APPENDIX B

Data Compiled for Use in Model Development

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Appendix B | Data Compiled for Use in Model Development

B.1 Background Data

Data in this study is summarized in **Table B-1**.

Table B-1 – Data Compiled for Use in Model Development

Item Requested	City Contact Person	Date Received	Comments	Status
GIS Base Map Data				
Contours	Donna Phillips	5/2/2012	Received entire City extents from Donna from Kootenai County as a Hi-Rez DEM	Complete
Vertical DEM	Donna Phillips	5/2/2012	Received entire City extents from Donna from Kootenai County as a Hi-Rez DEM	Complete
Parcels	Donna Phillips	1/17/2012	Downloaded from Kootenai County website.	Complete
City Limits	Donna Phillips	4/27/2012	Delivered by Sean Hoisington on CD.	Complete
City Impact Area	Donna Phillips	4/27/2012	Delivered by Sean Hoisington on CD.	Complete
Imagery	Donna Phillips	4/27/2012		Complete
New Connections	Donna Phillips	9/03/2019	Received from Donna Phillips via e-mail.	Complete
Sewer Craze	Donna Phillips	2/03/2020	Received from Donna Phillips via e-mail.	Complete
Hayden FLU Redevelopment	Donna Phillips	04/21/2020	Received from Donna Philips via e-mail	Complete
Roads	Donna Phillips	04/21/2020	Received from Donna Philips via e-mail	Complete
Treatment Plant Flows				
HARSB Influent Flow	Ken Windram	5/26/2012	30+ day wet/dry weather period 2010-2012. Data will be used for understanding of the wet to dry weather peaking factor for the entire system.	Complete
HARSB Influent Flow	Ken Windram	5/26/2012	For periods consistent with Flow monitor data (April 2012). Data will be used for an additional calibration point during flow monitoring activities.	Complete

Item Requested	City Contact Person	Date Received	Comments	Status
Lift Station Flows				
H-1, H1-D, H-2, H-4, H-5	Ken Windram	12/3/2019	December 2016 – December 2019 daily pump meter readings off SCADA. This data will be used in correlation with flow monitoring data for complete basin understanding.	Complete
H-1, H1-D, H-2, H-4, H-5	Ken Windram	12/3/2019	2012 – 2019 daily pump meter readings off SCADA. This data will be used in correlation with flow monitoring data for complete basin understanding.	Complete
Hayden	Ken Windram	12/3/2019	2012 – 2019 daily pump meter readings off SCADA. This data will be used in correlation with flow monitoring data for complete basin understanding.	Complete
H-1, H1-D, H-2, H-4, H-5, Hayden, Moonridge, Dakota, Emerald Oaks, Riley Place, Leisure Park, Empire, Cornerstone, Woodland Meadows	Ken Windram	12/3/2019	May 8 – 22 pump meter readings off SCADA. This data will be used in correlation with flow monitoring data for complete basin understanding.	Complete
Collection System Record Drawings				
Ethan's Place	Donna Phillips	8/01/2019	8/17 Record Drawings .pdf	Complete
Hayden Grove 1st Addition	Donna Phillips	8/01/2019	10/17/17 Record Drawings .pdf	Complete
Harmony House IV	Donna Phillips	8/01/2019	12/6/16 Record Drawings .pdf	Complete
Maple Grove	Donna Phillips	8/01/2019	1/23/17 Record Drawings .pdf	Complete
Giovanni Estates	Donna Phillips	8/05/2019	5/17 Record Drawings .pdf	Complete
Hayden North Phase 1 & 2	Donna Phillips	8/05/2019	1/25/18 Record Drawings .pdf	Complete
Hayden North Phase 3 & 4	Donna Phillips	8/05/2019	11/2/18 Record Drawings .pdf	Complete
Lookout Drive (Findley Duplexes)	Donna Phillips	8/05/2019	11/26/17 Record Drawings .pdf	Complete

Item Requested	City Contact Person	Date Received	Comments	Status
Maple Grove Lift Station	Donna Phillips	8/05/2019	9/11/18 Record Drawings .pdf	Complete
Villas at Hayden North	Donna Phillips	8/05/2019	9/19/18 Record Drawings .pdf	Complete
Warren K 7th Addition	Donna Phillips	8/05/2019	8/10/17 Record Drawings .pdf	Complete
Barrington Reserve	Donna Phillips	8/26/2019	8/23/19 Record Drawings .pdf	Complete
Carrington Meadows Force Main	Ken Windram	9/25/2019	9/23/19 Record Drawings .pdf	Complete
Carrington Meadows Lift Station	Donna Phillips	10/16/2019	9/23/19 Record Drawings .pdf	Complete
Carrington Meadows Phase 1	Donna Phillips	10/16/2019	9/23/19 Record Drawings .pdf	Complete
Bear Creek	Donna Phillips	1/28/2020	7/8/05 Record Drawings .pdf	Complete
Dakota Grove	Donna Phillips	2/3/2020	10/18/18 Record Drawings .pdf	Complete
Giovanni Estates	Donna Phillips	2/3/2020	9/12/17 As-Built Drawings .pdf	Complete
Wyoming Estates	Donna Phillips	7/6/2020	9/25/19 As-Built Drawings .pdf	Complete
Coeur D'Alene Airport	Donna Phillips	8/12/2020	9/2005 Record Drawings .pdf	Complete
Dakota Force Main	Ken Windram	8/12/2020	9/11/2015 Record Drawings .pdf	Complete

Other Data

Item Requested	City Contact Person	Date Received	Comments	Status
Development Plans & Preliminary Plats for Development in the Study Area	Alan Soderling		The Ramsey Road alignment used in the model are from the Hayden Transportation Plan. CIP Projects were coordinated with Hayden Transportation Plan for priority.	Complete
Lift Station Projected Maintenance Costs	Dan Messier	6/30/2020	Received from Dan Messier via email.	Complete

B.2 Collection System Flow Monitoring

B.2.1 General

The six sites that were selected to conduct flow monitoring in 2012 and 2019 are listed in **Table B-2** and are shown in Figure A in **Appendix A**. **Table B-3** summarizes flow monitoring activity at the sites. The purpose for flow monitoring was to collect data to be used for model calibration purposes and potentially supplementing inflow information depending on weather conditions.

Table B-2 – Summary of 2012 & 2019 Flow Monitoring Sites

Location	Site Number	Basin	Nominal Pipe Diameter
Reed Rd. South of Lacey Ave.	101	Reed Road/H-2	10”
Reed Rd. North of Honeysuckle Ave.	102	Reed Road/H-2	12”
Honeysuckle Ave. West of Davis (WalMart Signal)	103	Reed Road/H-2	12”
Government Way South of Dakota Ave.	501	H-1	10”
Honeysuckle Ave. East of Huntington Ct.	502	H-1	12”
Northwest of H-1 Lift Station	503	H-1	12”

Table B-3 – Flow Monitoring Activity (All Sites)

Site	Date Range	Acceptable Level Data?	Acceptable Velocity Data?	Date of Manual Measurement	Shift in Depth Measurement
101	4/4/12 – 4/18/12	Yes	Yes	4/18/12	0.480 in.
	5/8/19 – 5/28/19	Yes	Yes	5/8/19	0.0 in.
102	4/4/12 – 4/18/12	Yes	Yes	4/18/12	-0.621 in.
103	4/4/12 – 4/18/12	Yes	Yes	4/18/12	-0.282 in.
501	4/18/12 – 5/10/12	Yes	Yes	5/10/12	0.208 in.
502	4/18/12 – 4/27/12	Yes	No	4/27/12	0.157 in.
	4/27/12 – 5/10/12	Yes	Yes	5/10/12	-0.084 in
503	4/18/12 – 5/10/12	Yes	Yes	5/10/12	0.246 in.

B.2.2 Flow Monitoring Equipment and Process

American Sigma flow monitors were used for the 2012 study and an ADS Triton Plus flow monitor was used for the 2019 study. Flow monitoring sites are selected based on location, access, and uniformity of flow through the manhole. Flow monitor installation required measurement of horizontal and vertical pipe diameters and then use of size-specific steel bands for the sewer pipe to be monitored.

The steel bands support a submerged transducer setup, in which the band supports one area-velocity (AV) sensor mounted at the pipe invert to measure both depth and velocity. Bands are placed in the manhole’s upstream pipe far enough to be in the near-uniform flow condition before flow enters the manhole.

After installation, flow depth was manually checked, and the flow monitor was calibrated to depth. Flow monitors were set to automatically record both level and velocity at 5-minute intervals. Flow is calculated by the monitor based on the level and velocity measurements in conjunction with user-programmed pipe geometry information. Data was periodically downloaded from the monitors and processed in the office. Prior to removing the monitors and sensors, flow depth was again manually measured to provide additional calibration. This manual measurement was compared to the monitor reading and a shift was applied if the values differed. This shift is referred to as a “delta” value. Figures in this section represent shifted data.

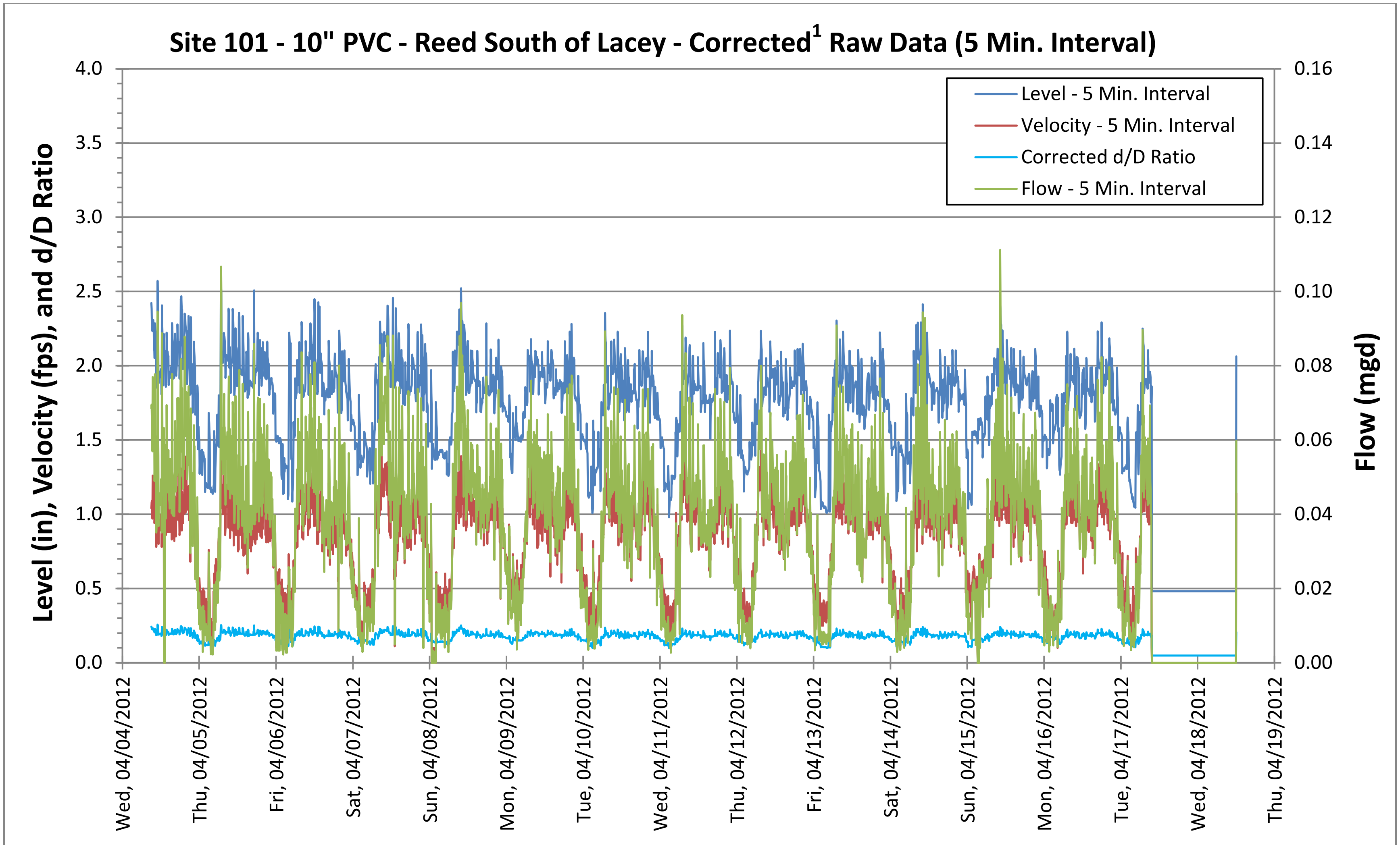
The equipment configurations for each site are summarized in subsequent sections, which also include a recommendation regarding the acceptability of the data.

Precipitation data was collected from published data from the Coeur d’Alene, Idaho airport.

B.2.3 Site 101 – Reed Road South of Lacey Avenue (H-2 Basin)

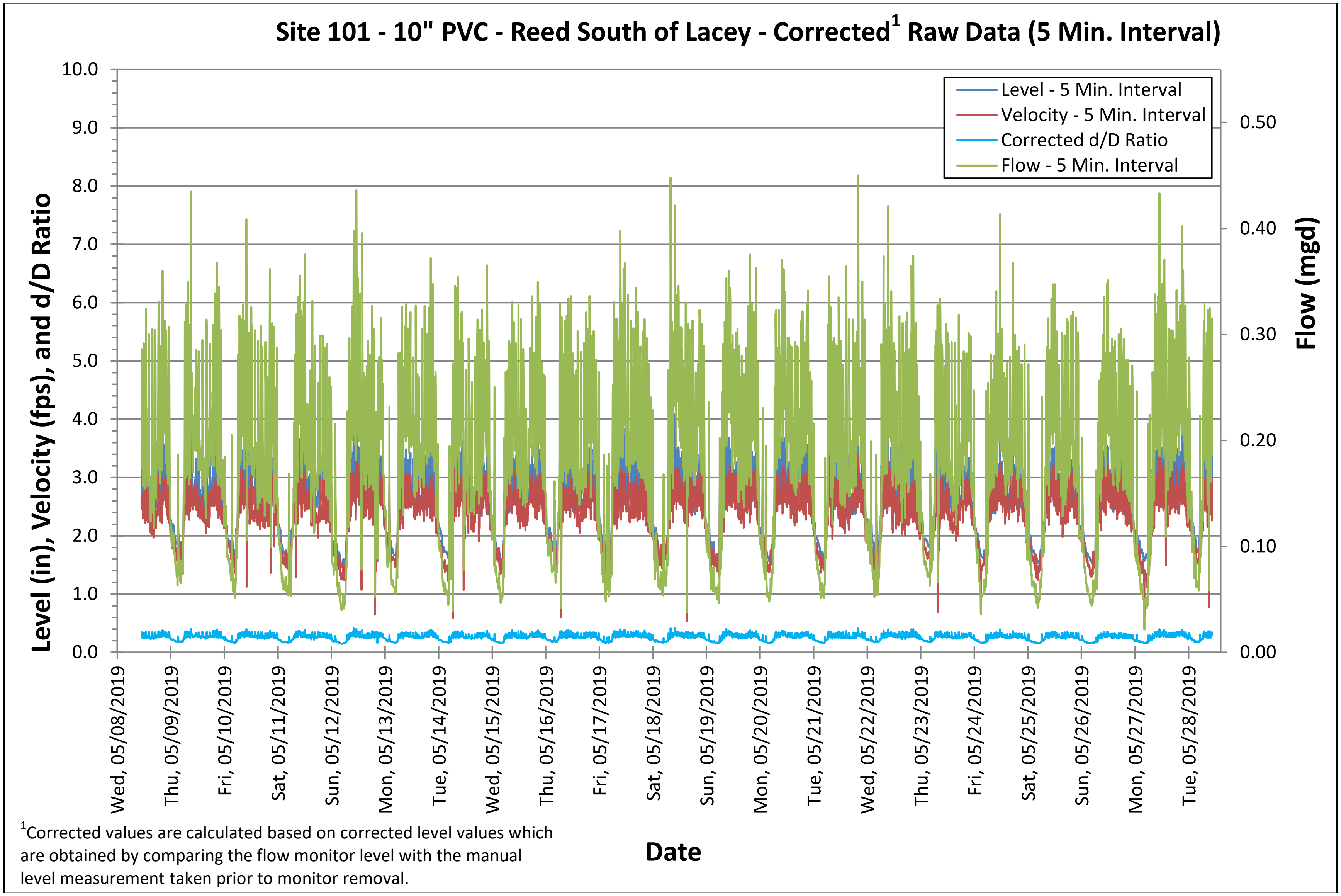
Site 101 was located at the second manhole south of the intersection of Reed Road and Lacey Avenue. The manhole is in the northbound travel lane. **Figure B-1** shows the 2012 graphical results for this site. Site 101 had acceptable level and velocity data for the majority of the 2012 monitoring effort. Readings stopped after a battery exchange on April 17, 2012 but came online again right before monitor removal on April 18, 2012. **Figure B-2** shows the 2019 graphical results for this site. Site 101 had acceptable level and velocity data for the entirety of the 2019 monitoring effort.

Figure B-1 – Corrected 2012 Raw Data for Site 101 (H-2 Basin)



[1]Corrected values are calculated based on corrected level values which are obtained by comparing the flow monitor level with the manual level measurement taken prior to monitor removal.

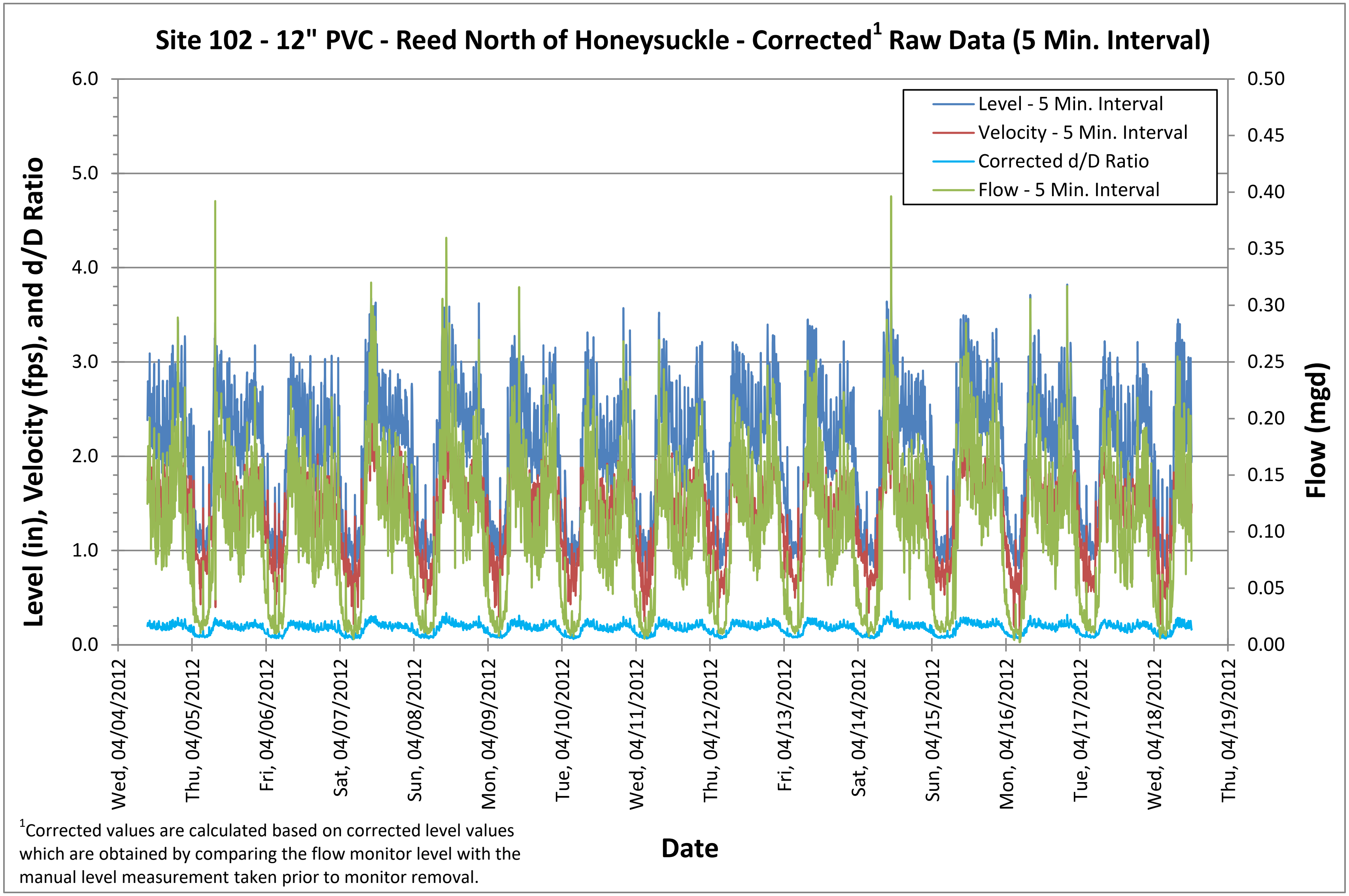
Figure B-2 – Corrected 2019 Raw Data for Site 101 (H-2 Basin)



B.2.4 Site 102 – Reed Road North of Honeysuckle Avenue (H-2 Basin)

Site 102 was located at the first manhole north of the intersection of Honeysuckle Avenue and Reed Road. The manhole is in the northbound travel lane. **Figure B-3** shows graphical results for this site. Site 102 had acceptable level and velocity data for the duration of the monitoring effort.

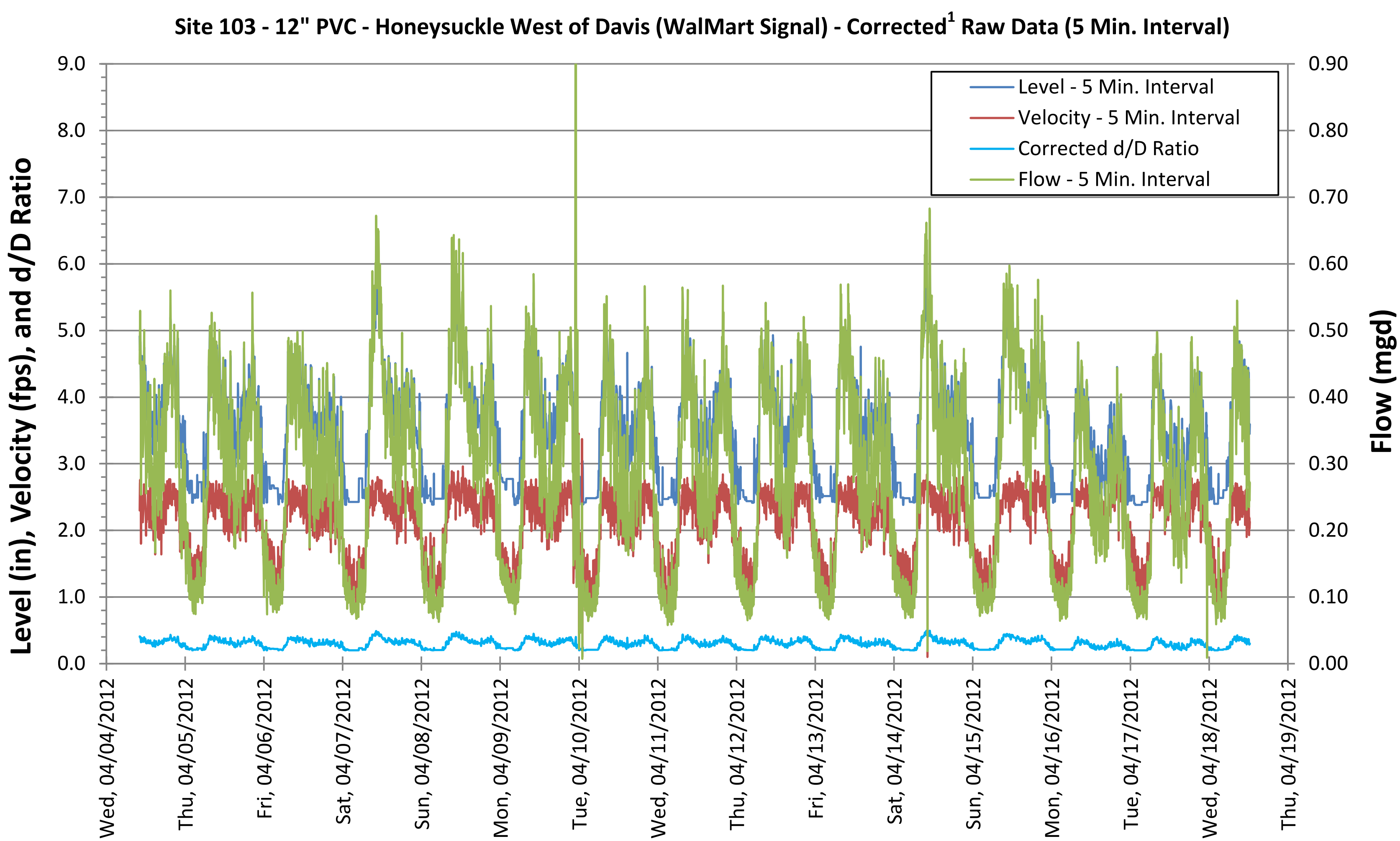
Figure B-3 – Corrected Raw Data for Site 102 (H-2 Basin)



B.2.5 Site 103 – Honeysuckle Avenue West of Davis Circle (H-2 Basin)

Site 103 was located at the manhole in Honeysuckle Avenue west of Davis Circle. The manhole is located in the eastbound left turn lane. **Figure B-4** shows graphical results for this site. Site 103 had acceptable level and velocity data for the majority of the monitoring effort. Generally, level readings were not recorded during low flow periods (typically midnight to 6:00 a.m.), which saw levels drop below the minimum recordable level of the probe. During data analysis, level values were interpolated for times with missing data.

