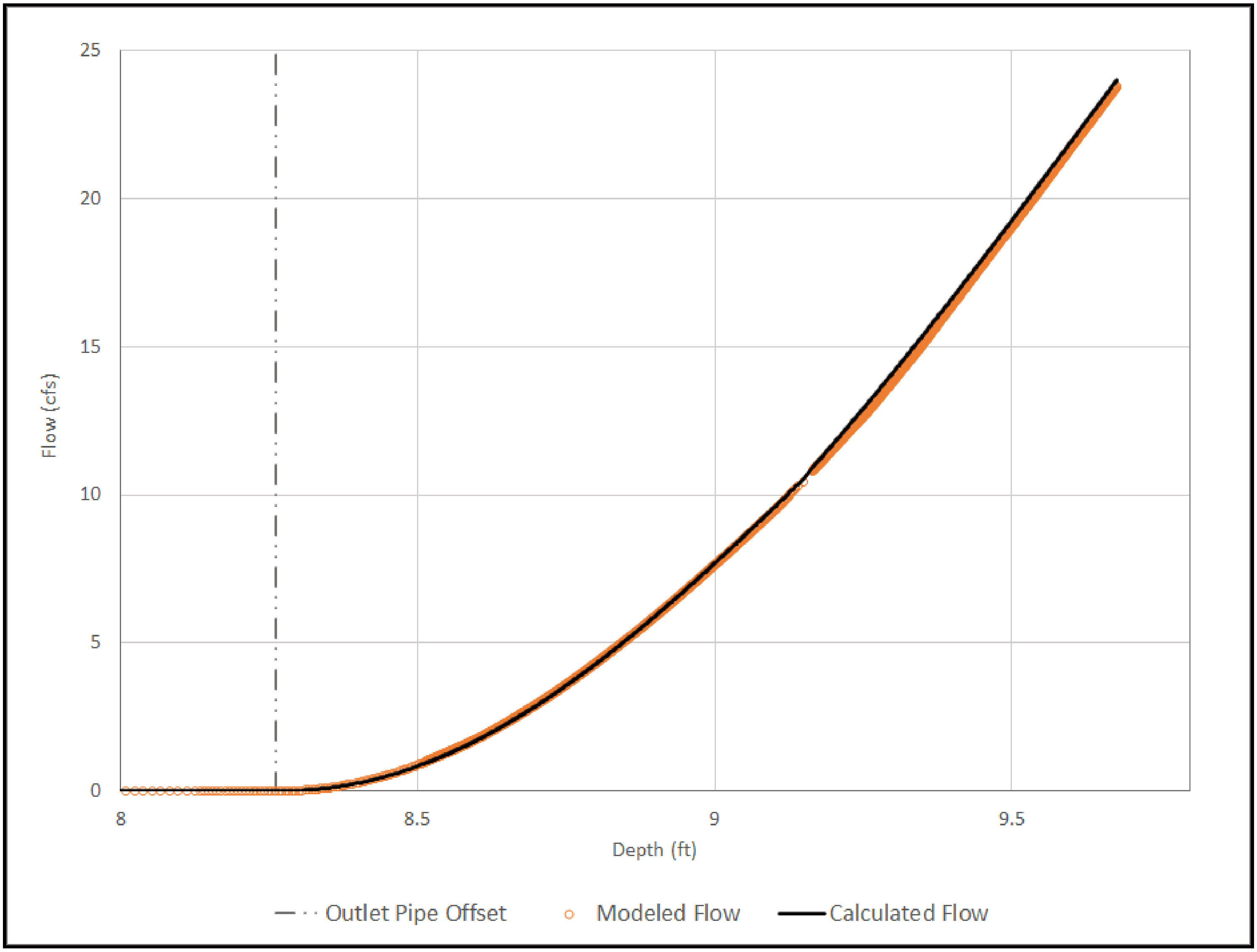


Sideflow Weir Equation to Calculate Flow: $Q = C_0 * L^{0.83} * h^{(5/3)}$	
d <= 7.18	Q = 0
7.18 < d	$Q = (2.9)(25.417)^{0.83}(d - 7.18)^{(5/3)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

Appendix A

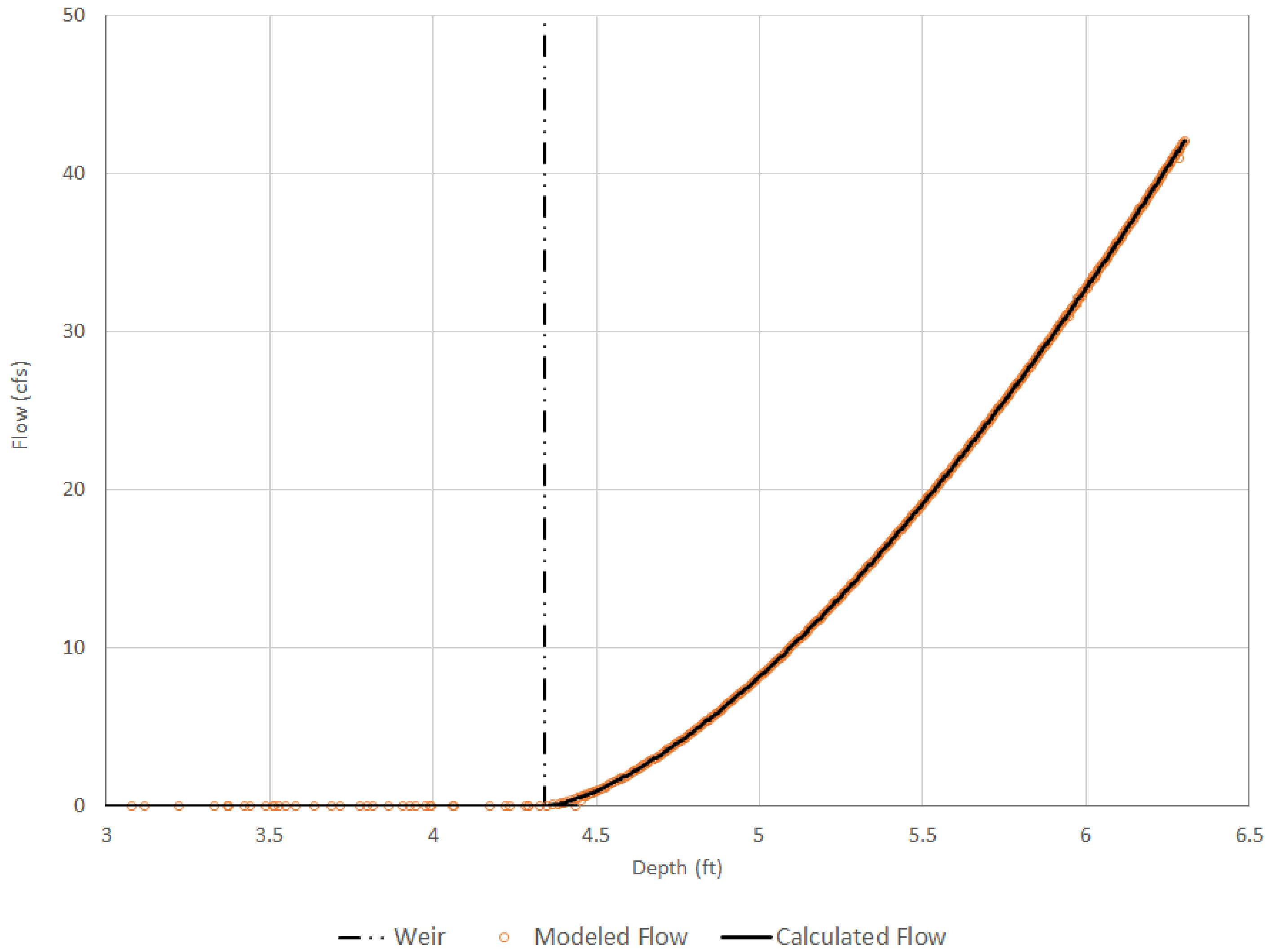
008 Regulator Level-Flow Relationship



Equation: $Q = (1.49/n) * A * (R_h)^{(2/3)} * S^{(1/2)}$	
d < = 8.26	Q = 0
8.26 < d <= 9.15	dia. 1.65 ft; n = 0.0105; S = 0.01221
9.15 < d < 9.7	dia. 2.50 ft; n = 0.0150; S = 0.012
A	Flow Area
R_h	Hydraulic Radius
S	Slope
n	Roughness
dia.	Pipe Diameter

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

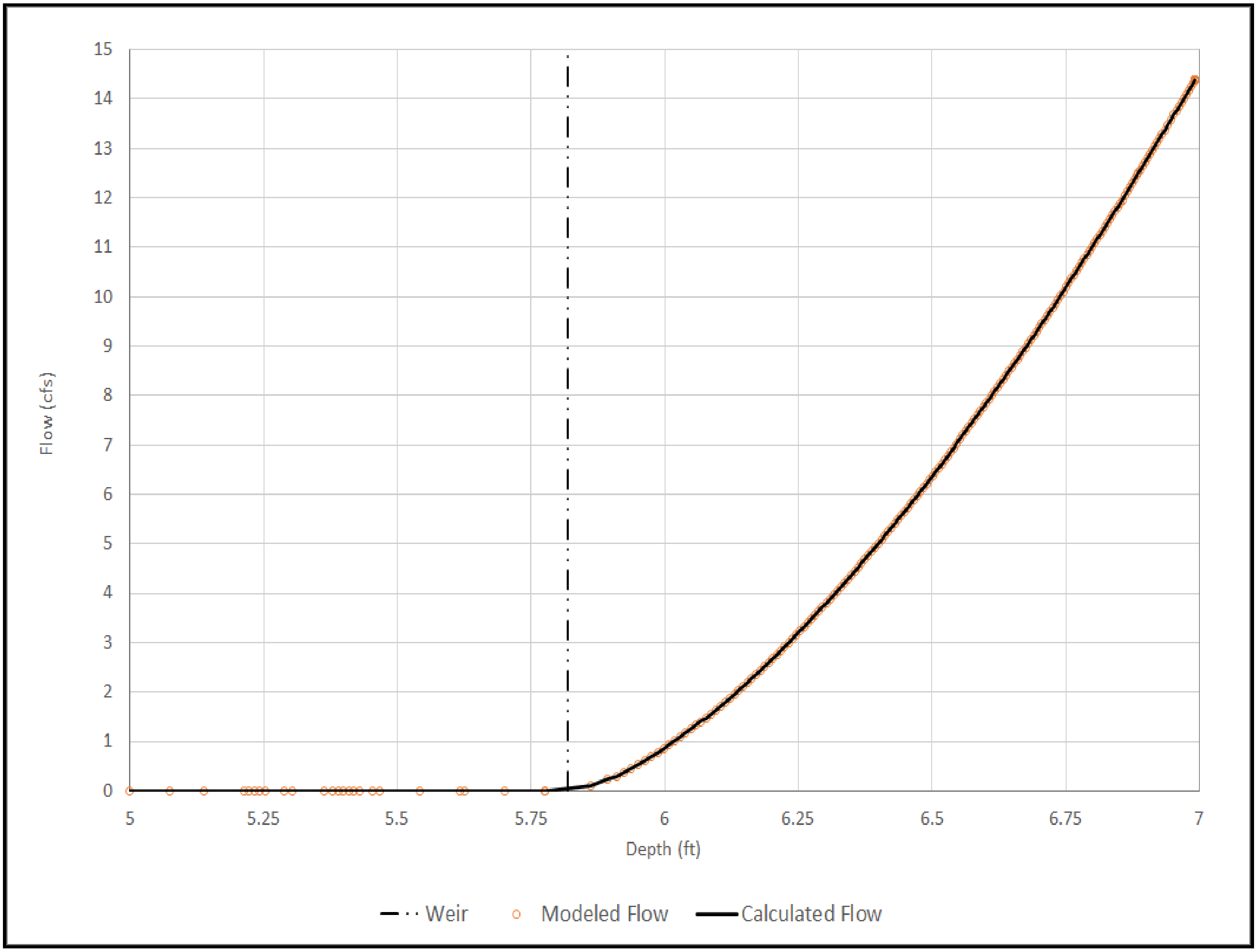
Appendix A
009 Regulator Level-Flow Relationship



Transverse Weir Equation to Calculate Flow: $Q = C_0 * L * h^{(3/2)}$	
d <= 4.34	Q = 0
4.34 < d <=6.3[T]	$Q = (3.33)(4.6)(d - 4.34)^{(3/2)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using precipitation data collected by rain gauges from May 2021 through June 2022, and additional modeled direct inflow to produce more overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

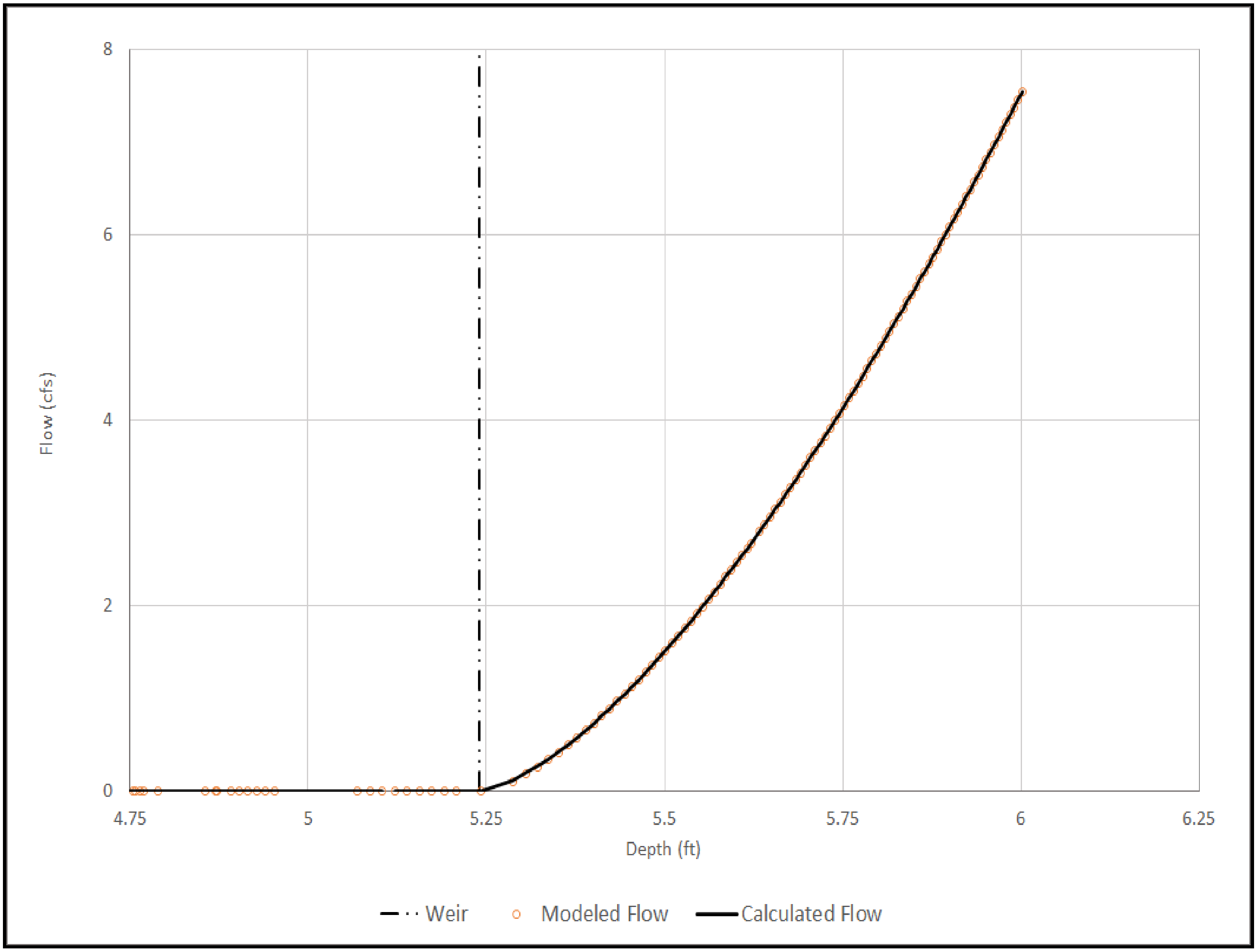
Appendix A
010 Regulator Level-Flow Relationship



Transverse Weir Equation to Calculate Flow: $Q = C_0 * L * h^{(3/2)}$	
d <= 5.82	Q = 0
5.82 < d	$Q = (2.9)(3.917)(d - 5.82)^{(3/2)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

Appendix A
011 Regulator Level-Flow Relationship

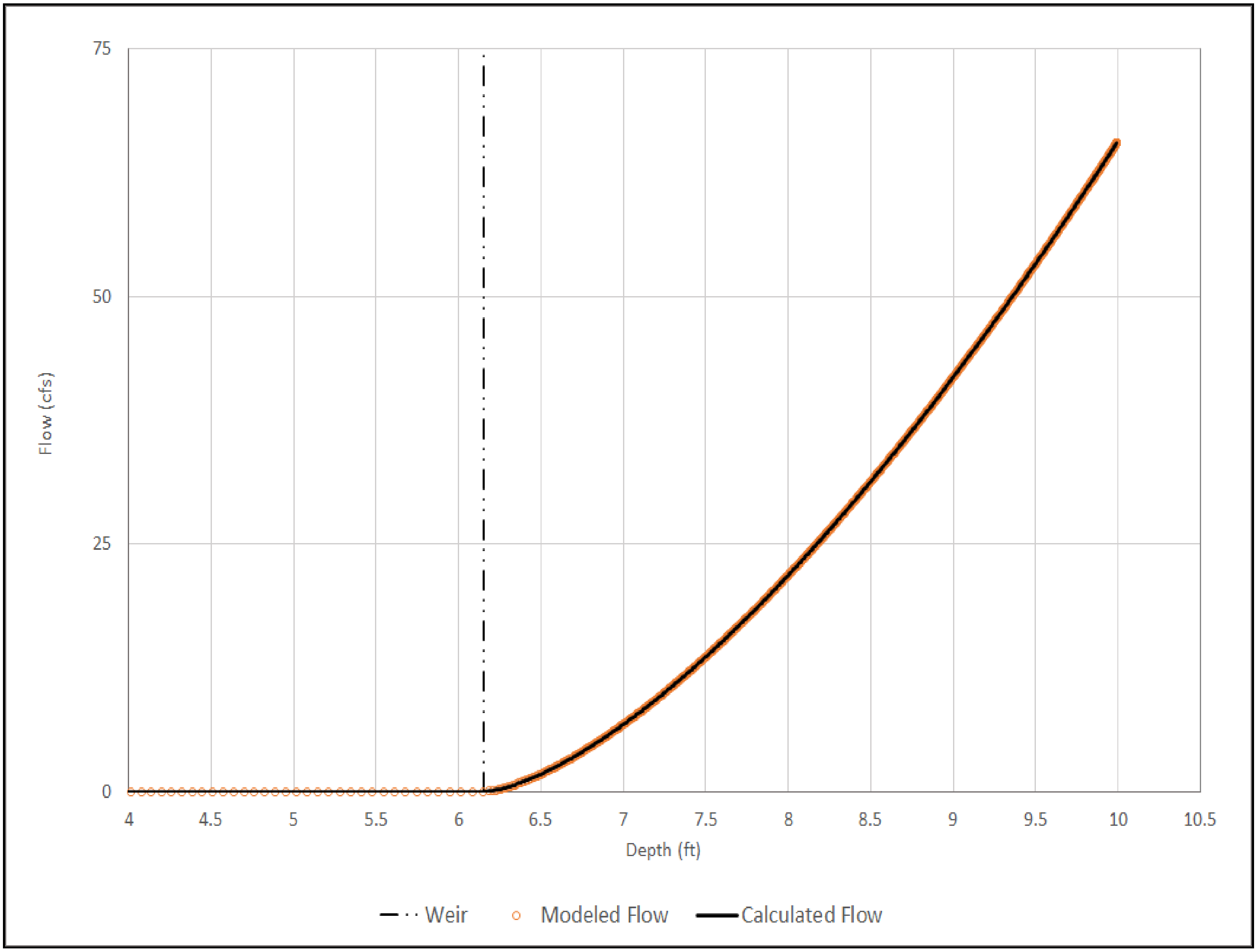


Transverse Weir Equation to Calculate Flow: $Q = C_0*L*h^{(3/2)}$	
d <= 5.24	Q = 0
5.24 < d	$Q = (2.9)(3.917)(d - 5.24)^{(3/2)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

