

APPENDIX B

V&A Flow Monitoring Reports

- B.1 V&A Flow Monitoring Site Reports: Data, Graphs, Information (Appendix A) November 22 – December 26, 2019
- B.2 V&A City of Merced – Sanitary Sewer Flow Monitoring Study Report (February 2022)



City of Merced

Sanitary Sewer Flow Monitoring

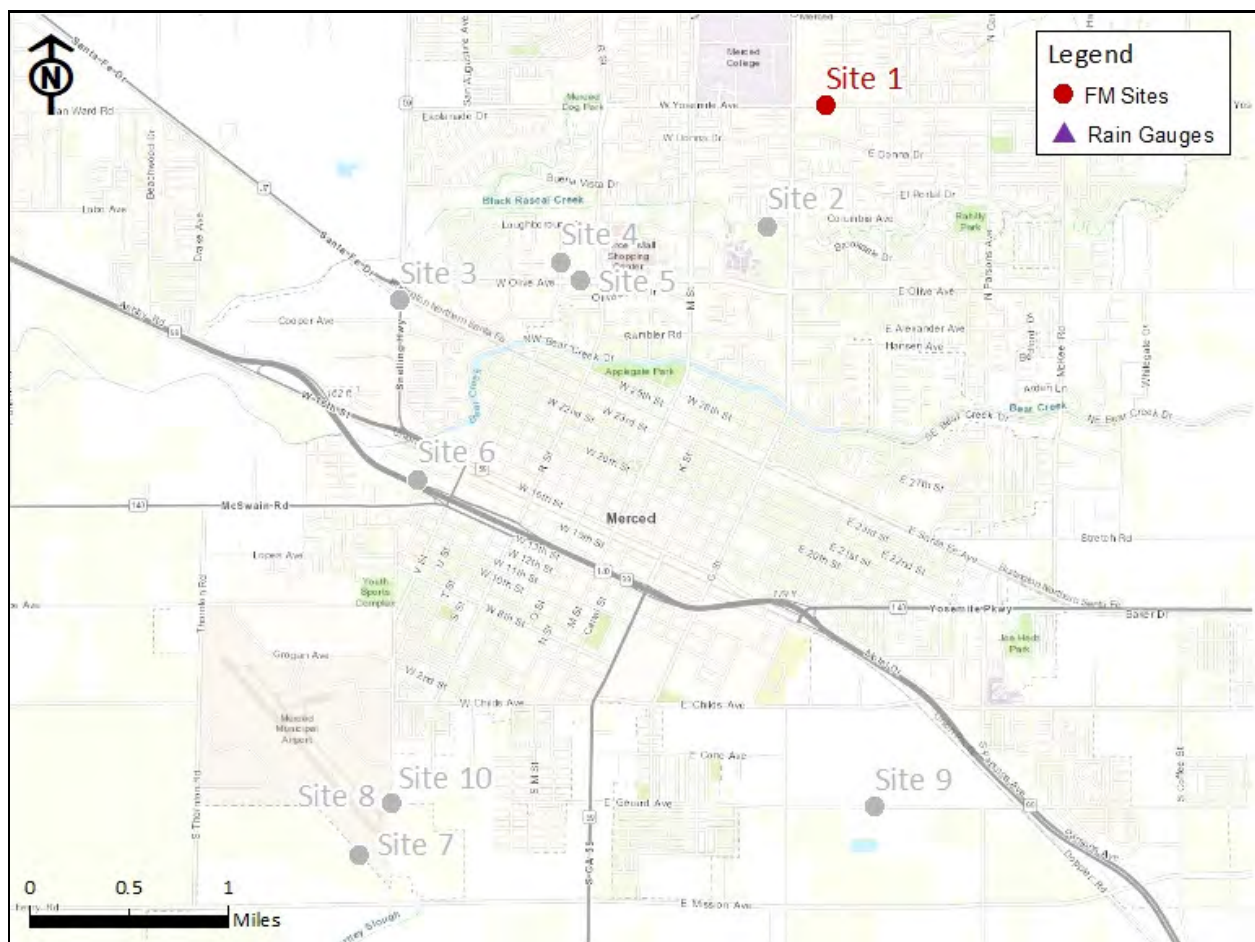
November 22 - December 26, 2019

Monitoring Site: Site 1

City Manhole: 1M149

Location: E Yosemite Avenue, east of G Street

Data Summary Report



Vicinity Map: Site 1

SITE 1

Site Information

Location: E Yosemite Avenue, east of G Street

City Manhole: 1M149

Coordinates: 120.4660° W, 37.3322° N

Rim Elevation (Earth): 179 feet

Pipe Diameter: 16 inches

ADWF: 0.380 mgd

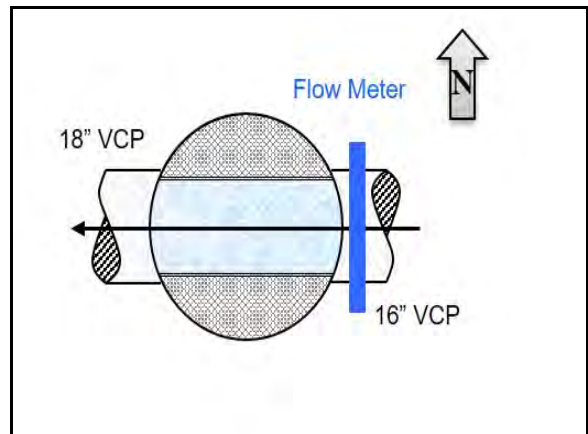
Peak Measured Flow: 1.115 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 1

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

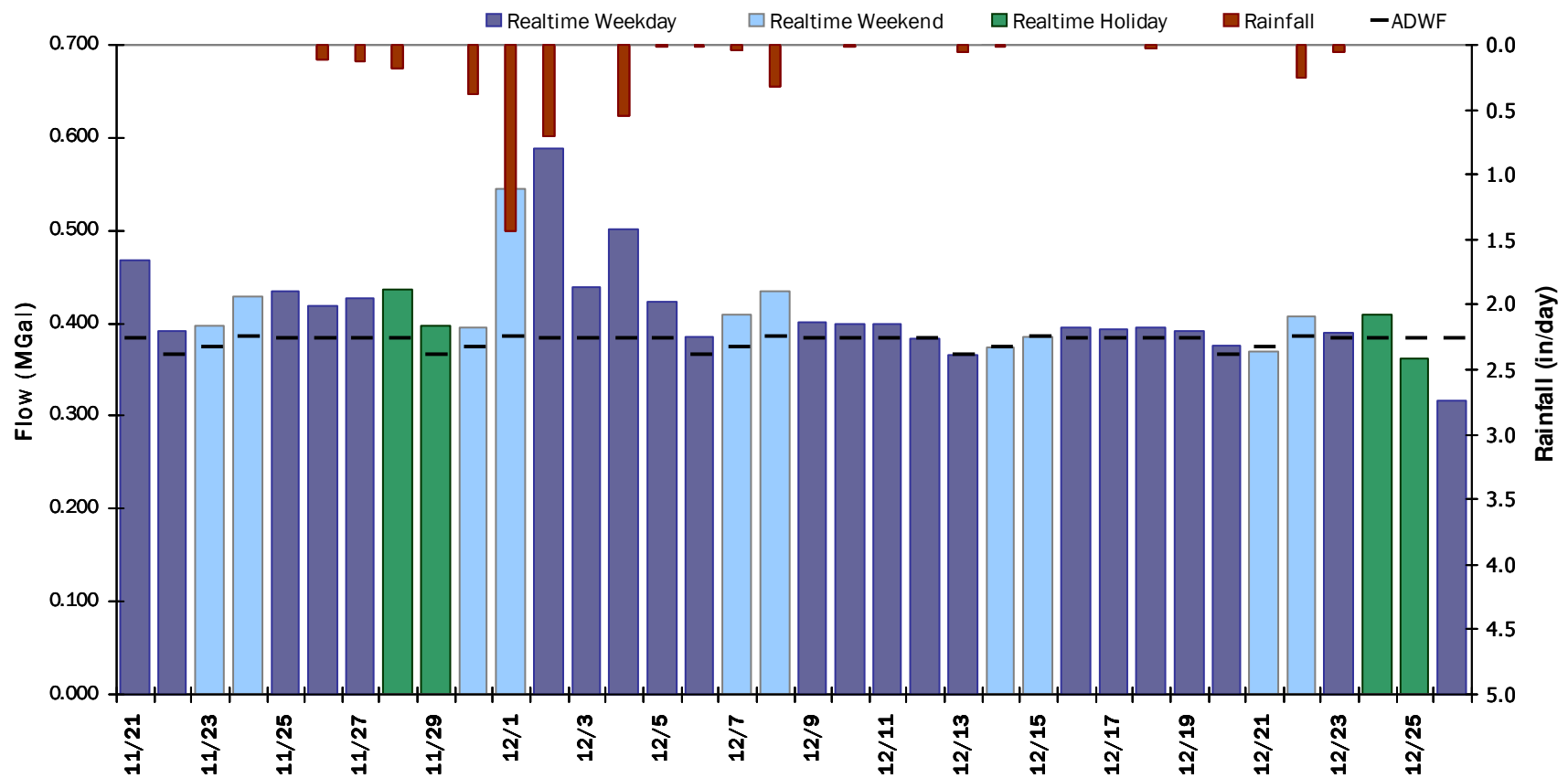


SITE 1

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.412 MGal Peak Daily Flow: 0.588 MGal Min Daily Flow: 0.317 MGal