Figure B-4 – Corrected Raw Data for Site 103 (H-2 Basin)

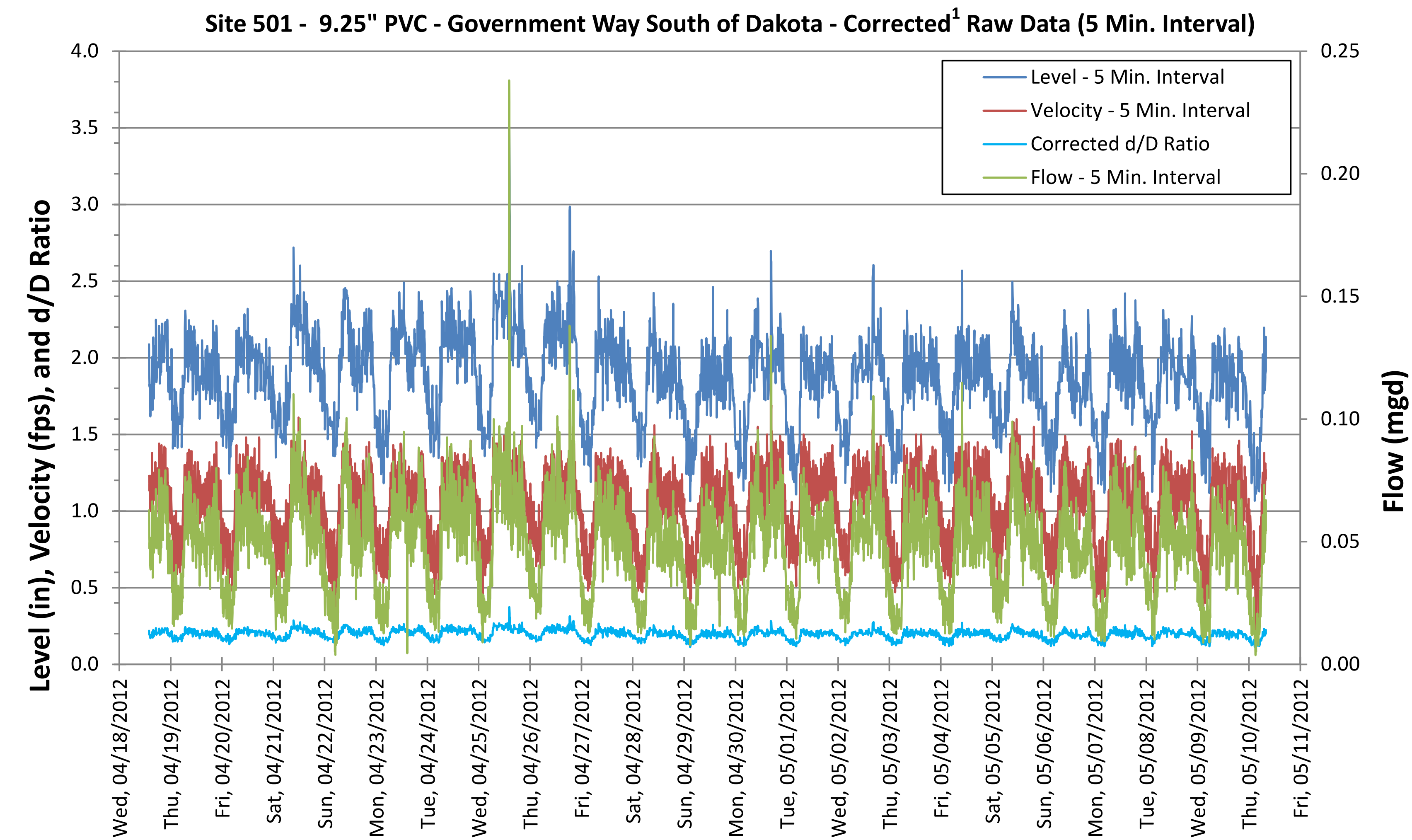


[1]Corrected values are calculated based on corrected level values which are obtained by comparing the flow monitor level with the manual level measurement taken prior to monitor removal.

B.2.6 Site 501 – Government Way South of Dakota Avenue (H-1 Basin)

Site 501 was located at the first manhole south of Dakota Avenue in Government Way. The manhole is located in the center turn lane. **Figure B-5** shows graphical results for this site. Site 501 had acceptable level and velocity data for the duration of the monitoring effort.

Figure B-5 – Corrected Raw Data for Site 501 (H-1 Basin)

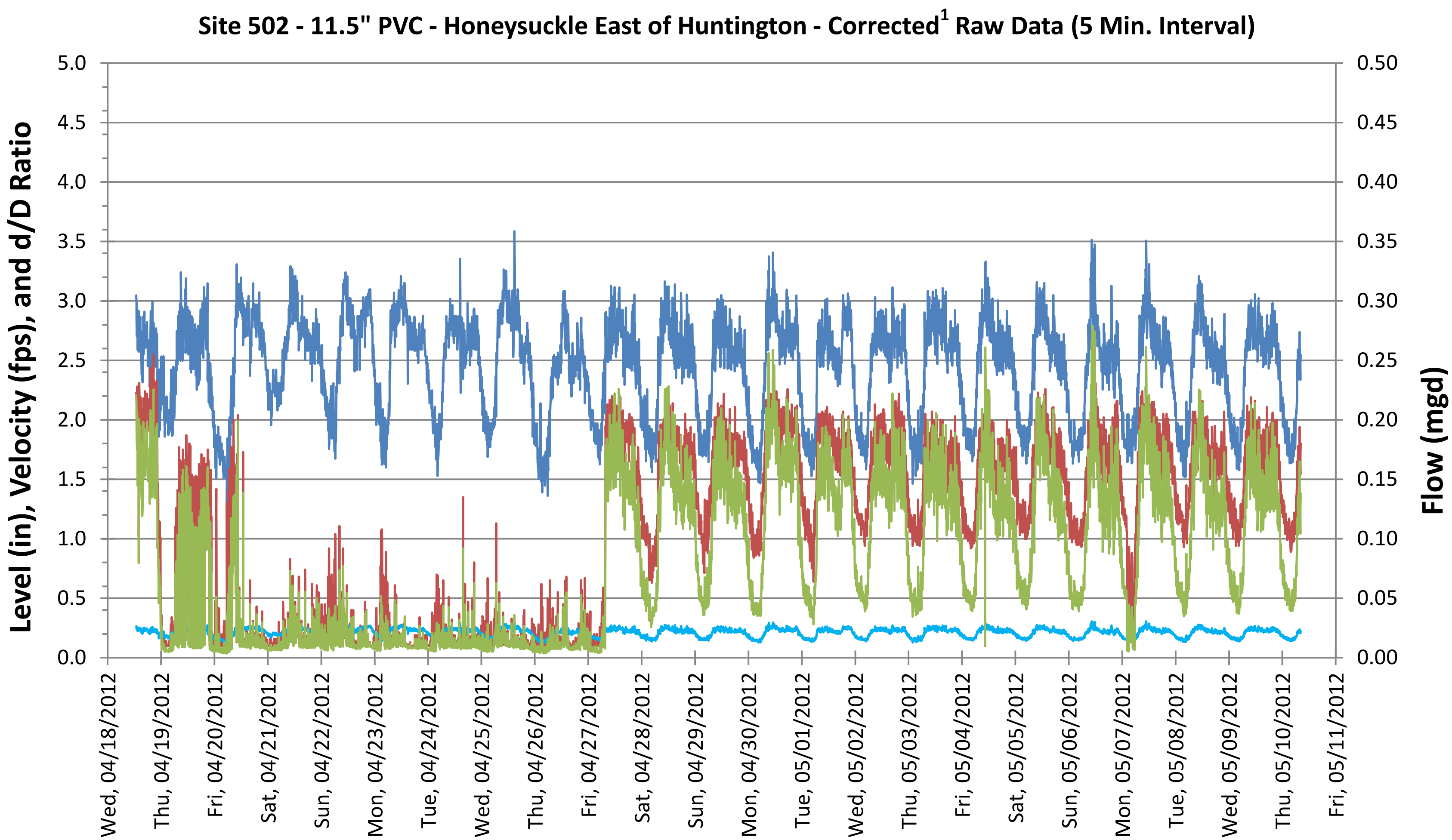


[1]Corrected values are calculated based on corrected level values which are obtained by comparing the flow monitor level with the manual level measurement taken prior to monitor removal.

B.2.7 Site 502 – Honeysuckle Avenue East of Huntington Court (H-1 Basin)

Site 502 was located at the first manhole east of Huntington Court in Honeysuckle Avenue. The manhole is located near the road centerline. **Figure B-6** shows graphical results for this site. Site 502 had acceptable level data for the duration of the monitoring effort. Velocity data for this site is acceptable starting April 27, 2012. Poor velocity data prior to this time can be attributed to the probe "ragging-up" shortly after monitor installation on April 18, 2012.

Figure B-6 – Corrected Raw Data for Site 502 (H-1 Basin)

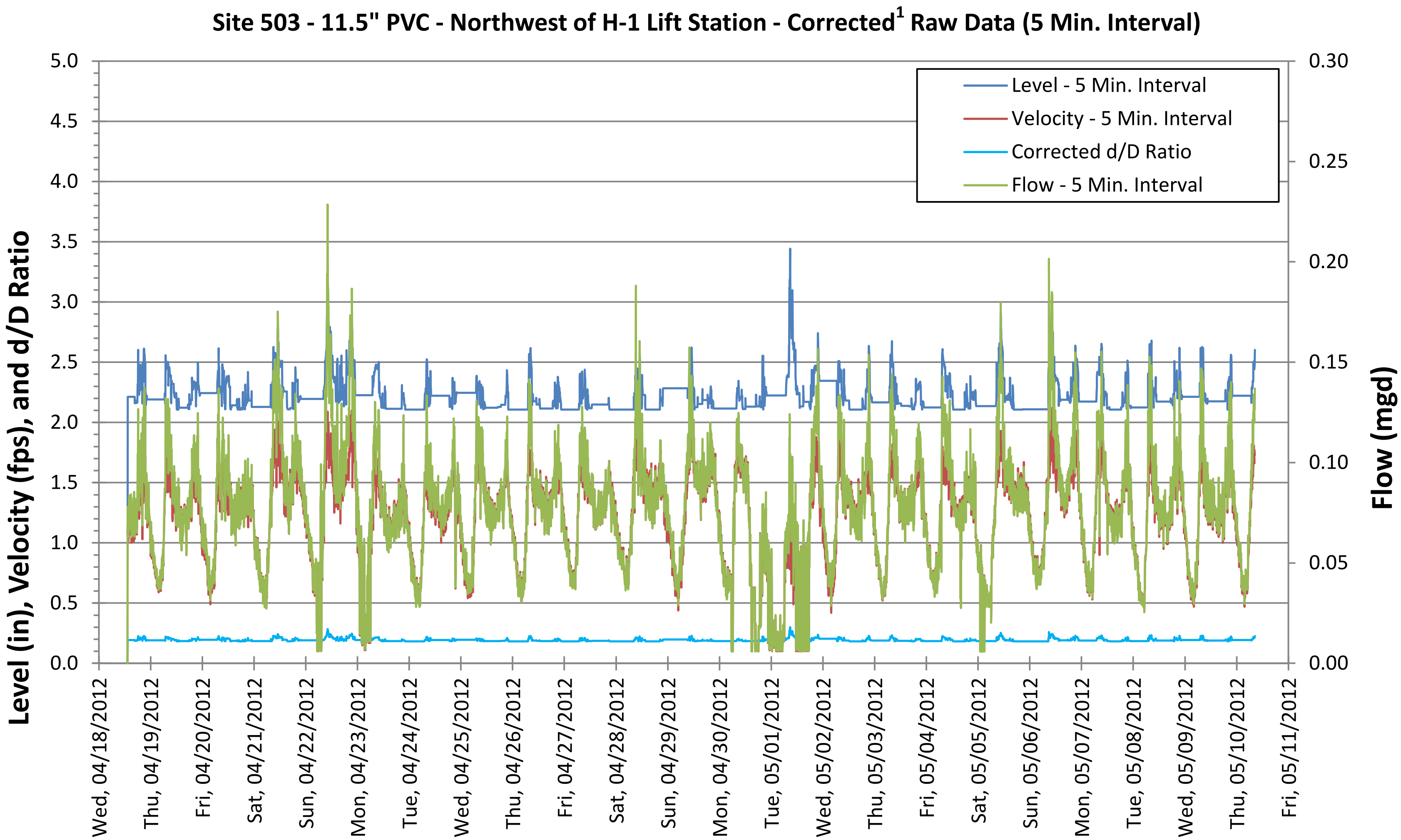


[1]Corrected values are calculated based on corrected level values which are obtained by comparing the flow monitor level with the manual level measurement taken prior to monitor removal.

B.2.8 Site 503 – Northwest of H-1 Lift Station (H-1 Basin)

Site 503 was located at the manhole northwest of H-1 lift station and southeast of Strahorn Road. The manhole is connected to the existing H-1 overflow basins west of the lift station. **Figure B-7** shows graphical results for this site. Site 503 had acceptable level and velocity data for the majority of the monitoring effort. Generally, level readings were not recorded during low flow periods (typically early morning), which saw levels drop below the minimum recordable level of the probe. During data analysis, level values were interpolated for times with missing data.

Figure B-7 – Corrected Raw Data for Site 503 (H-1 Basin)



[1]Corrected values are calculated based on corrected level values which are obtained by comparing the flow monitor level with the manual level measurement taken prior to monitor removal.

B.3 Lift Station Flow Data for Wet Weather Analysis

B.3.1 General

Flow meter and SCADA data were obtained from the Hayden Area Regional Sewer Board (HARSB) for the H-1, H-1D, H-2, H-4, H-5, and Dakota lift stations from 2012 to 2019. Precipitation data was also collected from published data from the Coeur d'Alene, Idaho airport from 2017 to 2019. Precipitation and lift station flow data was used to determine wet weather flows and peaking factors for individual sewer basins. These peaking factors were used to generate an infiltration value, which was used in the model to create wet weather flow scenarios. Reference **Appendix E – Model Calibration** for further description of how lift station data was used in the calibration process.

B.3.2 Data Collection and Process

Flow meter data was recorded on a daily basis by HARSB staff for all stations. Flow was calculated from flow meter data by calculating the difference between daily readings.

Flows from both data collection methods were plotted with precipitation data for all lift stations. The flow values establish a baseline flow value for each lift station. This same data also shows peaks when output is increased due to precipitation events, allowing for the calculation of a wet weather peaking factor. By inputting infiltration and inflow (I/I) into the model on a gallons per acre served per day basis, the model yields a wet weather flow to simulate peak conditions data. By comparing the dry weather and wet weather results from the model, a model peaking factor is established. Note that wet weather flows do not affect the shape of the diurnal curve; they simply increase the magnitude of flow, so the curve shifts "up". **Figure B-8** through **Figure B-13** show graphical results for each site. **Figure B-14** shows precipitation data.