Appendix A

013 Regulator Level-Flow Relationship

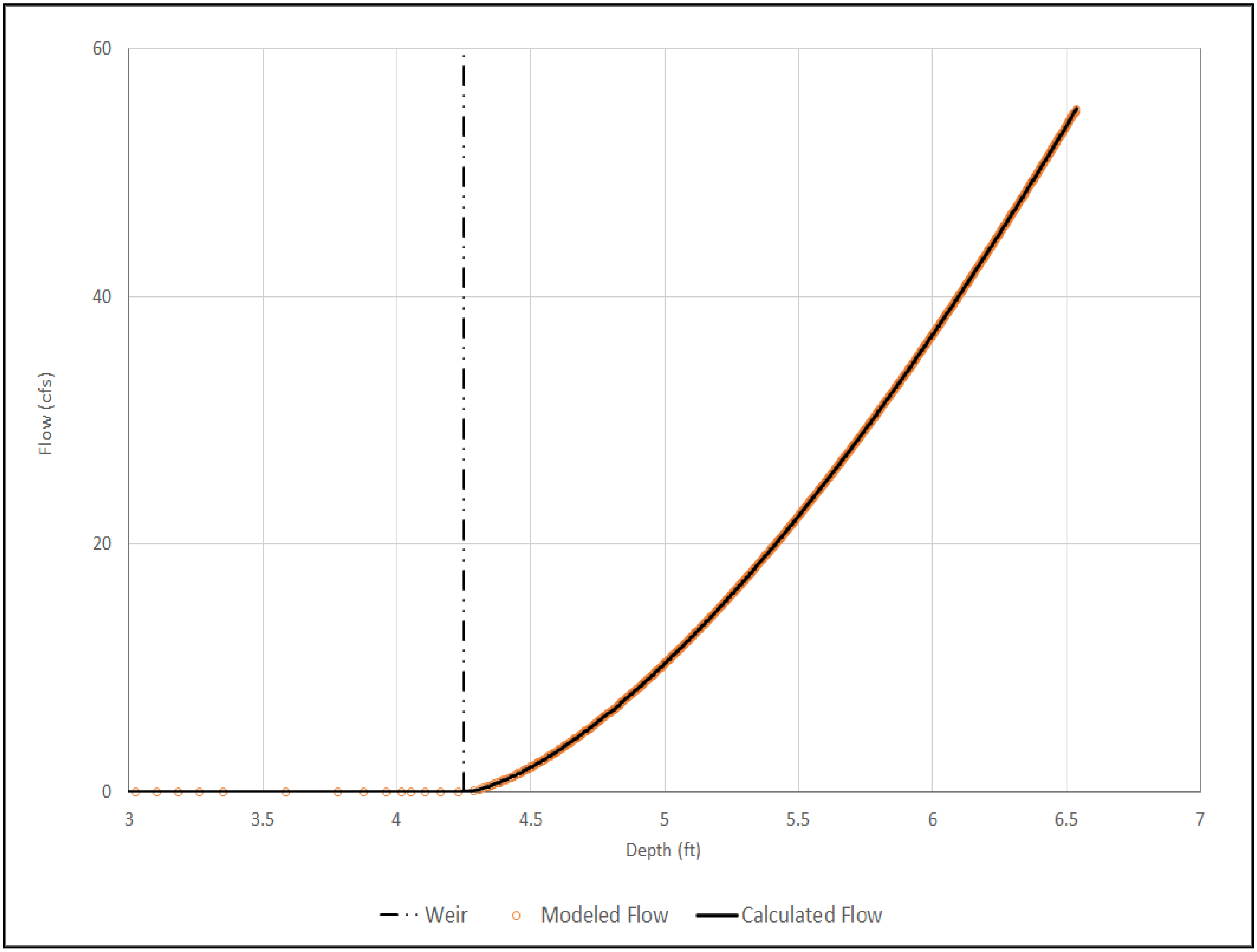


Transverse Weir Equation to Calculate Flow: $Q = C_0 * L * h^{(3/2)}$	
d <= 6.15	Q = 0
6.15 < d	$Q = (2.9)(3)(d - 6.15)^{(3/2)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

Appendix A

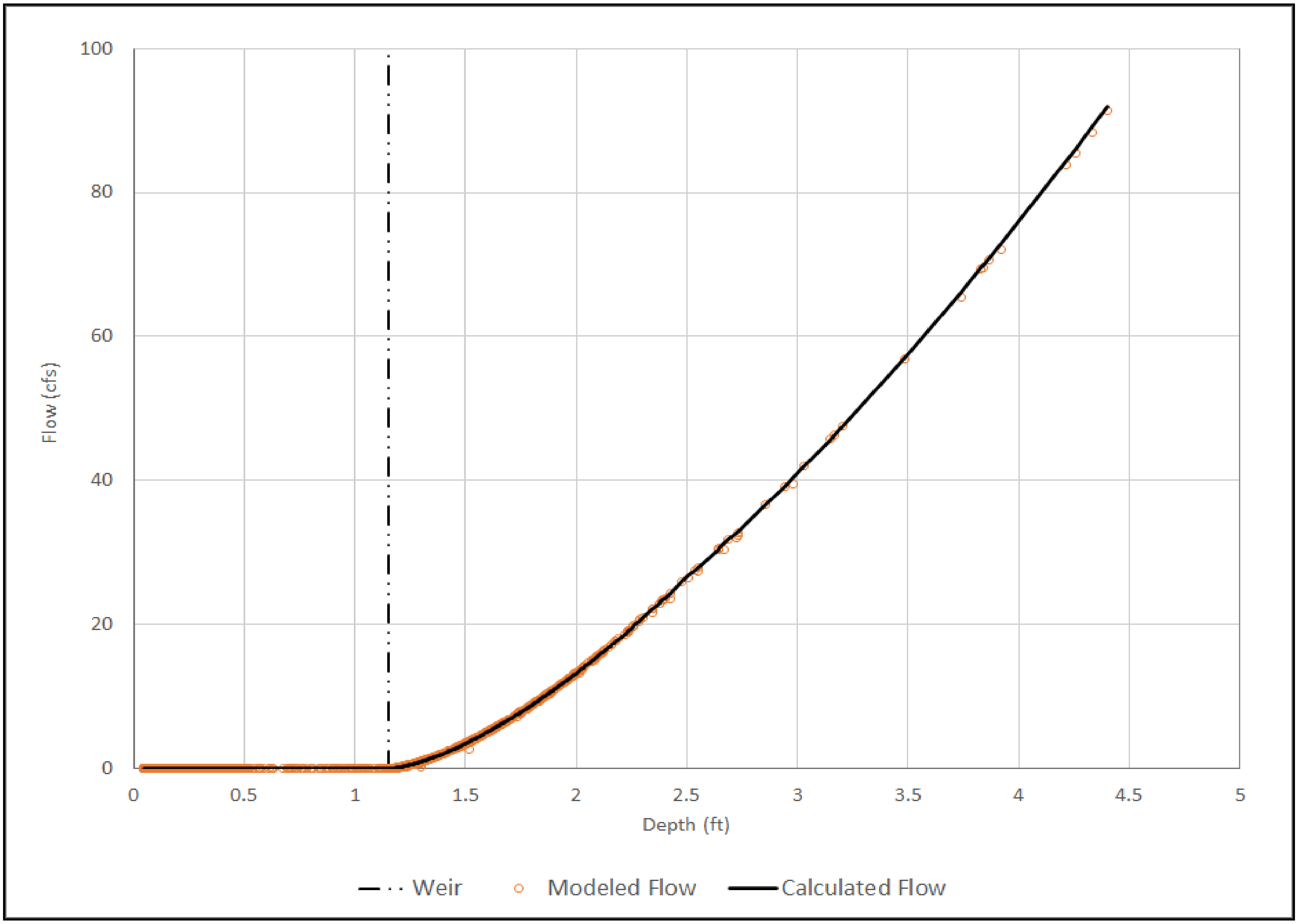
014 Regulator Level-Flow Relationship



Transverse Weir Equation to Calculate Flow: $Q = C_0 * L * h^{(3/2)}$	
d <= 4.25	Q = 0
4.25 < d	$Q = (2.9)(5.5)(d - 4.25)^{(3/2)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

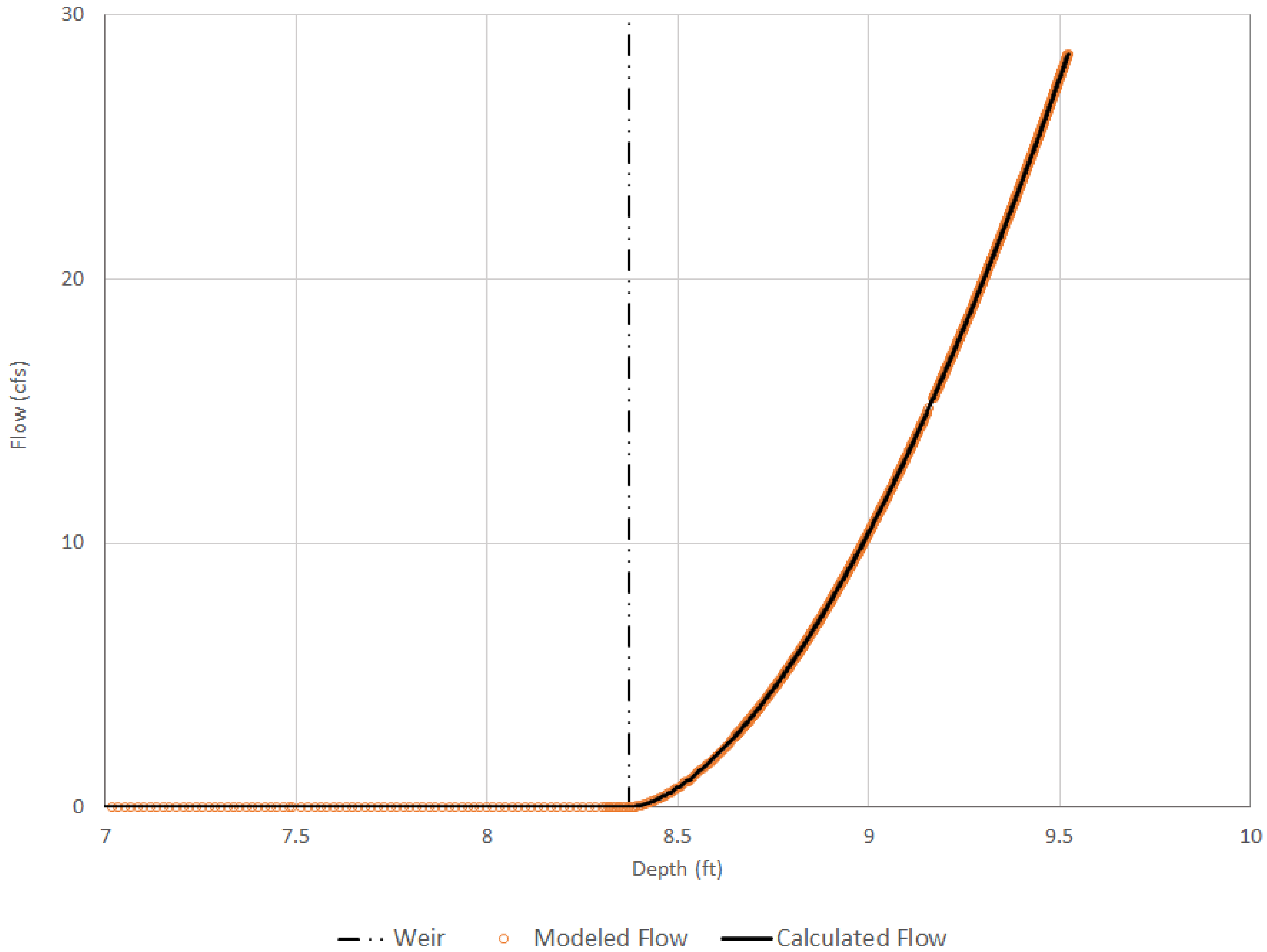
Appendix A
017 Regulator Level-Flow Relationship



Transverse Weir Equation to Calculate Flow: $Q = C_0 * L * h^{(3/2)}$	
d <= 1.15	Q = 0
1.15 < d <=2.5	$Q_1 = (3.33)(5.083)(d - 1.15)^{(3/2)}$
d > 2.5[T]	$Q_2 = (3)(5.083)(d-1.15)^{(3/2)} + 2.63$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)
[T] Constant of 2.63 used to achieve continuity between equations at a depth of 2.5 feet	

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using precipitation data collected by rain gauges from May 2021 through June 2022.

Appendix A
020 Regulator Level-Flow Relationship



Sideflow Weir Equation to Calculate Flow: $Q = C_0 * L^{0.83} * h^{(5/3)}$	
d <= 8.37	Q = 0
8.37 < d	$Q = (3.33)(10)^{0.83}(d - 8.37)^{(5/3)}$
Q	flow (cfs)
C_0	Weir Coefficient
L	Weir Length (ft)
h	d - Weir Height (ft)
d	Metered Flow Depth (ft)

Graph above uses depths and flows from Peoria's Starting Conditions H&H Model run using modeled direct inflow to produce overflows as there were not enough overflow occurrences and data points to develop relationship using only May 2021 through June 2022 precipitation data.

APPENDIX B

Example Equipment Data Sheets

TRITON+®
Flow Meter Specifications

Connectors	U.S. Military specification MIL-C 26482 series 1, for environmental sealing, with gold-plated contacts
Communication	Third-party, FCC/IC/EC- and carrier-approved wireless modem
	Compatible with 4G LTE-M networks worldwide with 2G fallback (where available)
	Automatically detects installed SIM upon boot up to determine correct network
	Modem FCCID: R17ME910C1WW
Monitor Interfaces	Supports simultaneous interfaces with up to two combo sensors
	Supports optional Analog and Digital I/O with ADS XIO: two 4-20 mA inputs and outputs, two switch inputs and two relay outputs
Power	**Internal -** Battery life with a cellular modem: • Over 15 months at a 15-minute sample rate* • Over 6 months at a 5-minute sample rate*
	External - Optional external power available with ADS External Power and Communications Unit (ExPAC) with an ADS- or customer-supplied 9-36 Volt DC power supply
	* Rate based on collecting data once a day and varies according to sensor configuration and operating temperature
Connectivity	**Modbus ASCII:** Wireless; Wired using ADS ExPAC or XBUS
	Modbus RTU: Wireless; Wired using ADS ExPAC or XBUS
	Modbus TCP: Wireless only
Operating and Storage Temperature	-4 degrees to 140 degrees F (-20 degrees to 60 degrees C)
Compatibility	Attachable ADS Sensors
	Qstart™***XML*** with ***TRITON+***® firmware version 6.42 and higher
	PRISM™

Mounting Options	**Mount on the manhole rung** use standard hook (ADS p/n 8000-0021)
	Mount permanently to the manhole wall use monitor mounting bracket/flange (ADS p/n I40-0009)
	Mount to the manhole rim use monitor bracket/flange (ADS p/n I40-0009)
Intrinsic Safety Certifications	**Certified under the ATEX** European Intrinsic Safety standards for Zone 0 rated hazardous areas
	Certified under IECEx (International Electrotechnical Commission) Intrinsic Safety Standards for use in Zone 0 rated hazardous areas (equivalent to Class I, Division 1, Groups C & D)
	CSA Certified to Class 225803 Process Control Equipment, Intrinsically Safe and Non-Incendive Systems – For Zone 0 Hazardous Locations, Ex ia IIB T3 (152°C) in Canada
	CSA Certified to Class 225883 Process Control Equipment, Intrinsically Safe and Non-Incendive Systems – For Class I Zone 0 Hazardous Locations, AEx ia IIB T3 (152°C) in the USA (equivalent to Class I, Division 1, Groups C & D)
Other Certifications/ Compliances	FCC Part 15 and Part 68 compliant
	Carries the EU CE mark
	ROHS (lead-free) compliant
	Canada IC CS-03 compliant

ISO 9001 Registered Company
sira CERTIFICATION
UKAS MANAGEMENT SYSTEMS 011
Certificate No: 940056

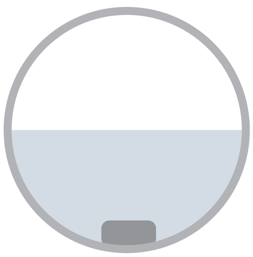
connected by verizon

Learn more about *TRITON+*
www.adsenv.com/triton

Call: 800.633.7246
Email: adssales@idexcorp.com

TRITON+®
Sensor Specifications

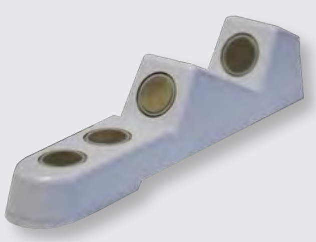
The ADS® ***TRITON+***® features three depths and two velocities with five sensor options. Each sensor provides multiple technologies for continuous running of comparisons.

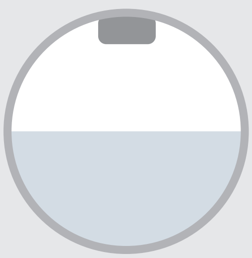


Peak Combo Sensor

This versatile and economical sensor includes three measurement technologies in a single housing: ADS-patented continuous wave *peak velocity, uplooking ultrasonic depth,* and *pressure depth*.

Dimensions	**Height:** 0.83 in (21 mm), **Width:** 1.23 in (31 mm), **Length:** 6.76 in (172 mm)
Continuous Wave Velocity	**Operating Range: -**30 fps to +30 fps (-9.1 m/s to +9.1 m/s)
	Resolution: 0.01 fps (0.003 m/s)
	Accuracy: +/- 0.04 fps (0.01 m/s) in velocities < 1 fps; +/- 2% of actual velocity in velocities > 1 fps (0.30 m/s) in uniform flow
Uplooking Ultrasonic Depth	Performs with rotation of up to 15 degrees from the center of the invert; up to 30 degrees rotation with Silt Mount Adapter
	Operating Range: 1.0 in (25 mm) to 5 ft (152 cm)
	Resolution: 0.01 in (0.254 mm)
	Accuracy: 0.5% of reading or 0.125 in (3.2 mm), whichever is greater
Pressure Depth	**Operating Range Option:** 0 - 05 PSI up to 11.5 ft (3.5 m) 0 - 15 PSI up to 34.5 ft (10.5 m) 0 - 30 PSI up to 69 ft (21.0 m)
	Resolution: 0.01 in (0.25 mm)
	Accuracy: +/-1.0% of full scale



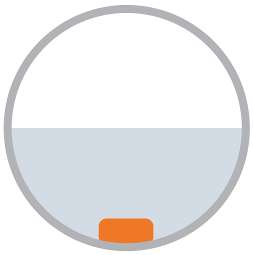


Surface Combo Sensor

This sensor features four technologies including surface velocity, ultrasonic depth, surcharge continuous wave velocity, and pressure depth.