Total Period Rainfall: 4.27 inches



SITE 1

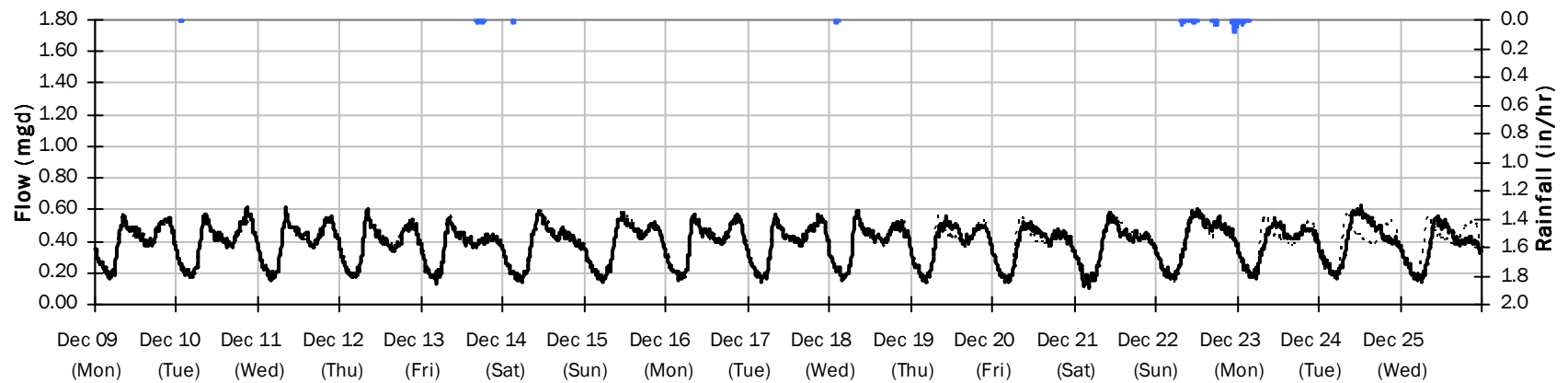
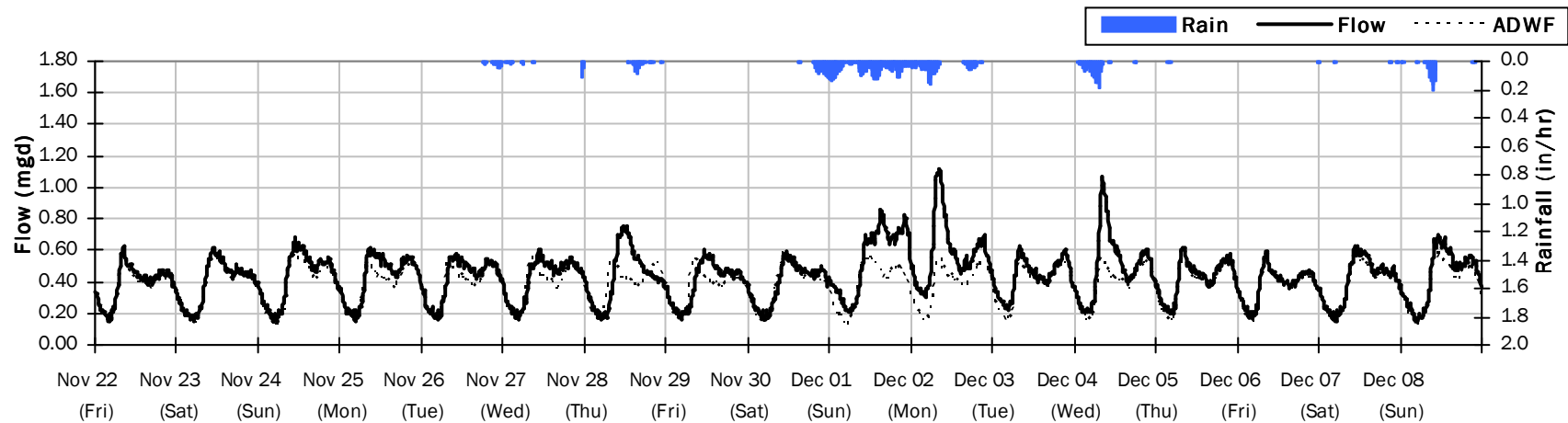
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.27 inches

Avg Flow: 0.413 mgd

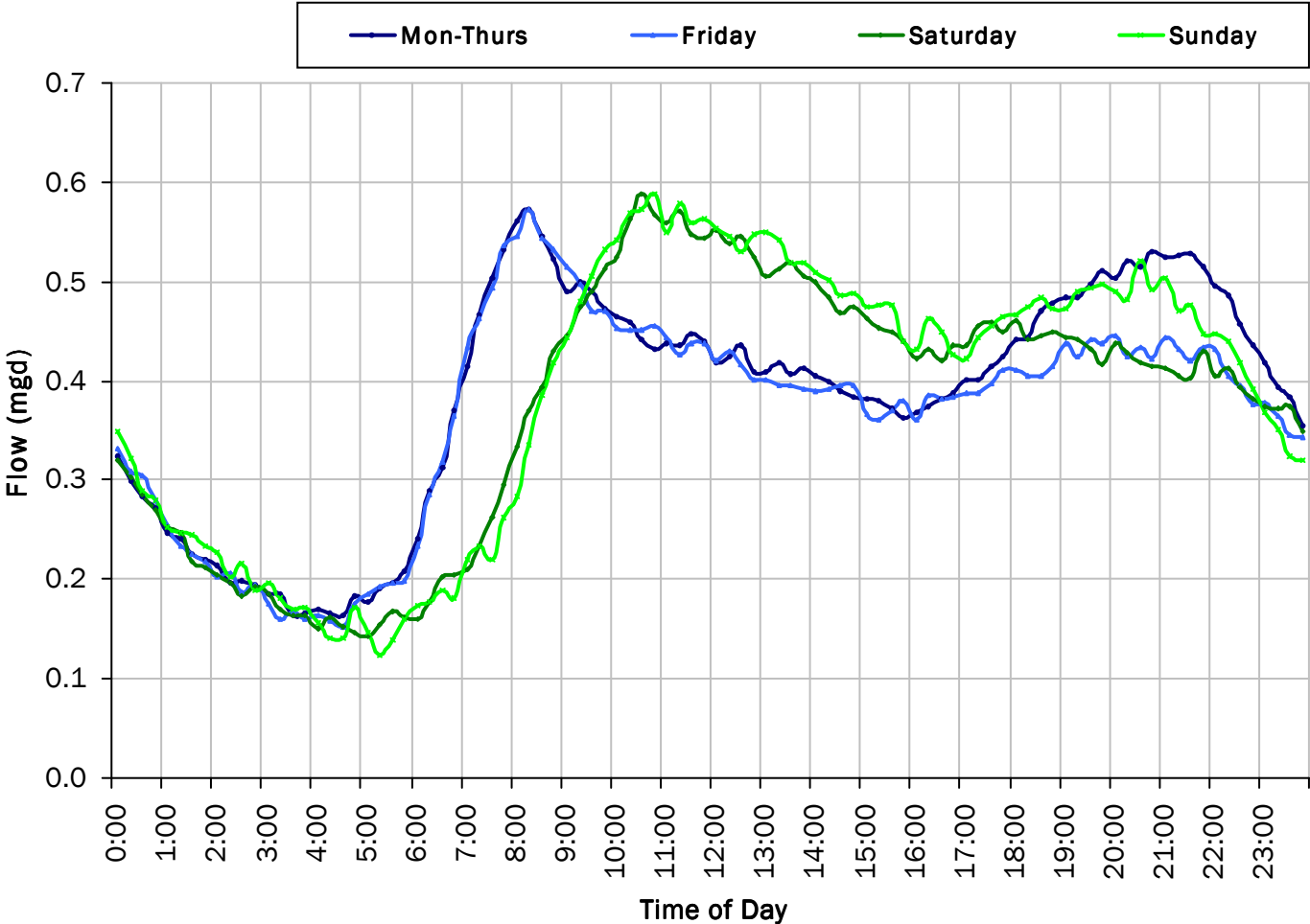
Peak Flow: 1.115 mgd

Min Flow: 0.104 mgd

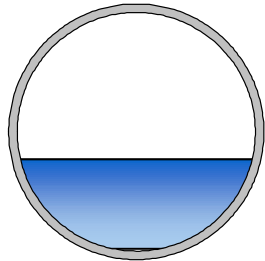


SITE 1

Average Dry Weather Flow Hydrographs

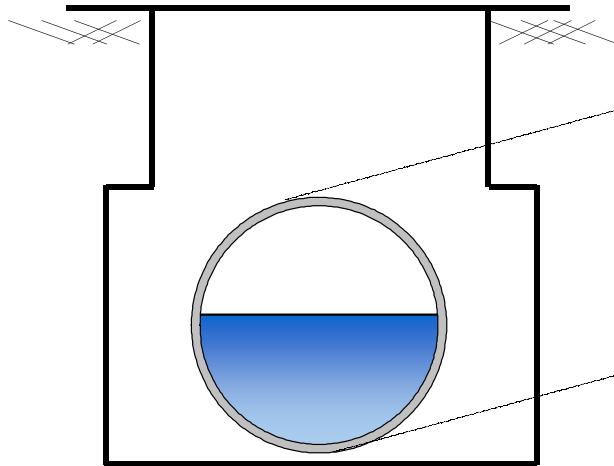
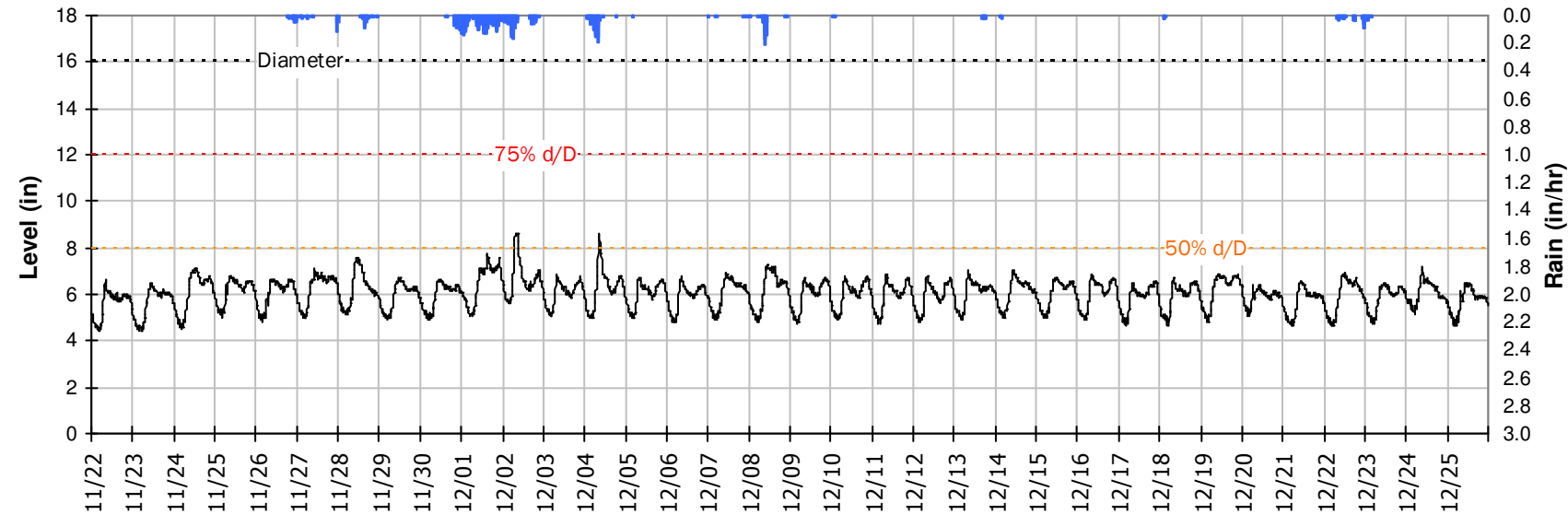