Figure B-8 – Flows for H-1 Lift Station

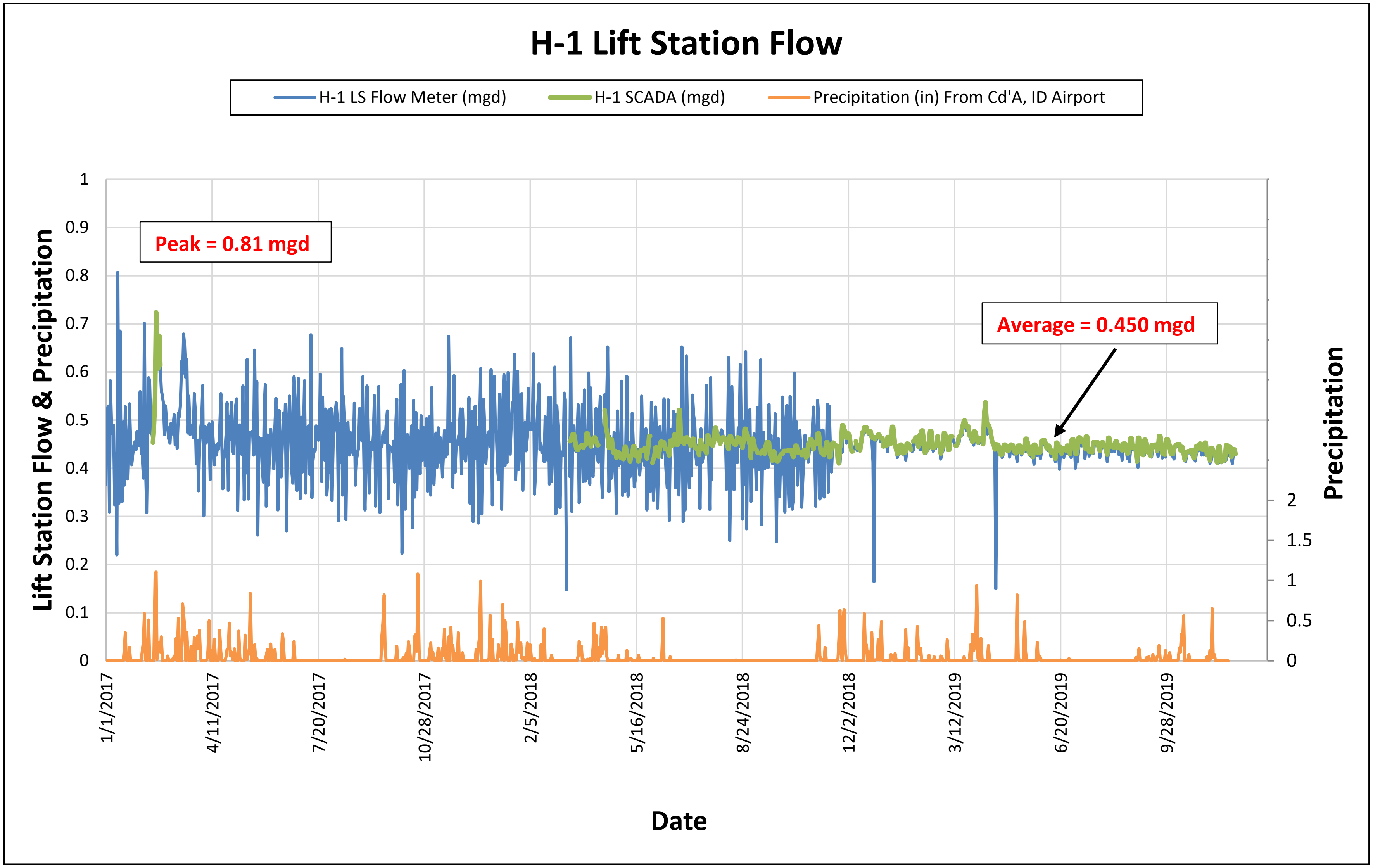


Figure B-9 – Flows for H-1D Lift Station

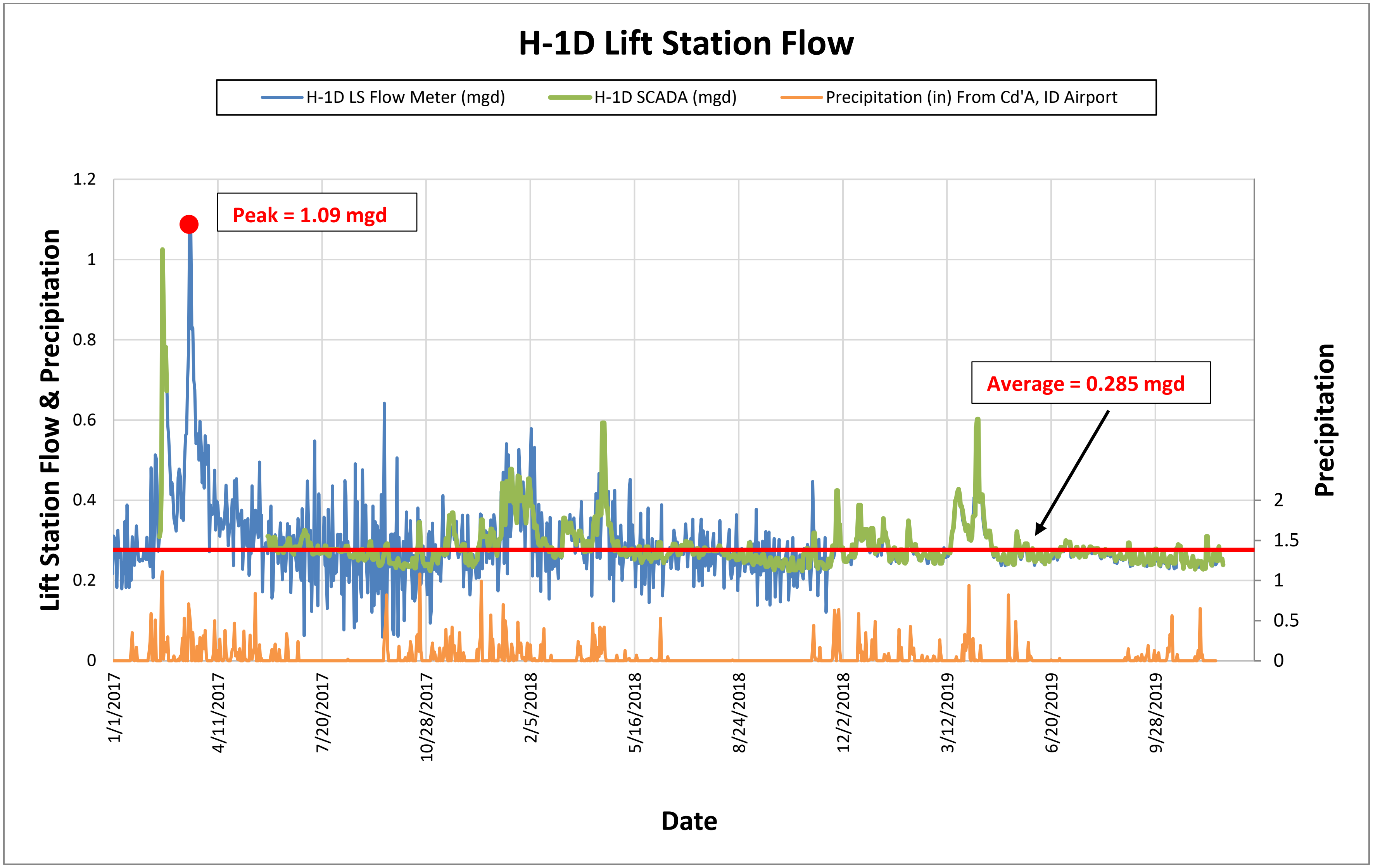


Figure B-10 – Flows for H-2 Lift Station

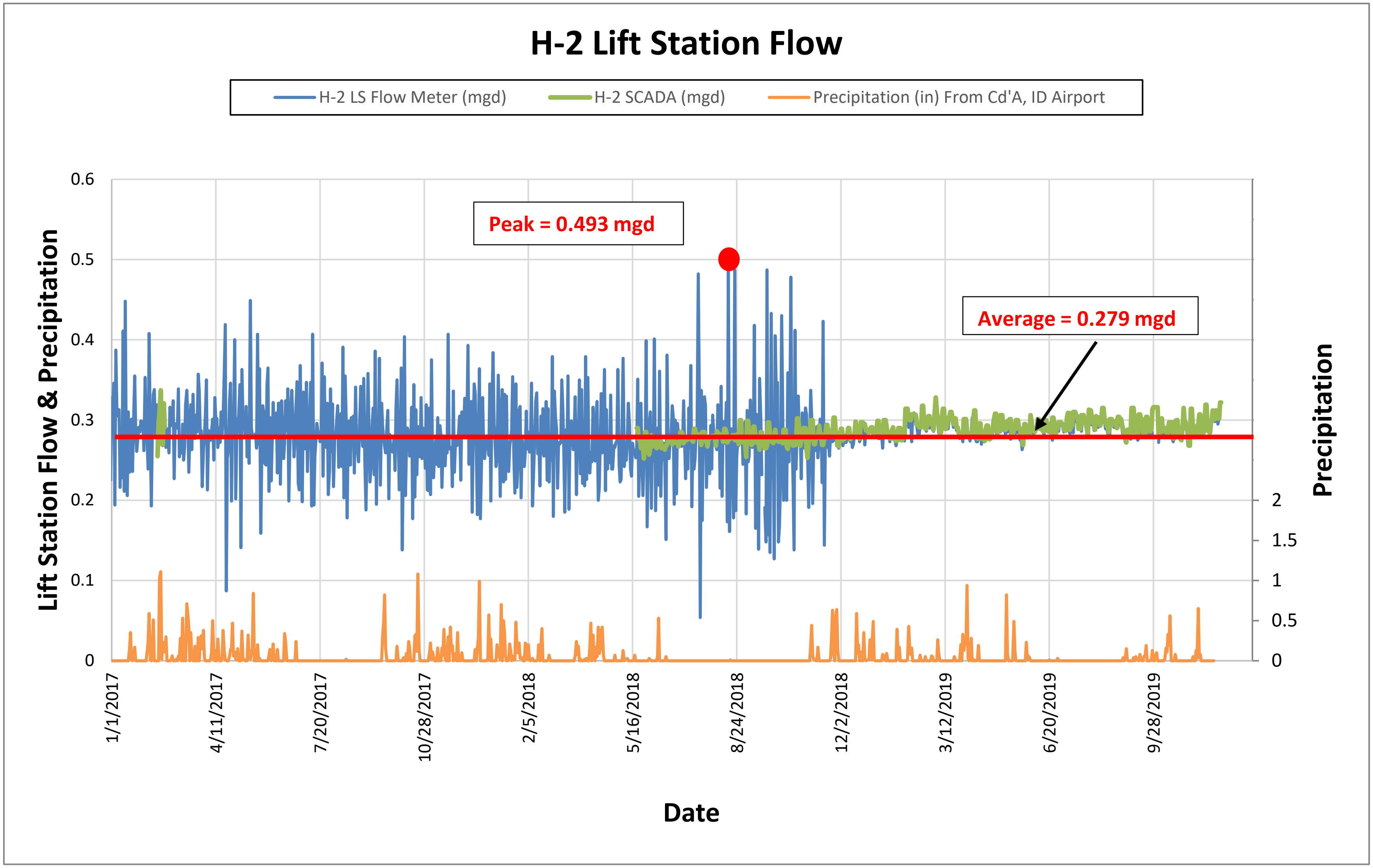


Figure B-11 – Flows for H-4 Lift Station

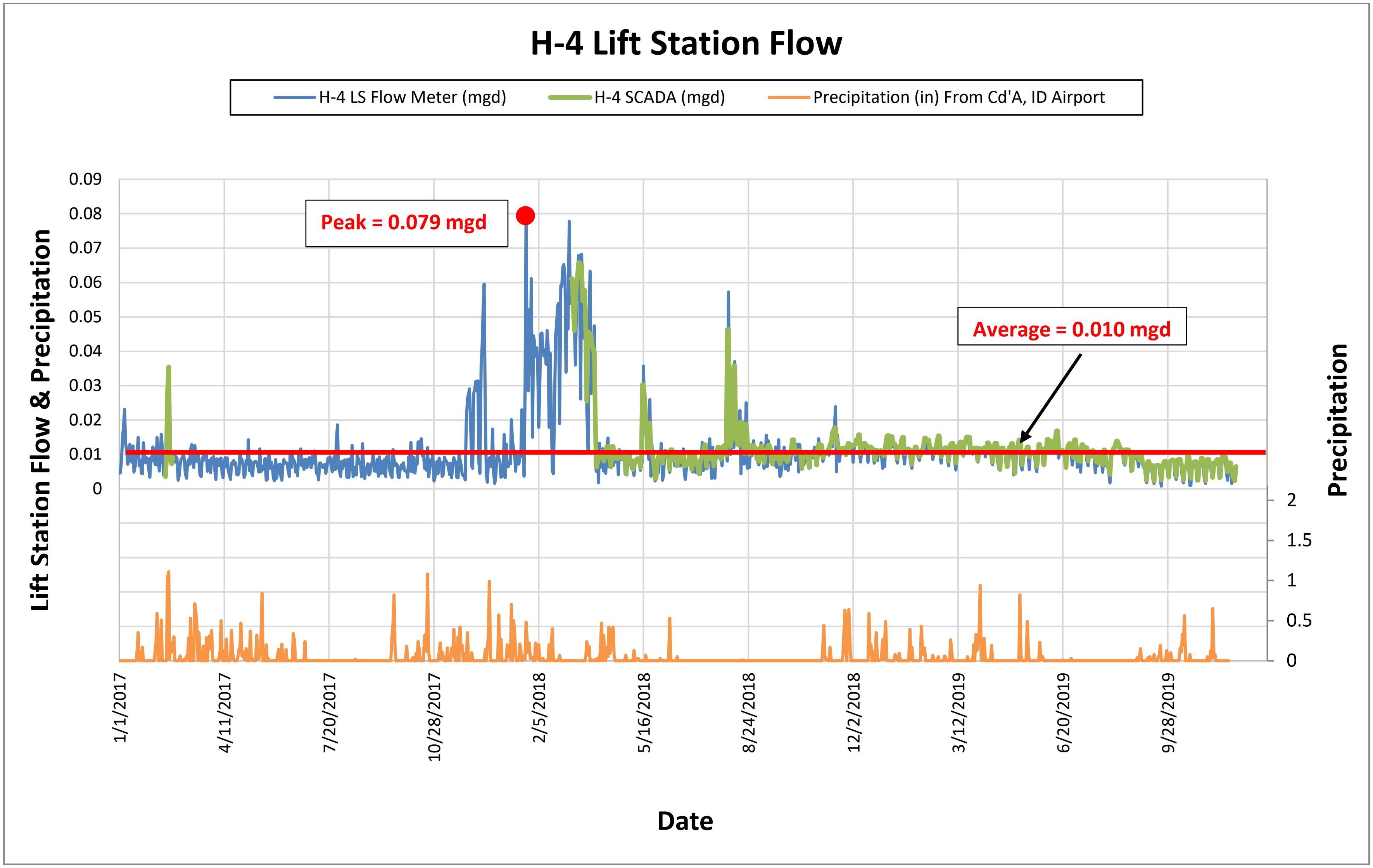


Figure B-12 – Flows for H-5 Lift Station

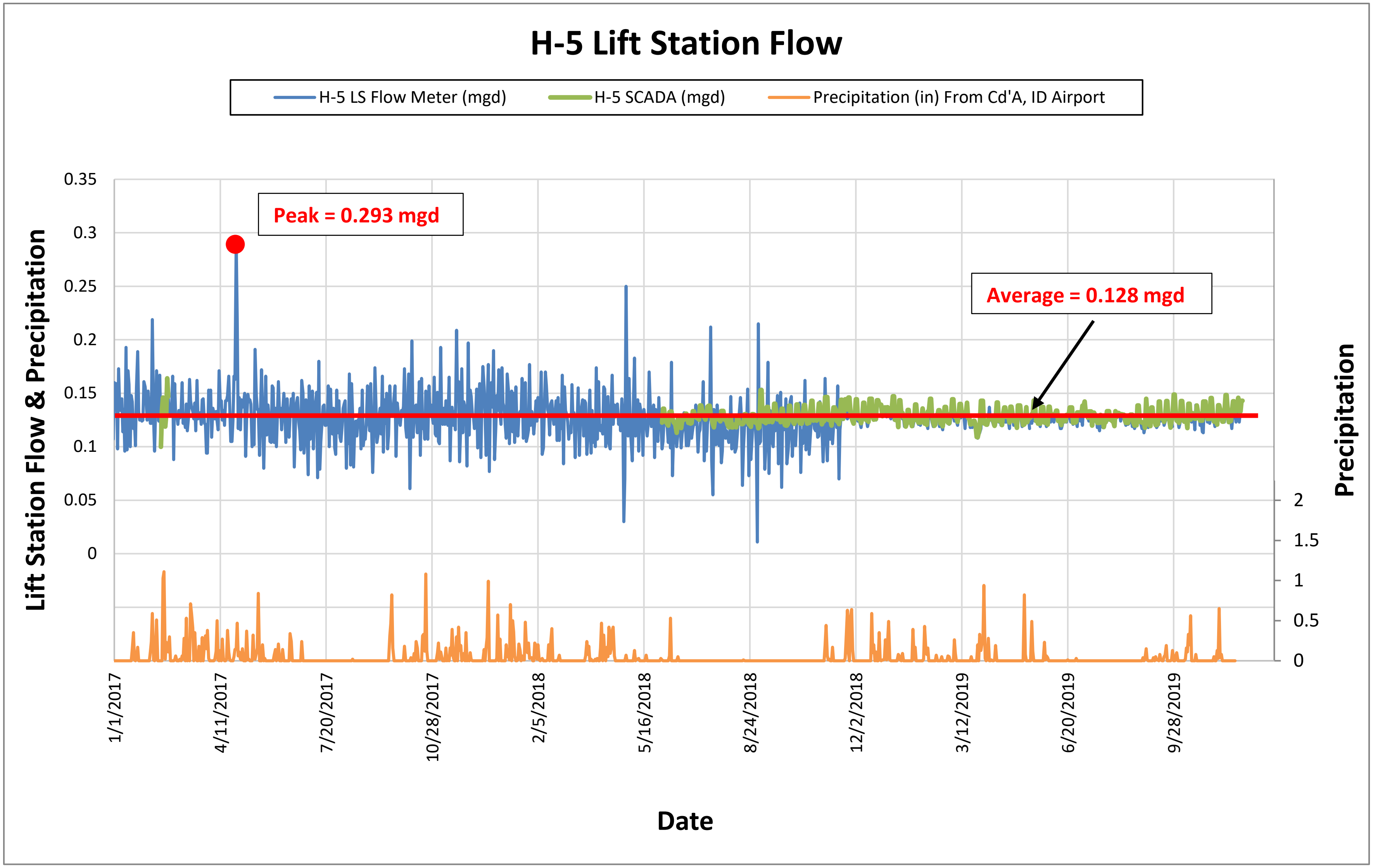


Figure B-13 – Flows for Dakota Lift Station

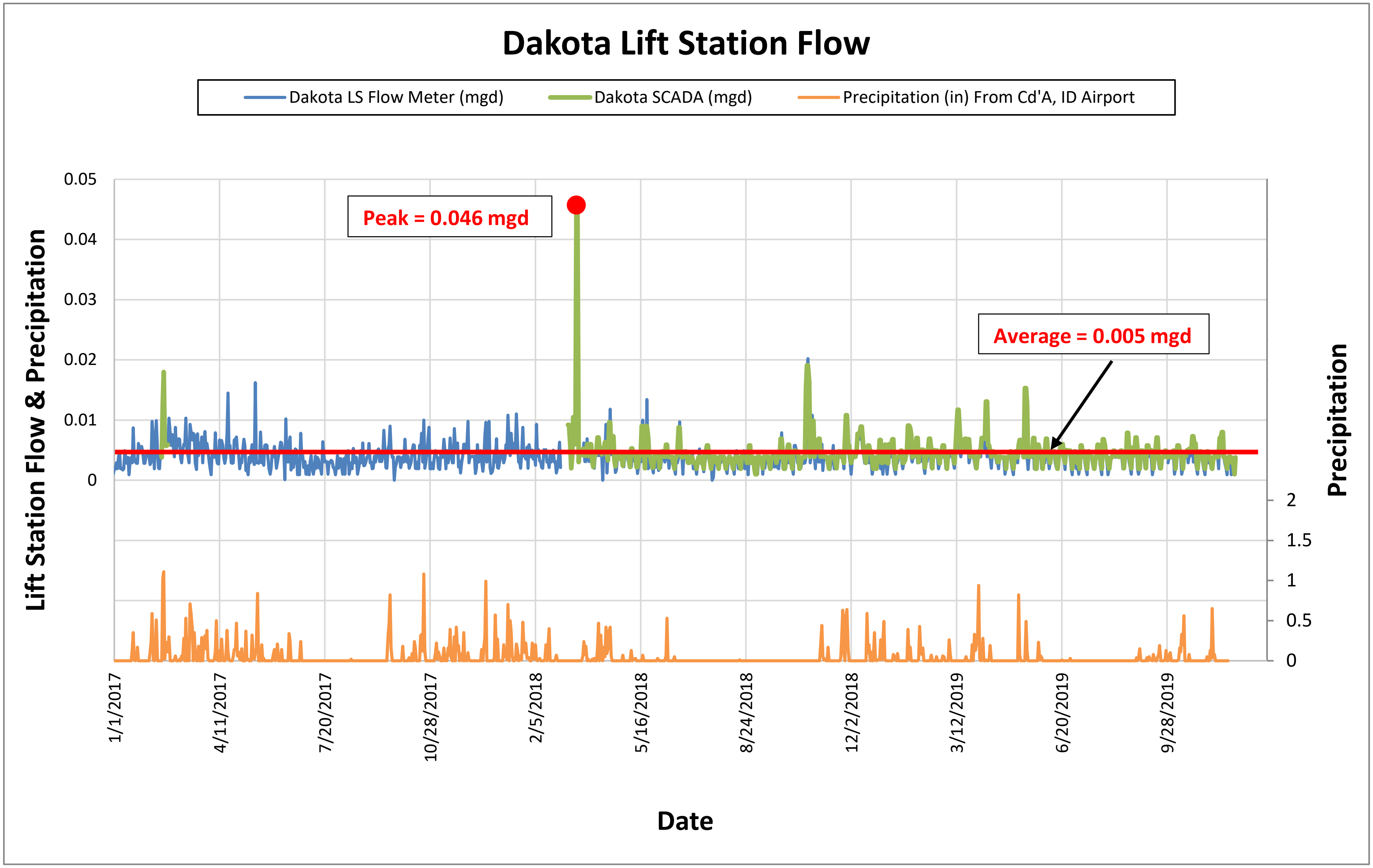
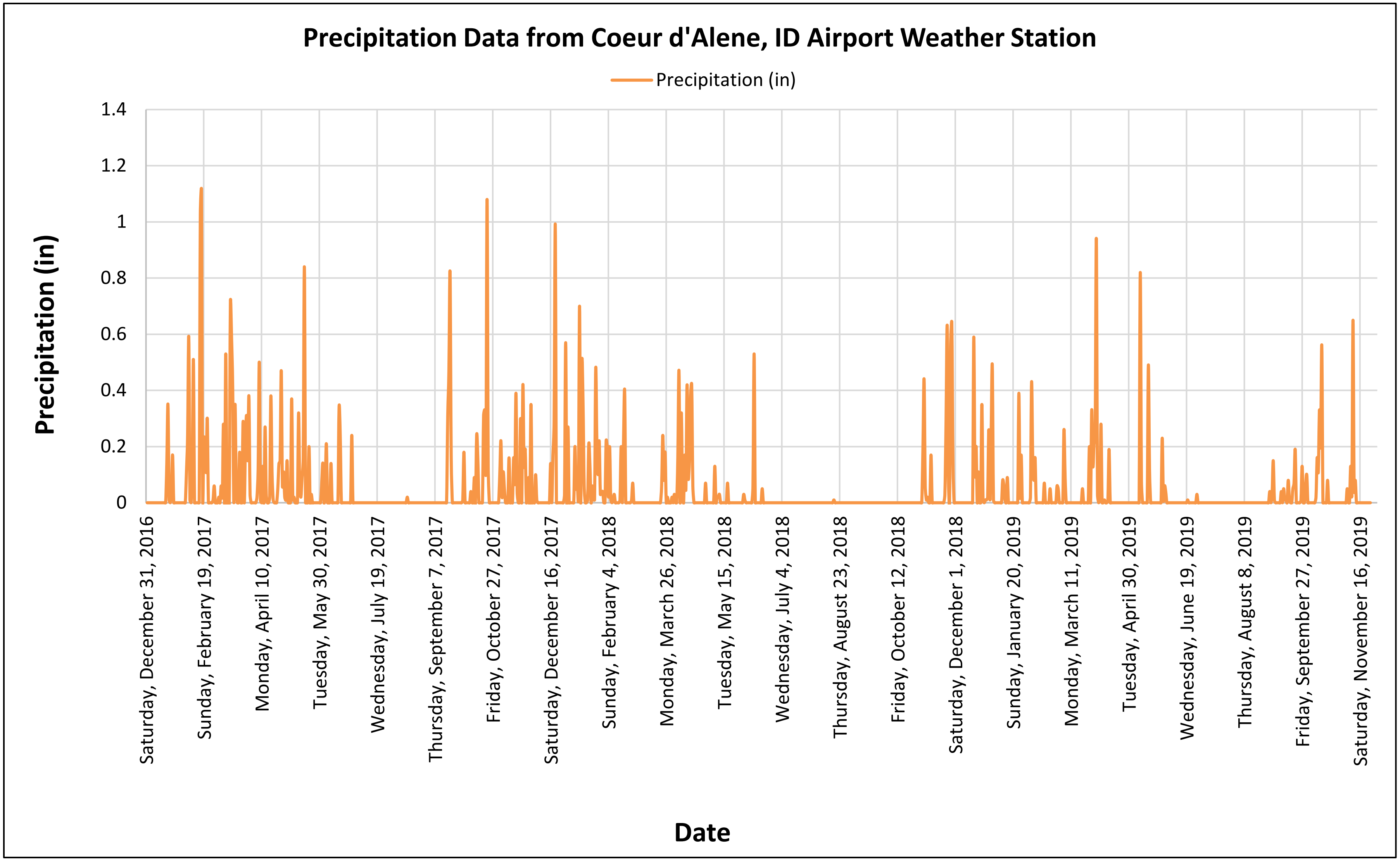


Figure B-14 – Precipitation Data from Coeur d'Alene, Idaho Airport



APPENDIX C

Lift Station Evaluation

Contents

Appendix C | Lift Station Evaluation

C.1 General

Figure A2 in **Appendix A - Figures** displays the existing system lift station locations within their respective sewer sheds.

C.2 Existing Lift Stations

Table C-1 lists the current lift stations that are operating in the City and are shown in the model. **Figure A2** in **Appendix A – Figures** displays the existing lift station locations.

Table C-1 - Operational Lift Stations Included in 2020 Existing Model

Station	Location	Basin
H-1	East of the intersection of Honeysuckle Avenue and Strahorn Road	H-1
Bear Creek [a]	Northwest corner of Bruin Loop	H-1
Maple Grove	Northwest corner of intersection of E Wyoming Avenue and N Maple Street	H-1
Woodland Meadows	Rude Street just north of Prairie Avenue	H-1
Franklin/Prairie	East of Franklin Street and south of Prairie Avenue (behind Grace Bible Church)	H-1
H-2	Southwest corner of intersection of Honeysuckle Avenue and U.S. Highway 95 (northeast corner of Wal-Mart parking lot)	H-2
Heatherstone	South of the intersection of Bounty Loop and N Heather Way	H-2
Leisure Park	North of Heron Avenue and southeast of Retirewood Court	H-2
Cornerstone	East of Cornerstone Drive and west of U.S. Highway 95	H-2
Riley Place	South of the intersection of N Stinson Drive and N Cutlass Street	H-2[b]
Moonridge Acres	Southeast corner of intersection of Ramsey Road and Olympus Avenue	H-2[b]
Emerald Oaks	South of Orchard Avenue east of the intersection with Entiate Street	H-2
H-4 [a]	North end of Atlas Road south of the Coeur d'Alene Airport	H-4
Airport (Miles Avenue) [a]	West end of Miles Avenue east of the Coeur d'Alene Airport	H-4
Airport 2 [a]	North of Coeur d'Alene Airport	H-4

H-5 (Strawberry Fields)	West of the intersection of Strawberry Lane and Courcelles Parkway	H-5
Gianna Estates [c]	Northwest corner of intersection of W Robinson Avenue and Prince William Loop	H-5
Dakota West [d]	South of the Intersection of Dakota Avenue and Navion Drive	H-7
H-7 (Carrington Meadows)	Southeast of Carrington Meadows development on W Hayden Avenue	H-7

(a) Lift Station not owned or maintained by City. No records kept by City.

(b) Lift Stations are to be re-routed to discharge into the H-6 Sewer Basin in future scenarios.

(c) Lift Station temporarily flows to the H-5 Sewer Basin. Lift station to be eliminated in future scenarios and will gravity flow into future H-8 Sewer Basin.

(d) Lift Station currently flows to HARSB WWTP. Lift Station to be eliminated in future scenarios and will gravity flow into H-7 Sewer Basin.

C.3 Evaluation and Recommended Projects

Lift stations were evaluated by City and HARSB staff for deficiencies. Lift station features, recommended work and equipment needed is summarized for each lift station in the Lift Station summaries in the following sections **C.3.1 H-1 Lift Station** through **C.3.19 H-7 (Carrington Meadows) Lift Station.** Operations and Maintenance (O&M) of the lift stations as noted in the following sections are not considered for Capital Improvement Plan (CIP) Projects. Lift Station O&M shall be funded through monthly user fees. If CIP projects include O&M activities, those portions shall be funded by the City through monthly user fees. Associated lift station Capital Improvement costs were provided by City staff and are estimates to be used for budgetary purposes.

C.3.1 H-1 Lift Station

Lift Station at a Glance — H-1 Lift Station

Location: 1173 E. Honeysuckle Avenue

Background: The H-1 Lift Station serves the entire H-1 basin, discharging to the Hayden Area Regional Sewer Board (HARSB) Wastewater Treatment Plant (WWTP) four miles away. All elements of the lift station included provisions for future expansion with minimal future construction costs.

Size and Features [a]:

- Originally Installed 1987
- New lift station constructed in 2013
- Triplex wet pit/dry pit lift station
- 1,250 gpm with expansion up to 4,700 gpm quadplex lift station
- Three (3) 45 HP Flygt centrifugal pumps
- 75,000 gallons of emergency overflow intentionally used to shave peaks at WRF
- Full time odor control system
- Pressure transducer level control
- Multitrode backup level control
- Onsite generator

Associated Costs [b]:

- Blower: $2,500.00

Total: $2,500.00

Key Issues and Recommended Improvements [b]:

- New Odor Removal Blower
- Rehab Biofilter & onsite irrigation
- Fencing & Gates
- SCADA changeover to high speed internet

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.2 Woodland Meadows Lift Station

Lift Station at a Glance — **Woodland Meadows Lift Station**

Location: 8021 N. Rude Street

Background:

The Woodland Meadows Lift Station serves approximately 110 acres within the H-1 basin. The Woodland Meadows Lift Station discharges from a 6-inch pressure main into the gravity sewer in the intersection of Maple St. and Honeysuckle Ave. and flows to the H-1 Lift Station.