Dimensions	**Height:** 2.45 in (62 mm), **Width:** 2.03 in (52 mm), **Length:** 10.61 in (269 mm)
Surface Velocity	**Minimum air range:** 3 in (76 mm) from bottom of rear, descended sensor
	Maximum air range: 42 in (107 cm)
	Range: 1.00 to 15 fps (0.30 to 4.57 m/s)
	Resolution: 0.01 fps (0.003 m/s)
	Accuracy: +/-0.25 fps (0.08 m/s) or 5% of actual reading (whichever is greater) in flow velocities between 1.00 and 15 fps (0.30 and 4.57 m/s)
Ultrasonic Depth	**Minimum dead band:** 1.0 in (25.4 mm) from the face of the sensor or 5% of the maximum range, whichever is greater
	Maximum operating air range: 10 ft (3.05 m)
	Resolution: 0.01 in (0.25 mm)
	Accuracy: +/- 0.125 in (3.2 mm) with 0.0 in (0 mm) drift, compensating for variations in air temperature
Surcharge Continuous Wave Velocity	*When submerged, this technology provides the same accuracy and range as Continuous Wave Velocity for Peak Combo Sensor*
Surcharge Pressure Depth	*When submerged, this technology provides the same accuracy and range as Pressure Depth for Peak Combo Sensor*

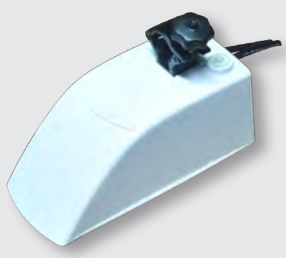
The **Ultrasonic Depth Sensor** version of this sensor specializes in depth measurement. This non-intrusive, zero-drift sensing method results in stable, accurate, and reliable flow depth calculation. Two independent ultrasonic transducers allow for independent cross-checking.

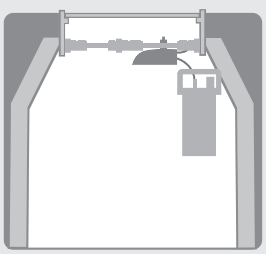


AV|GATED®

This sensor combines proven depth measurement methods with state-of-the-art gated velocity measurement technology to provide accurate and reliable area-velocity measurements to calculate accurate sewer flow rate.

Dimensions	**Height:** 0.83 in (21 mm), **Width:** 1.50 in (38 mm), **Length:** 7.11 in (181 mm)
Weight	2 lbs (0.91 kg)
Operating Temperature	-4° to 140° F (-20º to 60º C)
Operating Range	**Ultrasonic Depth:** 1 in to 72 in (2.54 cm to 182.88 cm) **Pressure Depth (standard):** 0 in to 277 in at 10 psi (0 cm to 703.58 cm at 10 psi) **Velocity:** -20 fps to +20 fps (-6.10 m/s to +6.10 m/s); minimum depth for velocity = 5 in (12.70 cm)
Accuracy	**Ultrasonic Depth:** ±0.13 in (3.2 mm) or ±0.5% of flow depth; whichever is greater **Pressure Depth:** ±1% of full range **Velocity:** ±0.2 fps (0.06 m/s) or ±4% of average velocity; whichever is greater in uniform flow in velocities between -5 and +20 fps (-1.52 to 6.10 m/s)
Resolution	**Ultrasonic Depth:** 0.01 in (0.03 cm) **Pressure Depth:** 0.01 in (0.03 cm) **Velocity:** 0.01 fps (0.003 m/s)





Long Range Depth Sensor

A narrow, powerful ultrasonic beam allows this depth sensor to perform well over long ranges. Integral Submersion Sensor provides detection of flooding at the point of interest.

Dimensions	**Height:** 4.22 in (107.2 mm), **Width:** 4.40 in (111.8 mm), **Length:** 9.15 in (232.4 mm)
Long Range Ultrasonic Depth	**Minimum Dead Band:** 0.0 in (0.0 mm) from the bottom of sensor housing
	Maximum Operating Air Range: 20 ft (6.1 m)
	Beam Angle: +/- 3º
	Resolution: 0.01 in (0.24 mm)
	Accuracy: +/- 0.25% of sensor range measurement or 0.13 in (3.2 mm) whichever is greater, in a homogeneous temperature air column
	Drift: 0.0 in (0.0 mm)
	Temperature Compensation: Additional compensation for variable temperature air column supported
Submersion	Detects submersion when fully covered with liquid

INCLINOMETER

This sensor utilizes an integrated accelerometer to accurately determine the state of a flood gate's positioning in water control and management systems.

Dimensions	**Height:** 0.87 in (2.20 cm), **Width:** 2.03 in (5.16 cm), **Length:** 3.00 in (7.62 cm)
Housing	Solid molded ABS, high impact and abrasion resistant, fully sealed device
Weight	1.5 lbs (0.68 kg) including 25 ft communication cable and connector
Operating Range	0° to 90°
Accuracy	+/- 0.25 between 0º and 40º
Resolution	0º to 60° = 0.03°
	60º to 90° = 0.3°
Mounting Options	Mount on flat surface of the wastewater side of closed flood gate, or a closed door or hatch for intrusion alarms
	Construction adhesive, stainless steel screws, zip ties, stainless steel clamp

Trusted Solutions for
Level Monitoring

ECHO™

Level Monitoring for Open Channel Flows

The ADS® **ECHO™** is an all-new generation level monitor. It gives users up to 10X more monitoring range and uses machine learning software to predict overflows long before they occur.

Coupled with its wide range of uses and low cost, **ECHO** is the leading solution for level monitoring applications.

Collection Systems, Plants, Surface and Storm Water Structures

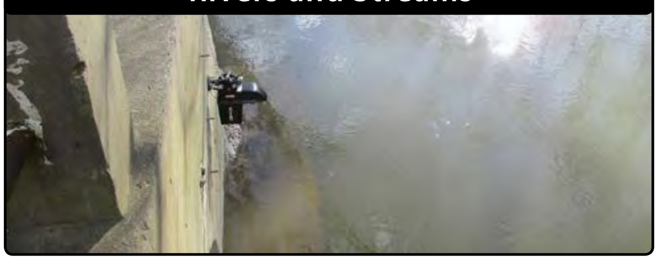
Sanitary Sewers

Combined Sewers

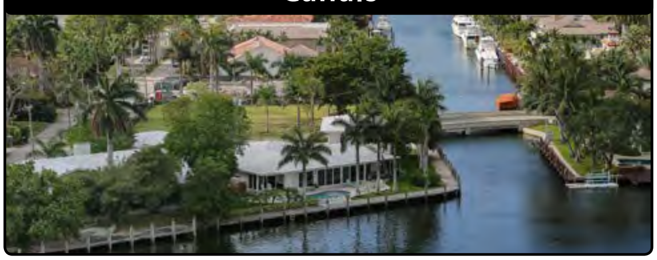
Wastewater Treatment Plants

Lagoons and Ponds

Rivers and Streams



Canals



ADS®
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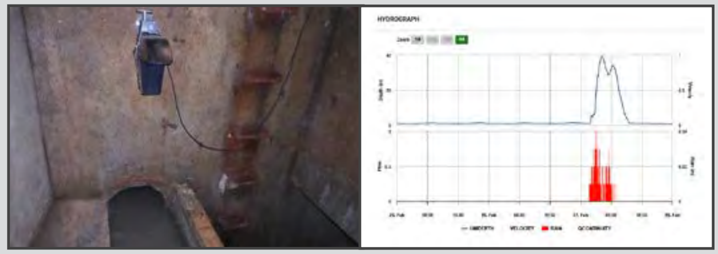
The Wide Range of ECHO Applications Gives You Flexibility

Operations, Engineering, Planning, Modeling, and Contractor Professionals

Efficient Cleaning Process

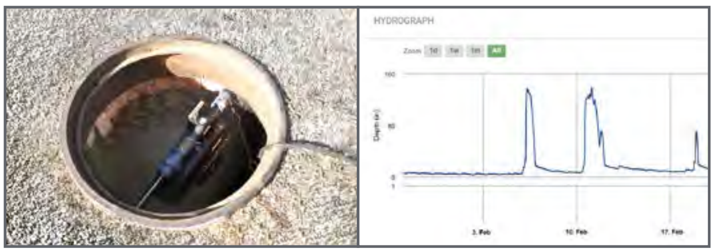
Reduce cleaning frequency and mitigate SSOs with continuous monitoring and blockage prediction software.

CSO Data and Reporting



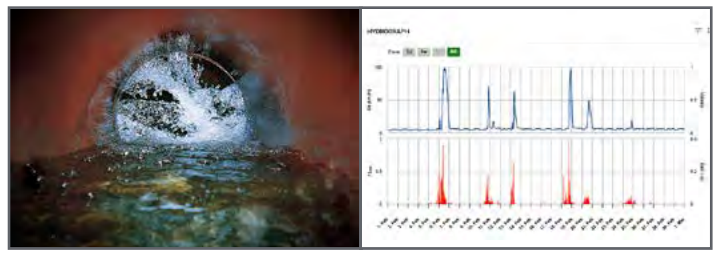
Monitor CSO activation and de-activation in real-time. Calculate overflows, prepare reports.

Hydraulic Model Validation



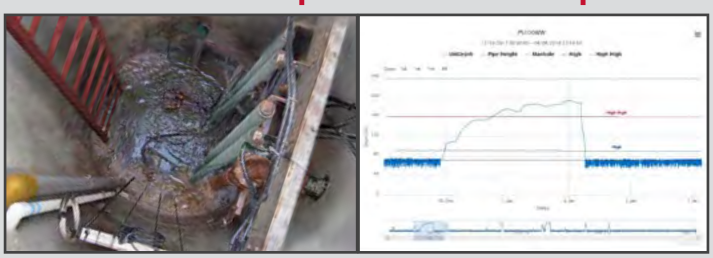
Acquire data for updating and validating hydraulic models. Low cost means higher sensor density.

I/I Scouting



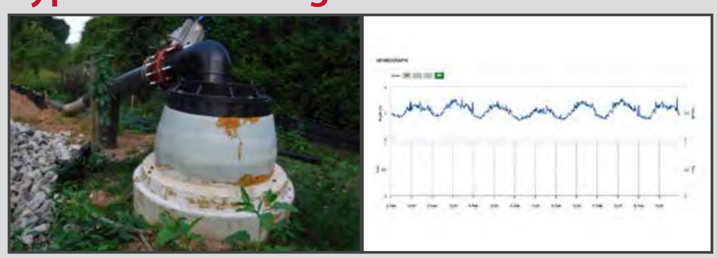
TRITON+® flow monitor, **PRISM**™ software and field services coupled with **ECHO** comprise a comprehensive I/I assessment solution.

Wastewater Pump Station Back-up



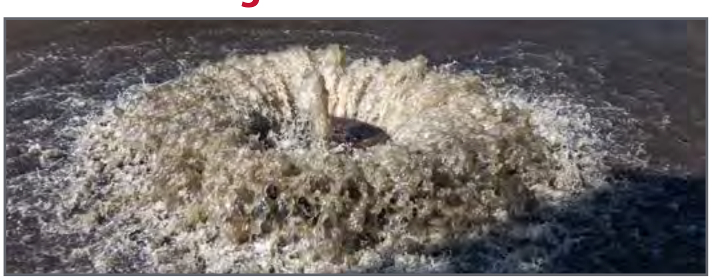
Avoid pump station overflows from power failures, partial pump blockages or failed alarms with ECHO back-up.

Bypass Monitoring



Secure 24/7 protection from overflows with bypass monitoring.

New **SSO Mitigation** Advancements Give You More Assurance



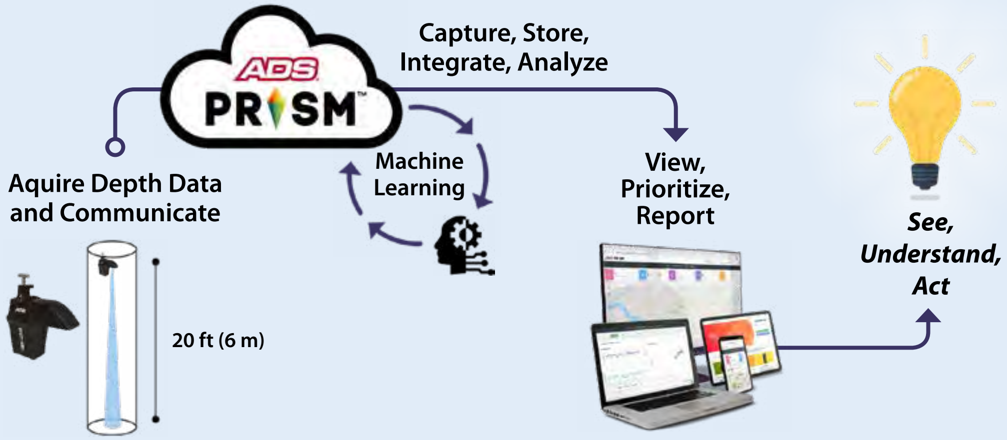
- ECHO is more advanced, less expensive
- Superior redundancy - five water-level alarms
- Simultaneous up/downstream monitoring
- Total Manhole Visibility™ 20 ft (6 m) below, 8 ft (2.5 m) above **ECHO**
- True readings with sensor alignment alarm, stable mount

ADS®

www.adsenv.com/echo

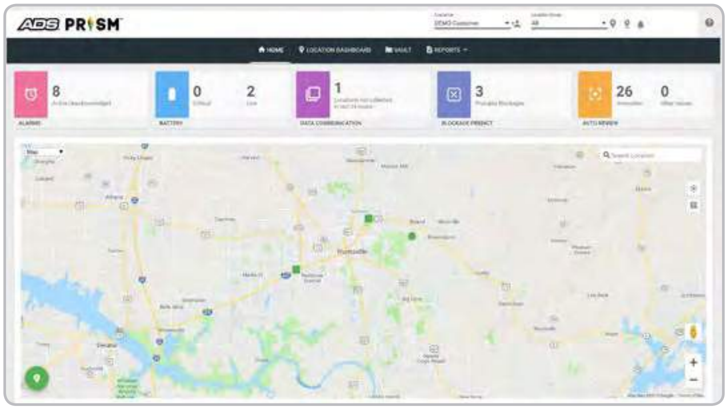
Continuous Monitoring Drives Informed Actions

Real-time depth data is collected and communicated to the cloud-based **PRISM** software and analytics. With continuous user access, informed actions are enabled.



ADS PRISM™ Software Enhances Understanding

PRISM is a cloud-based, secure software system that acquires, stores and presents data with ongoing user access. It's home page (right) provides a map view and a dashboard for quick access to essential parameters. Individual site details, hydrographs and remote site system settings are all accessible. **PRISM** APIs enable third party data exchange.



PRISM's new **blockage** PREDICT™ app (below) uses machine learning and will predictively detect blockages, with days' or weeks' worth of warning. When detected, blockages are presented in the dashboard.

Dashboard Reveals Prioritized List

2
Probable Blockages
BLOCKAGE PREDICT

blockage PREDICT lists prioritized, colored-coded symbols and access to details for sites of interest (below).

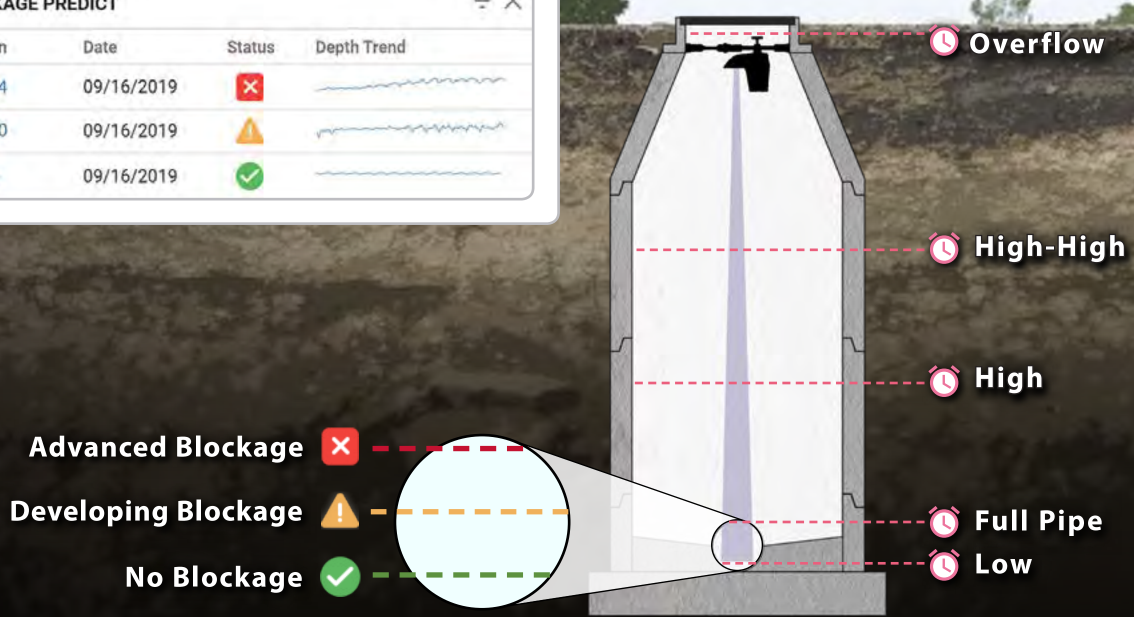
BLOCKAGE PREDICT

Location	Date	Status	Depth Trend
AN_204	09/16/2019	✖	
AN_110	09/16/2019	⚠	
AN_96	09/16/2019	✔	

Real-Time Alarms

5
Active Unacknowledged
ALARMS

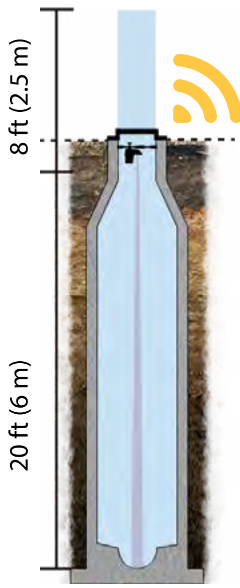
Dashboard summarizes Alarms and gives access details. Five redundant SSO alarms (below) guard against fast developing events.



The ECHO Difference Means New Standards in Performance:

New LTE-M communications
LTE-M communications provide improved reliability often allowing the antenna to be installed in the manhole, eliminating drilling. Set-up is fast and easy, taking just minutes.

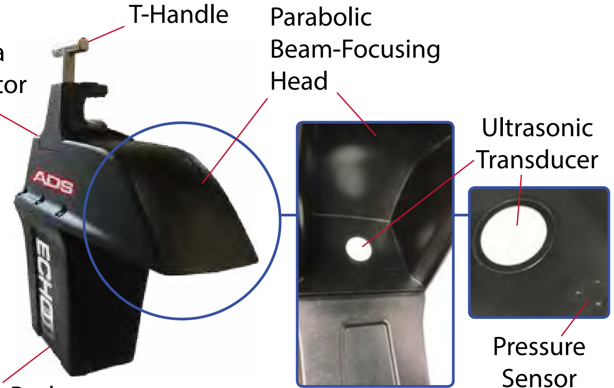
Total manhole visibility
Typical ultrasonic sensors' measurement range is 2 ft (60 cm) into an 8 in (20 cm) pipe. **ECHO**'s unique narrow beam technology provides 20 ft (6 m). Its pressure sensor provides 8 ft (2.5 m) measurement range above **ECHO**.



SPECIFICATIONS

System	dual-measurement sensor (ultrasonic and pressure), tilt alarm for sensor alignment, battery powered, wireless communication
Software	**PRISM**, cloud-based with data storage, dashboard, analytics and reports
Modem	universal for all SIM cards
Communications	LTE-M, 3G/4G / Worldwide MODEM
Battery Life	2-years (average)
Submersible	meets IP68
Manufacturing Standard	ISO-9001
Intrinsically Safe	CE, CSA, ATEX and IECEx certifications Multiple intrinsic safety certifications set the ADS ECHO apart with an intense focus on safety

ECHO System Components:



"Bullseye" Level Located on Top Assures Alignment in Seconds

Installation Options:

ECHO with Tension Bar Installation

The ADS **ECHO** installs quickly making it easy to move from one location to another.

Wall Mount Bracket and Bar

Adjustable Tension Bar

Tailored, Affordable Purchase Programs

Purchase
The ADS **ECHO** can be purchased bundled with communications and software. Every **ECHO** comes with a two-year product warranty.

D-Site Turn-Key Service
ADS takes care of your monitoring network including equipment, software, and onsite maintenance through one low monthly fee.