ADWF:
0.380 mgd



SITE 1
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

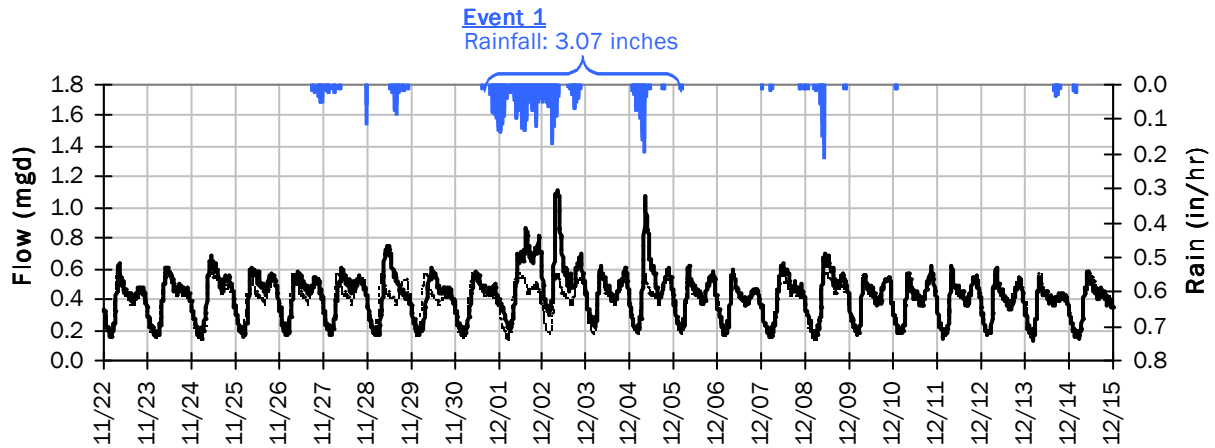


Pipe Diameter: 16 inches
Peak Measured Level: 8.61 inches
Peak d/D Ratio: 0.54

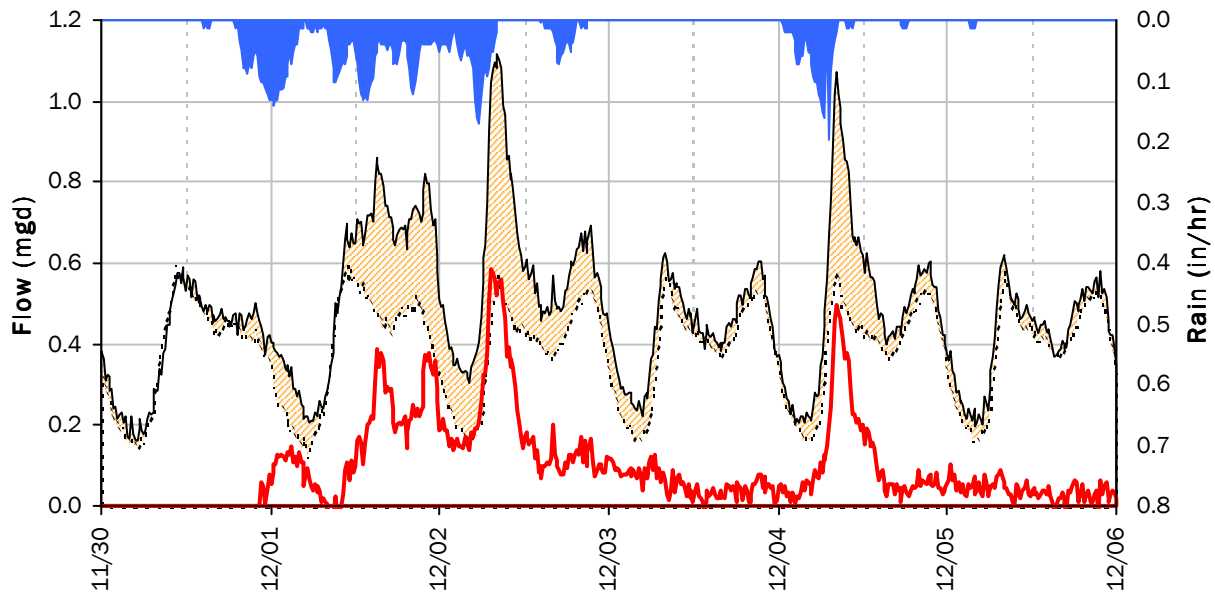
SITE 1

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.07 inches)