Size and Features [a]:

- Originally Installed 1994
- Modified 2001
- Duplex wet pit lift station
- 950 gpm
- Two (2) 20 HP Hydromatic submersible pumps
- No emergency overflow capability
- Full time odor control system
- Pressure transducer level control
- Multitrode backup level control
- Onsite generator

Associated Costs [b]:

- Grating: $3,000

Total: $3,000.00

Key Issues and Recommended Improvements [b]:

- Fall protection grating
- SCADA changeover to high speed internet

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.3 Maple Grove Lift Station

Lift Station at a Glance — Maple Grove Lift Station

Location: 11223 N. Maple Street

Background:

The Maple Grove Lift Station serves approximately 110 acres within the H-1 basin. The Maple Grove Lift Station discharges from a 4-inch pressure main into the gravity sewer in the Rockin' R development and flows to the H-1 Lift Station.

Size and Features [a]:

- Originally Installed 2017
- Modified 2019
- Duplex wet pit lift station
- Capacity: unknown
- Two (2) unknown HP Hydromatic submersible pumps
- No emergency overflow capability
- Full time odor control system
- Pressure transducer level control
- Multitrode backup level control
- Onsite generator

Associated Costs [b]:

- Grating: $3,000

Total: $3,000.00

Key Issues and Recommended Improvements [b]:

- Fall protection grating
- SCADA changeover to high speed internet

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.4 Franklin Prairie Lift Station

Lift Station at a Glance **Franklin Prairie Lift Station**

Location: W. Prairie Avenue

Background:

The Franklin Prairie Lift Station serves a very small area within the H-1 basin. The Franklin Prairie Lift Station discharges from a 2-inch pressure main into the gravity sewer in Prairie Avenue and flows to the H-1 Lift Station.

Size and Features [a]:

- Originally Installed 1996
- Modified: unknown
- Simplex wet pit lift station
- Capacity: unknown
- One (1) 5 HP submersible pump
- Emergency overflow availability: unknown
- Overflow Volume: unknown
- No odor control system
- Float level control
- No onsite generator

Associated Costs [b]:

- Manual Generator Connection: Unknown

Total: $0.00

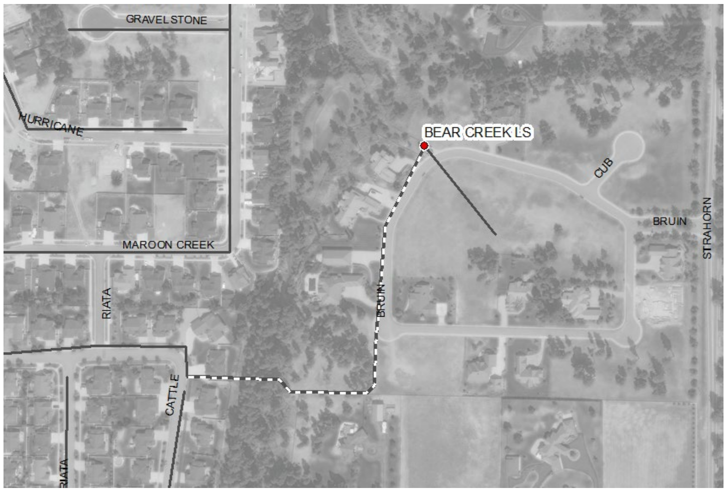
Key Issues and Recommended Improvements [b]:

- Complete remodel
  - Existing power is run through the Church's electrical panel

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.5 Bear Creek Lift Station

Lift Station at a Glance | **Bear Creek Lift Station (*Private*)**



Location: Bruin Loop

Background:

The Bear Creek Lift Station is a privately owned lift station that serves a very small area within the H-1 basin. The City does not operate, maintain, or keep record of this lift station. The Bear Creek Lift Station discharges from a 4-inch pressure main into the gravity sewer in N. Cattle Drive and flows to the H-1 Lift Station.

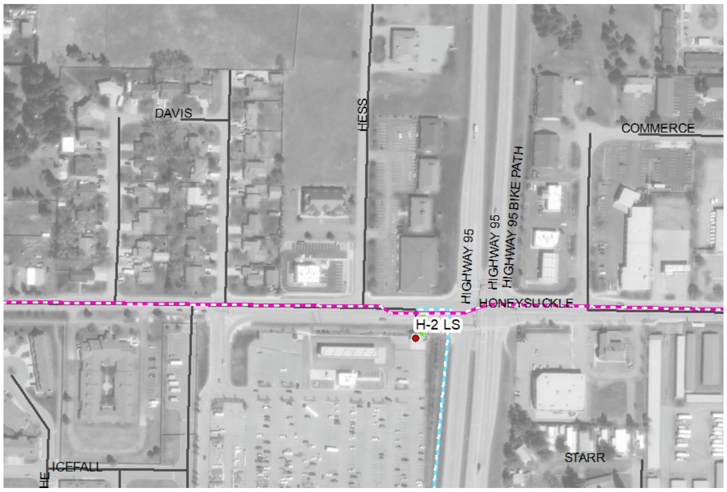
Size and Features [a]:

- Originally Installed 2005
- Information Unknown

(a) Lift Station information provided by Owner and Operations and Maintenance Manual

C.3.6 H-2 Lift Station

Lift Station at a Glance **H-2 Lift Station**



Location: 441 W. Honeysuckle Avenue

Background:

The H-2 Lift Station serves the entire H-2 basin, discharging to the Hayden Area Regional Sewer Board (HARSB) Wastewater Treatment Plant (WWTP) three miles away.

Size and Features [a]:

- Originally Installed 1987
- Modified 2010
- Triplex wet pit/dry pit lift station
- 1,650 gpm
- Three (3) 60 HP Gorman Rupp self-priming centrifugal pumps
- Emergency overflow availability
- Full time odor control system
- Cable pulley float level controls
- Onsite generator

Associated Costs [b]:

- Gorman Rupp: $2,800.00 ea.
- Grating: $3,000
- Inlet: $12,000
- ARV: $3,000

Total: $23,600.00

Key Issues and Recommended Improvements [b]:

- (QTY 2) Gorman Rupp replacement internals (20 HP)
- Fall protection grating
- Install new (higher) inlet from manhole to Lift Station
- Replace (QTY 3) air relief valves
- SCADA changeover to high speed internet

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.7 Leisure Park Lift Station

Lift Station at a Glance | **Leisure Park Lift Station**

Location: 1069 W. Heron Avenue

Background:

The Leisure Park Lift Station serves approximately 210 acres within the H-2 basin. The Leisure Park Lift Station discharges from a 6-inch pressure main into the gravity sewer in Reed Road south of Honeysuckle Avenue and flows to the H-2 Lift Station.

Size and Features [(a)]:

- Originally Installed 1991
- Modified 2000
- Duplex wet pit lift station
- 245 gpm
- Two (2) 5 HP Hydromatic submersible pumps
- No emergency overflow capability
- No odor control system
- Pressure transducer level control
- Multitrode backup level control
- Onsite generator

Associated Costs [(b)]:

- Basin: $18,000

Total: $18,000.00

Key Issues and Recommended Improvements [(b)]:

- Settling/Storm capacity basin
- Emergency overflow capable of 1-2 hours of storage
- SCADA changeover to high speed internet
- Improve wet well drop to allow cleaning from Leisure Park side

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.8 Moonridge Lift Station

Lift Station at a Glance — **Moonridge Lift Station**

Location: 1580 W. Olympus Avenue

Background:

The Moonridge Lift Station serves approximately 30 acres within the H-2 basin. The Moonridge Lift Station discharges from a 4-inch pressure main into the gravity sewer in Miles Avenue West of Reed Road and flows to the H-2 Lift Station.

Size and Features [a]:

- Originally Installed 1992
- Modified 2007
- Duplex wet pit lift station
- Capacity: unknown
- Two (2) 7.5 HP Meyers submersible pumps
- No emergency overflow capability
- No odor control system
- Pressure transducer level control
- Float backup level control
- Onsite generator

Associated Costs [b]:

- Grating: $3,000
- FOGR: $2,000

Total: $5,000.00

Key Issues and Recommended Improvements [b]:

- Fall Protection Grating
- FOGRod Level Control
- The Moonridge Lift Station is recommended to be rerouted to discharge into Ramsey Road as a Capital Improvement Project (CIP 1.06.5) The cost opinion for the pressure main is provided separately.

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.9 Riley Place Lift Station

Lift Station at a Glance **Riley Place Lift Station**

Location: 11016 N. Cutlass Street

Background:

The Riley Place Lift Station serves approximately 15 acres within the H-2 basin. The Riley Place Lift Station discharges from a 4-inch pressure main into the gravity sewer in Wyoming Avenue West of Reed Road and flows to the H-2 Lift Station.

Size and Features [a]:

- Originally Installed 2007
- Duplex wet pit lift station
- 200 gpm
- Two (2) 5 HP Meyers submersible pumps
- No emergency overflow capability
- No odor control system
- Pressure transducer level control
- Float backup level control
- Onsite generator

Associated Costs [b]:

- Grating: $3,000
- FOGR: $2,000

Total: $5,000.00

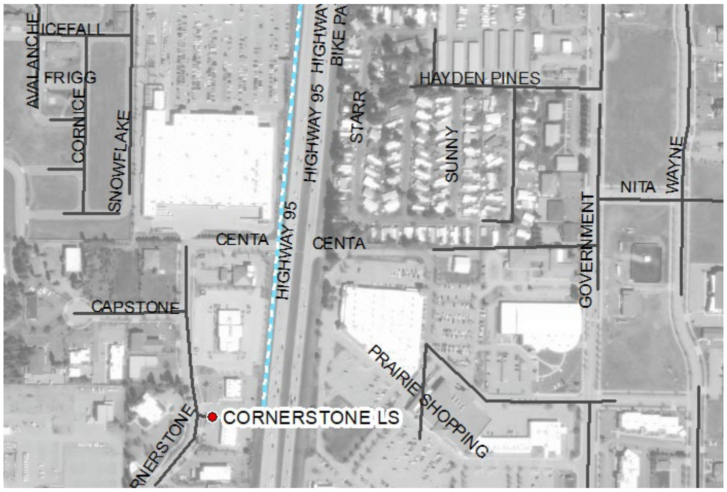
Key Issues and Recommended Improvements [b]:

- Fall Protection Grating
- FOGRod Level Control
- The Riley Place Lift Station is recommended to be rerouted to discharge into Ramsey Road as a Capital Improvement Project (CIP 2.06.7) The cost opinion for the pressure main is provided separately.

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.10 Cornerstone Lift Station

Lift Station at a Glance	**Cornerstone Lift Station**



Location: 8190 N. Cornerstone Drive

Background:

The Cornerstone Lift Station serves approximately 20 acres within the H-2 basin. The Cornerstone Lift Station discharges from a 6-inch pressure main into the gravity sewer in Honeysuckle Avenue immediately upstream of the H-2 Lift Station.

Size and Features (a)**:**

- Originally Installed 2007
- Duplex wet pit lift station
- 280 gpm
- Two (2) 5 HP Hydromatic submersible pumps
- No emergency overflow capability
- Odor control system
- Ultrasonic level control system
- Float backup level control
- No onsite generator

Associated Costs (b)**:**

- Unknown

Total: $0.00

Key Issues and Recommended Improvements (b)**:**

- Onsite generator
- Flow meter
- Multi-smart control system

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.11 Emerald Oaks Lift Station

Lift Station at a Glance — **Emerald Oaks Lift Station**

Location: 1840 W. Orchard Avenue

Background:

The Emerald Oaks Lift Station serves approximately 20 acres within the H-2 basin. The Emerald Oaks Lift Station discharges from a 4-inch pressure main into the gravity sewer in Orchard Avenue and flows to the H-2 Lift Station.

Size and Features [(a)]:

- Originally Installed 2002
- Duplex wet pit lift station
- 222 gpm
- Two (2) 2.8 HP Barnes submersible pumps
- No emergency overflow capability
- Odor control system
- Ultrasonic level control system
- Float backup level control
- Onsite generator

Associated Costs [(b)]:

- **Grating: $3,000**
- **Generator: $3,000**

Total: $6,000.00

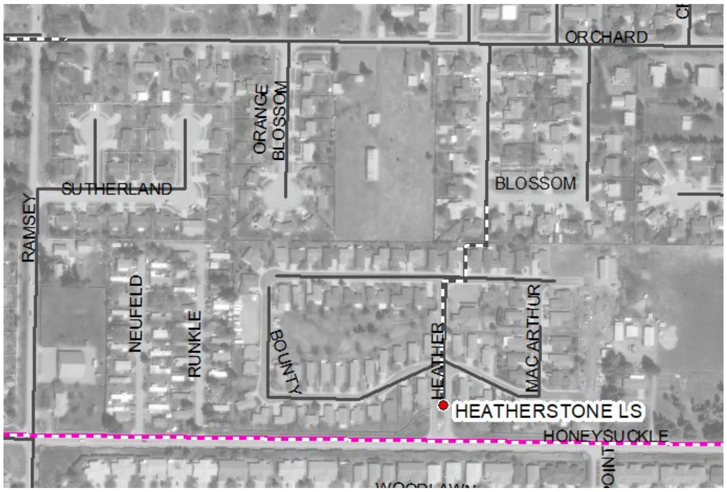
Key Issues and Recommended Improvements [(b)]:

- Fall protection grating
- Generator installation
- Multitrode level control
- Gate
- Multismart panel

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.12 Heatherstone Lift Station

Lift Station at a Glance — Heatherstone Lift Station



Location: N. Heather Way

Background:

The Heatherstone Lift Station serves approximately 15 acres within the H-2 basin. The Heatherstone Lift Station discharges from a 4-inch pressure main into the gravity sewer in Blossome Drive and flows to the H-2 Lift Station.

Size and Features [(a)]**:**

- Originally Installed 1996
- Modified: unknown
- Duplex wet pit lift station
- Capacity: unknown
- Two (2) unknown HP Hydromatic submersible pumps
- No emergency overflow capability
- Level control type: unknown
- No onsite generator

Associated Costs [(b)]**:**

- **Misc.: $45,000**

Total: $45,000.00

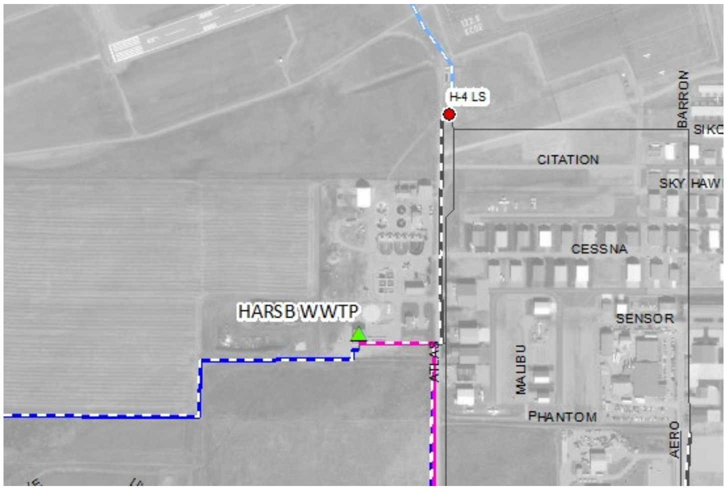
Key Issues and Recommended Improvements [(b)]**:**

- Multi-smart control panel
- Pump mounts
- 480 Volt pumps
- Multitrode level control
- Onsite generator

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.13 H-4 Lift Station

Lift Station at a Glance — H-4 Lift Station



Location: Address Unknown

Background:

The H-4 Lift Station is a County owned lift station that serves the entire H-4 (Airport) basin, discharging to the Hayden Area Regional Sewer Board (HARSB) Wastewater Treatment Plant (WWTP) less than one mile away. The City does not operate, maintain, or keep record of this lift station.

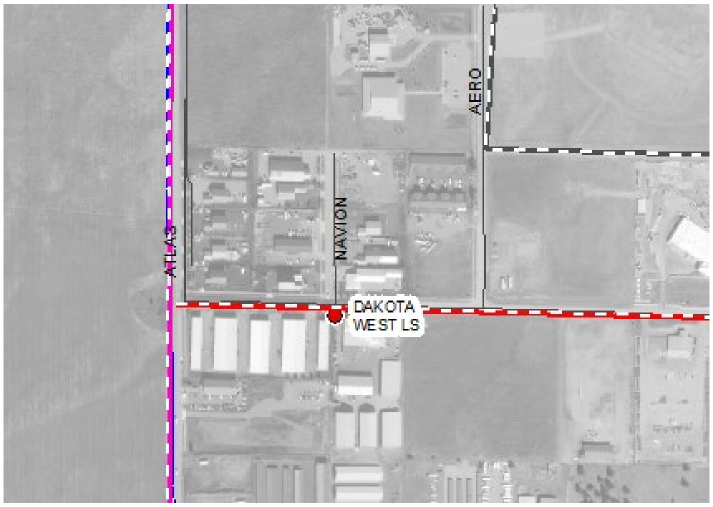
Size and Features [a]:

- Originally Installed 1985
- Information Unknown

(a) Lift Station information provided by Owner and Operations and Maintenance Manual

C.3.14 Dakota Lift Station

Lift Station at a Glance | **Dakota Lift Station**



Location: 3008 W. Dakota Avenue

Background:

The Dakota Lift Station serves approximately 20 acres within the H-4 (Airport) basin. The Dakota Lift Station connects to the 15-inch pressure main in Dakota Avenue and discharges to the Hayden Area Regional Sewer Board (HARSB) Wastewater Treatment Plant (WWTP) less than one mile away.

Size and Features [(a)]:

- Originally Installed 1992
- Modified: 2015
- Duplex wet pit lift station
- 320 gpm
- Two (2) 7.5 HP Gorman Rupp self-priming centrifugal pumps
- No emergency overflow capability
- No odor control system
- Ultrasonic level control system
- No backup level control
- No onsite generator

Associated Costs [(b)]:

- **Building: $3,200**

Total: $3,200.00

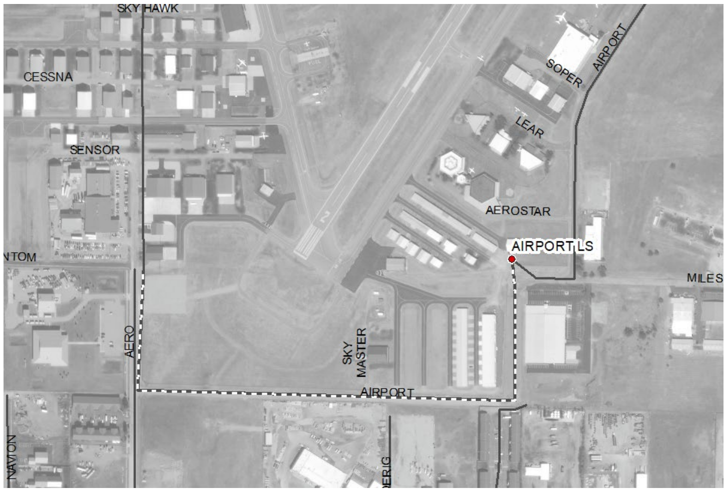
Key Issues and Recommended Improvements [(b)]:

- The Dakota Lift Station is to be eliminated in the near term. CIP Project 3.07.3 outlines the gravity sewer needed to remove the lift station from service and is costed separately.
- If not removed from service, remodel to include:
  - Shed or building
  - Multismart control system
  - Replace pumps
  - Replace level controls

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.15 Airport (Miles) Lift Station

Lift Station at a Glance **Airport (Miles) Lift Station**



Location: 2253 W. Miles Avenue

Background:

The Airport Lift Station is a County owned lift station that serves a very small area within the H-4 (Airport) basin. The Airport Lift Station discharges from a 4-inch pressure main into the gravity sewer in N. Aero Drive and flows to the H-4 Lift Station. The City does not operate, maintain, or keep record of this lift station.

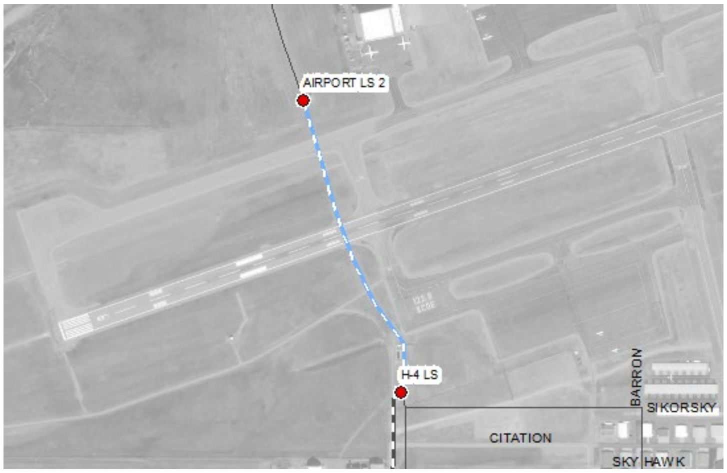
Size and Features [(a)]:

- Information Unknown

(a) Lift Station information provided by Owner and Operations and Maintenance Manual

C.3.16 Airport 2 Lift Station

Lift Station at a Glance | **Airport 2 Lift Station**



Location: Address Unknown

Background:

The Airport 2 Lift Station is a County owned lift station that serves a very small area within the H-4 (Airport) basin. The Airport 2 Lift Station discharges from an 8-inch pressure main into the gravity sewer immediately upstream of the H-4 Lift Station. The City does not operate, maintain, or keep record of this lift station.

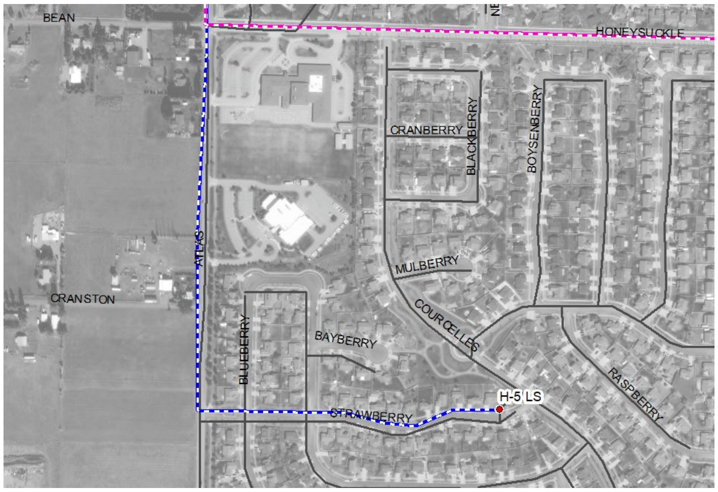
Size and Features [(a)]**:**

- Information Unknown

(a) Lift Station information provided by Owner and Operations and Maintenance Manual

C.3.17 H-5 Lift Station

Lift Station at a Glance — H-5 Lift Station



Location: 2841 W. Strawberry Lane

Background:

The H-5 Lift Station serves the entire H-5 basin, discharging to the Hayden Area Regional Sewer Board (HARSB) Wastewater Treatment Plant (WWTP) two miles away.