2 Year Warranty
Our two-year warranty gives you added assurance of its quality and reliability.

Learn more about ECHO: www.adsenv.com/echo

Access PRISM: https://www.adsprism.com

Call: 800.633.7246
Email: adssales@idexcorp.com

Trusted Solutions for

Rainfall Monitoring

RAINALERT® III

Overview

Important decisions are made every day regarding sanitary sewer, combined sewer, and storm sewer systems and often require the use of rainfall data. Although these decisions involve significant capital investment and expenditures required to protect public health and the environment, the integrity of rainfall measurements supporting them is often overlooked.

The ADS® ***RainAlert®III*** is a rainfall monitor that connects to a tipping bucket rain gauge to measure and record rainfall data. The ***RainAlert III*** is simple to install and simple to operate, with flexible configuration options, wireless communications, and alarming to deliver rainfall data when and where you need it.

Applications

The ***RainAlert III*** is used to gather rainfall data for use in a variety of applications:

- Rainfall event analysis
- Rainfall alarming
- Infiltration and inflow analysis
- Hydrologic modeling
- CSO and SSO monitoring
- Regulatory compliance

Typical Installation

The ***RainAlert III*** connects to an ADS or customer supplied tipping bucket.

3 Mounting options to suit your needs

ground mount

pole mount

rooftop mount

www.adsenv.com/rainalert

RAINALERT® III

Rainfall Monitor Specifications

Enclosure	Polycarbonate enclosure reinforced with 10% glass fiber resin
	NEMA Type 4X, IP67, and UL Rated
	Access cover includes stainless steel latches and a continuous gasket
	Pressure equalizing vent
Weight	10 lbs (4.54 kg), with battery
Operating Temperature	-4°F to +140°F (-20°C to +60°C)
Mounting	Optional mounting hardware designed for ground, pole mount, or rooftop installation
Resolution	0.01 inch/tip (United States)
	0.1, 0.2, 0.5, 1.0 mm/tip (International)
Dimensions	Height 10.63 in (270 mm) Width 7.09 in (180 mm) Depth 4.53 in (115 mm)

Memory	1MB program memory, 256 KB RAM
	8MB NV flash memory, 32KB NV FRAM
Processor	ARM Cortex M4 microprocessor
Data Storage	700+ days for two stored entities (Rain and Rain Intensity)
Clock	Battery-backed real-time clock module synchronized with wireless carrier
Firmware	Upgrade via remote wireless or local USB connection
Power	Replaceable 9V 60Ah alkaline battery pack or user-provided external power supply (6 to 24V DC, 1A)
Battery Life	Up to 3 years depending on operating temperature, modem power management and frequency/type of communications
Connector	2-Conductor 22 AWG wire provided for connection to tipping bucket
Diagnostics	Wireless communication or USBconnection to the unit through ADS ***Qstart***™***XML*** software for reading the latest monitor status and performing diagnostics to resolve problems
Antenna	Delivered with an internal ultra-wide band I-BAR type antenna. An SMA connector on the board is available for applications requiring an external antenna
Communications	Third-party, FCC/IC/EC- and carrier-approved wireless modem
	Compatible with all 4G LTE-M networks worldwide with 2G fallback (where available)
	Automatically detects installed SIM upon boot up to determine correct network
	Modem FCCID: R17ME910C1WW
Compatibility	***Qstart***™***XML***
	PRISM™

Learn more about *RainAlert III*
www.adsenv.com/rainalert

Call: 800.633.7246
Email: adssales@idexcorp.com

ADS®
www.adsenv.com/rainalert

Specifications subject to change without notice.

Trusted Solutions for
Rainfall Monitoring

TB6 Series II
Standard Tipping Bucket Rain Gauge

Overview
Reliable rainfall measurements are important for the design, evaluation, and operation of sewer systems. Rainfall characteristics vary widely, as do rainfall monitoring needs. Therefore, ADS offers a range of tipping bucket rain gauges (TBRGs) to meet your needs based on an approach that is technically sound, flexible, and cost-conscious.

The ***TB6*** uses standard tipping bucket technology to provide accurate rainfall measurements at lower rainfall intensites. It provides professional grade features and durable construction to provide high-quality measurements at an affordable cost.

Application
The standard TBRG is recommended for use where lower rainfall intensities are expected at design storms of interest. ADS recommends a siphoning TBRG if higher accuracy is required at higher rainfall intensities.

Key Features

Standard tipping bucket
measures low intensity rainfall

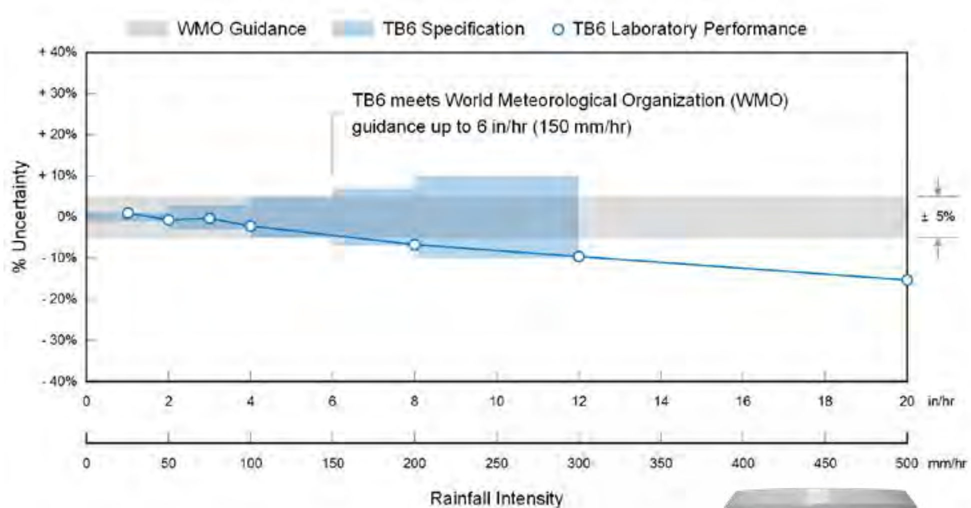
Finger filter
reduces funnel plugging

Integrated insect screens
keep spiders and insects out

Sapphire bearings
provide stable calibration

ISO-9001 certification
ensures quality

TB6 Tipping Bucket Rain Gauge Performance



TB6 outer enclosure secures the rim and funnel to the base and provides easy access for O&M

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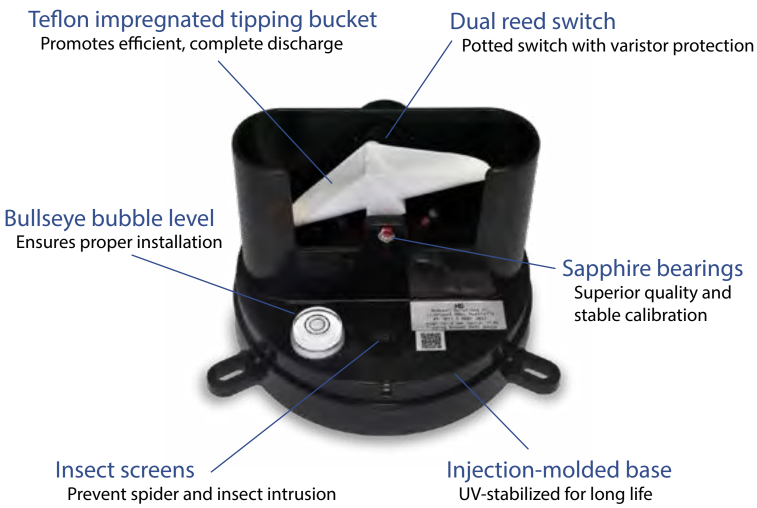
TB6 Standard Tipping Bucket Rain Gauge

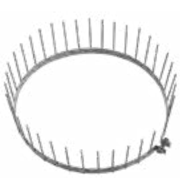


Integrates with RainAlert® III

The ADS ***RainAlert III*** is a rainfall monitor that connects to the ***TB6*** and provides data acquisition and alarming via cellular communications. Use for both permanent and temporary applications, including infiltration and inflow studies, hydraulic model calibration, regulatory compliance programs, and more.

Accessories

Bird Guard



Mounting Hardware

Field Calibration Device

TB6 *Series II Specifications*

Type	Standard TBRG
Receiver	8-inch nominal diameter
	(200 mm ± 0.3 mm)
	Die-cast aluminum, powder-coated
Enclosure	Removable for easy access to interior
	Spun aluminum, powder-coated
Finger Filter	Injection-molded ABS
	Stainless steel mesh screen
Bucket	Teflon impregnated ASA
	Balanced to ± 0.05 g
	Discharge extensions
	0.01 inch/tip (United States)
	0.2 mm/tip (International)
Bearings	Sapphire bearings
	Stainless steel shaft
Accuracy	< ± 1% up to 2 in/hr (50 mm/hr)
	± 3% up to 4 in/hr (100 mm/hr)
	± 5% up to 6 in/hr (150 mm/hr)
	± 7% up to 8 in/hr (200 mm/hr)
	± 10% up to 12 in/hr (300 mm/hr)
Max Intensity	28 in/hr (700 mm/hr)
Contacts	Dual reed switch
	Potted in soft silicon rubber
	Varistor protection
	24 V (0.5 A) max capacity
	0.1 Ω initial contact resistance
Base	Injection-molded ASA
	Integrated mesh insect screens
	Drain fittings
	Bullseye bubble level
Temperature	-4°F to +158°F (-20°C to +70°C)
	Not suitable for frozen precipitation Heater unit not available for this model
Height	13 in (330 mm)
Weight	4.9 lbs (2.2 kg)
Shipping	11.0 lb / 1.1 ft^3 (5.0 kg / 0.03 m^3)
Compatibility	***RainAlert® III***
	Qstart™XML
	PRISM™

Learn more about *RainAlert III*
www.adsenv.com/rainalert

Call: 800.633.7246
Email: adssales@idexcorp.com

www.adsenv.com/rainalert

APPENDIX C

2015 Greeley and Hansen Regulator Details

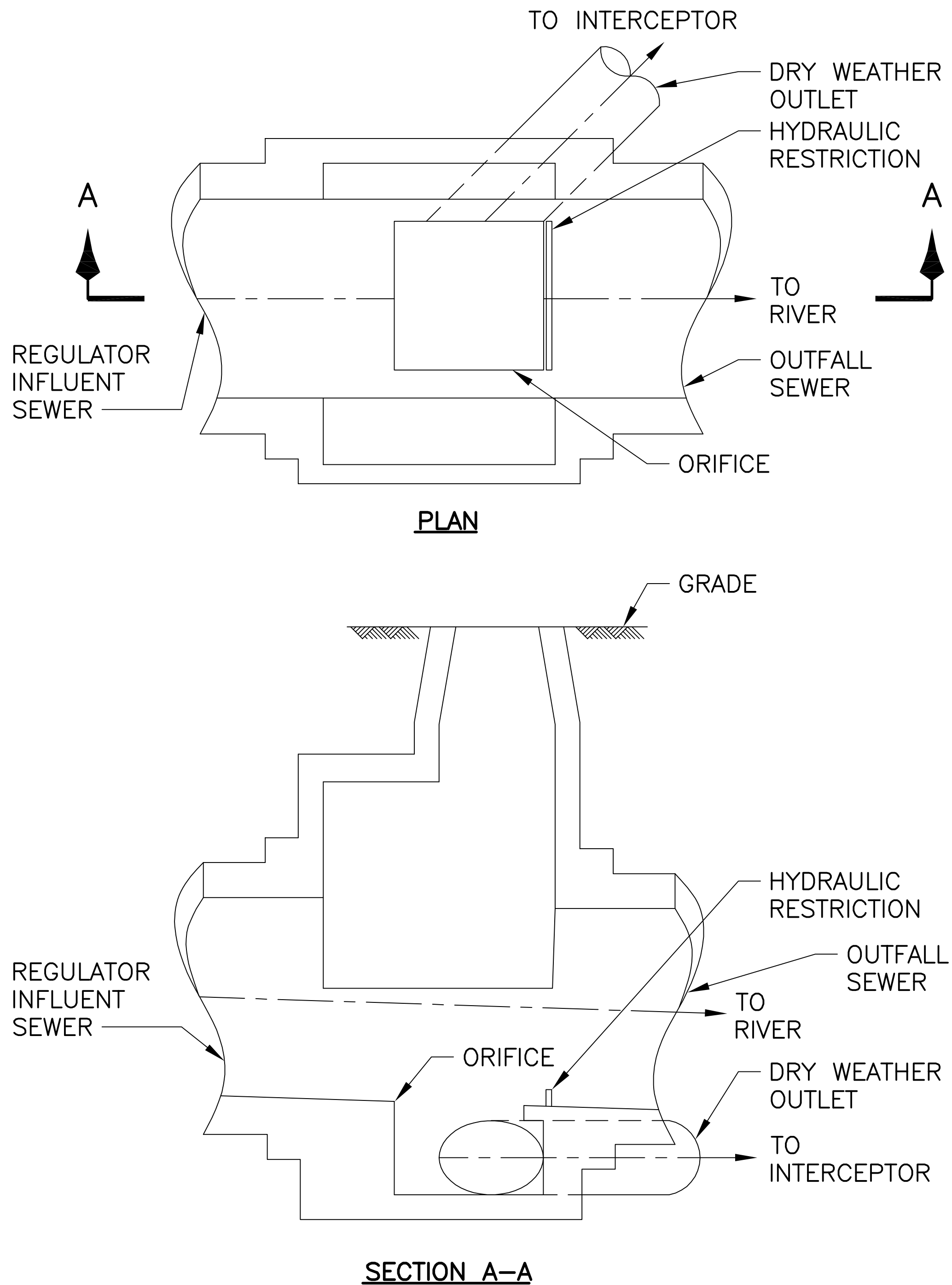
Table 1
Active CSO Regulator Data

Greeley and Hansen
June 2015

CSO Outfall Number[1]	Name	Type	Regulator Influent Sewer Size (in)	Dry Weather Outlet Size[2] (in)	Regulator Invert Elevation (ft)	Dry Weather Outlet Invert Elevation (ft)	Weir Elevation (ft)	Weir Length (ft)	Orifice Opening Size	Regulator Updates
003	Spring Street	Double Side Weir	60, 60	48	450.10, 450.25	449.95	457.30	50.0	None	None
001	Green Street	Sidespill Weir	48 x 30 Egg	42	460.95	460.75	465.87	10.0	None	None
A06 & B06	Old Eaton Street	Sidespill Weir	60, 42	60	456.00	455.93	461.00	12.8	None	None
	New Eaton Street	Swirl Concentrator	60	15	446.35	449.35	459.00	73.3[3]	3.0' dia.	None
A07	Fayette Street	Swirl Concentrator	72	24	446.35	449.35	459.00	73.3[3]	3.0' dia.	None
		Sidespill Weir	60, 66	72	456.35	456.00	461.04	23.0	None	None
008	Hamilton Street	Sidespill Weir	42	60	465.90	457.20	465.60	6.3	None	None
020	Main Street	Sidespill Weir	36	60	461.80	457.76	466.13	10.0	None	Raised weir 12"
009	Fulton Street	Sidespill Weir	18	16	454.24	452.86	457.20	4.6	None	None
016	Water Street	Orifice	36 x 50 Egg	27	452.79	449.65	N/A	N/A	1.5' x 1.5'	Added 5" hydraulic restriction in outfall
	Cedar Street	Orifice	72	27	453.10	450.20	N/A	N/A	4.5' x 3.75'	Added 9" hydraulic restriction in outfall
017	South Street	Sidespill Weir	48	15	451.73	451.49	452.64	7.7	None	None
018	Washington Street East	Orifice	28 x 42 Egg	12	455.70	454.10	N/A	N/A	1.0' x 1.0'	None
	Sanger Street	Sidespill Weir	48	18	453.40	451.40	454.80	6.0	None	None
	Washington Street West	Orifice	44	24	451.70	449.10	N/A	N/A	3.7' x 1.0'	None
019	Darst Street	Orifice	84	24	453.30	450.80	N/A	N/A	4.5' x 4.5'	Constructed influent trough to reduce hydraulic loss, added 9" hydraulic restriction in outfall

NOTES:
1) Regulators in order from upstream to downstream.
2) Dry Weather Outlet discharges to Riverfront Interceptor.
3) Primary Weir Length only, does not include Secondary (Overflow) Weir.
4) All elevations are NGVD 29 Datum.

FIGURE NO. 1



ORIFICE REGULATOR

NOT TO SCALE (SEE NOTE 1)

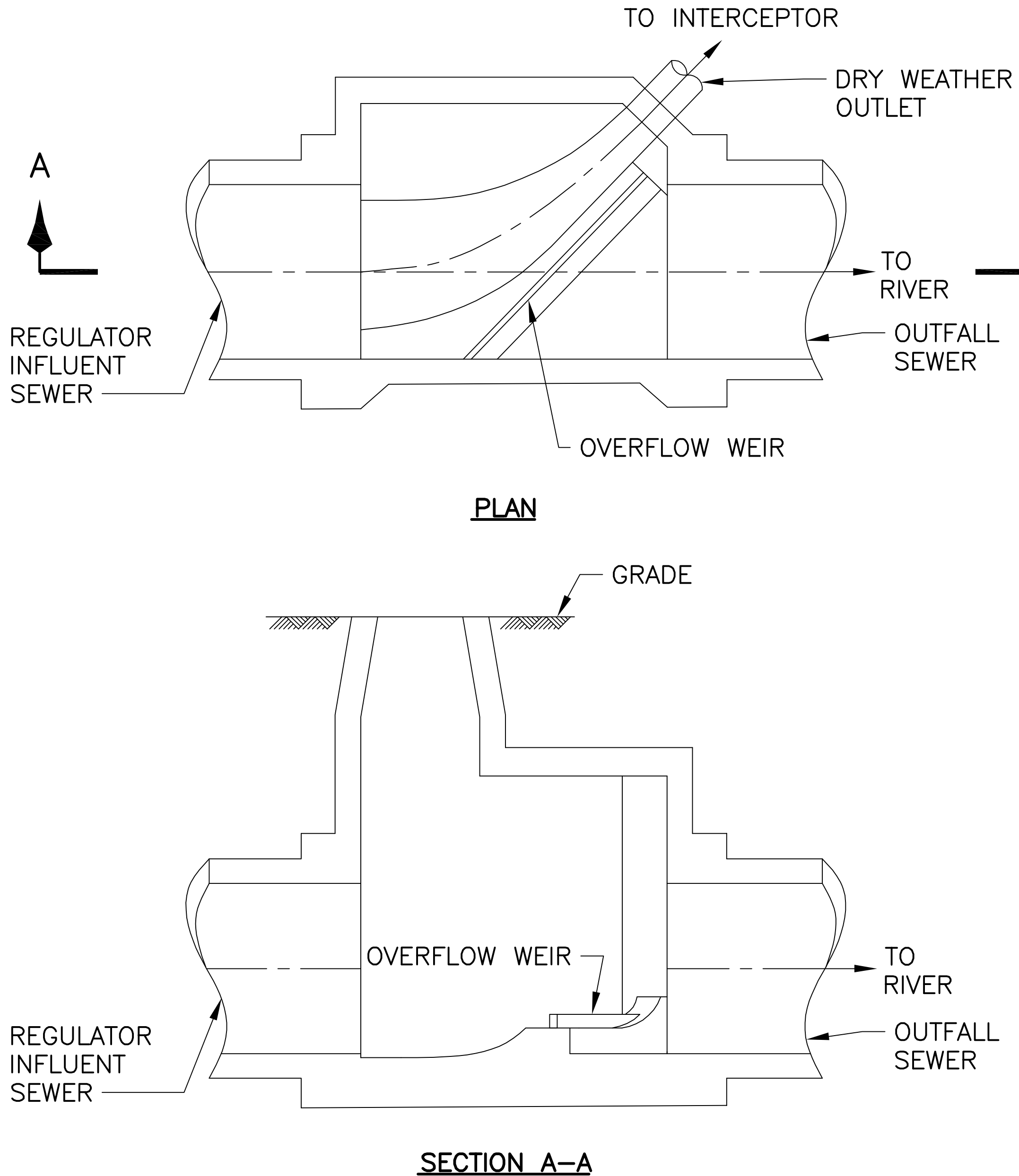
NOTE:

1. TYPICAL OF CSO OUTFALL 016, 018, 019.
2. REFER TO TABLE 1 FOR HYDRAULIC RESTRICTION LOCATIONS.

GREELEY AND HANSEN

GREATER PEORIA SANITARY DISTRICT

FIGURE NO. 2



SIDESPILL WEIR REGULATOR

NOT TO SCALE (SEE NOTE 1)

NOTE:

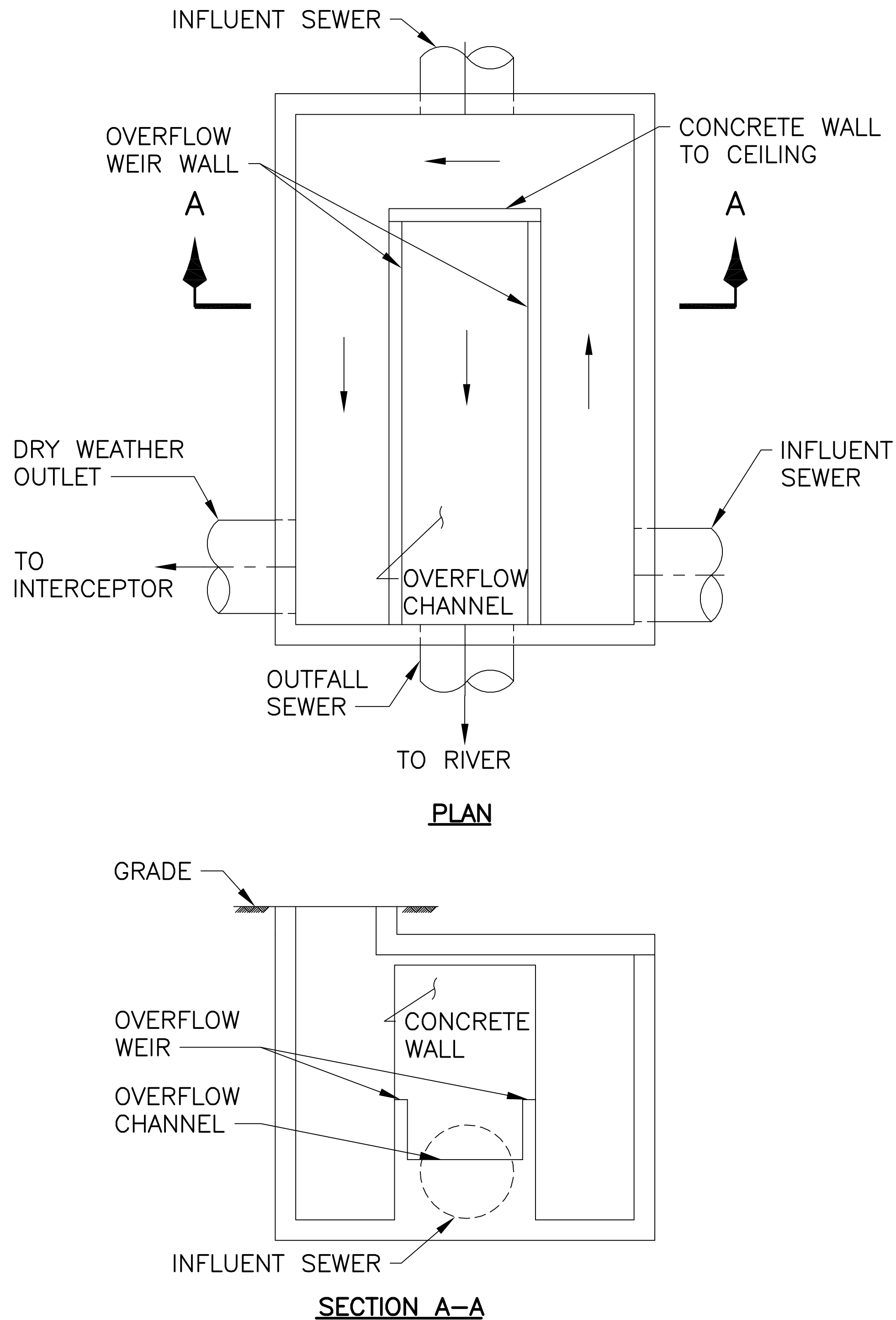
1. TYPICAL OF CSO OUTFALL 001, A06 & B06, A07, 008, 009, 017, 018, 020.

K:\0051K–GPSD–RIVERFRONT AREA ASSISTANCE\07 CADD\FIGURES\FIGURE 2 2015/06/18 12:34 PM NICHOLS, WILLIAM

GREELEY AND HANSEN

GREATER PEORIA SANITARY DISTRICT

FIGURE NO. 3



DOUBLE SIDE WEIR REGULATOR

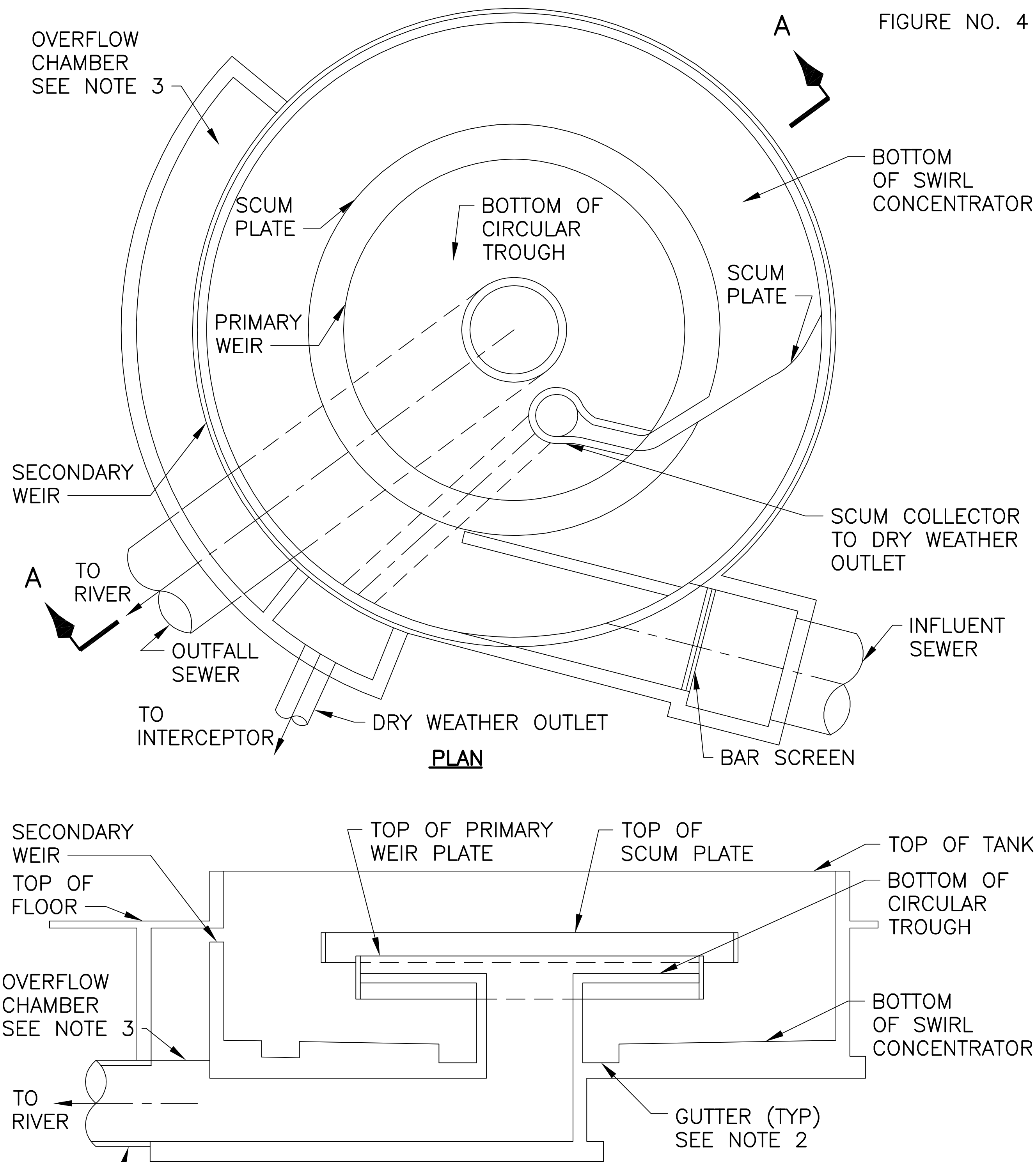
NOT TO SCALE (SEE NOTE 1)

NOTE:

1. TYPICAL OF CSO OUTFALL 003.

GREELEY AND HANSEN

GREATER PEORIA SANITARY DISTRICT



SECTION A–A

SWIRL CONCENTRATOR

NOT TO SCALE (SEE NOTE 1)

NOTE:

1. TYPICAL OF CSO OUTFALL A06 & B06, A07.
2. GUTTERS DIRECT FLOW TO DRY WEATHER OUTLET. GUTTERS NOT SHOWN IN PLAN FOR CLARITY.
3. OVERFLOW CHAMBER DISCHARGES TO OUTFALL SEWER BELOW.

GREELEY AND HANSEN

GREATER PEORIA SANITARY DISTRICT

K:\0051K-GPSD-RIVERFRONT AREA ASSISTANCE\07 CADD\FIGURES\FIGURE 4 2015/06/18 12:34 PM NICHOLS, WILLIAM

APPENDIX D

CSO Regulator Photos and Descriptions

019 Darst

Description: Orifice with hydraulic restriction at outfall pipe invert downstream of orifice
Condition: Good
Estimated Construction Date: 1933 with modifications or updates since then

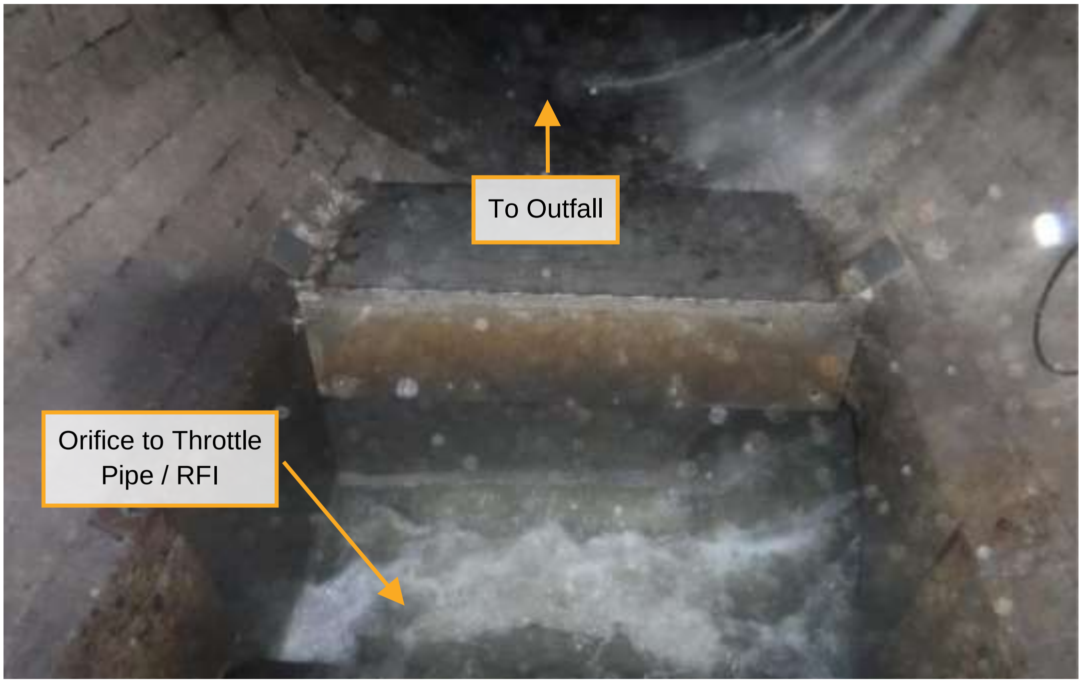


Figure 1 | Darst Regulator, Facing Downstream Toward Outfall

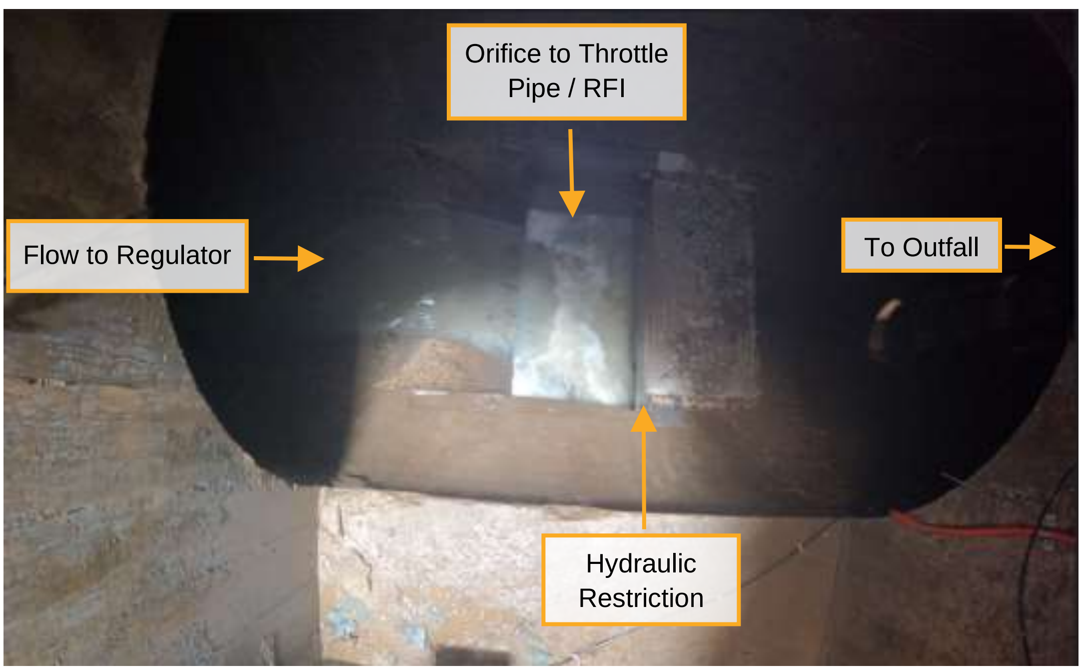


Figure 2 | Darst Regulator, from Above

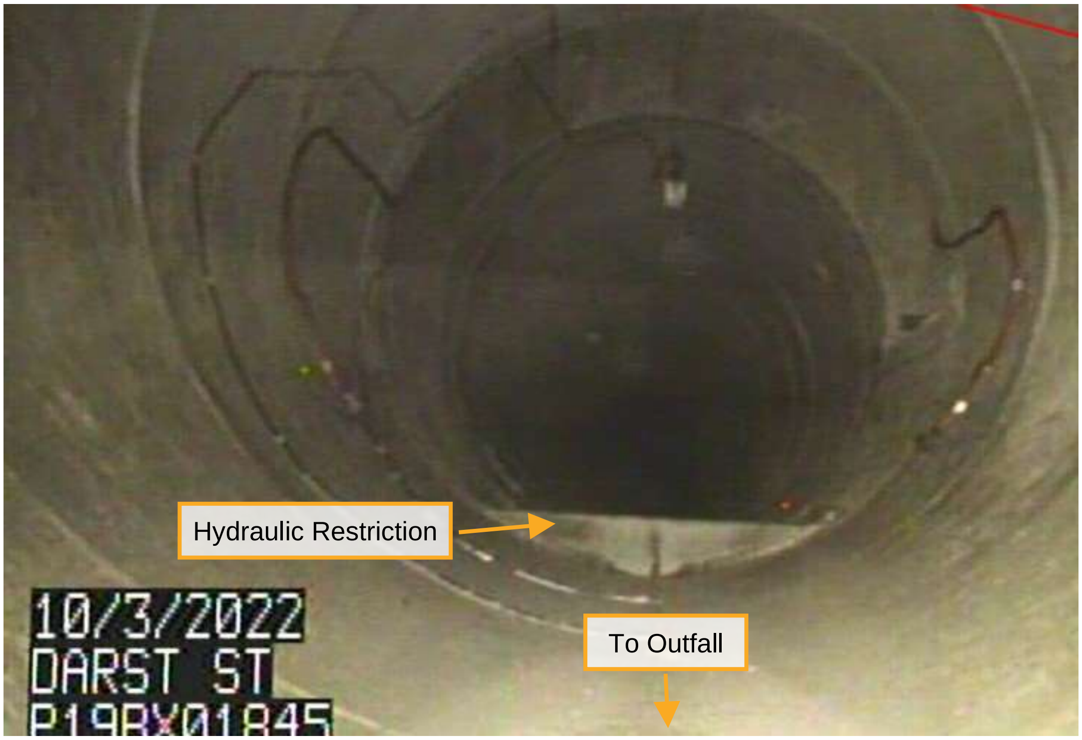


Figure 3 | Darst Hydraulic Restriction from Outfall Pipe, Facing Upstream Toward Regulator

018 Sanger - Sanger North

Description: Orifice
Condition: Good
Estimated Construction Date: 1929 with potential modifications or updates since then