Capacity

Peak Flow: 1.12 mgd
PF: 2.93
Peak Level: 8.61 in
d/D Ratio: 0.54

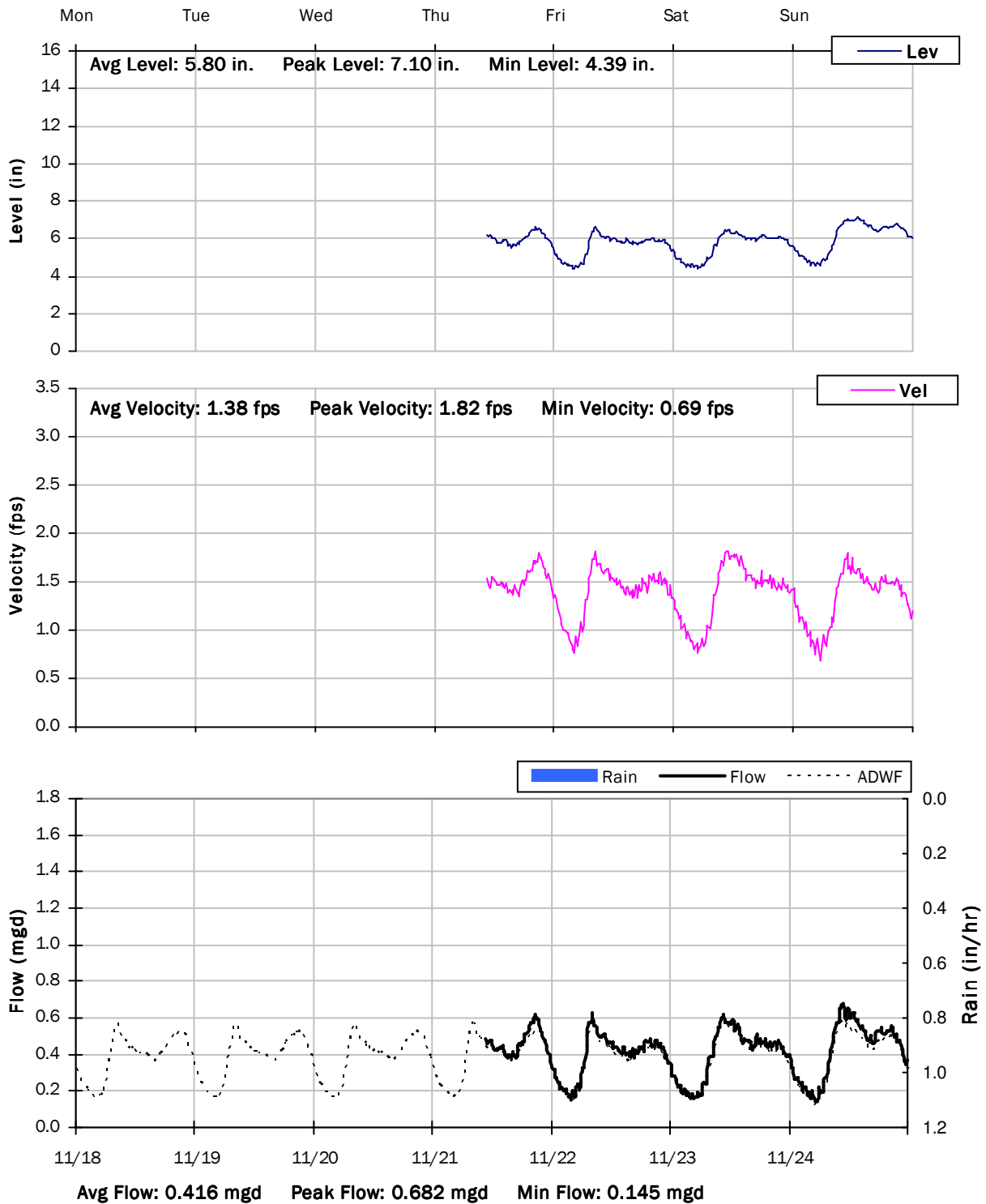
Inflow / Infiltration

Peak I/I Rate: 0.58 mgd
Total I/I: 575,000 gallons

SITE 1

Weekly Level, Velocity and Flow Hydrographs

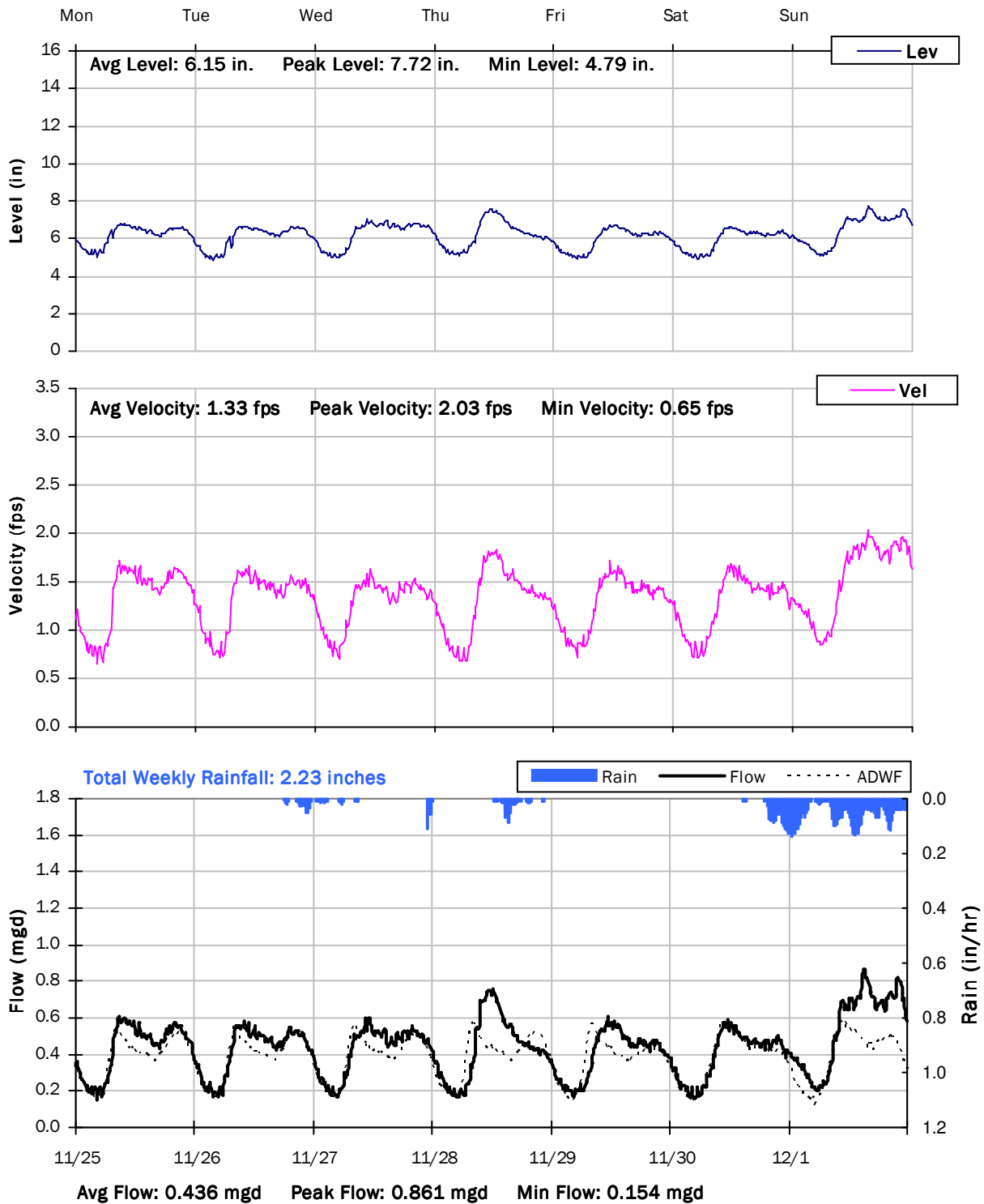
11/18/2019 to 11/25/2019



SITE 1

Weekly Level, Velocity and Flow Hydrographs

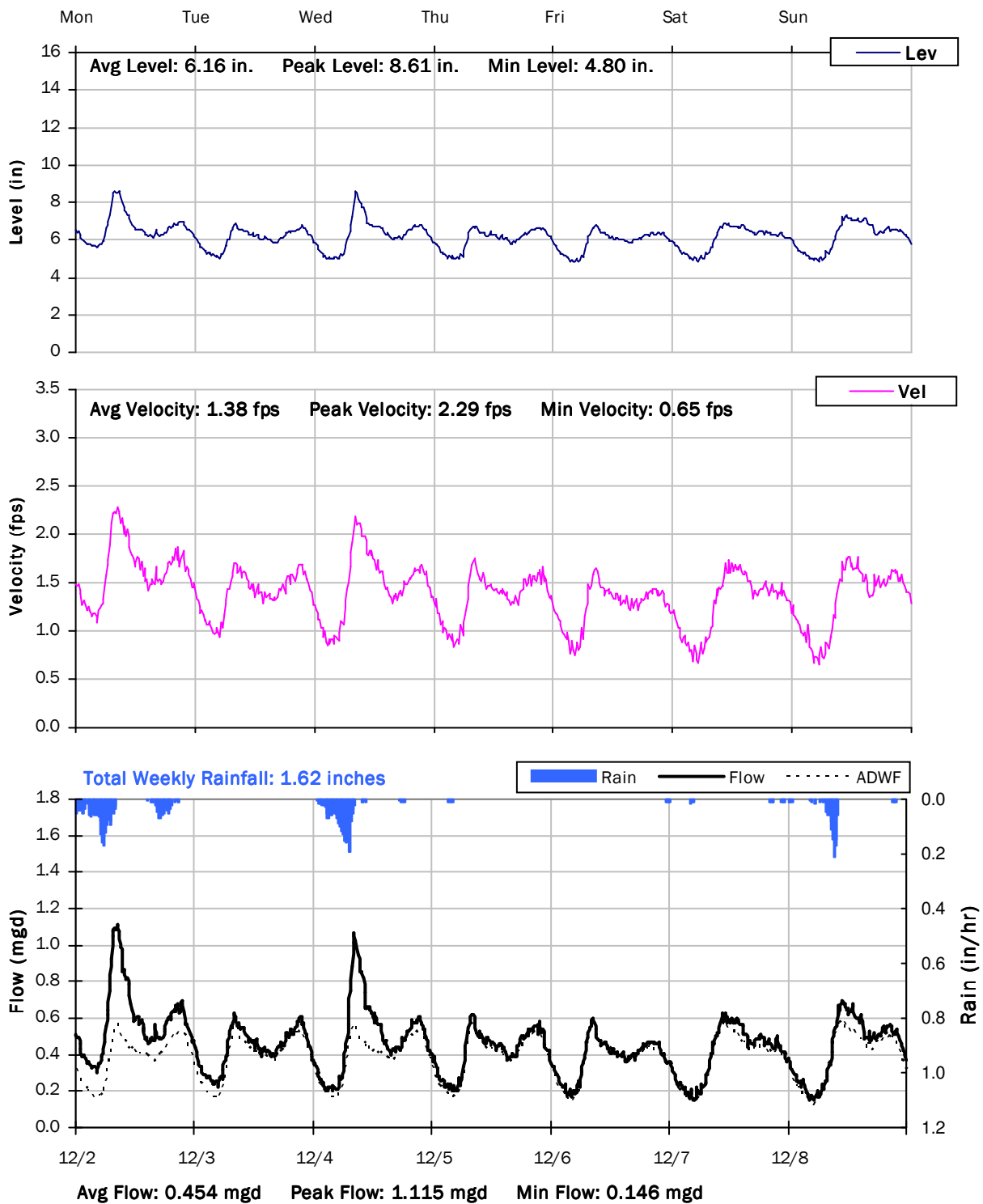
11/25/2019 to 12/2/2019



SITE 1

Weekly Level, Velocity and Flow Hydrographs

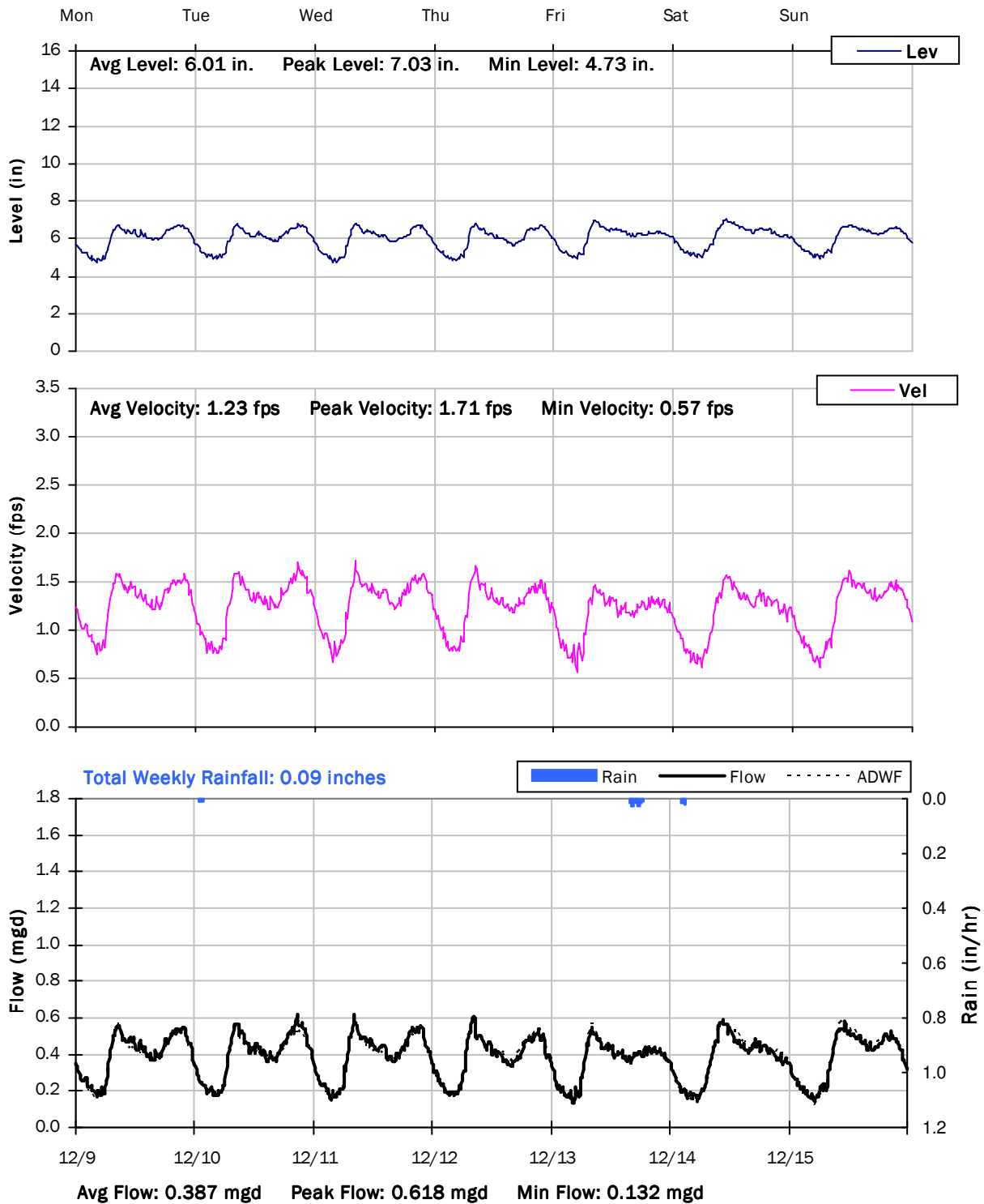
12/2/2019 to 12/9/2019



SITE 1

Weekly Level, Velocity and Flow Hydrographs

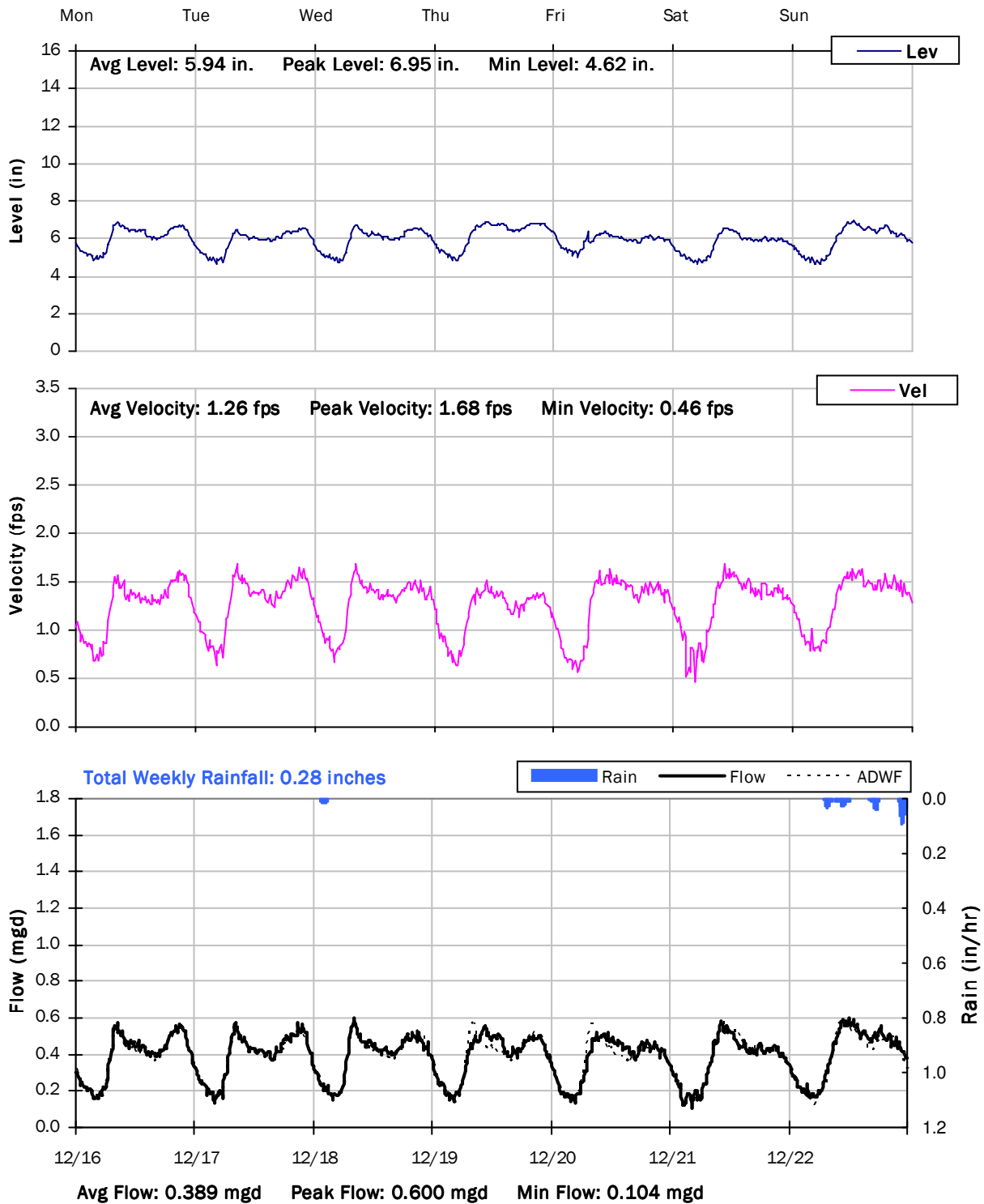
12/9/2019 to 12/16/2019



SITE 1