Size and Features [(a)]**:**

- Originally Installed 2005
- Modified 2007
- Triplex wet pit lift station
- 760 gpm
- Two (2) 30 HP Hydromatic submersible pumps
- No emergency overflow capability
- Odor control system
- Onsite generator

Associated Costs [(b)]**:**

- Grating: $3,000
- FOGR: $2,000

Total: $5,000.00

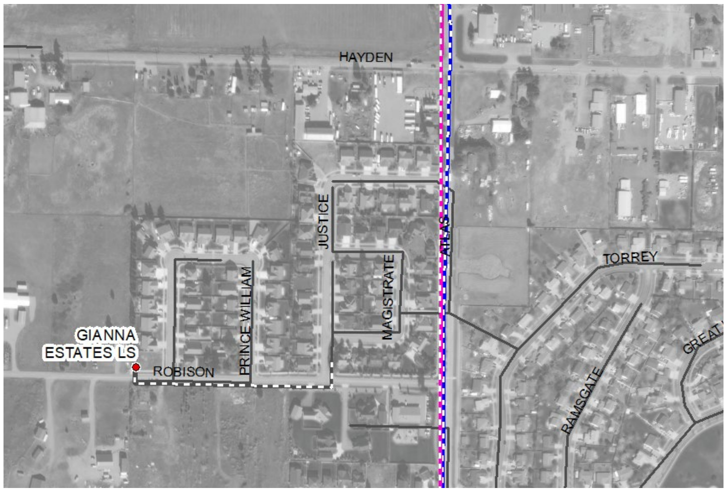
Key Issues and Recommended Improvements [(b)]**:**

- Fall protection grating
- FOGR level control

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.18 Gianna Estates Lift Station

Lift Station at a Glance — Gianna Estates Lift Station



Location: 9568 N. Prince William Loop

Background:

The Gianna Estates Lift Station serves approximately 10 acres within the H-5 basin. The Gianna Estates Lift Station discharges from a 4-inch pressure main into the gravity sewer in North Justice Way and flows to the H-5 Lift Station.

Size and Features [(a)]**:**

- Originally Installed 2015
- Modified 2016
- Duplex wet pit lift station
- Capacity: unknown
- Two (2) 5 HP Hydromatic submersible pumps
- No emergency overflow capability
- Odor control system
- Pressure transducer level control
- Float backup level control
- No onsite generator

Associated Costs [(b)]**:**

- Generator: $45,000

Total: $45,000.00

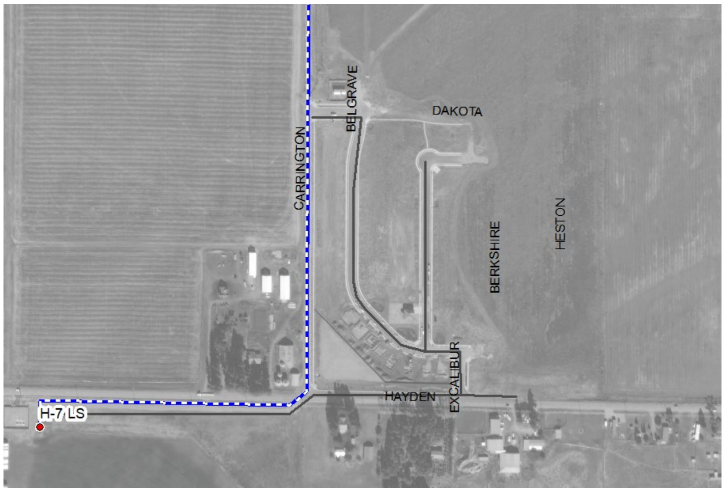
Key Issues and Recommended Improvements [(b)]**:**

- Generator backup and controls

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

C.3.19 H-7 (Carrington Meadows) Lift Station

Lift Station at a Glance — H-7 (Carrington Meadows) Lift Station



Location: 4098 W Hayden Avenue

Background:

The Carrington Meadows Lift Station was built to serve the entire H-7 basin. The Carrington Meadows Lift Station discharges from a 10-inch pressure main to the Hayden Area Regional Sewer Board (HARSB) Wastewater Treatment Plant (WWTP) less than a mile away.

Size and Features [a]:

- Originally Installed 2019
- Duplex wet pit lift station
- 500 gpm
- Two (2) 20 HP Wemco Hidrostal submersible pumps
- Emergency overflow capability
- Odor control system
- Ultrasonic level control system
- Multitrode backup level control
- Onsite generator

Associated Costs [b]:

- **None**

Total: $0.00

Key Issues and Recommended Improvements [b]:

- The H-7 Lift Station is recommended to have upsized pumps as a Capital Improvement Project (CIP 1.07.2) The cost opinion for the lift station is provided separately.

(a) Lift Station information provided by Owner and Operations and Maintenance Manual
(b) Budgetary estimates provided by Owner

APPENDIX D

Model Assumptions

Contents

Appendix D | Model Assumptions

D.1 General

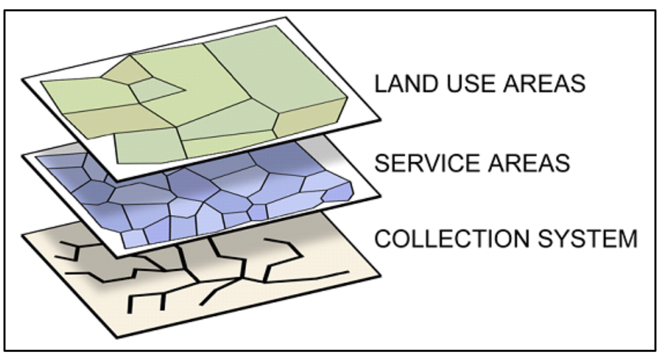
A computer model of a sewer system is based on assumptions that characterize the area and system under study. The review and recommendations are based on discussions with City staff, learned characteristics of the system, and a general knowledge of sewer flow characteristics gained through past experience with monitoring flows and modeling other sewer systems.

D.2 Model Layers

Both the existing and future sewer system models have three layers—the System Layer, the Service Area Layer, and the Land Use Layer. These layers are described below and illustrated in **Figure D-1**.

System Layer:	The System Layer contains a graphical and informational representation of the sewer collection system. The System Layer contains a database that holds information about the sewer system such as length of line, diameter, infiltration, inverts, elevations, slopes, etc.
Service Area Layer:	Flow generated through the Land Use Layer is routed into the system through the Service Area Layer. The Service Area Layer designates which point in the system the flow from a tributary area is injected.
Land Use Layer:	The Land Use Layer is intended to represent areas of various land uses oriented how people live and work. The Land Use Layer must be used with the Service Area Layer to generate sewer flow. This layer contains parameters such as population, contribution per capita, diurnal curves, commercial flow, etc.

Figure D-1 – HYDRA Model Layers



D.3 Model Parameters

D.3.1 Manning's

Description: The roughness factor used in the Manning's formula for open channel flow:

$$Q = \frac{1.49}{n} \times A \times R^{2/3} \times \sqrt{S}$$

Q = flow in cubic feet per second (ft^3/s)

n = Manning's coefficient for conduit roughness (unitless)

A = area of flow within the conduit (ft^2)

R = hydraulic radius of flow within the conduit; equal to the area divided by the wetted perimeter (ft)

S = slope of the conduit carrying flow (ft/ft)

Manning's formula relates flow in a pipe with the depth of flow, diameter of the pipe, and the slope of the pipe. Typical n values range from 0.009 for very smooth glass or plastic to greater than 0.016 for unfinished concrete.

Discussion: A Manning's n of 0.013 is the industry standard roughness value for sanitary sewers. Over time, a slime layer develops on sewer pipes, providing a consistent roughness regardless of material.

Model Setting: A Manning's n of 0.013 is used throughout the system.

D.3.2 Manhole Type

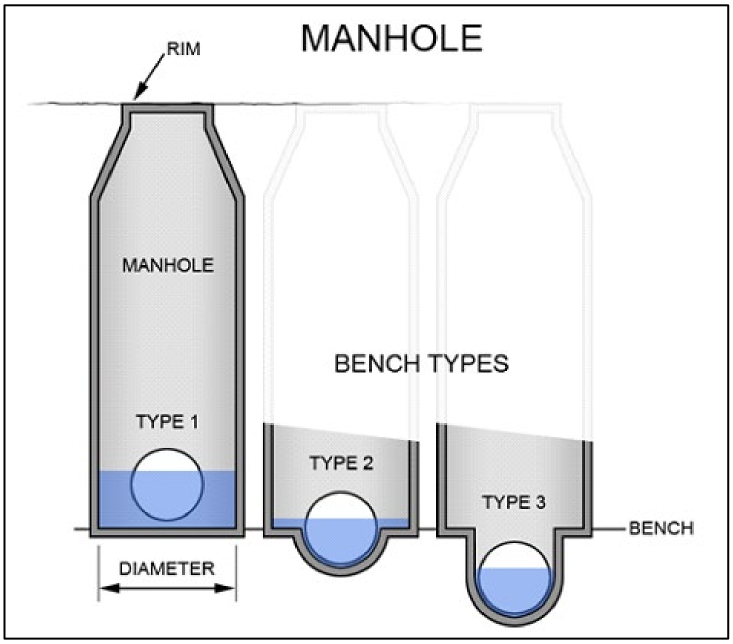
Description: HYDRA allows for the following three types of manholes, depending on the shelf configuration (see **Figure D-2**):

1. Flat bottom, no shelf.
2. Channeling to one half the depth of the incoming and outlet pipes.
3. Channeling to the full depth of the incoming and outlet pipes. This is common for municipalities and is recommended for new construction. This type of channeling decreases the headlosses through manholes.

Discussion: The Type 3 manhole with channeling to the full depth of the pipes is the standard configuration for the Idaho Standards for Public Works Construction (ISPWC).

Model Setting: Type 3 manholes are used throughout the system.

Figure D-2 – HYDRA Manhole Types



D.3.3 Pump System Design Paragraph

Description:	The pump system design paragraph establishes the design criteria of pump stations.
Discussion:	Pumps in HYDRA will pump all influent flow as programmed into the model. The pump design paragraphs do not match existing conditions. HYDRA does not perform a capacity or headloss analysis for pump systems and force mains. This approach could fail to reveal existing pump stations that cannot pump peak period flows.
Model Setting:	Pump design paragraphs were reviewed to verify pumping capacity of each lift station to ensure the pumps can deliver the required influent flow.

D.3.4 Service Area Layer

Description:	The area and shape of each service area is determined by where the model pipes can convey sewage by gravity within a given flow basin.
Discussion:	The service area size should be small enough to provide reasonable incremental increases in flow along a trunk line but not so small as to unnecessarily increase the complexity of the model. In addition, they should correspond to the diurnal curve for daily flow fluctuations passing through the service area.

Model Setting:	Service areas appeared reasonable as previously drawn in the model. Alterations, additions, or deletions were made in areas of known infrastructure change (or proposed change for the future model) since the previous model update.

D.3.5 Service Area Layer Connection Point

Description:	Each service area has a point on the system where it connects to the system.
Discussion:	The service area connection point can affect the sizing of the trunk lines. If service areas are small, the connection point is not as critical.
Model Setting:	The service area connection points appear reasonable as previously drawn in the model. No modification was performed unless alterations or additions were made to the Service Area Layer, in which case the new service areas were connected to a nearby gravity pipeline or lift station.

D.3.6 Service Area Delay

Description:	Delay of flows for travel time from the service area to the system. Can be calculated based on a velocity and the distance from the centroid of the service area to the connection point.
Discussion:	The service area delay is particularly useful when a service area is not adjacent to the trunk line that serves it. A value of 1 to 2 feet per second (fps) is generally representative of flow velocities in small collectors and service laterals.
Model Setting:	One foot per second (1 fps) was used as a basis for flow delays calculated from the centroid of each service area.

D.3.7 Service Area Percent Active

Description:	Percent Active is the percent of the residential population and commercial or industrial activity actually contributing flow to the system. This input attempts to most nearly reflect the actual amount, or percentage, of development (both residential and commercial) in a service area as compared to its zoning or land use build-out potential. This information works with population and also determines the amount of flow routed through the pipe network. This input exists in the Service Area Layer as well as the Land Use Layer.
Discussion:	Unless a sewer service area is truly 100% built-out to its zoning or land use potential, there is possibility for increased density.
Model Setting:	The Percent Active setting was applied in the Land Use Layer. No percent active values were assigned in the Service Layer.

D.3.8 Land Use Layer

Description:	Land use is a means of describing zoning to produce estimated population densities within an area.
Discussion:	Land use areas were updated to reflect information provided by the City regarding current and projected future land uses. Land use areas are generally drawn to group areas of the City that have similar uses (i.e., residential, commercial, or industrial). While some areas are strictly single use, many land use areas have a combination of uses. Land use, density, and flow generation from a given use/density were based on information from the City's Comprehensive Plan and input from City staff.
Model Setting:	The Land Use Layer uses a residential and then a commercial or industrial input value to incorporate flow demands on the system.

D.3.9 Land Use Percent Active

Description:	Percent Active is the percent of the residential population and commercial or industrial activity actually contributing flow to the system. This input attempts to most nearly reflect the actual amount, or percentage, of development (both residential and commercial) in a service area as compared to its zoning or land use build-out potential. This information works with population and also determines the amount of flow routed through the pipe network. This input exists in the Land Use Layer as well as the Service Layer.
Discussion:	For the 2020 existing model, percent active values were adjusted to get the output diurnals from the model to match the observed diurnals recorded the flow monitoring. This entailed varying residential, commercial, and industrial values within reasonable ranges for each land use area. Percent active values were increased to build-out values for the future model, which uses the same land use areas as the 2020 model. Based on land use, densities, and flow prediction from the model, we utilized 90% active is the build-out value, not 100% of the project land use maximum. This correlates well with data from HARSB (*Detailed in the January 29, 2020 HARSB Wastewater Unit Evaluation Amendment No. 1*), which currently sees, on average, about 172.5 gallons/day/ER, which is approximately 90% of the City's previous flow generation value of ~200 gal/day/ER (6,000 gal/month/ER).
Model Setting - Existing:	Percent active values vary for the 2020 existing model.

Model Setting - Future:	Percent active values for all land use areas in the future model were determined from the Sewer Craze and Future Land Use Development and Redevelopment data provided by the City. Reference **Table D-1** and Error! Reference source not found. for the applied land use percent active for each land use area designated on **Figure A3** in Appendix A.

D.3.10 People per Dwelling Unit (PPDU)

Description	Average number of persons living in a single dwelling unit.
Discussion	2010 census data indicates an average of 2.55 people per dwelling unit for the City of Hayden.
Model Setting:	A value of 2.55 PPDU was used throughout the model.

D.3.11 Flow Contribution per Capita (CPC)

Description:	Average sanitary sewer flow generated per person.
Discussion:	Per City requirements, flow contribution was calculated based on 172.5 gallons per day per dwelling unit, as adopted in April of 2020. Using 2.55 people per dwelling unit, the average daily flow generated per person is 67.65 gallons per capita per day.
Recommendation	A value of 67.65 gallons per capita per day was used throughout the model.

D.3.12 Commercial Volume

Description:	The average amount of daily commercial flow in gallons.
Discussion:	The commercial flow is based on the zoning and surrounding flows from areas with similar uses. Through discussions with the City, flow values were assigned for different commercial use areas: 450 gallons per day per acre (gpd/acre) for Light Industrial; and 900 gpd/acre for General Commercial. The City provided the number of Wastewater Units (WU) allotted and received for each commercial area. The units received, combined with the area of a given flow land use area, result in a Commercial Volume value that is used in the model. The commercial percent active is calculated using the number of WU's received compared to the total volume allowed by the City zoning plan.
Model Setting:	Commercial Volume values vary throughout the model.

D.3.13 Flow Generation Diurnal Curve

Description:

A diurnal curve is a graphical representation of the amount of sanitary sewer flow generated and contributed to a collection system over a 24-hour period.

Discussion:

Diurnal curves have different shapes based on contributing land uses. For example, a typical residential diurnal curve exhibits the following characteristics: 1) low early morning flows while residents are sleeping; 2) a morning peak when they get up, take showers, and get ready for the day; 3) a mid-day low while most people are at work, out running errands, or otherwise out of the house; 4) an evening peak when residents return home, prepare dinner, get ready for bed, etc.; and 5) a late evening decline that eventually drops to the early morning low. The cycle then repeats the next day. Commercial and industrial curves typically exhibit different patterns, and may have higher or lower peaks, lengthened or shortened peaks, and higher or lower nighttime and early morning flows.

Flow monitoring results were used to establish typical diurnal curve shapes for different land uses in the Hayden area. Patterns from the adjacent Coeur d'Alene area were also reviewed and were found to be well representative of the Hayden area.

Model Setting:

Residential, commercial, and industrial diurnal curves used in the model are shown in **Figure D-3**, **Figure D-4**, and **Figure D-5**, respectively. All three curves are compared in **Figure D-6**. The horizontal axis, or "x" axis, represents hours in the day, while the vertical axis, or "y" axis, represents the percent of flow for a given hour as compared to average flow for the day. For example, the residential peak is approximately 215%, meaning the peak flow will be 215% larger than the average daily flow for a residential area.