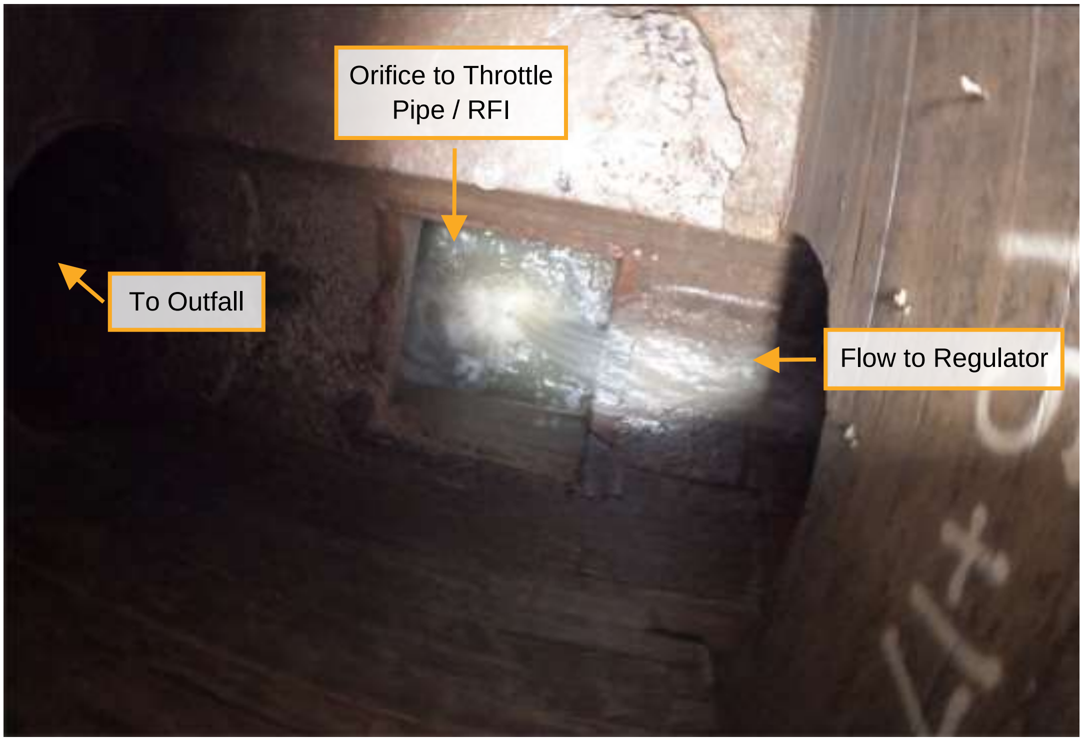


Figure 4 | Sanger North Regulator, from Above

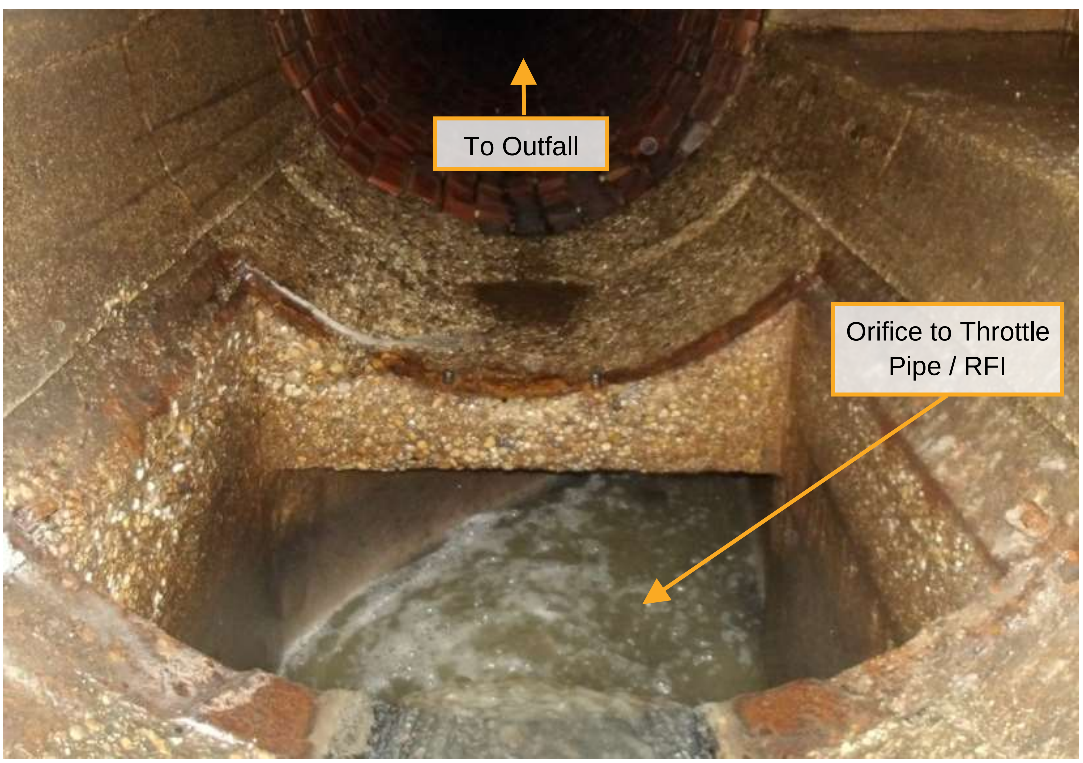


Figure 5 | Sanger North Regulator, Facing Downstream Toward Outfall

018 Sanger - Washington West

Description: Orifice
Condition: Good
Estimated Construction Date: Unknown

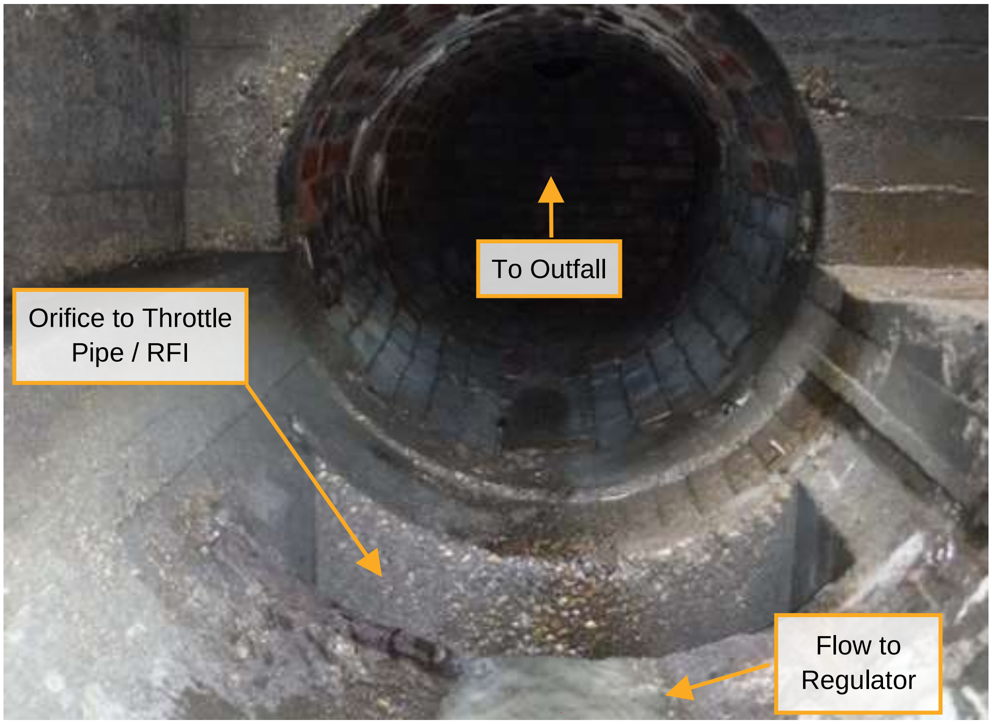


Figure 6 | Sanger – Washington West Regulator, Facing Downstream Toward Outfall

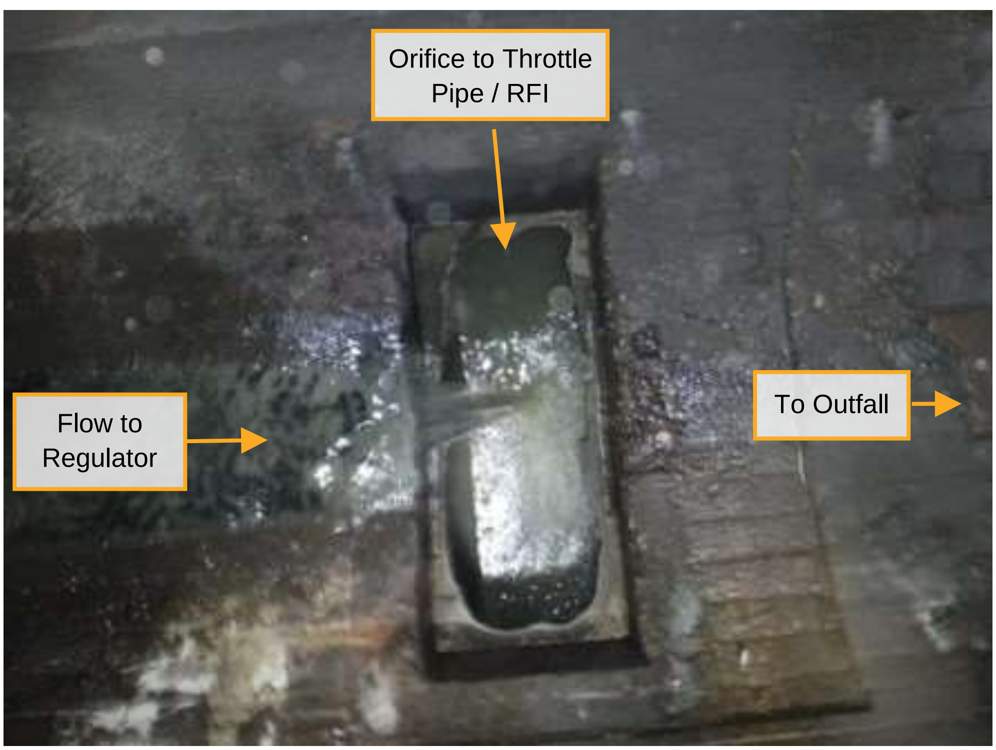


Figure 7 | Sanger – Washington West Regulator, from Above

018 Sanger - Washington East

Description: Orifice
Condition: Good
Estimated Construction Date: Unknown

Figure 8 | Sanger – Washington East Regulator, Facing Downstream Toward Outfall

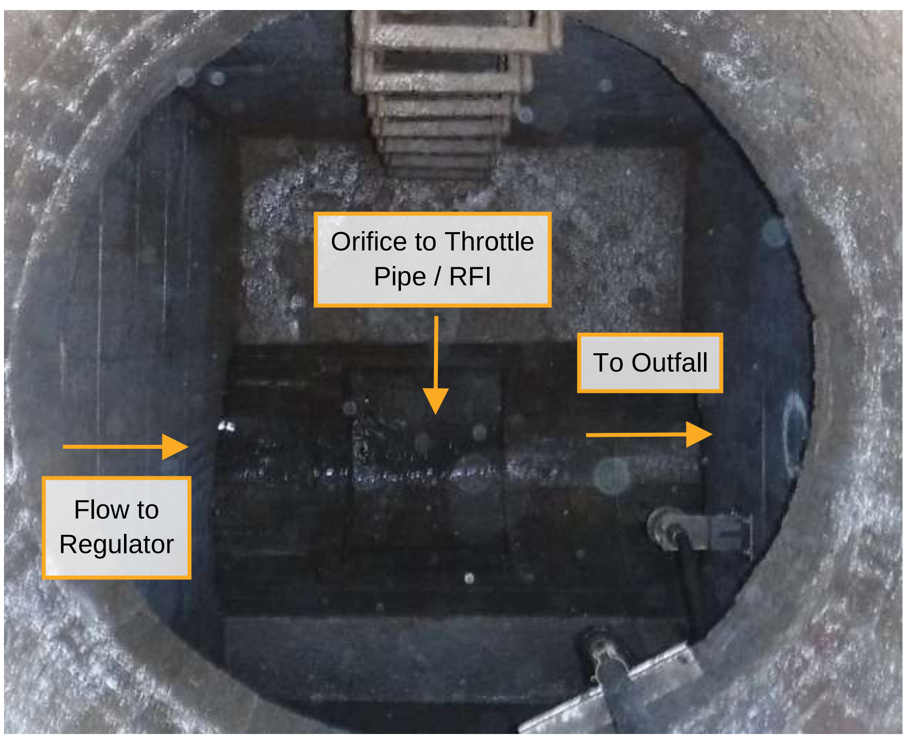


Figure 9 | Sanger – Washington East Regulator, from Above

017 South

Description: Sideflow weir, concrete with wood plank at top
Condition: Good
Estimated Construction Date: 1929 with potential modifications or updates since then

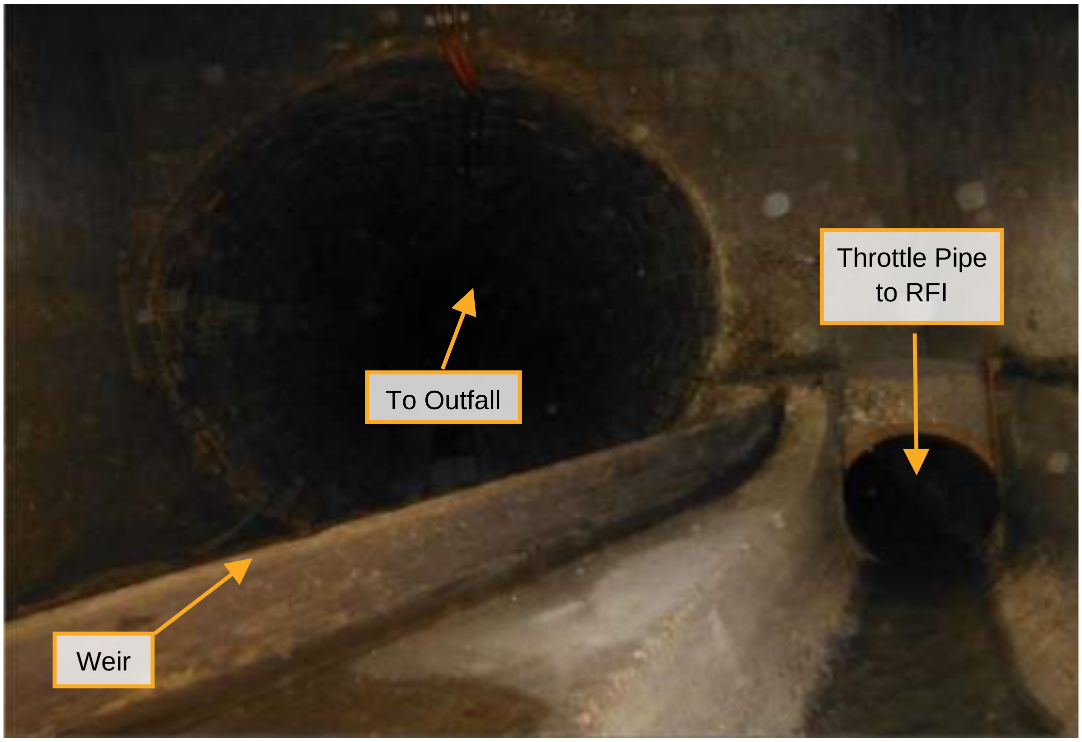


Figure 10 | South Regulator, Facing Downstream

Figure 11 | South Weir from Outfall Pipe, Facing Upstream Toward Regulator

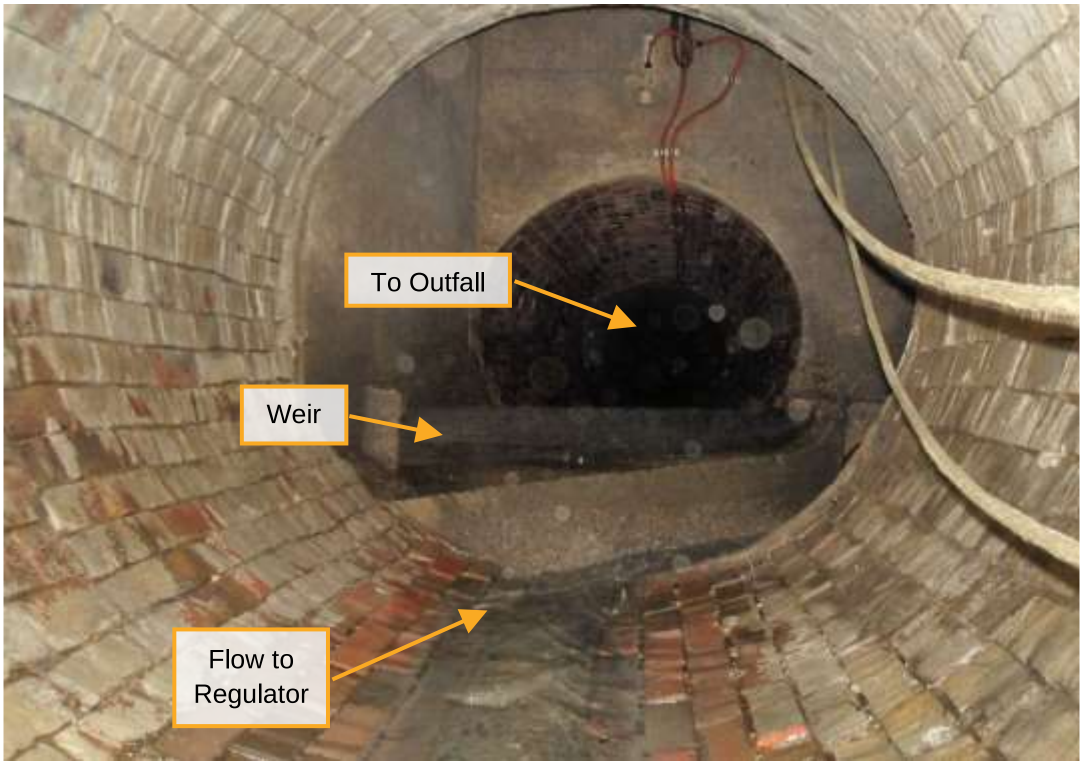


Figure 12 | South Regulator, Facing Downstream Toward Outfall

016 Cedar - Cedar Street

Description: Orifice with hydraulic restriction at outfall pipe invert downstream of orifice
Condition: Good
Estimated Construction Date: 1929 with modifications or updates since then

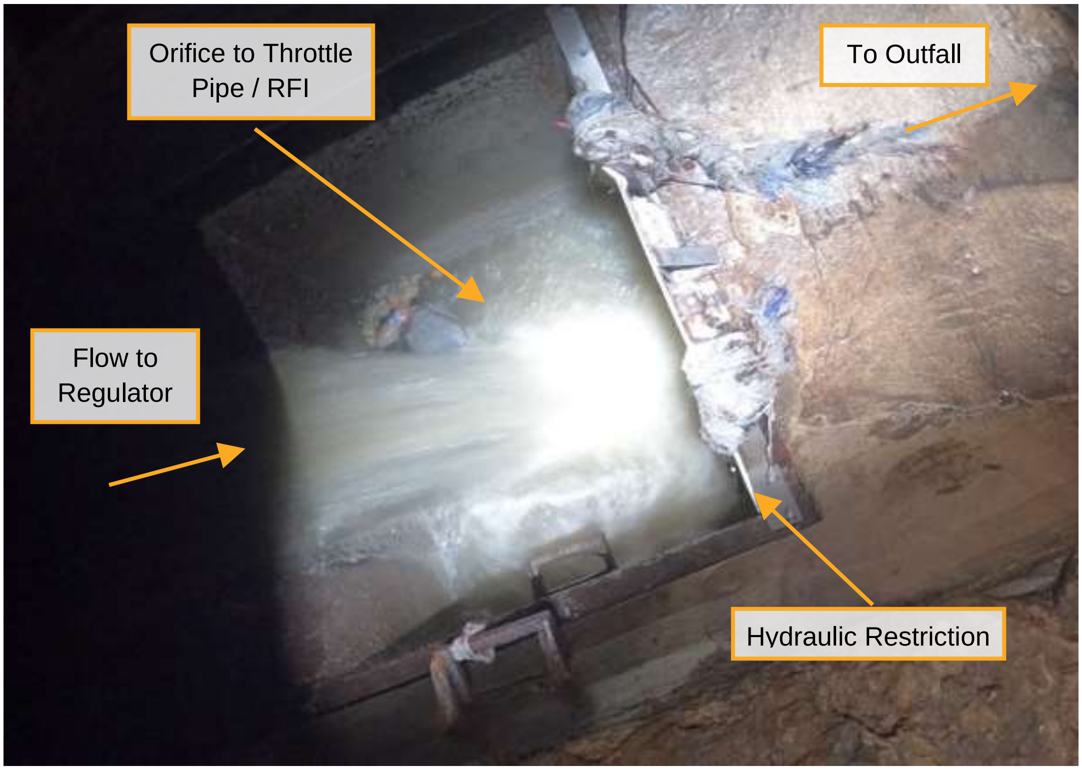


Figure 13 | Cedar Regulator, from Above

Figure 14 | Cedar Hydraulic Restriction from Outfall Pipe, Facing Upstream Toward Regulator

016 Cedar - Water Street

Description: Orifice with hydraulic restriction at outfall pipe invert downstream of orifice
Condition: Good
Estimated Construction Date: 1929 with modifications or updates since then