Weekly Level, Velocity and Flow Hydrographs

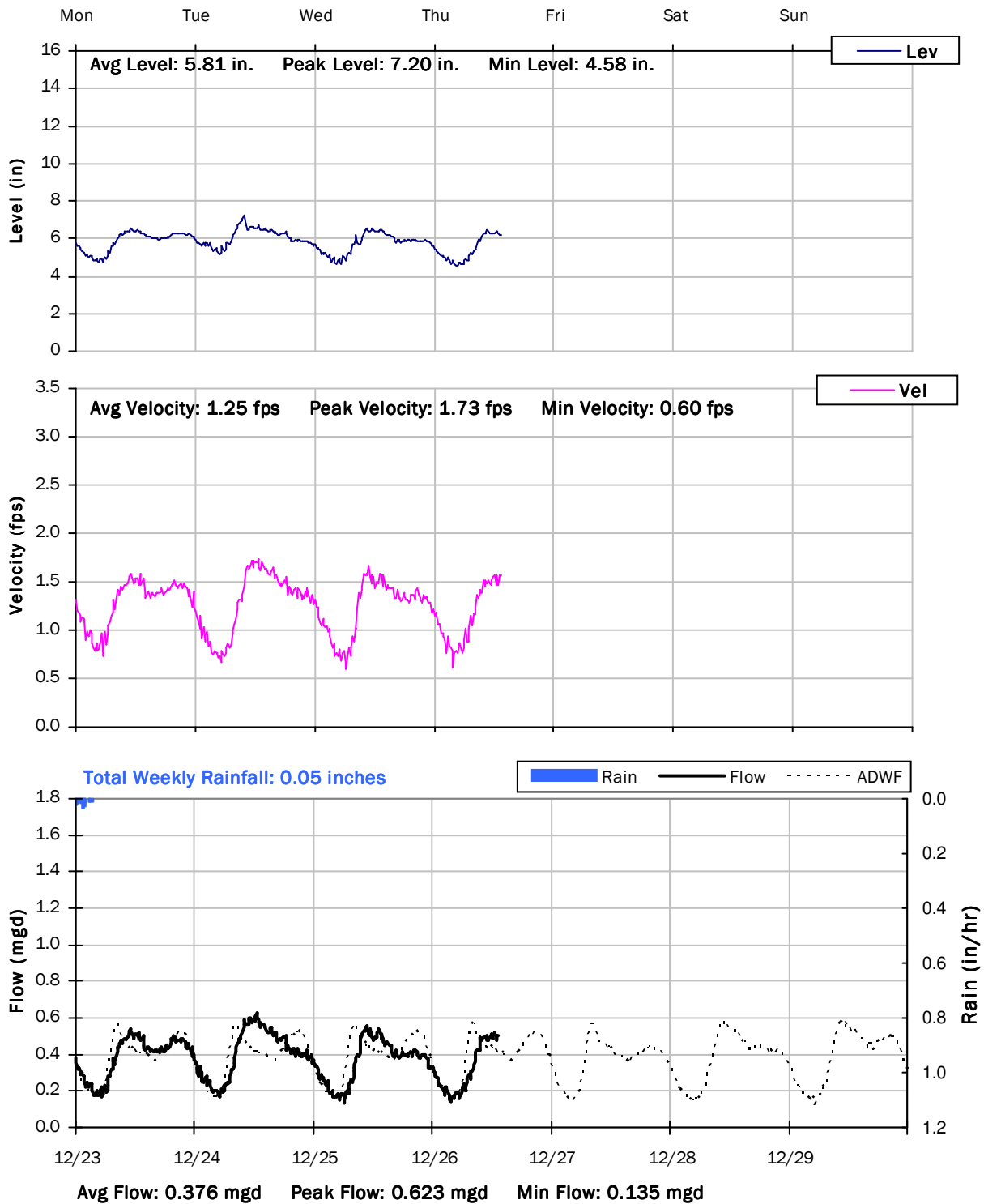
12/16/2019 to 12/23/2019



SITE 1

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

November 22 - December 26, 2019

Monitoring Site: Site 2

City Manhole: 5M040

Location: Side of path next to 3167 Campus Drive

Data Summary Report



Vicinity Map: Site 2

SITE 2

Site Information

Location: Side of path next to 3167 Campus Drive

City Manhole: 5M040

Coordinates: 120.4715° W, 37.3232° N

Rim Elevation (Earth): 178 feet

Pipe Diameter: 30 inches

ADWF: 1.033 mgd

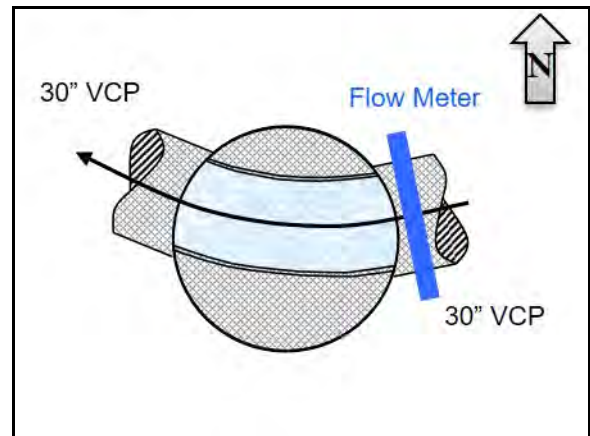
Peak Measured Flow: 2.340 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 2