Figure D-3 – Hayden Residential Curve

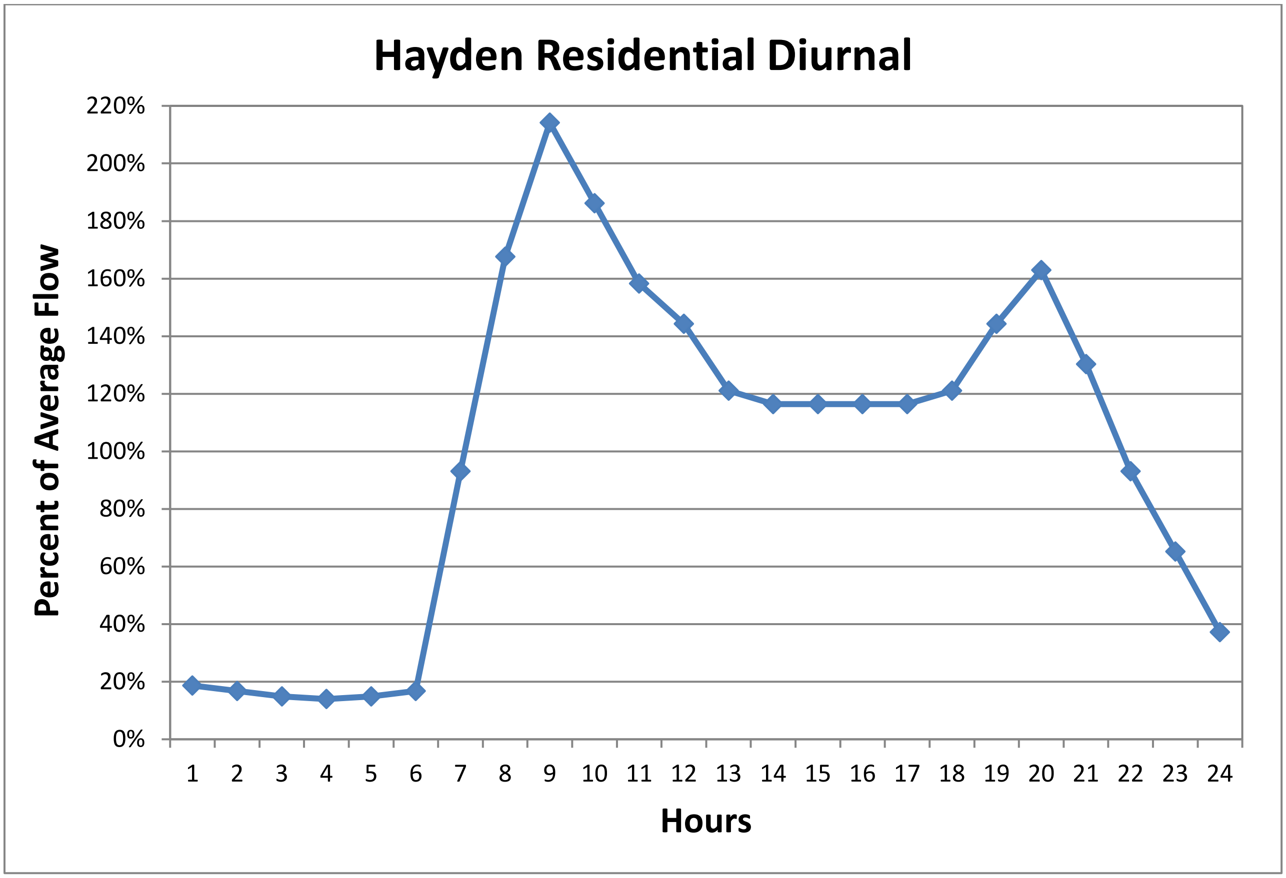


Figure D-4 – Hayden Commercial Curve

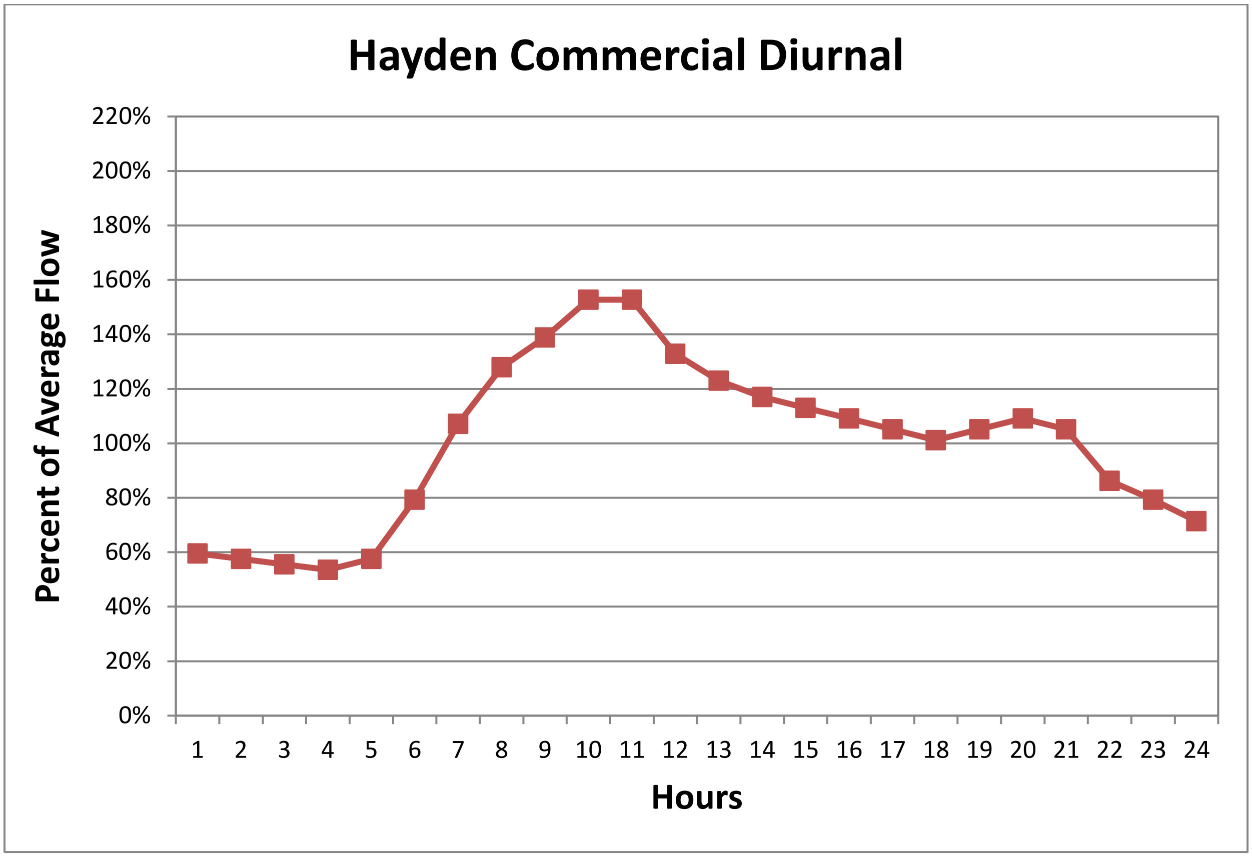


Figure D-5 – Hayden Industrial Curve

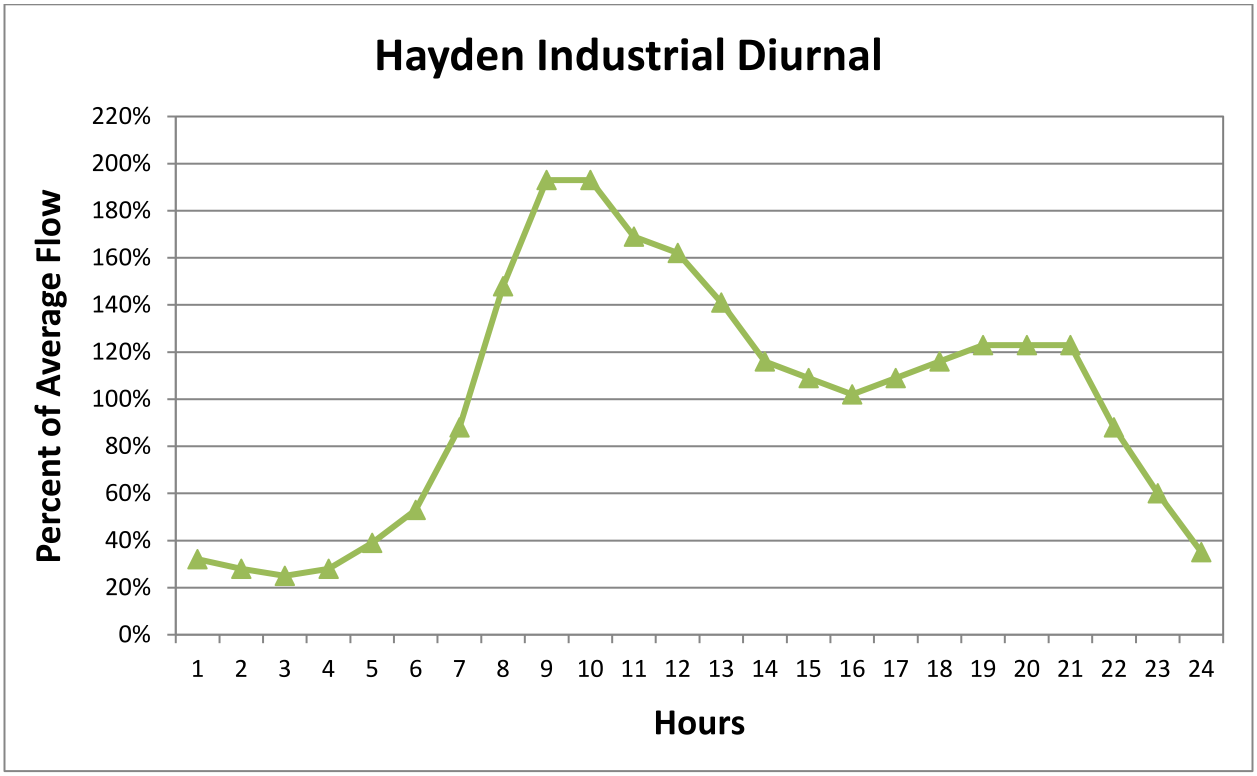
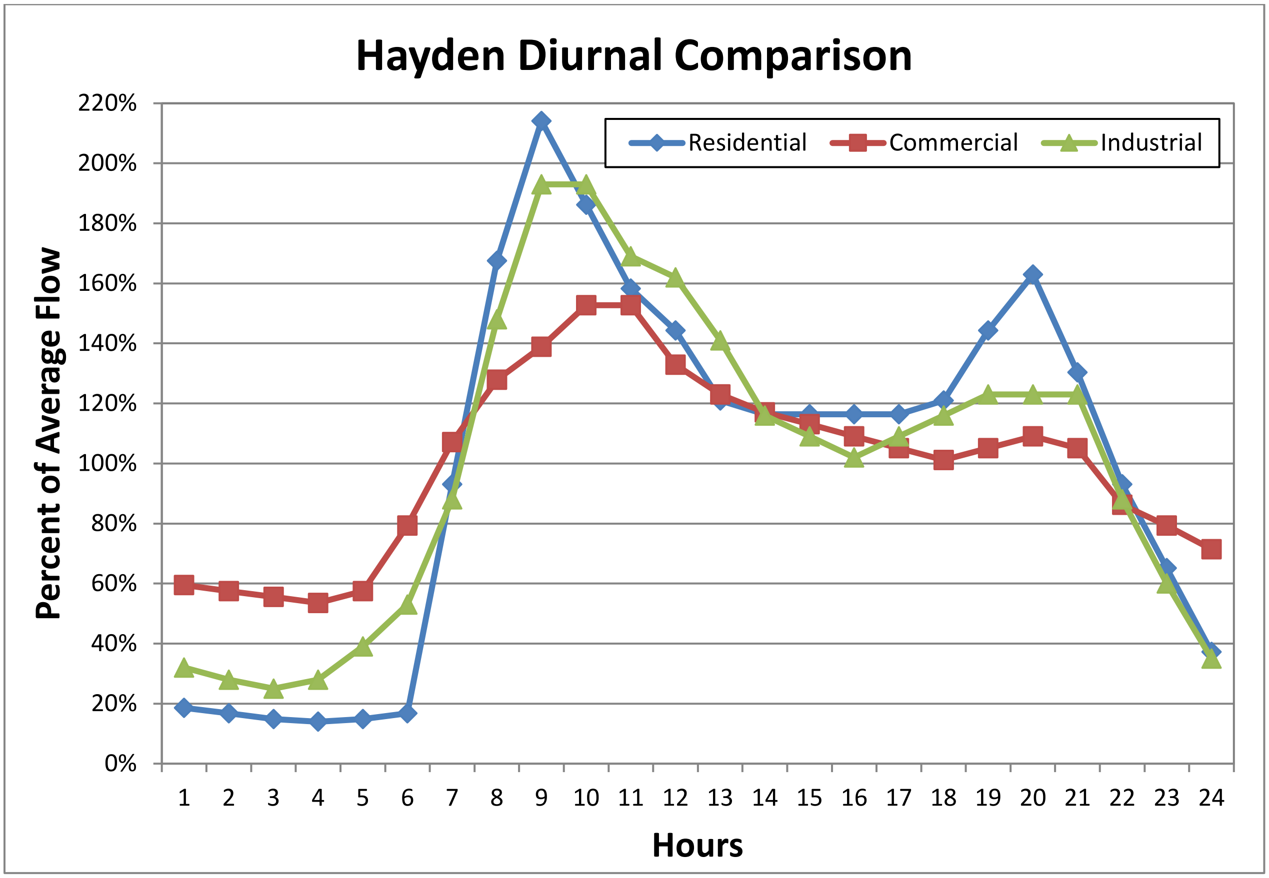


Figure D-6 – Comparison of Hayden Residential, Commercial, and Industrial Diurnal Curves



D.3.14 Inflow and Infiltration (I/I)

Description: Inflow is flow that enters a sewer system with very little delay and is typically associated with storm events. Inflow reaches a sewer system via leaky manhole lids, roof drains, catch basins, or other direct connections to storm runoff. Inflow typically starts when rain starts and stops when the storm ends and increases in system flows exhibit a shape and timing nearly identical to that of the rainfall. Infiltration is flow that enters a sewer system on a consistent basis. Typically, infiltration is groundwater entering the system through cracks and breaks in manholes and pipes. HYDRA models infiltration and inflow as “defects,” or flaws, that cause water to enter the system and increase flows. Model runs that include I/I are typically considered “wet weather” scenarios.

Discussion: HYDRA has multiple ways to impress I/I on a model, including the Defects Database and Infiltration (INF) command. The Defects Database involves a more comprehensive analysis of specific manholes and reaches of pipe within a system and can yield more accurate results than other methods. However, data entry for this process can be lengthy and requires an in-depth knowledge of the collection system and its specific defects. The infiltration command adds I/I to a model using based on 1) gallons per capita per day, 2) gallons per acre per day, 3) gallons per mile of pipe per day, or 4) gallons per inch of diameter per mile of pipe per day. This method can be useful when little is known about collection system defects or when a more general approach is desired.

Model Setting: Inflow and infiltration was modeled on a gallons per acre per day basis using the infiltration command. An I/I input value was determined for individual basins and applied to pipes and manholes within that basin. Reference **Appendix E – Model Calibration** for I/I calibration discussion. The following table lists I/I values applied to each basin in both the 2020 existing and future models.

Basin	I/I Value (gal/acre/day)
H-1	350
H-2	150
H-4	1,000
H-5	150
H-6[a]	150
H-7	150
H-8	150
H-10	150
Dakota	400

a) 350 gal/acre/day is used for the H-6 basin east of Highway 95

D.3.15 Future Model – Design Pipe Sizing

Description: HYDRA has the capability to size future pipes based on several parameters, including the ratio of maximum depth of flow to pipe diameter (known as the d/D ratio). When the flow in a pipe reaches the point where the d/D ratio is greater than the set maximum allowable d/D ratio for a given pipe size, HYDRA will increase the pipe diameter to the next size. The process repeats until an acceptable d/D ratio is achieved.

Discussion: J-U-B has developed and used a graduated scale for maximum d/D ratio based on pipe size. The scale originated from the ASCE manual "Design and Construction of Sanitary Sewers," which recommended master planning sewer systems at a d/D ratio of less than 0.50 for sewers less than 18 inches in diameter and 0.75 for larger sewers. This allows for a larger safety factor for smaller sewers where variations in land use and extensions of the service area can have more significant impacts on the available capacity of the sewer as compared to larger pipelines. The larger sewer lines have a smaller safety factor because isolated variations in land use tend to attenuate over the greater area served by the larger sewer. Safety factors are calculated by comparing flow at a set slope for the listed d/D value versus full pipe flow at the same slope. For example, a 12-inch pipe with Manning's n = 0.013 at minimum slope (0.22%) and d/D = 0.60, flow is approximately 505 gpm. Full pipe flow (d/D = 1.0) for the same scenario yields 752 gpm. 752 divided by 505 results in the listed safety factor of 1.49.

Model Setting: The graduated scale for d/D ratio shown below is used throughout the model:

Pipe Size	Maximum d/D	Resultant Safety Factor
8"	0.50	2.00
10"	0.55	1.71
12"	0.60	1.49
15"	0.65	1.32
18"	0.75	1.10
>18"	0.80	1.10

D.3.16 Future Model – Design Pipe Slope

Description: HYDRA has the capability to set the slopes of future pipes based on several parameters, including minimum velocity or a pre-selected value.

Discussion: Most gravity sewer designs in the surrounding region use minimum pipe slopes based on the Recommended Standards for Wastewater Facilities (aka Ten State Standards).

Model Setting: Recommended minimum slopes from the Ten State Standards are used to set the minimum slope for all design pipes in the model.

Pipe Size	Minimum Slope (ft/100 ft)
8”	0.40
10”	0.28
12”	0.22
15”	0.15
18”	0.12
21”	0.10
24”	0.08
27”	0.067

D.3.17 Future Model – Design Pipe Match Point

Description: When sewer lines of different sizes meet, HYDRA can match pipe inverts, match pipe crowns, or match somewhere in between.

Discussion: Convention and some sewer standards require the design to match the crowns or to match the design depths of the sewers to keep from surcharging the smaller line.

Model Setting: The model will be set to match crowns.

D.3.18 Future Model – Allowable Decreases

Description: HYDRA allows the user to select the number of pipe size decreases that will be allowed in a model simulation.

Discussion: Decreases are not recommended in smaller lines (less than 24 inches) due to the tendency of obstructions to lodge at locations where trunk lines decrease in size. Decreases may be necessary when tying a master planned line into an existing trunk line, but the allowable decreases command does not affect those situations.

Model Setting: No decreases are allowed throughout the model.

D.3.19 Future Model – Design Pipe Distances Between Manholes

Description: The distance between manholes in future design pipe reaches.

Discussion: Distance between manholes is usually determined by the user and may vary depending on the situation. According to the Ten State Standards, this distance should be limited to 400 feet for lines less than 18 inches in diameter and 500 feet for lines 18 inches and larger. A shorter distance between manholes also provides a conservative estimate on the number of manholes needed during construction

Model Setting: A maximum value of 350 feet was used throughout the model for all pipe sizes. This distance was applied only to new design pipes added to the model. Design pipes already in the model with lengths greater than 350 feet were not adjusted.

D.3.20 Future Model – Design Pipe Depths

Description: HYDRA allows minimum pipe bury depths to be selected. Maximum depths must be checked by the user.

Discussion: Conventional wisdom in the region dictates a minimum bury depth of four feet to avoid freezing, which is more of a concern for smaller diameter lines. When modeling, deeper minimum depths help build a factor of safety into pipe design by ensuring that trunk lines and major collectors are deep enough to serve to the boundaries of their service areas. A method to verify that appropriate depth has been selected is to use check lines, which are 8-inch lines extended to locations within a service area that may be difficult to reach and serve with sewer in the future. Check lines can force the trunk line depth down, if necessary, to serve an outlying service area.

Model Setting: The following depths are used throughout the model and vary by pipe size. Some pipe sizes have multiple minimum depth settings to help facilitate specific situations.

Design Pipe Designation	Design Pipe Minimum Diameter	Design Pipe Minimum Depth
8IN_5DP	8 inches	5 feet
8IN_6DP	8 inches	6 feet
8IN_8DP	8 inches	8 feet
CIP	8 inches	8 feet
10IN_5DP	10 inches	5 feet
10IN_10DP	10 inches	10 feet
12IN_5DP	12 inches	5 feet
12IN_10DP	12 inches	10 feet
15IN_10DP	15 inches	10 feet
18IN_12DP	18 inches	12 feet
UP18IN_12DP	21 inches	12 feet

D.3.21 Future Model – Design Manhole Drop

Description: Invert drop through manholes of master-planned pipelines.

Discussion: The commonly accepted design value for elevation drop across a manhole is 0.10 feet. This provides a reasonable downstream slope to prevent flow from surcharging the upstream line. In modeling, the invert drop helps account for headloss in manholes. It also provides a safety factor with respect to pipe meander. Pipe meander describes the necessity for additional manholes or pipeline during construction (as opposed to in the model) due to pipes following non-straight streets. This tends to be especially true for smaller diameter lines in residential subdivisions. Large-diameter lines are not as likely to have significant headloss through a manhole or meander. Therefore, the manhole drop can be reduced for large-diameter lines. Based on previous modeling experience, J-U-B typically recommends a 0.10 foot plus 20 percent drop in manholes to account for pipe meander and headloss. This calculation is made by taking the additional drop required for 20 percent additional length over a 400-foot pipe reach at minimum slope (per Ten States Standards) and adding that to the standard drop of 0.1 feet at the manhole. For example, an 8-inch pipe has a minimum slope of 0.40 feet/100 feet; therefore, [(0.4 feet/100 feet)*(400 feet)*20%] + 0.1 feet = 0.42 feet.

Model Setting: Manhole drops used for design pipe manholes throughout the model are listed in the following table:

Design Pipe Size	Manhole Drop (ft)
8" & 10"	.42
12" & 15"	.28
>18"	.20

D.4 Land Use Types

Table D-1 summarizes and discusses the various land use types that are likely to occur as part of the City's current planning and that are used in the HYDRA model. The table lists types of flow generation, values for each generation type, and a discussion of how each flow generation value was determined based on past work in similar areas and determinations made by the City. The discussion also documents the applicability of each area to the City of Hayden's most recent City planning.

Error! Reference source not found. shows the percent actives for each land use area in the model. A land use area is identified by the land use area number (HYDRA G_ID), followed by the area covered by that land use area and then a description of the use/zoning in that area. **Figure A3** in **Appendix A** shows the land use used for the 2020 Existing Model.

Table D-1 – Flow Generation Types, Values, and Notes on Derivation

Flow Generation Type (Sub-Areas)	Flow Generation Value (gpd/acre)	Derivation of Flow Generation Values
Agriculture	600	• This Master Plan Update assumes the Agriculture component of the 2020 Comprehensive Plan will develop at a density similar to the Single Family at 3.5 Single Family (SF) connections per acre (SF/Acre) • 3.5 SF/Acre is the allowable maximum. $\frac{3.5\ SF}{Acre} * \frac{172.5\ gal}{day*SF} = 603 \frac{gal}{day*acre} = 600 \frac{gal}{day*acre} (round)$

Commercial	900	• Allowable activities of the City's 2020 Future Land Use Plan include retail and service-oriented activities (commercial) accessed by vehicle and that may require a moderate amount of parking and service areas and have an acceptable impact on local roads. Allowed activities are expected to vary in service flow factor and size.
		• Existing commercial activities include the commercial portions of Prairie Commerce Park (Parkwood), Prairie Shopping Center consisting of Fast Food Restaurants, Shopping, Retail M, Grocery, Banks, Triple Play and Holiday Inn Express and the Commercial portions of Warren K.
		• Water meter record information provided by the City (from Hayden Lake Irrigation District, Avondale Irrigation District, and North Kootenai Water District) concludes these users have an average historical winter daily water use per acre (Oct to March 2009 to 2011) of:
		  ○ 757 gpd/acre for Commercial Users
		    ▪ Includes Triple Play & Holiday Inn Express at 1,520 gpd/acre and Prairie Shopping Center at 1,194 gpd/acre
		• Water System analysis from nearby Post Falls (Water System Master Plan – August 2011) concludes their Commercial users average consumption is 883 gpd/acre
		• The City of Coeur d'Alene sewer flow projections in the adjacent Highway 95 corridor as referenced in the City of Coeur d'Alene Northwest Quadrant Sewer Master Plan Evaluation and Updates (2009) is 900 gpd/acre
		• This Master Plan utilizes a flow value of 900 gpd/acre. City Staff and Consultant believe this value represents the range of potential users

Light Industrial	450	• Allowable activities of the City's 2020 Future Land Use Plan include commercial activity with minimal aesthetic impact from noise, odor, and visual character. Commercial and light industrial activities that are customer-oriented and do not require large parking areas or large service areas.
		• Types of allowed activities include, but are not limited to, service-oriented businesses, retail, and low-impact light industrial manufacturing generally at one service flow of 5,000 gal/month per parcel.
		• Existing activities in this area includes the existing Warren K subdivision, Aviation Plaza, BKL, Garage Town, Iverson, KEC, Stancraft.
		• Water meter record information provided by the City (from Hayden Lake Irrigation District, Avondale Irrigation District, and North Kootenai Water District) concludes these users have an average historical winter daily water use per acre (Oct to March 2009 to 2011) of:
		  ○ 144 gpd/acre for Light Industrial Users
		  ○ 455 gpd/acre for Low Impact Commercial
		• This Master Plan utilizes a flow value of 450 gpd/acre. City staff and consultant believe this value represents the range of potential users.

Mixed Residential	1,200	• Allowable residential density per the City's 2020 Future Land Use Plan is 6.0 to 8.0 Single Family (SF) connections per acre (SF/Acre) • 7.0 SF/Acre is an average of the allowable range. $\frac{7.0\ SF}{Acre} * \frac{172.5\ gal}{day*SF} = 1{,}207 \frac{gal}{day*acre} = 1{,}200 \frac{gal}{day*acre} (round)$

Mixed Use	2,350	• Allowable uses include a mixed use of Commercial and residential density of approximately at 10 -12 single family (SF) connections per acre.
		• Mix of the following uses equates to 2,350 gpd/acre:
		  ○ Commercial at 900 gpd/acre over half the land use area, plus
		  ○ Mixed Use Residential at 11 SF/Acre over the entire land use area $\frac{11.0\ SF}{Acre} * \frac{172.5\ gal}{day*SF} = 1{,}897 \frac{gal}{day*acre} = 1{,}900 \frac{gal}{day*acre} (round)$
		  ○ $50\% * 900 \frac{gal}{day*acre} + 100\% * 1{,}900 \frac{gal}{day*acre} = 2{,}350 \frac{gal}{day*acre}$

Recreation	15	• Allowable activities of the City's 2020 Future Land Use Plan are: • This Master Plan utilizes an average flow value of 3.8 gpd/visitor according to Metcalf & Eddy (2014) Wastewater Engineering: Treatment and Resource Recovery, 5th Edition, McGraw-Hill, New York for the baseline flow contribution of a public park. • These land zones are assumed to contribute little to no flow. Assume 4 visitors per day to represent minimum flow.
Residential Suburban	173	• Allowable residential density per the City's 2020 Future Land Use Plan is 1.0 Single Family (SF) connections per acre (SF/Acre) • 1.0 SF/Acre is the allowable maximum. $\frac{1.0\ SF}{Acre} * \frac{172.5\ gal}{day*SF} = 172.5 \frac{gal}{day*acre} = 173 \frac{gal}{day*acre} (round)$
Single Family	520	• Allowable residential density per the City's 2020 Future Land Use Plan is 3.0 Single Family (SF) connections per acre (SF/Acre) • 3.0 SF/Acre is the allowable maximum. $\frac{3.0\ SF}{Acre} * \frac{172.5\ gal}{day*SF} = 517.5 \frac{gal}{day*acre} = 520 \frac{gal}{day*acre} (round)$

Table D-2 –Land Use Areas and Percentages of Given Flow Generation Type

Land Use Area No. (G_ID)	Land Use Area (acre)	Zoning / Land Use Type	Maximum Residential Population	Maximum Commercial Flow (gpd)	Existing Model Percent Active (%)		Near-Term Model Percent Active (%)		Build Out Model Percent Active (%)	
					Residential	Commercial	Residential	Commercial	Residential	Commercial
1	40.1	General Commercial	0	36,120.3	0	0.0	0	0.0	0	100.0
2	44.9	Mixed Use – Residential and Commercial	1,259	20,197.9	0	0.0	0.0	0.0	74.7	50.0
3	318.8	Mixed Density Residential	5,690	0.0	0	0.0	0.6	0.0	95.9	0.0
4	484.2	Agricultural	4,321	0.0	0	0.0	0.0	0.0	0.0	0.0
5	31.0	General Commercial	0	27,914.9	0	0.0	0	0.0	0	100.0
6	325.5	Residential Suburban	830	0.0	0	0.0	0.0	0.0	18.4	0.0
7	108.5	Agricultural	968	0.0	0	0.0	0.0	0.0	100.0	0.0
8	197.0	Agricultural	1,759	0.0	0	0.0	0.0	0.0	100.0	0.0
9	18.2	General Commercial	0	16,377.2	0	0.0	0	0.0	0	100.0
10	20.3	General Commercial	0	18,298.1	0	0.0	0	0.0	0	100.0
11	72.9	General Commercial	0	65,566.5	0	0.0	0	15.3	0	100.0
12	67.1	General Commercial	0	60,361.6	0	0.0	0	0.0	0	100.0
13	46.3	General Commercial	0	41,638.8	0	2.0	0	3.6	0	100.0
14	45.9	General Commercial	0	41,302.7	0.0	8.6	0	15.0	0	100.0
15	101.8	General Commercial	0	91,583.1	0.0	2.4	0	4.2	0	100.0
16	272.8	Light Industrial	0	122,771.4	0	0.0	0	0.0	0	100.0
17	415.8	Light Industrial	0	187,103.3	0	0.0	0	0.0	0	100.0
18	174.2	Light Industrial	0	78,389.7	0.0	0.0	0	25.5	0	100.0
19	180.0	Mixed Density Residential	3,213	0.0	0	0.0	0.0	0.0	92.6	0.0
20	95.7	Mixed Density Residential	1,707	0.0	0	0.0	0.0	0.0	2.8	0.0
21	16.7	Mixed Density Residential	298	0.0	61.7	0.0	72.7	0.0	72.7	0.0
22	37.4	Mixed Density Residential	668	0.0	0	0.0	0.0	0.0	92.4	0.0
23	59.7	Mixed Density Residential	1,066	0.0	0	0.0	0.0	0.0	87.5	0.0
24	95.2	Mixed Density Residential	1,699	0.0	0	0.0	30.0	0.0	93.1	0.0
25	65.8	Mixed Density Residential	1,174	0.0	18.6	0.0	28.3	0.0	76.2	0.0
26	53.1	Mixed Density Residential	948	0.0	1.3	0.0	2.0	0.0	78.6	0.0
27	126.8	Mixed Density Residential	2,264	0.0	23.1	0.0	35.1	0.0	70.3	0.0
28	9.9	Mixed Use – Residential and Commercial	277	4,438.5	1.8	0.0	2.8	0.0	74.7	50.0
29	7.7	Mixed Use – Residential and Commercial	217	3,476.4	0	0.0	0.0	0.0	101.2	50.0
30	9.4	Mixed Use – Residential and Commercial	264	4,231.7	92.8	0.0	93.8	0.0	93.8	50.0
31	7.3	Mixed Use – Residential and Commercial	205	3,295.2	0	0.0	0.0	0.0	95.6	50.0
32	53.2	Mixed Use – Residential and Commercial	1,493	23,959.7	0	0.0	0.0	0.0	99.9	50.0
33	122.1	Mixed Use – Residential and Commercial	3,424	54,927.2	0	0.0	0.0	0.0	88.4	50.0
34	100.1	Mixed Use – Residential and	2,807	45,028.5	0	0.0	31.8	66.6	95.3	66.6