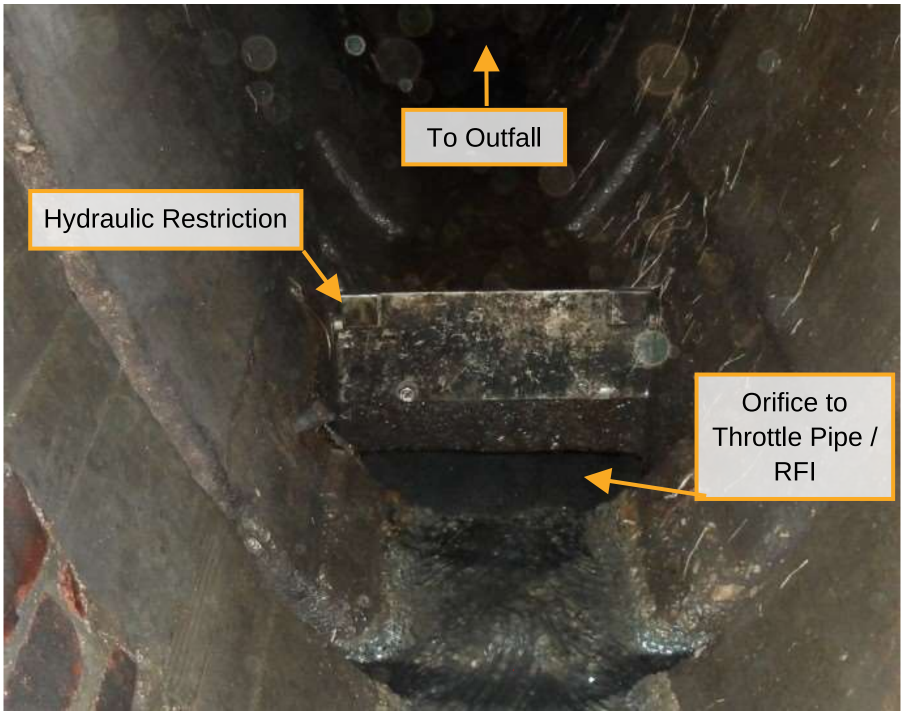


Figure 15 | Water Regulator, Facing Downstream Toward Outfall

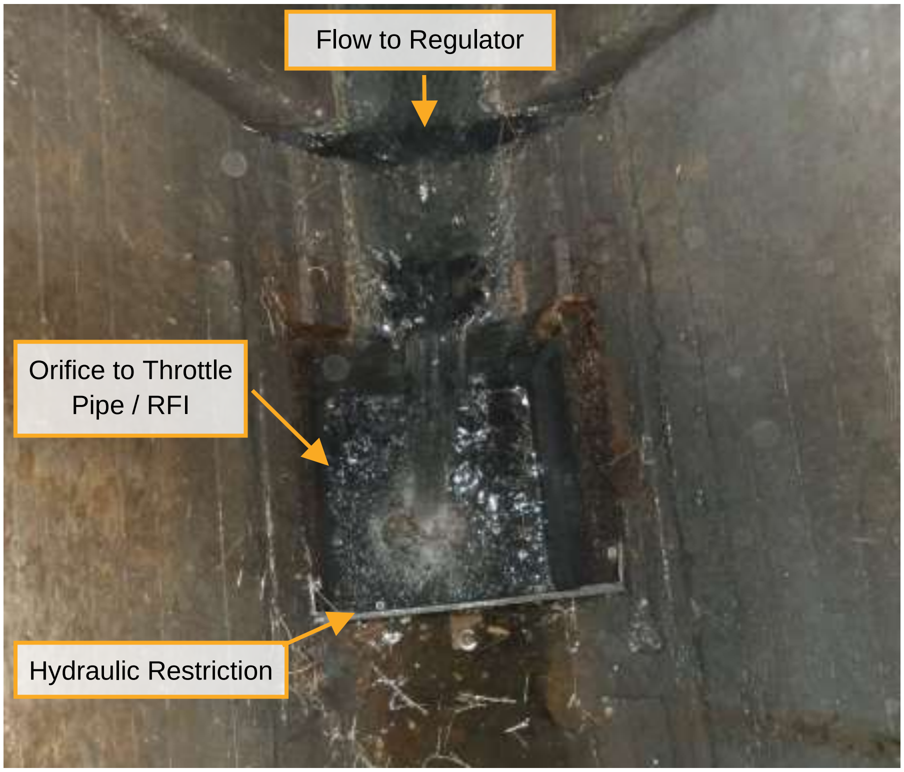


Figure 16 | Water Regulator, from Above

014 State

Description: Concrete transverse weir
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

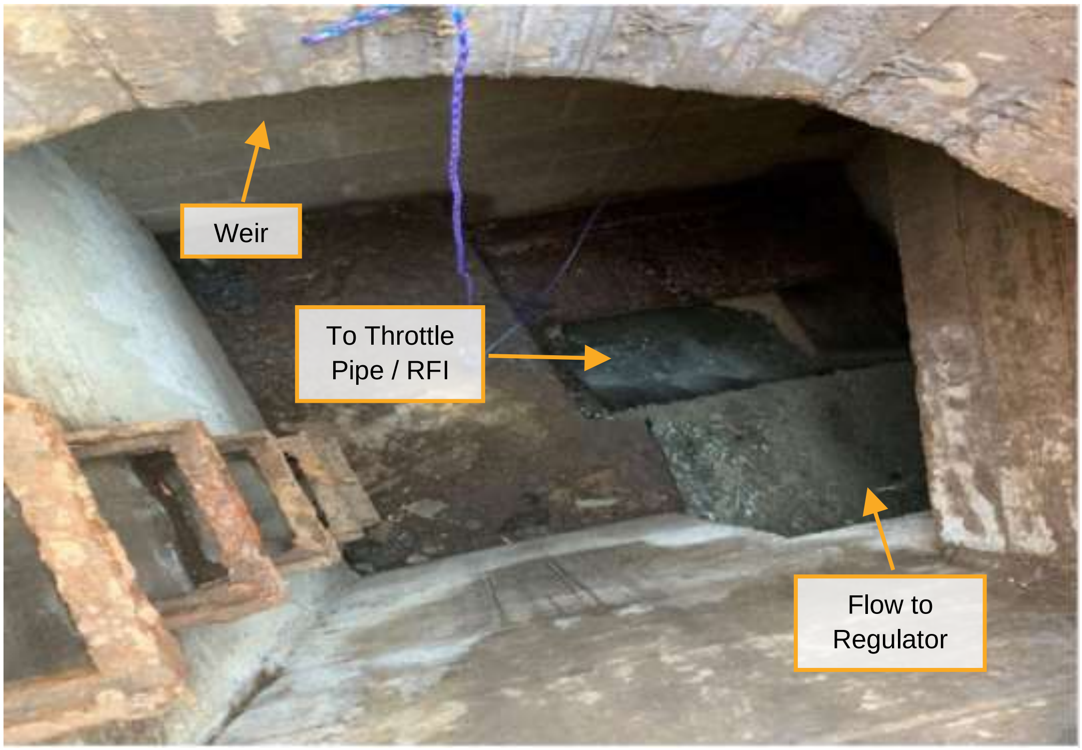


Figure 17 | State Regulator, from Above

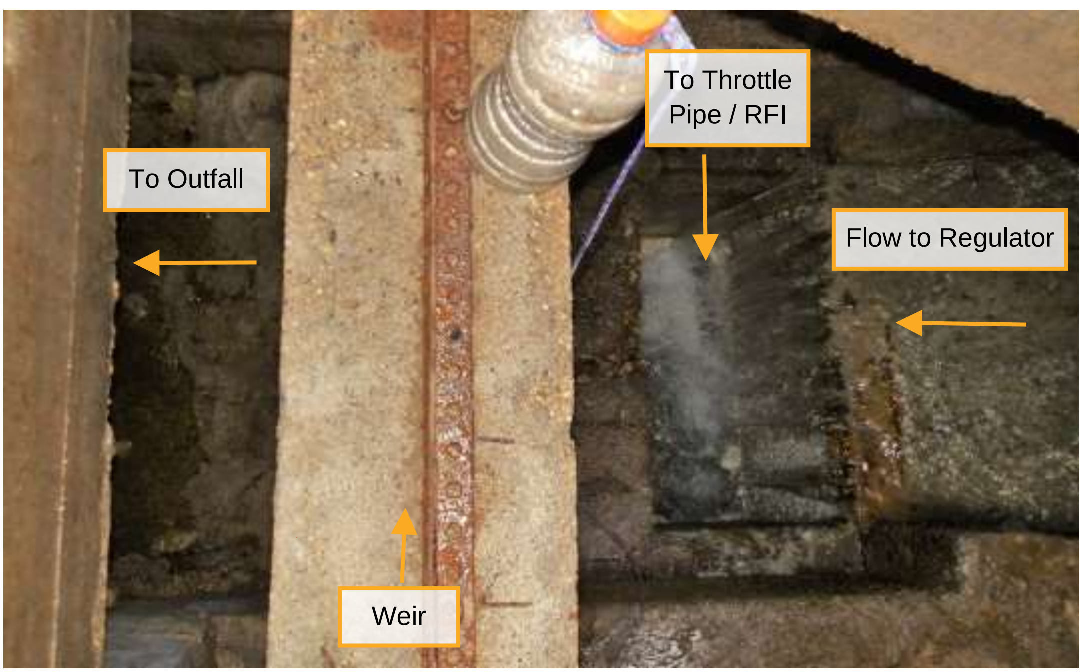


Figure 18 | State Regulator, from Above

013 Walnut

Description: Concrete transverse weir
Condition: Good
Estimated Construction Date: 1992 with potential modifications or updates since then

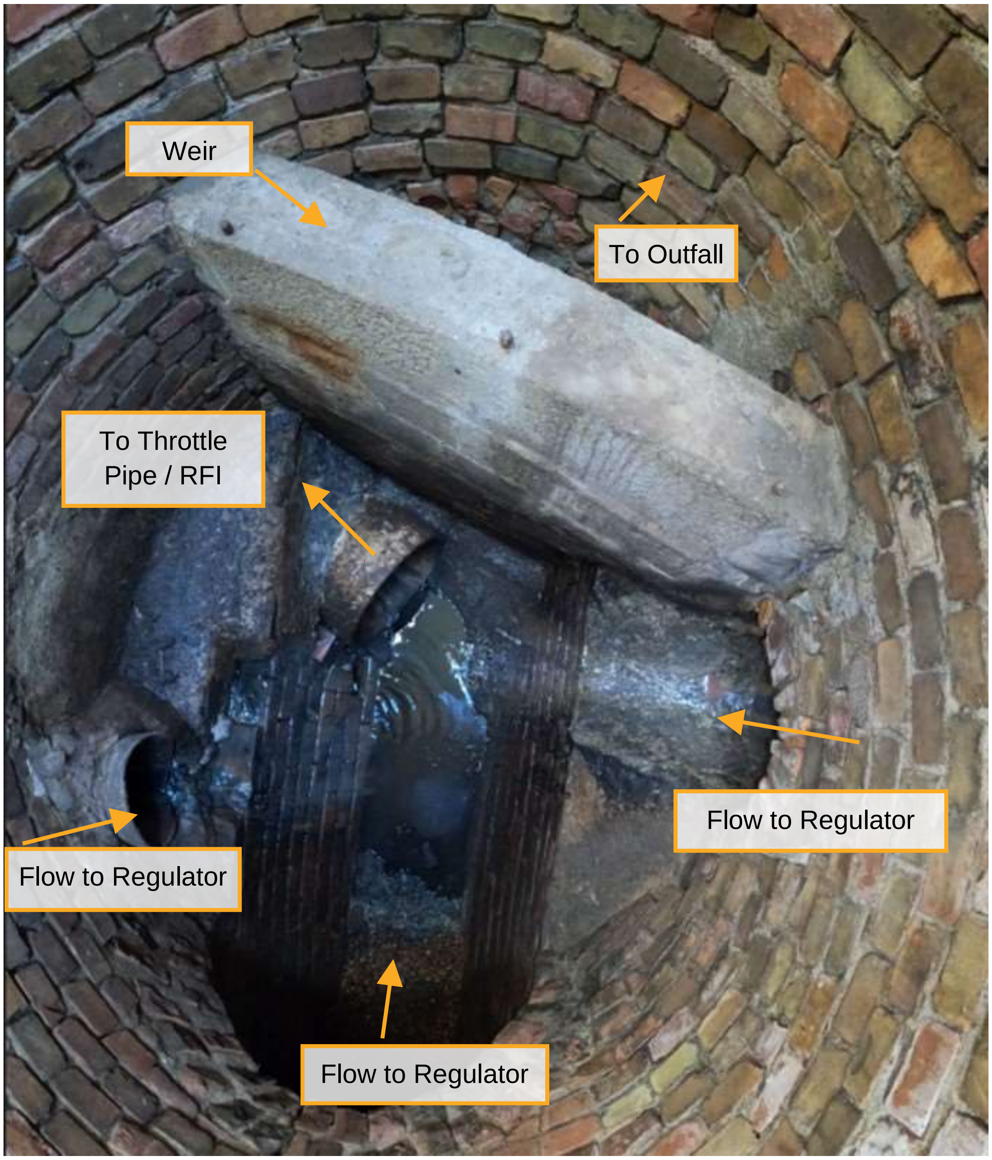


Figure 19 | Walnut Regulator, from Above

011 Harrison

Description: Concrete transverse weir
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

Figure 20 | Harrison Regulator, from Above

Figure 21 | Harrison Regulator, from Overflow Side of Weir

010 Liberty

Description: Concrete transverse weir
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

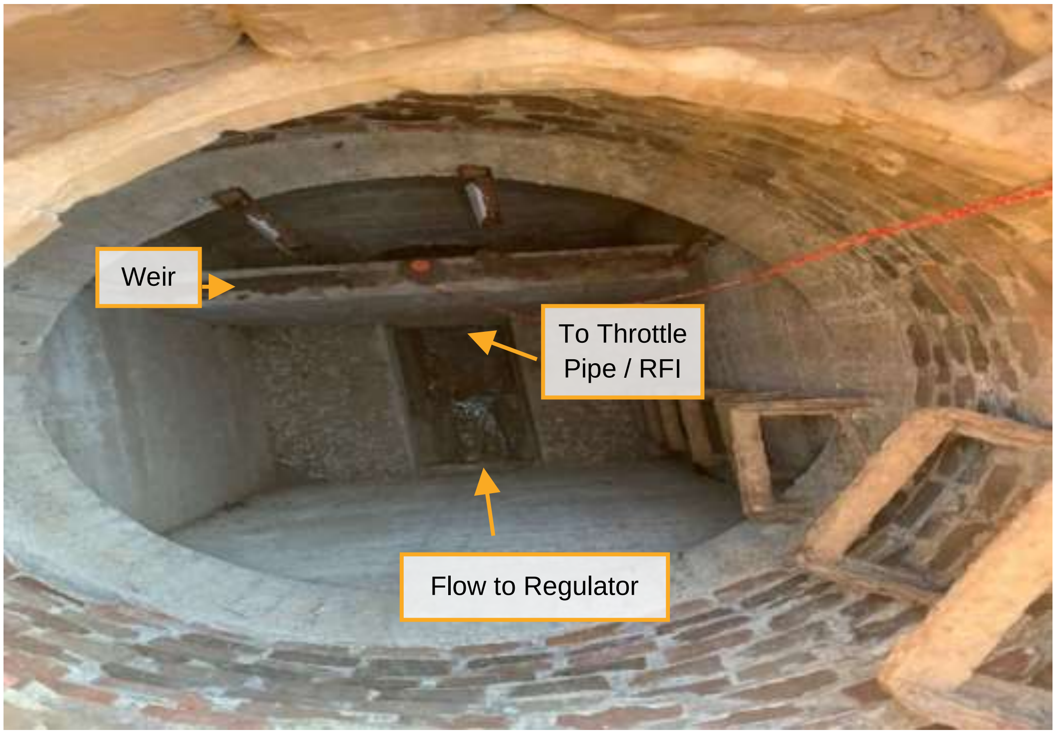


Figure 22 | Liberty Regulator, from Above

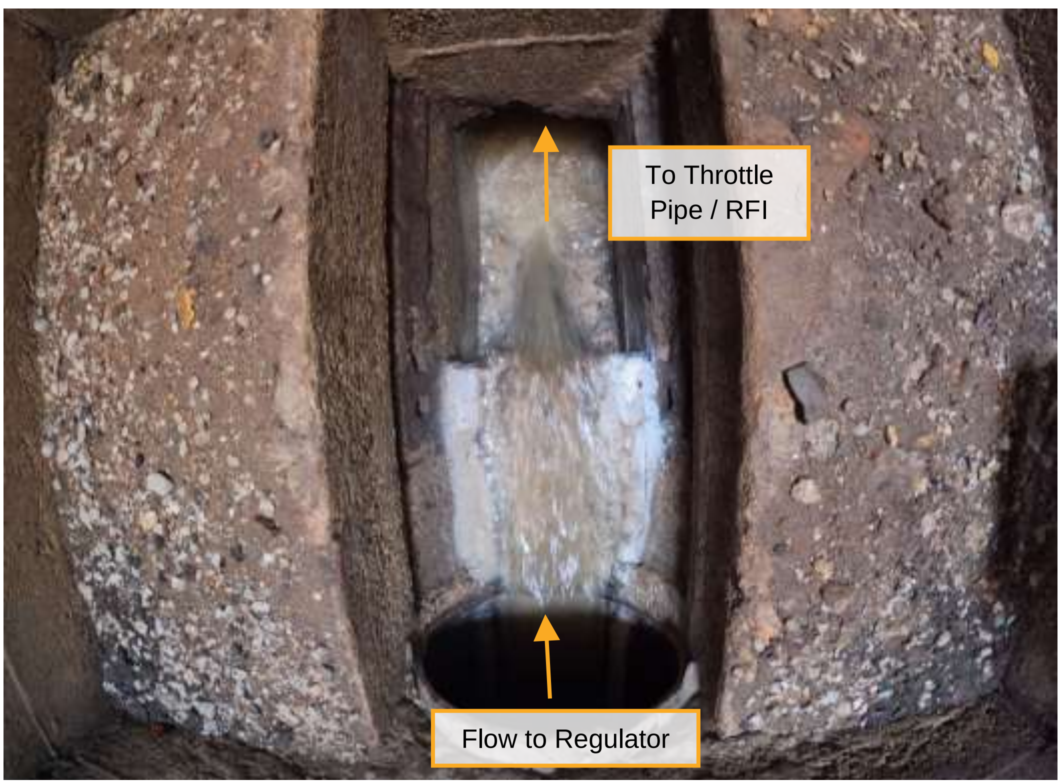


Figure 23 | Liberty Regulator, from Above

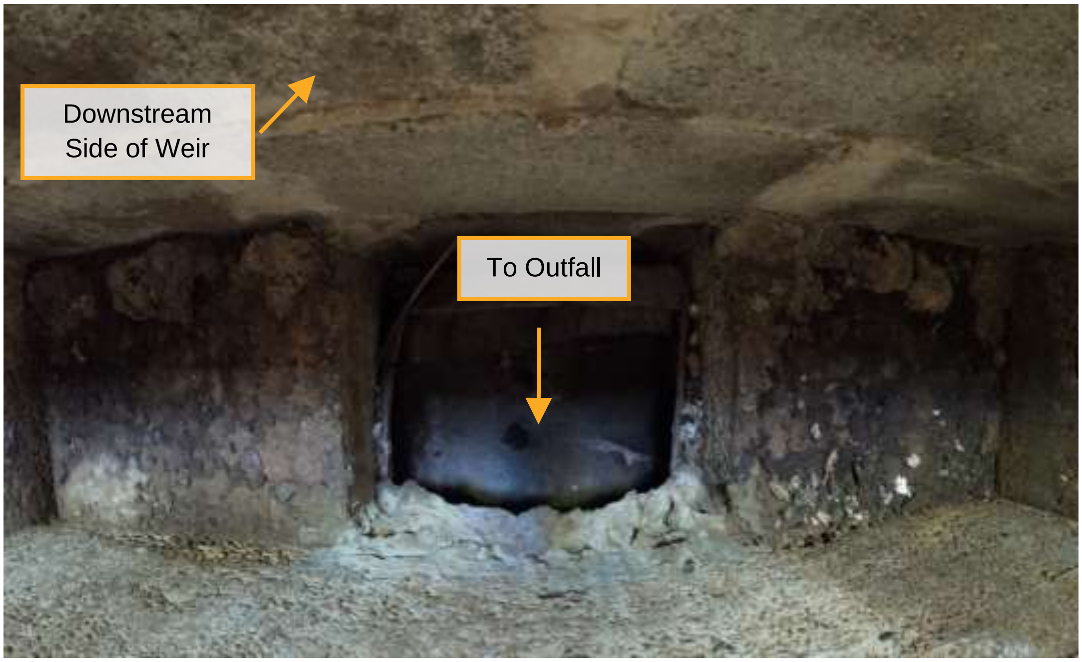


Figure 24 | Liberty Regulator, from Overflow Side of Weir

009 Fulton

Description: Transverse weir
Condition: Good
Estimated Construction Date: 1929 with potential modifications or updates since then