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

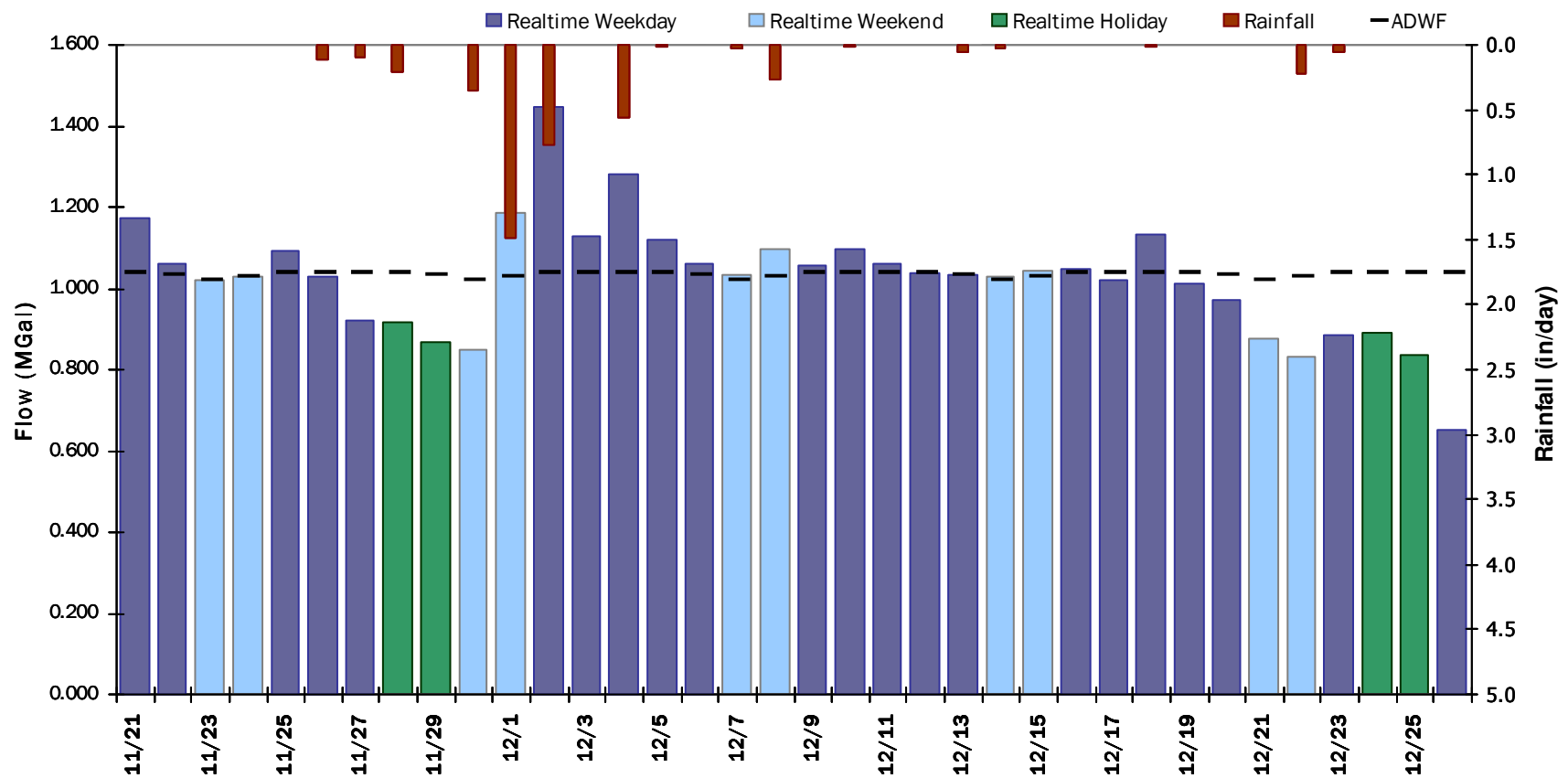


SITE 2

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 1.023 MGal Peak Daily Flow: 1.447 MGal Min Daily Flow: 0.653 MGal

Total Period Rainfall: 4.32 inches



SITE 2

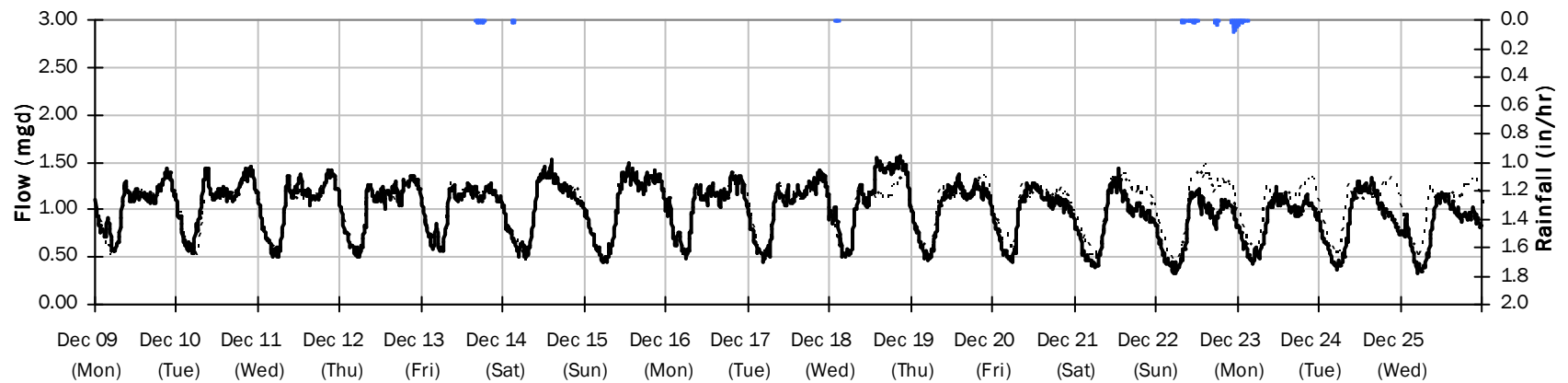
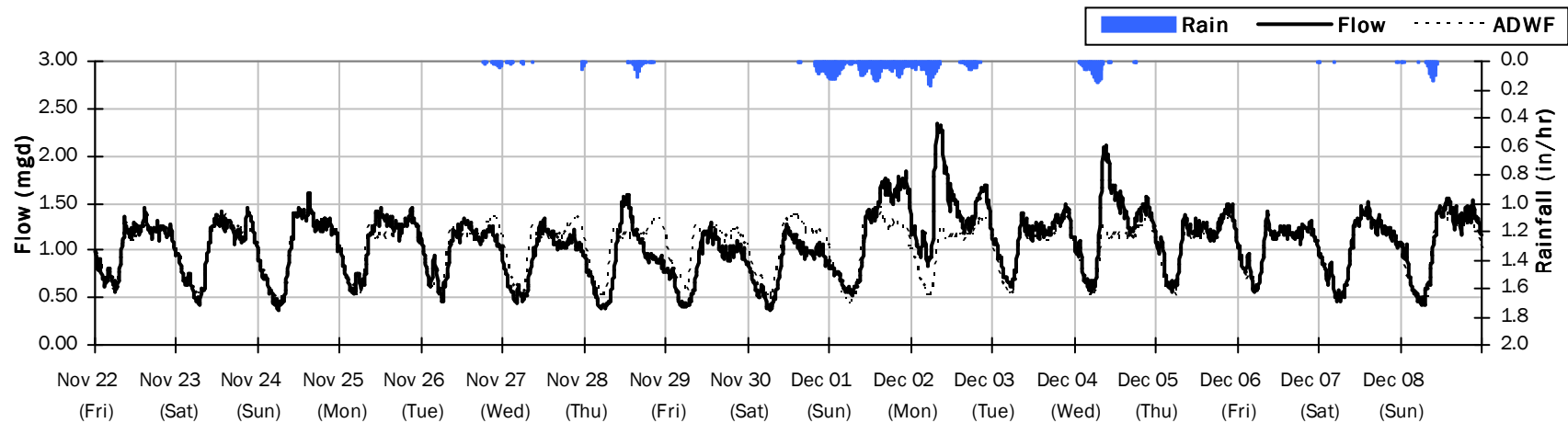
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.32 inches