Land Use Area No. (G_ID)	Land Use Area (acre)	Zoning / Land Use Type	Maximum Residential Population	Maximum Commercial Flow (gpd)	Existing Model Percent Active (%)		Near-Term Model Percent Active (%)		Build Out Model Percent Active (%)	
					Residential	Commercial	Residential	Commercial	Residential	Commercial
		Commercial								
35	125.2	Mixed Use – Residential and Commercial	3,512	56,349.6	0	0.0	14.5	0.0	98.7	50.0
36	39.0	General Commercial	0	35,065.6	0.0	25.1	0	43.7	0	100.0
37	46.9	Mixed Use – Residential and Commercial	1,316	21,118.2	21.3	0.0	32.4	0.0	61.4	50.0
38	75.1	Mixed Use – Residential and Commercial	2,107	33,797.6	24.3	129.8	36.9	129.8	58.5	129.8
39	45.6	Mixed Use – Residential and Commercial	1,278	20,500.9	14.0	27.9	44.1	48.5	62.3	50.0
40	218.3	Mixed Use – Residential and Commercial	6,123	98,226.2	0	0.0	0.0	0.0	95.3	50.0
41	217.8	Mixed Use – Residential and Commercial	6,108	97,990.4	0	0.0	0.0	0.0	99.5	50.0
42	58.0	Residential Suburban	148	0.0	0	0.0	0.0	0.0	187.8	0.0
43	36.8	Rural	0	552.2	0.0	0.0	0	0.0	0	100.0
45	2.2	Rural	0	33.6	0.0	0.0	0	0.0	0	100.0
46	1.9	Rural	0	27.8	0	0.0	0	0.0	0	100.0
47	2.6	Rural	0	39.4	0	0.0	0	0.0	0	100.0
51	10.1	Rural	0	151.0	0	0.0	0	0.0	0	100.0
52	0.4	Rural	0	6.3	0.0	0.0	0	0.0	0	100.0
53	0.8	Rural	0	12.6	0	0.0	0	0.0	0	100.0
54	0.6	Rural	0	9.1	0	0.0	0	0.0	0	100.0
55	1.4	Rural	0	20.8	0.0	0.0	0	0.0	0	100.0
56	8.5	Rural	0	128.2	0.0	663.8	0	100.0	0	100.0
57	9.8	Rural	0	147.6	0.0	0.0	0	0.0	0	100.0
59	6.4	Rural	0	96.3	0.0	176.7	0	100.0	0	100.0
60	0.8	Rural	0	11.5	0.0	0.0	0	0.0	0	100.0
61	139.2	Single Family Residential	1,243	0.0	0	0.0	0.0	0.0	98.9	0.0
62	7.2	Single Family Residential	64	0.0	79.7	0.0	79.7	0.0	79.7	0.0
64	141.0	Single Family Residential	1,259	0.0	0	0.0	20.3	0.0	88.7	0.0
65	205.9	Single Family Residential	1,838	0.0	31.3	0.0	47.6	0.0	69.4	0.0
66	126.5	Single Family Residential	1,129	0.0	87.9	0.0	87.9	0.0	87.9	0.0
71	277.4	Single Family Residential	2,475	0.0	0	0.0	41.2	0.0	96.4	0.0
72	116.5	Single Family Residential	1,039	0.0	28.7	0.0	68.1	0.0	75.1	0.0
73	19.8	Single Family Residential	177	0.0	0	0.0	0.0	0.0	79.2	0.0
75	25.2	Single Family Residential	225	0.0	0	0.0	47.6	0.0	47.6	0.0
76	96.4	Light Industrial	0	43,399.7	0.0	0.0	0	0.0	0	100.0
78	77.1	Single Family Residential	688	0.0	86.0	0.0	95.3	0.0	95.3	0.0
79	9.4	Single Family Residential	83	0.0	0	0.0	0.0	0.0	76.4	0.0
80	9.4	Single Family Residential	84	0.0	84.7	0.0	93.8	0.0	93.8	0.0
81	4.6	Single Family Residential	41	0.0	0	0.0	0.0	0.0	99.6	0.0

Land Use Area No. (G_ID)	Land Use Area (acre)	Zoning / Land Use Type	Maximum Residential Population	Maximum Commercial Flow (gpd)	Existing Model Percent Active (%)		Near-Term Model Percent Active (%)		Build Out Model Percent Active (%)	
					Residential	Commercial	Residential	Commercial	Residential	Commercial
82	10.2	Single Family Residential	91	0.0	0	0.0	0.0	0.0	0.0	0.0
83	12.2	Single Family Residential	109	0.0	0	0.0	0.0	0.0	100.4	0.0
84	2.1	Single Family Residential	18	0.0	0	0.0	0.0	0.0	111.2	0.0
85	70.7	Single Family Residential	631	0.0	19.8	0.0	30.1	0.0	86.1	0.0
86	44.5	Single Family Residential	397	0.0	39.2	0.0	59.5	0.0	83.5	0.0
87	21.1	Single Family Residential	188	0.0	29.8	0.0	45.2	0.0	82.5	0.0
88	45.5	Single Family Residential	406	0.0	85.9	0.0	91.6	0.0	91.6	0.0
89	6.1	Mixed Use – Residential and Commercial	170	2,724.7	54.1	0.0	82.1	0.0	99.1	50.0
90	16.4	Mixed Use – Residential and Commercial	459	7,369.7	1.7	0.0	2.5	0.0	59.4	50.0
91	14.1	Mixed Use – Residential and Commercial	394	6,327.8	36.2	18.8	47.2	32.8	47.2	50.0
92	14.9	Mixed Density Residential	265	0.0	59.6	0.0	69.2	0.0	69.2	0.0
93	18.7	Mixed Use – Residential and Commercial	523	8,393.4	0	0.0	0.0	0.0	102.4	50.0
94	17.5	Mixed Use – Residential and Commercial	490	7,858.9	0	0.0	0.0	0.0	106.2	50.0
95	38.0	Mixed Use – Residential and Commercial	1,065	17,080.1	7.7	10.0	11.6	17.3	61.3	50.0
96	38.4	Mixed Use – Residential and Commercial	1,076	17,263.7	0	72.8	0.0	72.8	0.0	72.8
97	19.9	Mixed Use – Residential and Commercial	557	8,937.7	0	20.0	0.0	50.0	30.2	50.0
98	15.2	Mixed Use – Residential and Commercial	426	6,837.9	1.8	0.0	2.7	4.3	82.6	50.0
99	15.2	Mixed Use – Residential and Commercial	427	6,849.5	21.5	0.0	32.6	0.0	49.0	50.0
100	14.5	Mixed Use – Residential and Commercial	408	6,547.1	1.9	0.0	1.9	0.0	1.9	50.0
101	9.6	Mixed Use – Residential and Commercial	269	4,319.7	0	1.3	0.0	2.3	0.0	50.0
102	18.6	General Commercial	0	16,727.1	0.0	40.1	0	69.8	0	100.0
103	60.5	Light Industrial	0	27,216.2	0.0	2.5	0	4.4	0	100.0
104	20.5	Light Industrial	0	9,205.1	0.0	34.4	0	59.8	0	100.0
105	71.7	Light Industrial	0	32,280.2	0.0	1.1	0	1.8	0	100.0
106	29.8	Light Industrial	0	13,429.5	0.0	27.1	0	47.2	0	100.0
107	70.8	Light Industrial	0	31,859.6	0.0	8.4	0	14.7	0	100.0
108	9.7	Mixed Density Residential	174	0.0	29.4	0.0	32.3	0.0	32.3	0.0
109	12.6	Mixed Density Residential	224	0.0	8.0	0.0	12.6	0.0	83.0	0.0
110	23.6	Mixed Density Residential	421	0.0	69.1	0.0	69.1	0.0	69.1	0.0
111	14.3	Mixed Density Residential	255	0.0	46.0	0.0	46.0	0.0	46.0	0.0
112	123.0	Single Family Residential	1,098	0.0	92.2	0.0	92.2	0.0	92.2	0.0

Land Use Area No. (G_ID)	Land Use Area (acre)	Zoning / Land Use Type	Maximum Residential Population	Maximum Commercial Flow (gpd)	Existing Model Percent Active (%)		Near-Term Model Percent Active (%)		Build Out Model Percent Active (%)	
					Residential	Commercial	Residential	Commercial	Residential	Commercial
113	81.4	Single Family Residential	726	0.0	105.3	0.0	105.3	0.0	105.3	0.0
114	6.6	Single Family Residential	59	0.0	0	0.0	0.0	0.0	60.6	0.0
115	46.5	Single Family Residential	415	0.0	0	0.0	0.0	0.0	67.6	0.0
116	12.5	Single Family Residential	111	0.0	89.5	0.0	89.5	0.0	89.5	0.0
117	139.4	Single Family Residential	1,244	0.0	83.2	0.0	83.2	0.0	83.2	0.0
118	19.1	Single Family Residential	171	0.0	1.5	0.0	2.3	0.0	52.3	0.0
119	110.4	Single Family Residential	985	0.0	80.2	0.0	80.2	0.0	80.2	0.0
120	33.3	Single Family Residential	297	0.0	80.7	0.0	80.7	0.0	80.7	0.0
121	29.0	Single Family Residential	259	0.0	0	0.0	100.6	0.0	100.6	0.0
122	15.4	Single Family Residential	138	0.0	0	0.0	118.6	0.0	118.6	0.0
123	27.6	General Commercial	0	24,858.9	0.0	8.2	0	14.3	0	100.0
124	34.3	General Commercial	0	30,892.5	0.0	60.7	0	100.0	0	100.0
125	32.1	General Commercial	0	28,886.2	0.0	89.5	0	100.0	0	100.0
126	30.4	General Commercial	0	27,369.1	0.0	50.4	0	87.7	0	100.0
127	29.3	General Commercial	0	26,357.3	0.0	102.2	0	100.0	0	100.0
128	29.3	General Commercial	0	26,338.3	0.0	36.9	0	64.1	0	100.0
129	29.0	General Commercial	0	26,094.3	0.0	26.7	0	46.5	0	100.0
130	27.4	General Commercial	0	24,673.0	0.0	11.3	0	19.7	0	100.0
131	25.2	General Commercial	0	22,702.6	0.0	12.7	0	22.2	0	100.0
132	40.4	General Commercial	0	36,380.8	0.0	15.0	0	26.0	0	100.0
133	26.9	General Commercial	0	24,201.5	0.0	0.0	0	0.0	0	100.0
134	81.1	Single Family Residential	723	0.0	82.1	0.0	82.1	0.0	82.1	0.0
135	18.2	Rural	0	272.4	0.0	0.0	0	0.0	0	100.0
136	15.5	Single Family Residential	139	0.0	5.5	0.0	8.4	0.0	84.6	0.0
137	50.3	Single Family Residential	449	0.0	25.6	0.0	37.5	0.0	37.5	0.0
138	26.8	Single Family Residential	239	0.0	0	0.0	0.0	0.0	13.9	0.0
139	33.3	Single Family Residential	298	0.0	0	0.0	0.0	0.0	77.1	0.0
140	25.0	Single Family Residential	223	0.0	0	0.0	0.0	0.0	100.8	0.0
141	36.3	Single Family Residential	324	0.0	30.7	0.0	46.6	0.0	69.2	0.0
142	176.7	Single Family Residential	1,577	0.0	55.5	0.0	67.6	0.0	67.6	0.0
143	65.7	Single Family Residential	587	0.0	54.8	0.0	62.6	0.0	62.6	0.0
144	4.6	Single Family Residential	41	0.0	0	0.0	0.0	0.0	68.0	0.0
145	71.5	Single Family Residential	638	0.0	0	0.0	0.0	0.0	65.9	0.0
146	40.6	Single Family Residential	362	0.0	50.0	0.0	69.0	0.0	69.0	0.0
147	48.8	Single Family Residential	436	0.0	39.2	0.0	59.6	0.0	82.6	0.0
148	19.4	Single Family Residential	173	0.0	50.1	0.0	76.0	0.0	78.1	0.0
149	20.9	Single Family Residential	187	0.0	45.0	0.0	68.4	0.0	91.4	0.0
150	20.1	Single Family Residential	179	0.0	61.3	0.0	72.7	0.0	72.7	0.0
151	27.4	Single Family Residential	244	0.0	35.5	0.0	53.9	0.0	73.1	0.0
152	19.7	Single Family Residential	176	0.0	36.2	0.0	54.9	0.0	94.1	0.0

Land Use Area No. (G_ID)	Land Use Area (acre)	Zoning / Land Use Type	Maximum Residential Population	Maximum Commercial Flow (gpd)	Existing Model Percent Active (%)		Near-Term Model Percent Active (%)		Build Out Model Percent Active (%)	
					Residential	Commercial	Residential	Commercial	Residential	Commercial
153	33.3	Single Family Residential	297	0.0	48.9	0.0	65.2	0.0	65.2	0.0
154	12.6	Single Family Residential	112	0.0	77.1	0.0	77.1	0.0	77.1	0.0
155	37.7	Single Family Residential	336	0.0	43.2	0.0	65.6	0.0	73.5	0.0
156	9.7	Single Family Residential	87	0.0	0	0.0	0.0	0.0	93.8	0.0
157	20.5	Single Family Residential	183	0.0	2.8	0.0	4.2	0.0	97.6	0.0
158	39.7	Mixed Use – Residential and Commercial	1,113	17,849.2	2.7	11.4	4.1	19.9	65.3	50.0
159	39.9	Mixed Use – Residential and Commercial	1,120	17,974.3	3.8	16.1	5.8	28.0	31.2	50.0
160	85.4	Light Industrial	0	38,436.6	0.0	23.9	0	41.6	0	100.0
161	162.4	Light Industrial	0	73,088.2	0.0	2.3	0	4.1	0	100.0
162	131.6	Mixed Density Residential	2,350	0.0	0	0.0	10.9	0.0	76.8	0.0
163	50.9	General Commercial	0	45,765.7	0	0.0	0	32.8	0	100.0
164	34.7	General Commercial	0	31,273.1	0	0.0	0	32.7	0	100.0
165	22.2	General Commercial	0	19,982.8	0	0.0	0	0.0	0	100.0
167	50.2	Single Family Residential	448	0.0	0	0.0	0.0	0.0	68.9	0.0
168	124.7	Single Family Residential	1,113	0.0	0	0.0	8.2	0.0	93.0	0.0
169	65.3	Light Industrial	0	29,368.1	0.0	8.7	0	15.1	0	100.0
170	18.4	Single Family Residential	164	0.0	3.1	0.0	4.7	0.0	46.6	0.0
171	219.6	Light Industrial	0	98,831.1	0	0.0	0	0.0	0	100.0
172	150.7	Agricultural	1,345	0.0	0	0.0	0.0	0.0	100.0	0.0
173	111.7	Mixed Use – Residential and Commercial	3,133	50,259.0	0	0.0	0.0	0.0	46.3	50.0
174	44.9	Mixed Use – Residential and Commercial	1,258	20,186.9	0	0.0	0.0	0.0	81.5	50.0
175	17.8	Mixed Density Residential	317	0.0	5.3	0.0	8.0	0.0	58.7	0.0
176	242.2	Light Industrial	0	108,984.1	0.0	0.0	0	0.0	0	100.0
177	74.5	Single Family Residential	665	0.0	46.1	0.0	70.0	0.0	85.9	0.0
178	102.4	Central Business District	0	573,616.0	0	0	0	0	0	100.0

APPENDIX E

Model Calibration

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E.1 General

Existing pipes in the model were updated using Record Drawing information from Hayden and HARSB, as well as knowledge of City and HARSB staff. Land use, density, and flow generation for a given use (i.e., residential, commercial, or industrial) were populated in the model using information from the City's Comprehensive Plan and as provided by City staff. Model runs generated flows and diurnals for each pipe and manhole. Flows were varied by changing the "Percent Active" field for residential, commercial, and industrial areas in the model. The "percent active" was varied based on existing densities obtained from City provided data, GIS and from general observations using aerial images. The overall goal was to get the model output diurnals to match the flow monitoring diurnals that were observed in the field during the 2012 April - May and 2019 May flow monitoring efforts, especially to capture peaking periods so demand conditions were not excessively overestimated or underestimated. Considerations were taken for areas that have undergone infrastructure changes since the 2012 flow monitoring was conducted, as overall flow volumes may have increased or decreased accordingly. Model results were compared to weekend flow monitoring data in an effort to capture peaking periods. When the model diurnals closely matched the flow monitoring diurnals, the dry weather flow was considered calibrated.

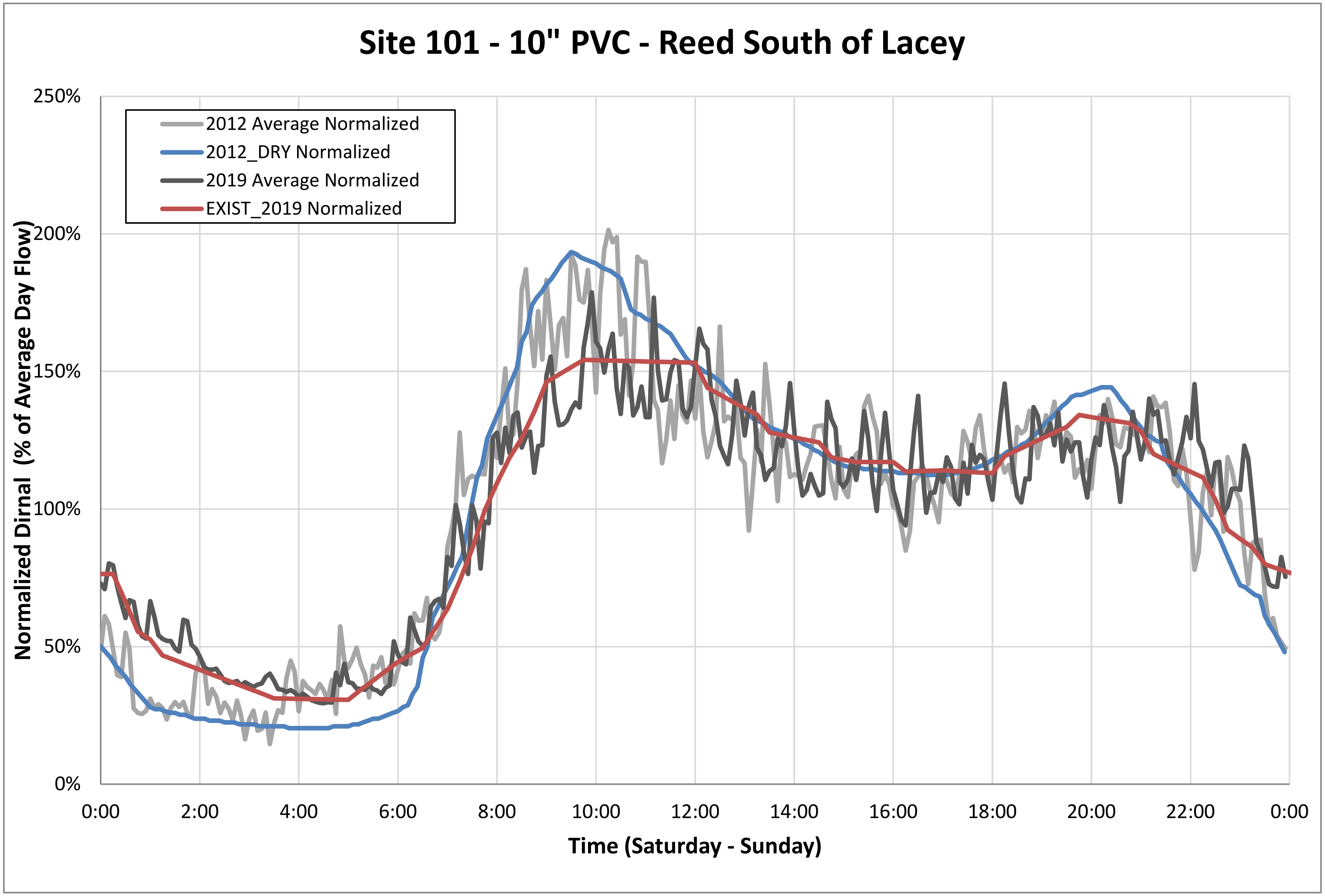
Calibration was performed for the 2020 existing model. The calibrated model settings were then applied to the future build-out model, percent active fields were adjusted to build-out levels, and the model was run to generate projects for the Capital Improvement Plan.

E.2 Calibration Process

E.2.1 Matching Diurnal Shape

The first step in the calibration process involved matching the shape of the model diurnal with the shape of the flow monitoring diurnal. For the flow monitoring data, collected at 5-minute intervals, weekend data points were averaged to create a representative diurnal for each site. Each data point was then normalized on the average of the representative diurnal. The normalized value represents the amount a given data point is above or below the average of the representative diurnal. The same process is applied to diurnals created by model runs. By normalizing both the flow monitoring and model results, diurnal shapes can be compared independent of magnitude of flow. An example of a graph of the normalized results is presented in **Figure E-1**. This shows the average of the normalized average flow monitoring results ("Average Normalized" data series) compared to the model run results. For locations that were not flow monitored in 2019, the diurnals previously developed from the 2012 flow monitoring efforts were used.

Figure E-1 – Normalized Results from Calibration Effort to Match Diurnal Shape



E.2.2 Matching Flow Magnitude

Flow magnitude was considered after diurnal shape was adjusted. Magnitude was adjusted in the model by toggling the “Percent Active” values in the Land Use Layer. The Percent Active values for the existing model were determined according to the number of dwelling units within a land use area divided by the number of dwelling units allowed per the City’s zoning plan. Normalized results were not used when considering magnitude as the actual flow values between the flow monitoring and model were being compared.

E.2.3 Inflow and Infiltration Value Derivation for Wet Weather Scenario

The wet weather flow was modeled by imposing inflow and infiltration (I/I) on the sewer system. Based on lift station data supplied by HARSB for “H” stations and the Dakota West Lift Station, a baseline flow value was established out of each station. This same data also shows peaks when output is increased due to precipitation events. This provides the ability to calculate a wet weather peaking factor. Reference **Appendix B – Data Compiled for Use in Model Development** for graphs representing the lift station flow data.

By inputting I/I into the model on a gallons per acre served per day basis, the model yields a wet weather flow to simulate peak conditions data. By comparing the dry weather and wet weather results from the model, a model peaking factor is obtained. The model I/I input value was calculated, specifically using the February 2017 flood event data, as the delta between the average wet and average dry weather flows. At this point, the wet weather portion of the model is considered calibrated. It should be noted that wet weather flows do not affect the shape of the diurnal, they simply increase the magnitude of flow (i.e., the curve shifts “up”).

E.3 Calibration Results

E.3.1 Calibration Results to Lift Station Data

Table E-1 – Peak Factor Comparison between Model Results and Lift Station Data shows a comparison between the lift station data and model results. A discussion of model calibration at each lift station is below:

- The H-1 basin average and peak flow values from the model sit slightly above the lift station data and the peaking factors are relatively close. This provides for a conservative model result.

- The H-2 basin average and peak flow values from the model are above values from the lift station data, however the peak factor is nearly matched.

- The H-4 and Dakota lift station peaking factors could be matched only by setting the model infiltration value for the lift stations to an unreasonably high number. The large infiltration amount observed from the lift station data seems to be an anomaly, and it was deemed most representative to assign a more reasonable infiltration value to this basin.