Figure 25 | Fulton Regulator, from Above

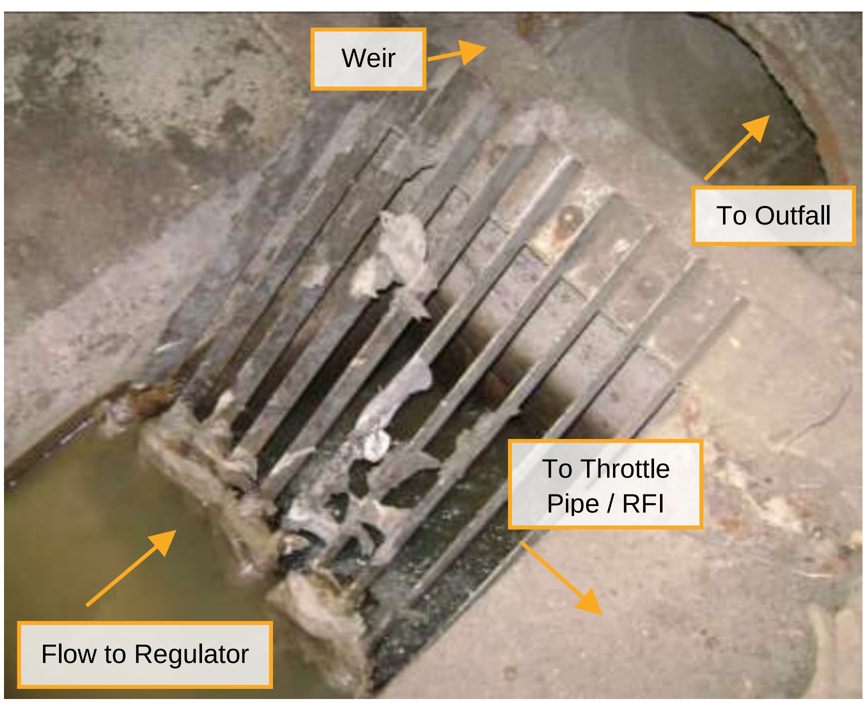


Figure 26 | Fulton Regulator, from Upstream to Downstream

020 Main

Description: Concrete sideflow weir
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

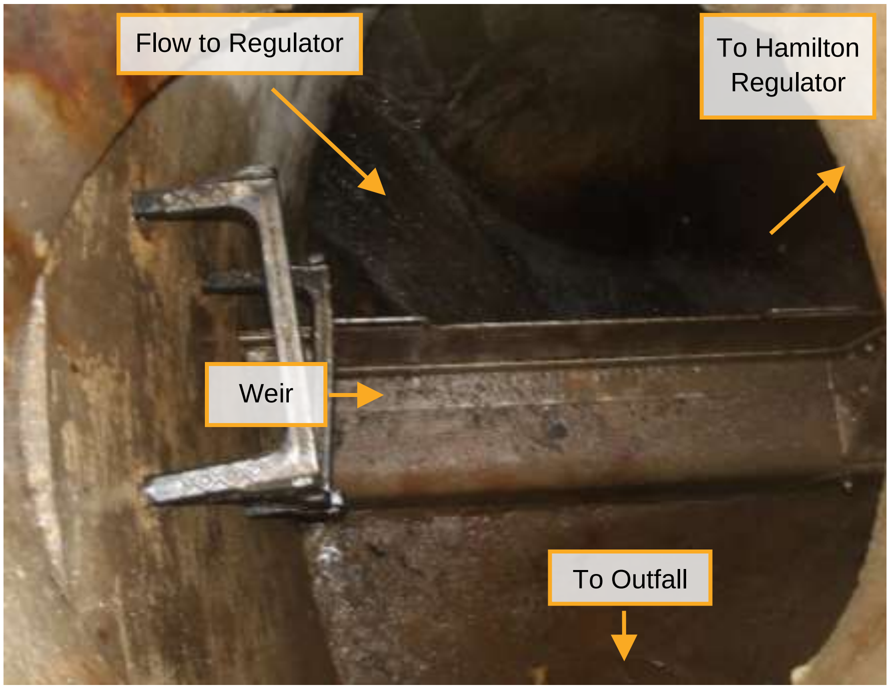


Figure 27 | Main Regulator, from Above

Figure 28 | Main Flow Path, from Above

008 Hamilton

Description: Offset pipe
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

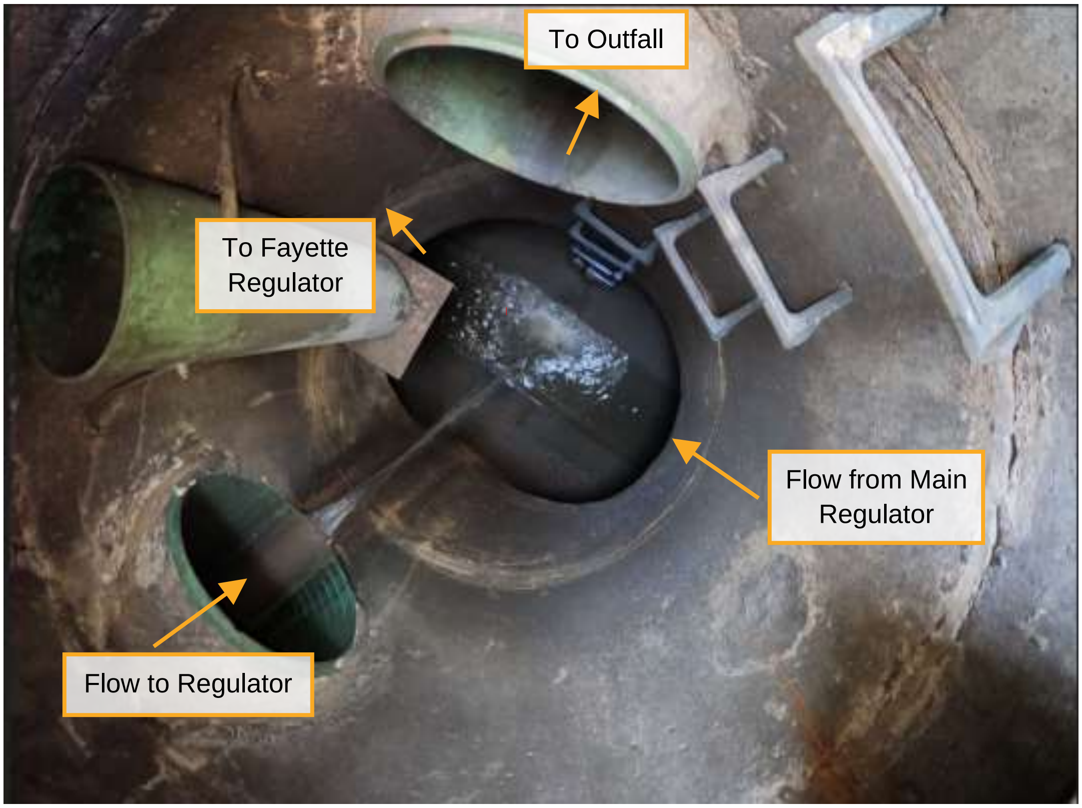


Figure 29 | Hamilton Regulator, from Above

007 Fayette Regulator

Description: Concrete sideflow weir
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

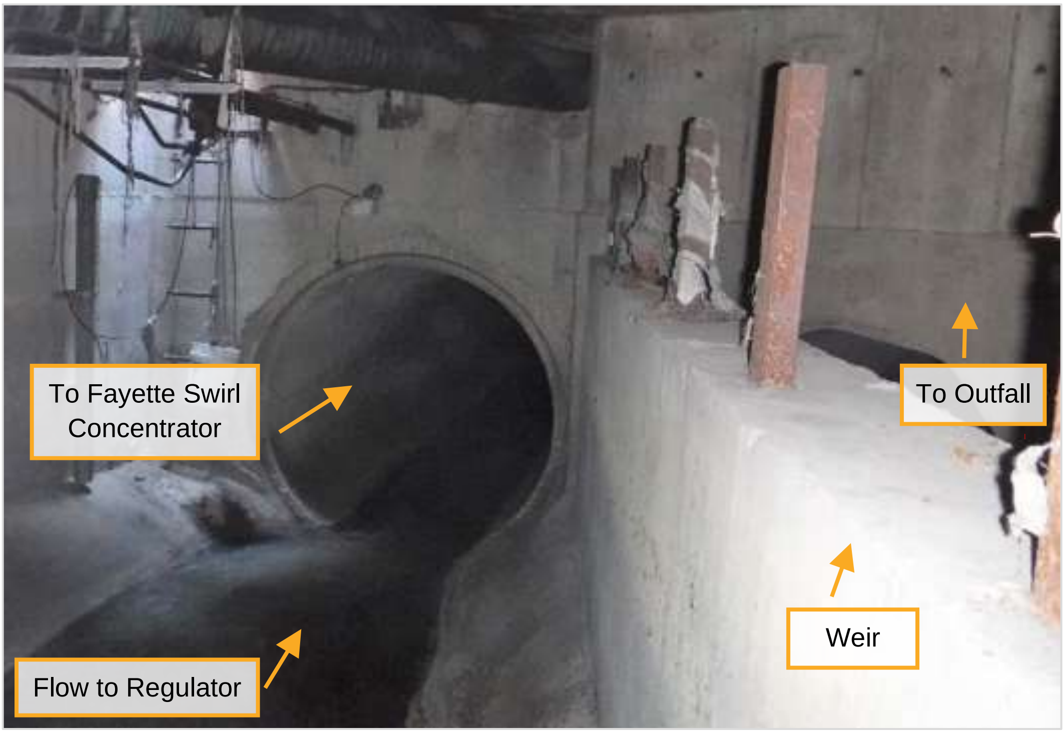


Figure 30 | Fayette Regulator, from Upstream Facing Downstream

Figure 31 | Fayette Regulator, from Overflow Side of Weir

007 Fayette Swirl Concentrator

Description: Swirl concentrator
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

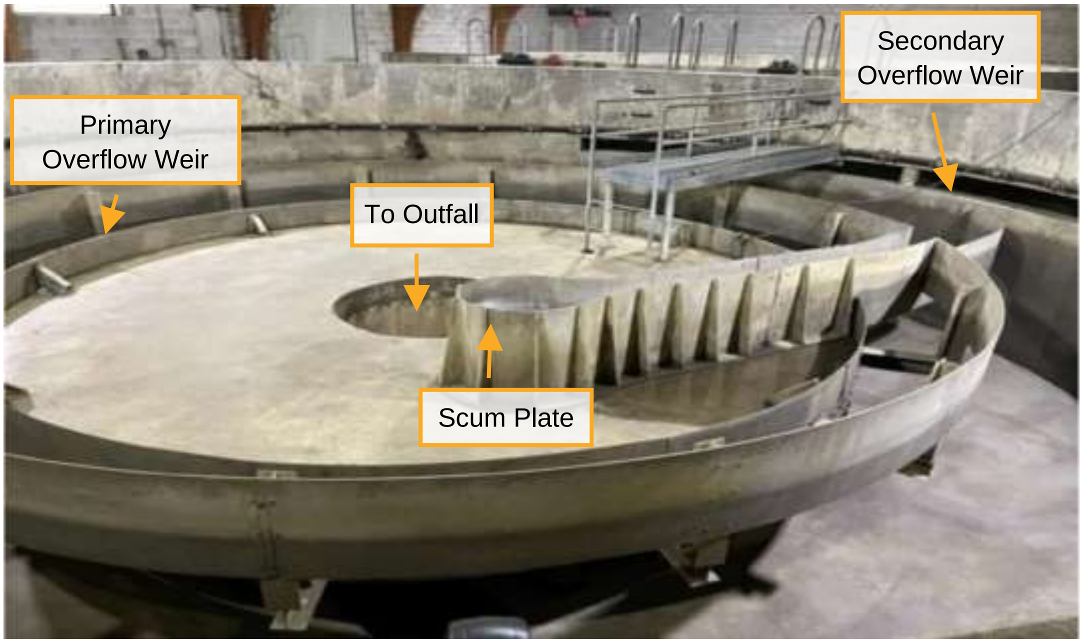


Figure 32 | Fayette Swirl Concentrator

Figure 33 | Fayette Swirl Concentrator Dry Weather Flow Channel

Figure 34 | Fayette Swirl Concentrator, from Above

006 Eaton Swirl Concentrator

Description: Swirl concentrator
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

Figure 35 | Eaton Swirl Concentrator, from Above During Active Overflow

Figure 36 | Eaton Swirl Concentrator, from Downstream Looking Upstream at Influent Pipe

Figure 37 | Eaton Swirl Concentrator, from Above

006 Eaton Regulator

Description: Concrete sideflow weir
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

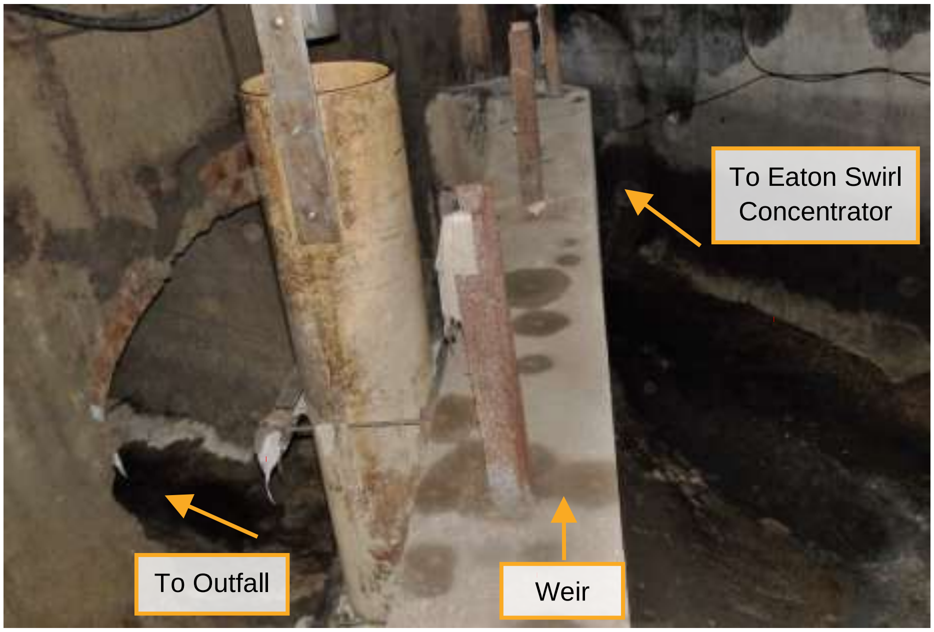


Figure 38 | Eaton Regulator, from Upstream Looking Downstream

Figure 39 | Eaton Regulator, from Above

001 Green

Description: Concrete sideflow weir
Condition: Good
Estimated Construction Date: 1993 with potential modifications or updates since then

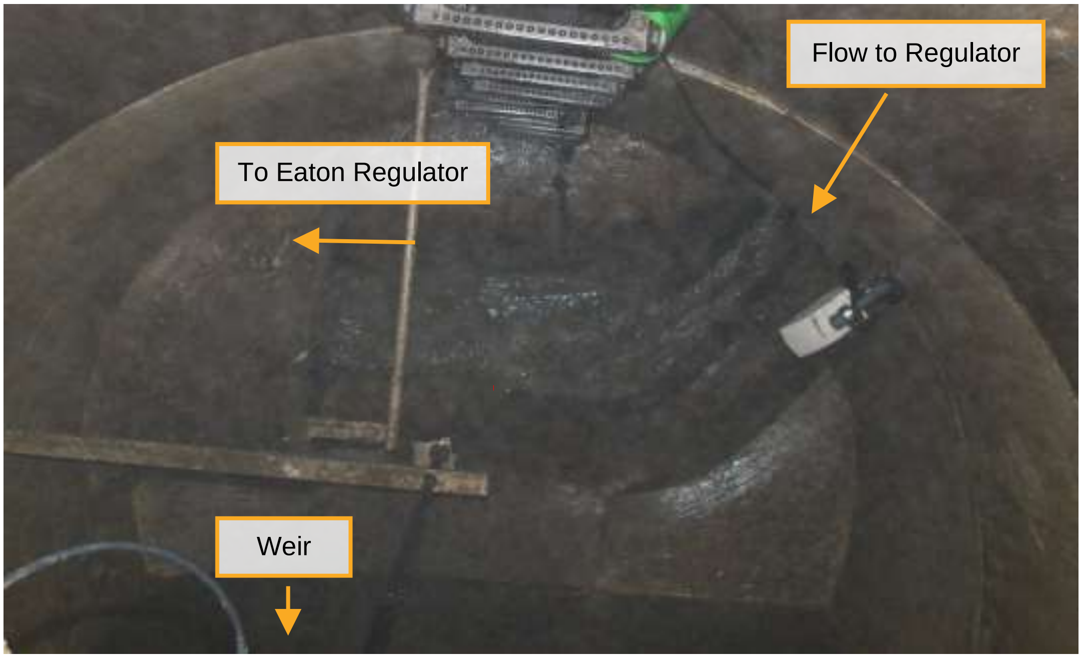


Figure 40 | Green Regulator, from Above

Figure 41 | Green Regulator, from Above Showing Outfall Pipe

003 Spring

Description: Double sided concrete weir
Condition: Good
Estimated Construction Date: 1991 with potential modifications or updates since then

Figure 42 | Spring Regulator, Influent Side of Structure

Figure 43 | Spring Regulator, Effluent Side of Structure

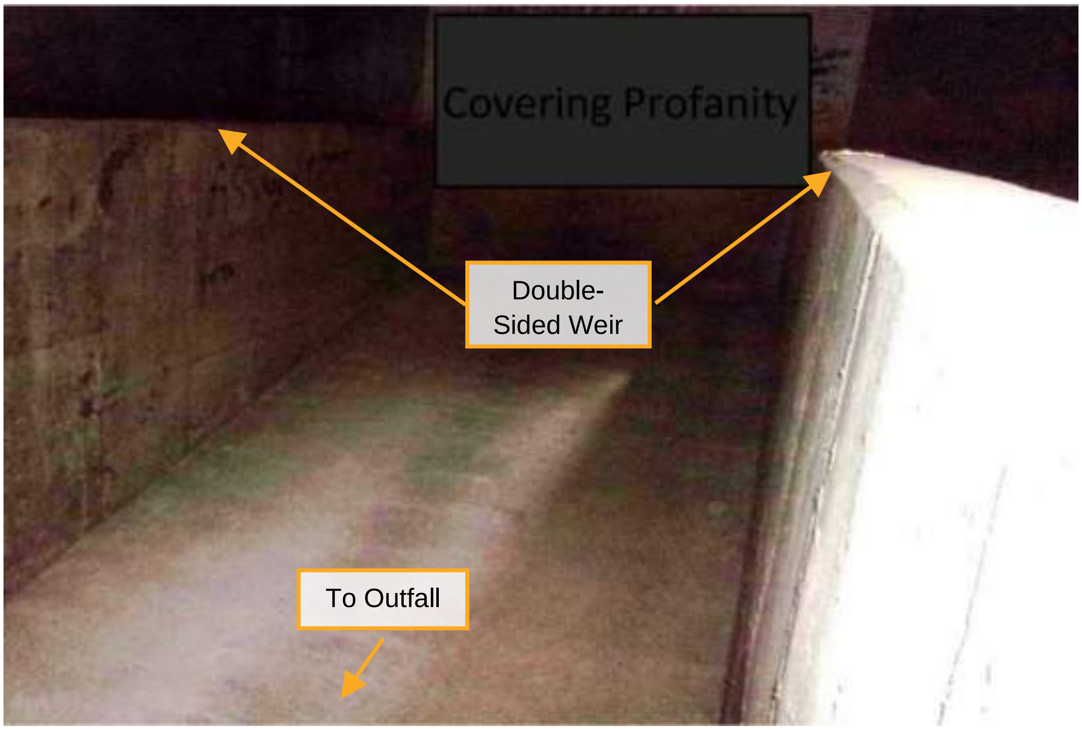


Figure 44 | Spring Regulator, from Overflow Side of Weir