Avg Flow: 1.029 mgd

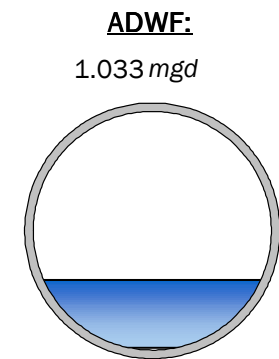
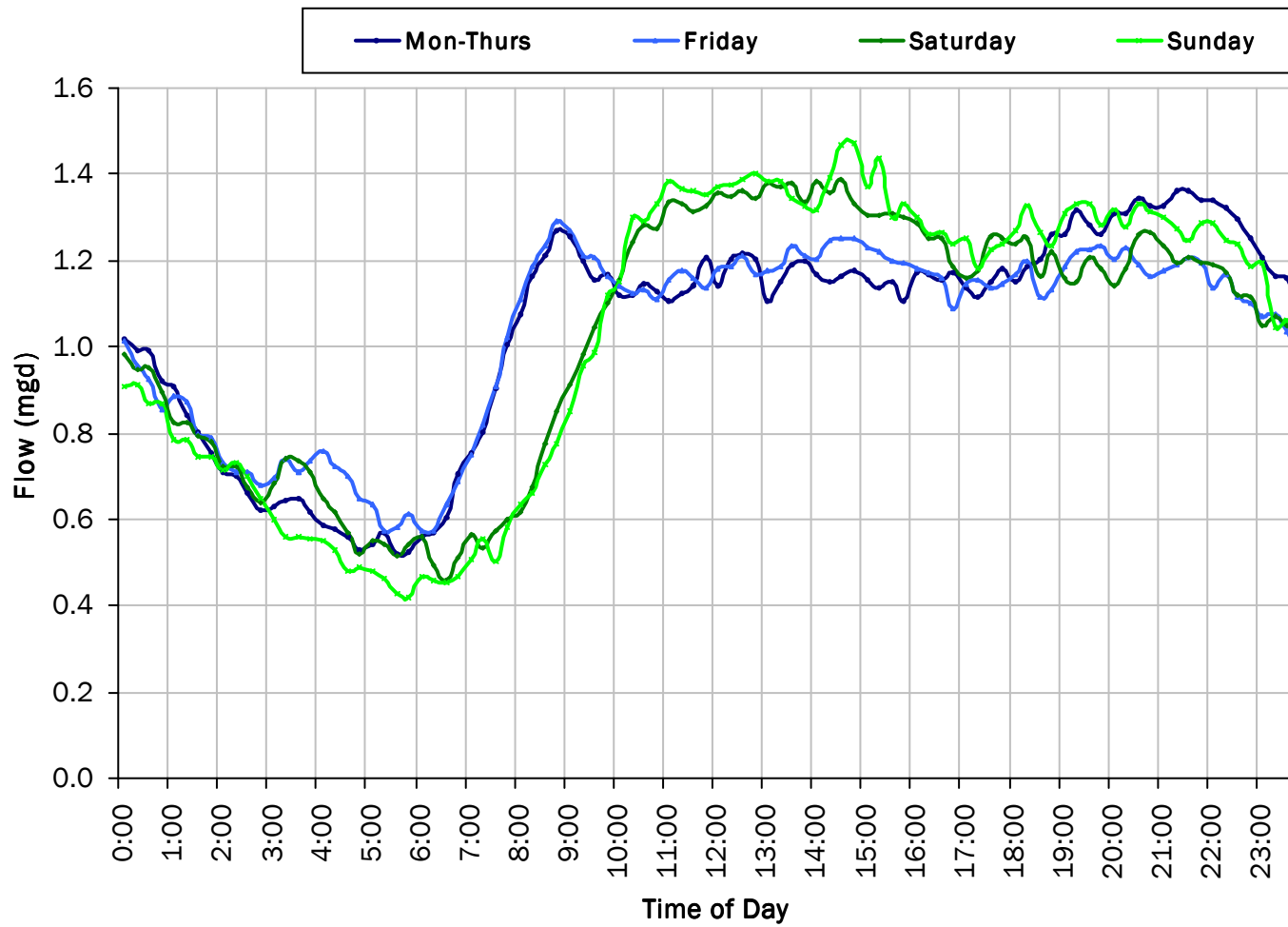
Peak Flow: 2.340 mgd

Min Flow: 0.323 mgd



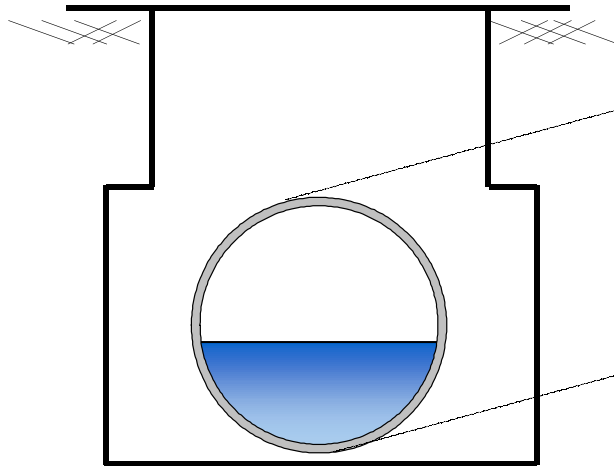
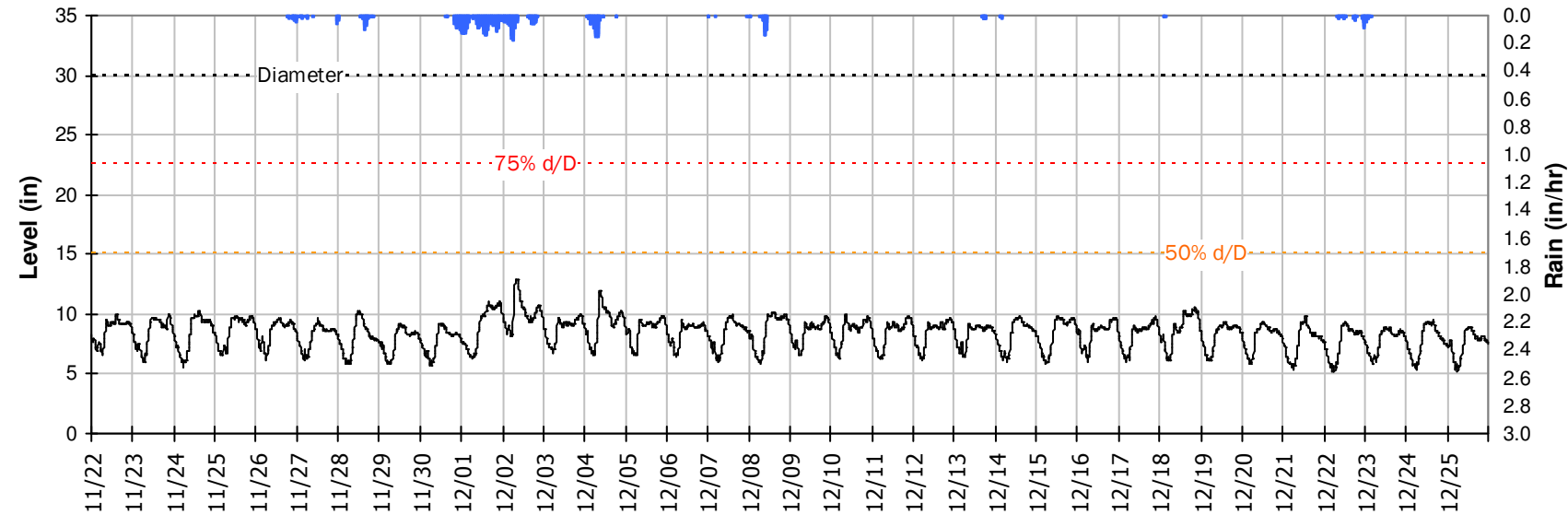
SITE 2