Table E-1 – Peak Factor Comparison between Model Results and Lift Station Data

Station	Data Source		2019 Service Area (ac)	Average Daily Flow (Dry Weather) (mgd)	Peak Hour Flow (Wet Weather) (mgd)	Infiltration Value[3] (gal/ac/day)	Infiltration (gal/ac)	Peak Factor[4]
H-1	Daily LS Data	1	857	0.45	0.72		845	1.63
	Model Results	2		0.53	0.80	350.00	933	1.51
H-2	Daily LS Data	1	596	0.27	0.34		565	1.25
	Model Results	2		0.39	0.47	150.00	794	1.22
H-4	Daily LS Data	1	24	0.010	0.024		996	2.39
	Model Results	2		0.003	0.010	1000.00	399	2.99
H-5	Daily LS Data	1	330	0.13	0.16		473	1.22
	Model Results	2		0.15	0.20	150.00	613	1.31
Dakota	Daily LS Data	1	16	0.005	0.018		1,125	3.60
	Model Results	2		0.008	0.014	400.00	869	1.83

1. Data provided by HARSB from daily lift station pump operation times read from the period of January 1, 2012 to November 30, 2019.

2. Hydraulic model results from the 2019 Calibrated Model.

3. Value used in model analysis to generate wet weather flow.

4. Peak hour wet weather flow over average dry weather flow.

E.3.2 Calibration Results to Historical Flow Monitoring Data

The calibration was analyzed for all six flow monitoring sites. Calibration results are presented in **Figure E-2, Figure E-3, Figure E-4, Figure E-5, Figure E-6,** and **Figure E-7**. Each graph shows flow monitoring results for individual days, the average of the individual days, and the final dry weather and wet weather diurnal curves. Only one location included updated 2019 flow monitoring data as shown on **Table E-2**.

For reference, a summary of the flow monitoring locations and site identification numbers is provided in **Table E-2**. See **Appendix B** for more information on the flow monitoring process and results.

Table E-2 – Summary of Flow Monitoring Locations and Site Identification Numbers

Year	Site Number	Location	Basin
2019 and 2012	101	Reed Road South of Lacey Avenue	H-2
2012	102	Reed Road North of Honeysuckle Avenue	H-2
2012	103	Honeysuckle Avenue West of Davis (WalMart Signal)	H-2
2012	501	Government Way South of Dakota Avenue	H-1
2012	502	Honeysuckle Avenue East of Huntington Court	H-1
2012	503	Northwest of H-1 Lift Station	H-1

Data from each location and its calibration results is discussed below:

- **Site 101 Reed Road South of Lacey Avenue** – The model results for the wet and dry flow conditions appear on **Figure E-2.** The model results correlate very well to 2019 flow monitoring in both the daily diurnal as well as the peak hour. The flow monitoring data was obtained during the summer of 2019, during the dry weather conditions. The 2012 data is also included on **Figure E-2,** which shows the significant amount of growth in the upper extents of this basin.
- **Site 102 Reed Road North of Honeysuckle Avenue** – The model results for the wet and dry flow conditions appear on **Figure E-3.** This site compares the 2012 flow monitoring to the updated model results, as updated flow monitoring was not obtained. The comparison is reasonable and demonstrates the increase of flow in the basin.
- **Site 103 Honeysuckle Avenue West of Davis (WalMart Signal)** – The model results for the wet and dry flow conditions appear on **Figure E-4.** This site compares the 2012 flow monitoring to the updated model results, as updated flow monitoring was not obtained. The comparison is reasonable and demonstrates the increase of flow in the basin. This location is immediately upstream of the H-2 Lift Station and obtains flow from nearly the entire basin. Basin-wide calibration is quantified above in **Table E-1.**
- **Site 501 Government Way South of Dakota Avenue** – The model results for the wet and dry flow conditions appear on **Figure E-5.** This site compares the 2012 flow monitoring to the updated model results, as updated flow monitoring was not obtained. The comparison is reasonable and demonstrates the increase of flow in the upper extents of the Government Way Corridor.
- **Site 502 Honeysuckle Avenue East of Huntington Court** – The model results for the wet and dry flow conditions appear on **Figure E-6.** This site compares the 2012 flow monitoring to the updated model results, as updated flow monitoring was not obtained. The comparison is reasonable. The results demonstrate a decrease in flow from the 2012 flow monitoring,

attributed to the Hayden Elementary lift station elimination that occurred following the 2012 Master Plan.

- **Site 503 Northwest of H-1 Lift Station** – The model results for the wet and dry flow conditions appear on **Figure E-7.** This site compares the 2012 flow monitoring to the updated model results, as updated flow monitoring was not obtained. The comparison is reasonable. The results demonstrate a significant increase in flow since the 2012 flow monitoring, attributed to the Hayden Elementary lift station elimination. That project occurred following the 2012 Master Plan (and the 2012 flow data) and redirected a significant amount of the Government Way flow east on Hayden Avenue. This location is immediately upstream of the H-1 Lift Station and flow from one of the major sub-basins into the lift station. Basin-wide calibration for the H-1 basin is quantified above in **Table E-1.**

Figure E-2 – Calibration Results for Site 101

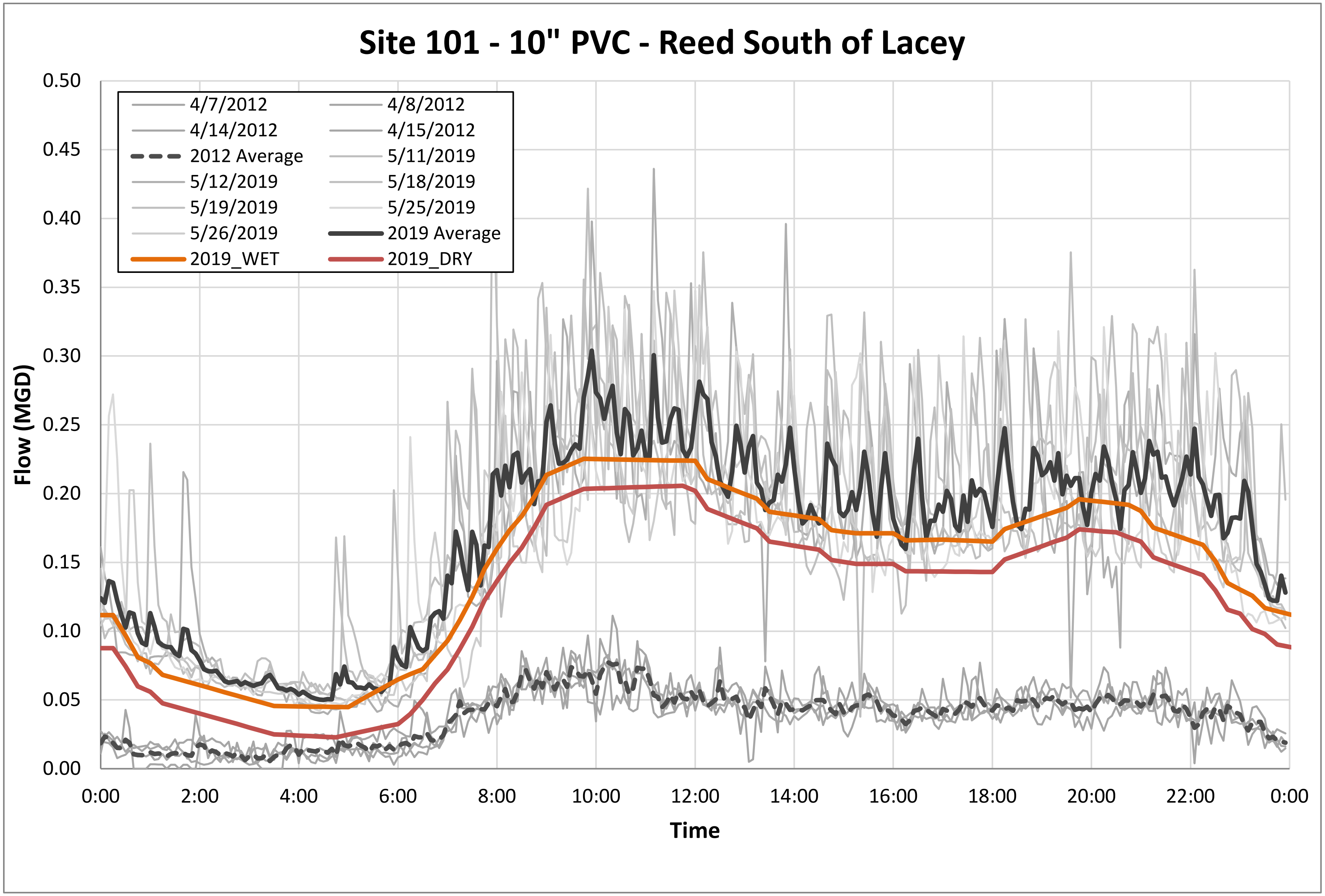


Figure E-3 – Calibration Results for Site 102

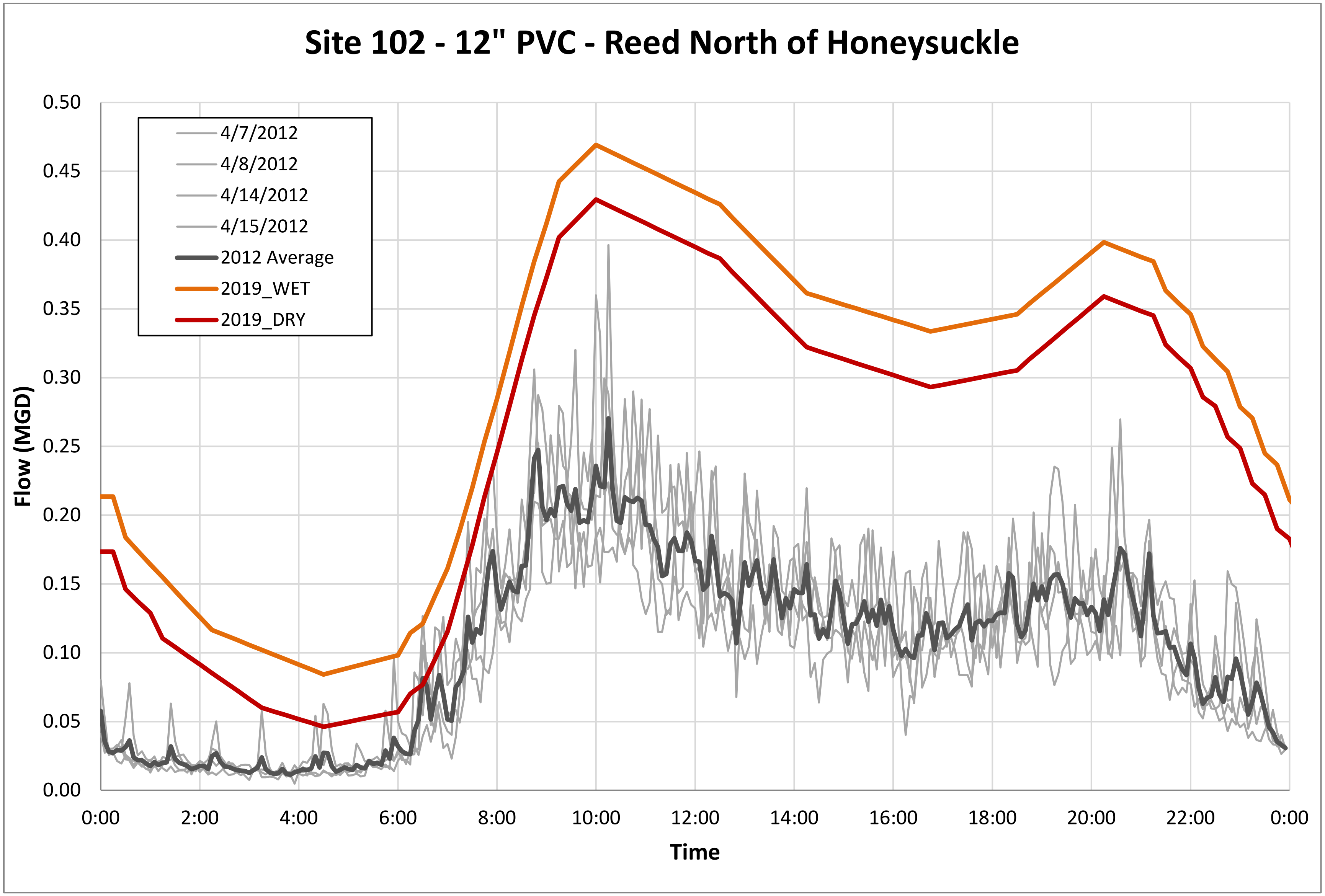


Figure E-4 – Calibration Results for Site 103

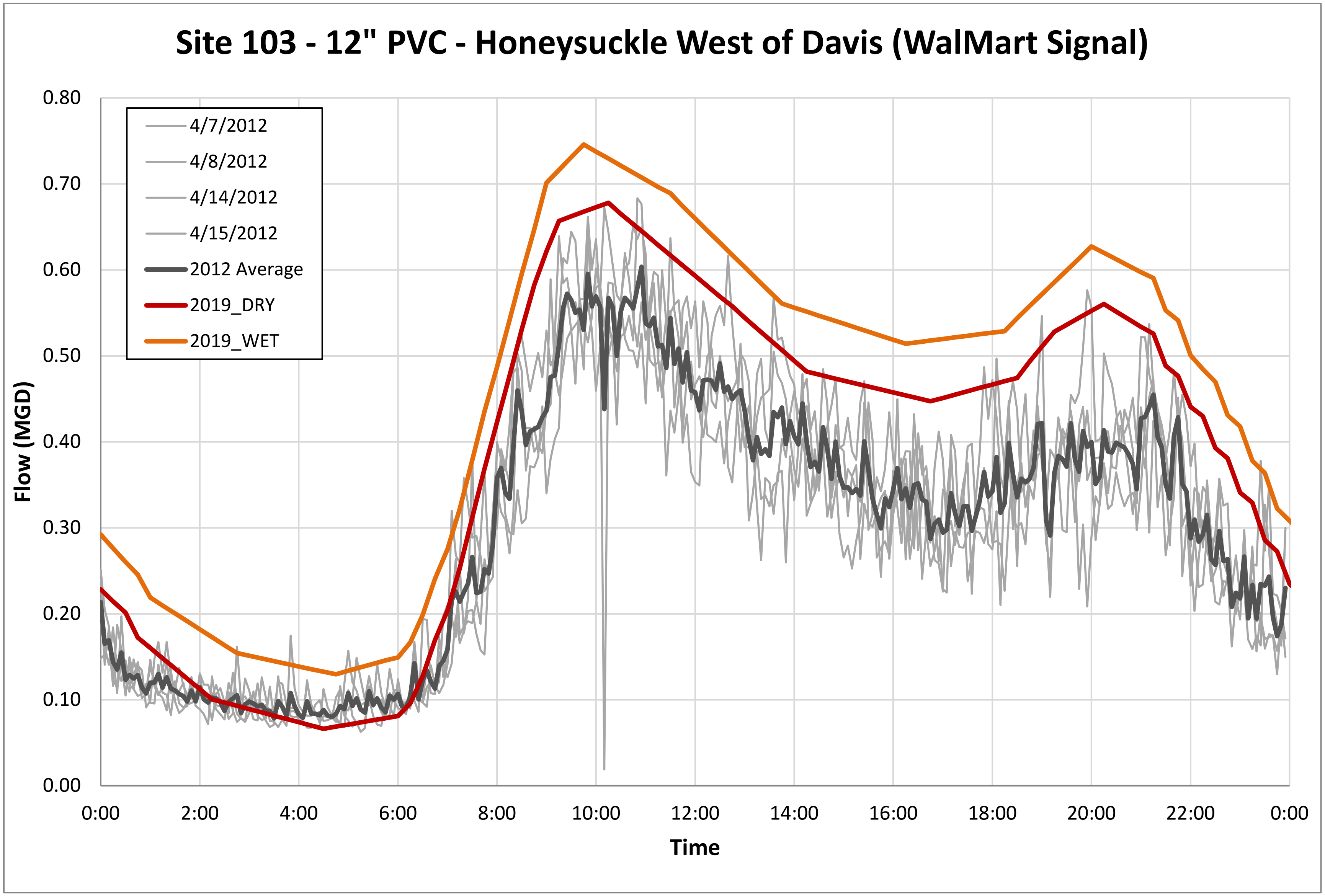


Figure E-5 – Calibration Results for Site 501

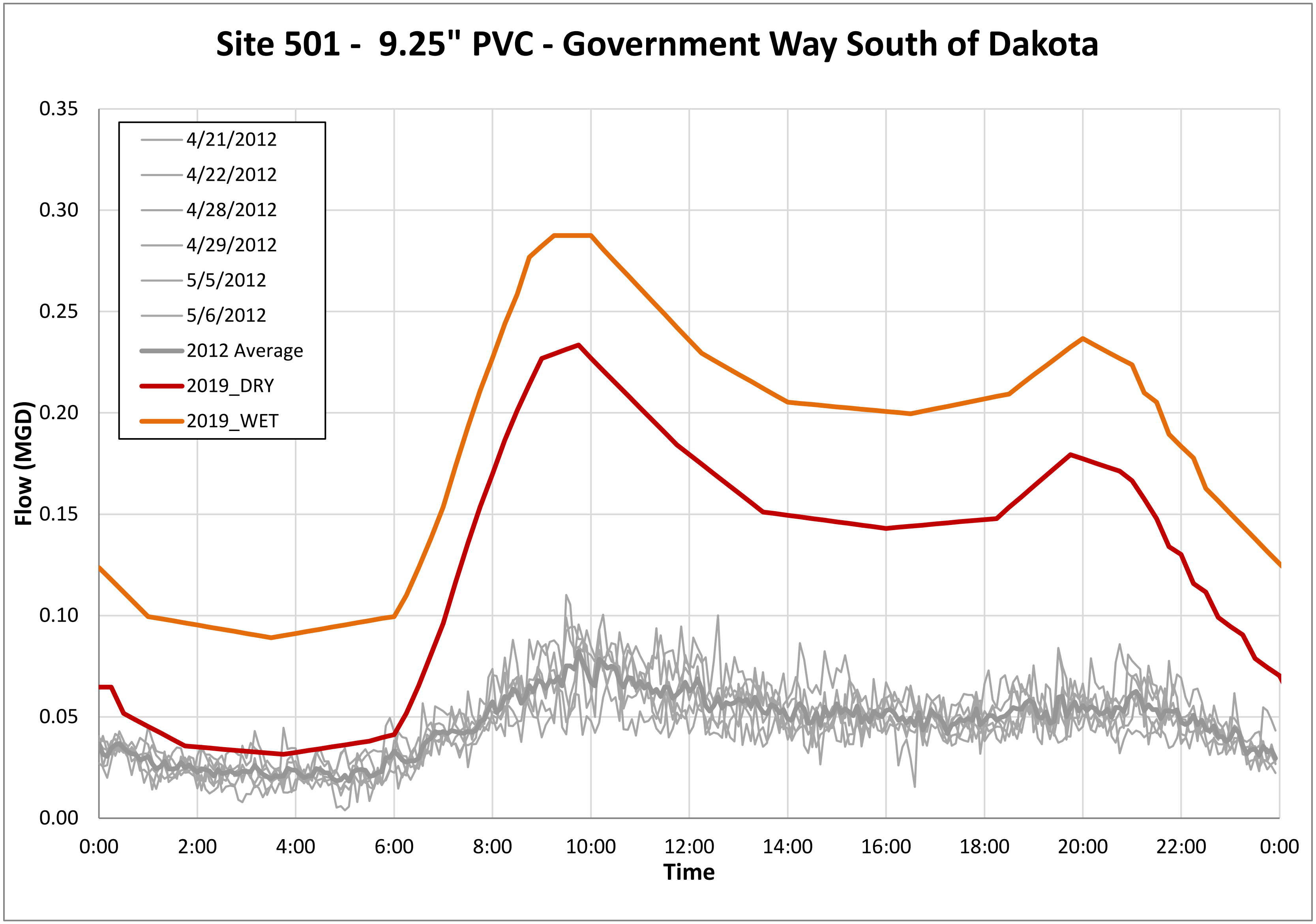


Figure E-6 – Calibration Results for Site 502

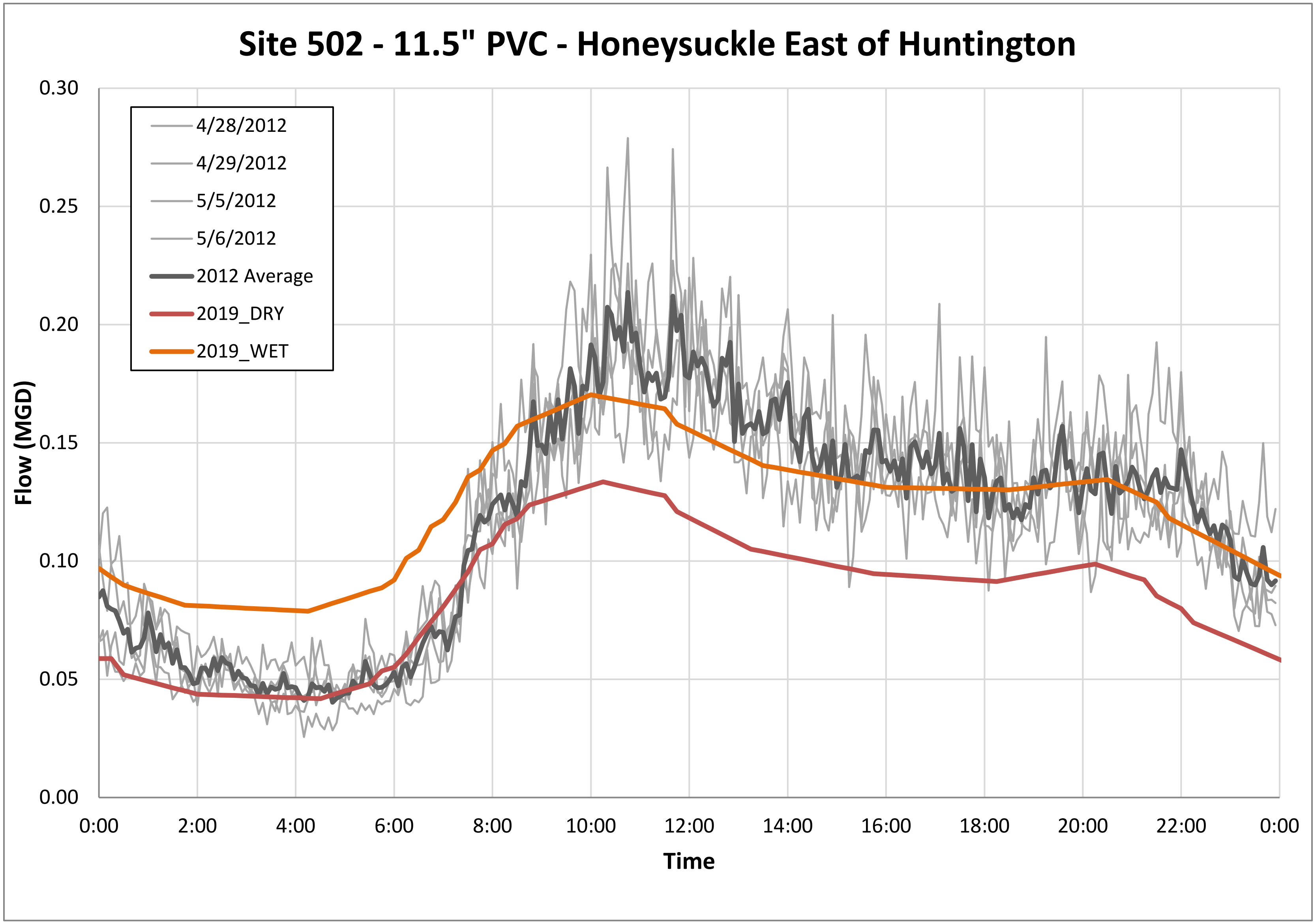


Figure E-7 – Calibration Results for Site 503