Average Dry Weather Flow Hydrographs



SITE 2
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

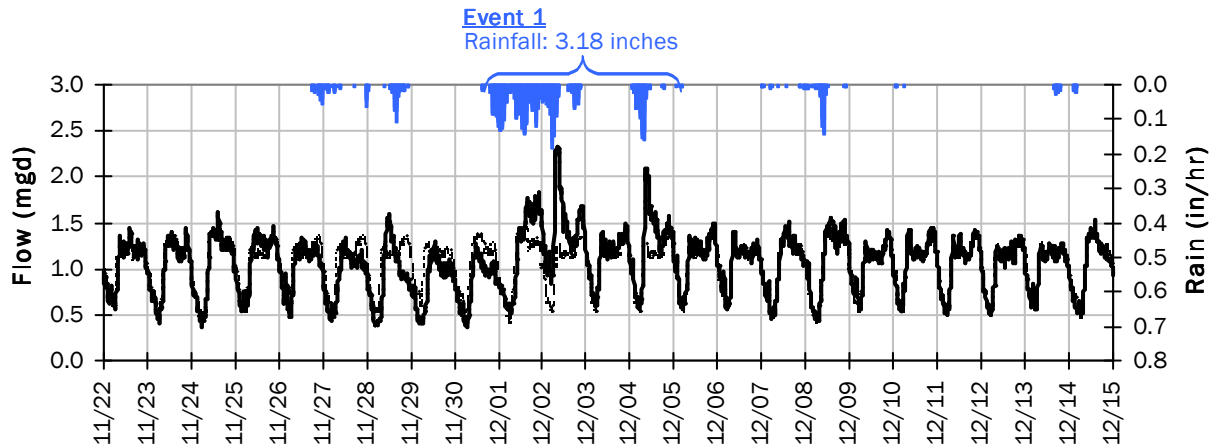


Pipe Diameter: 30 inches
Peak Measured Level: 12.9 inches
Peak d/D Ratio: 0.43

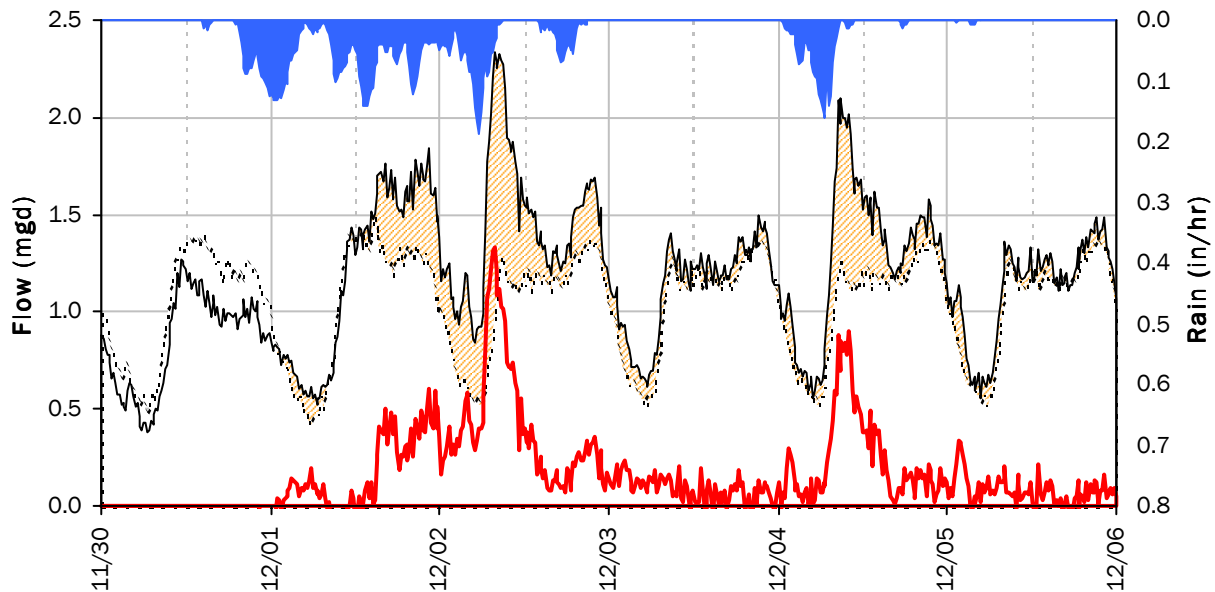
SITE 2

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.18 inches)

Capacity

Peak Flow: 2.34 mgd
PF: 2.26

Peak Level: 12.90 in
d/D Ratio: 0.43

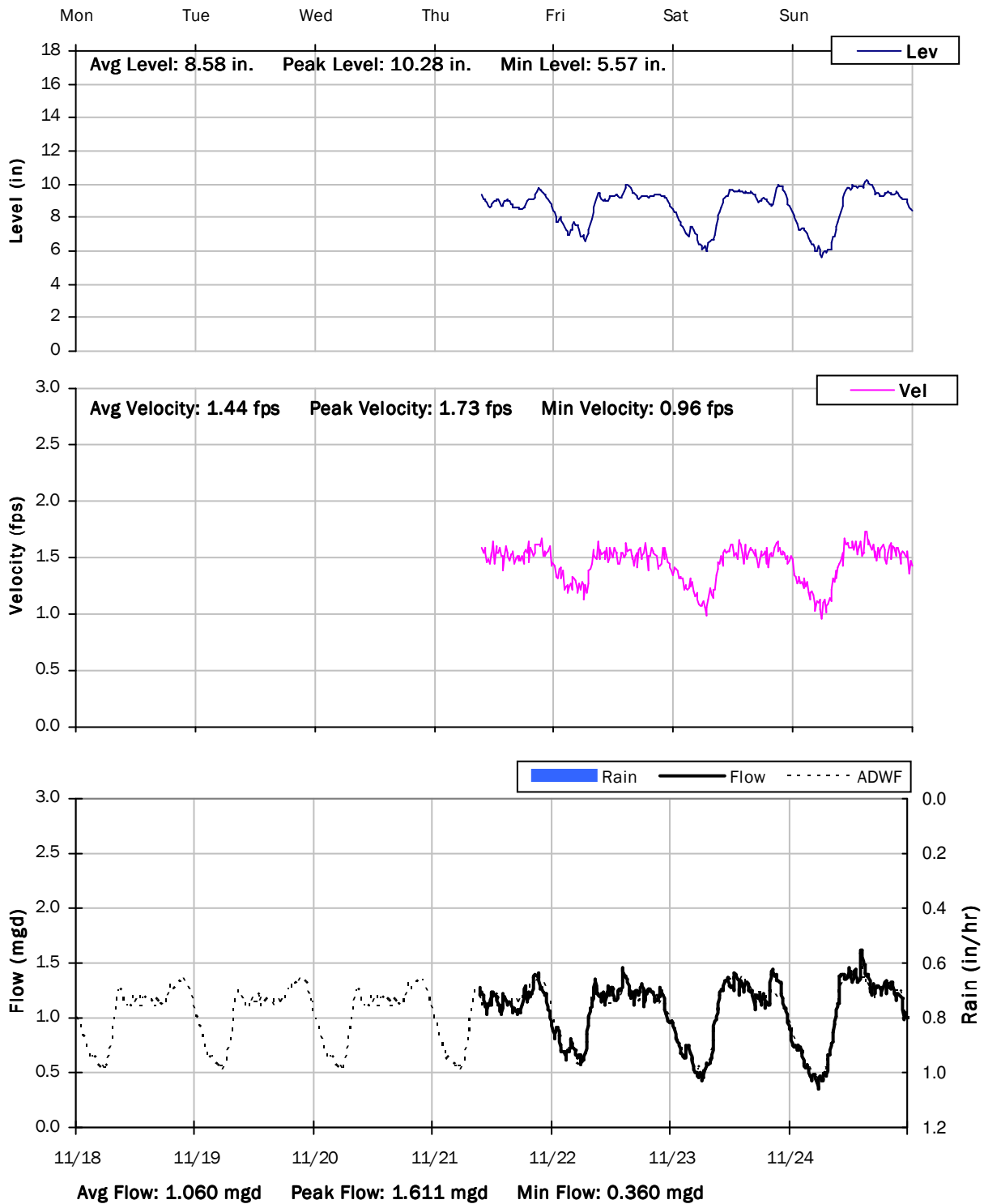
Inflow / Infiltration

Peak I/I Rate: 1.33 mgd
Total I/I: 973,000 gallons

SITE 2

Weekly Level, Velocity and Flow Hydrographs

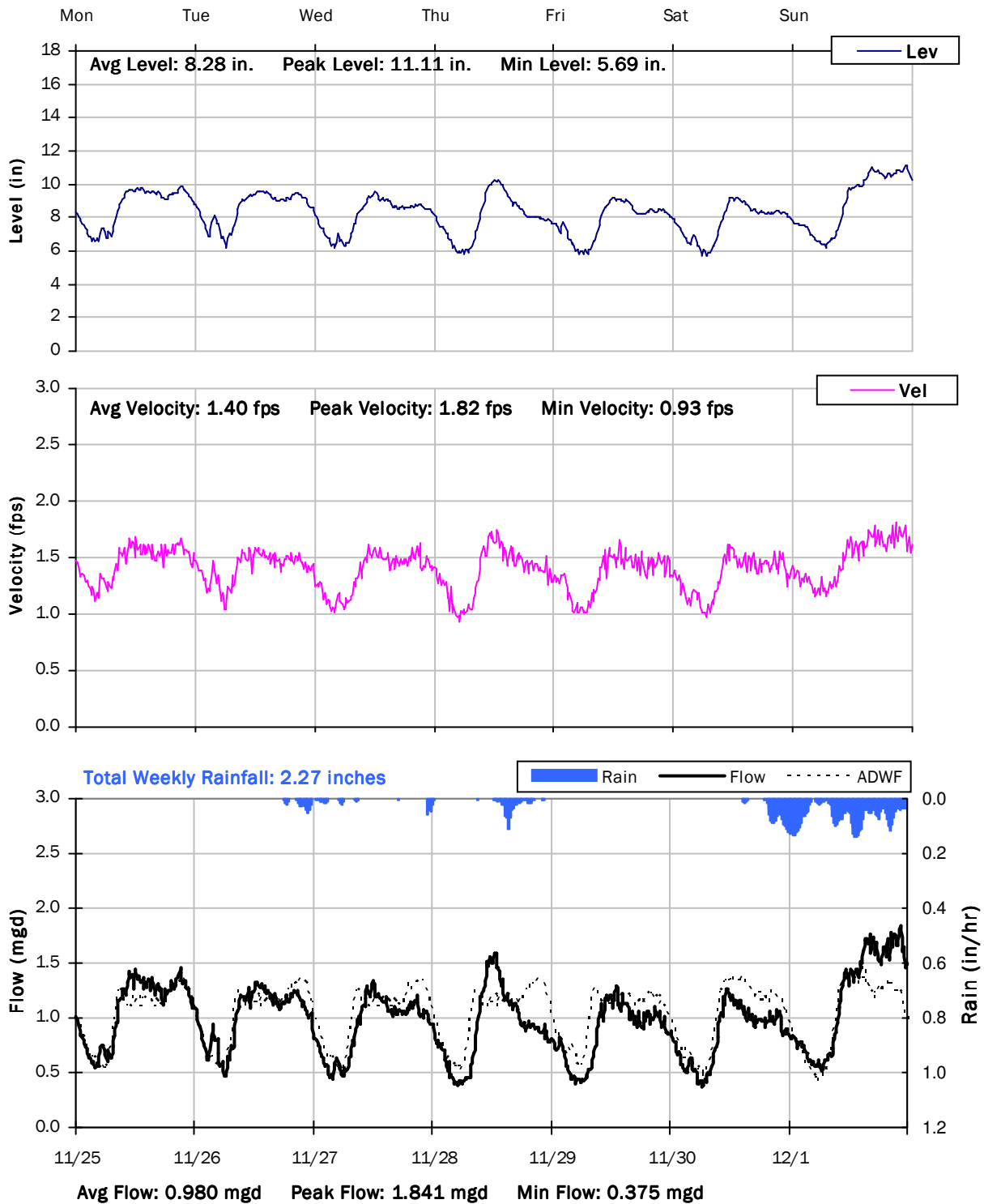
11/18/2019 to 11/25/2019



SITE 2

Weekly Level, Velocity and Flow Hydrographs

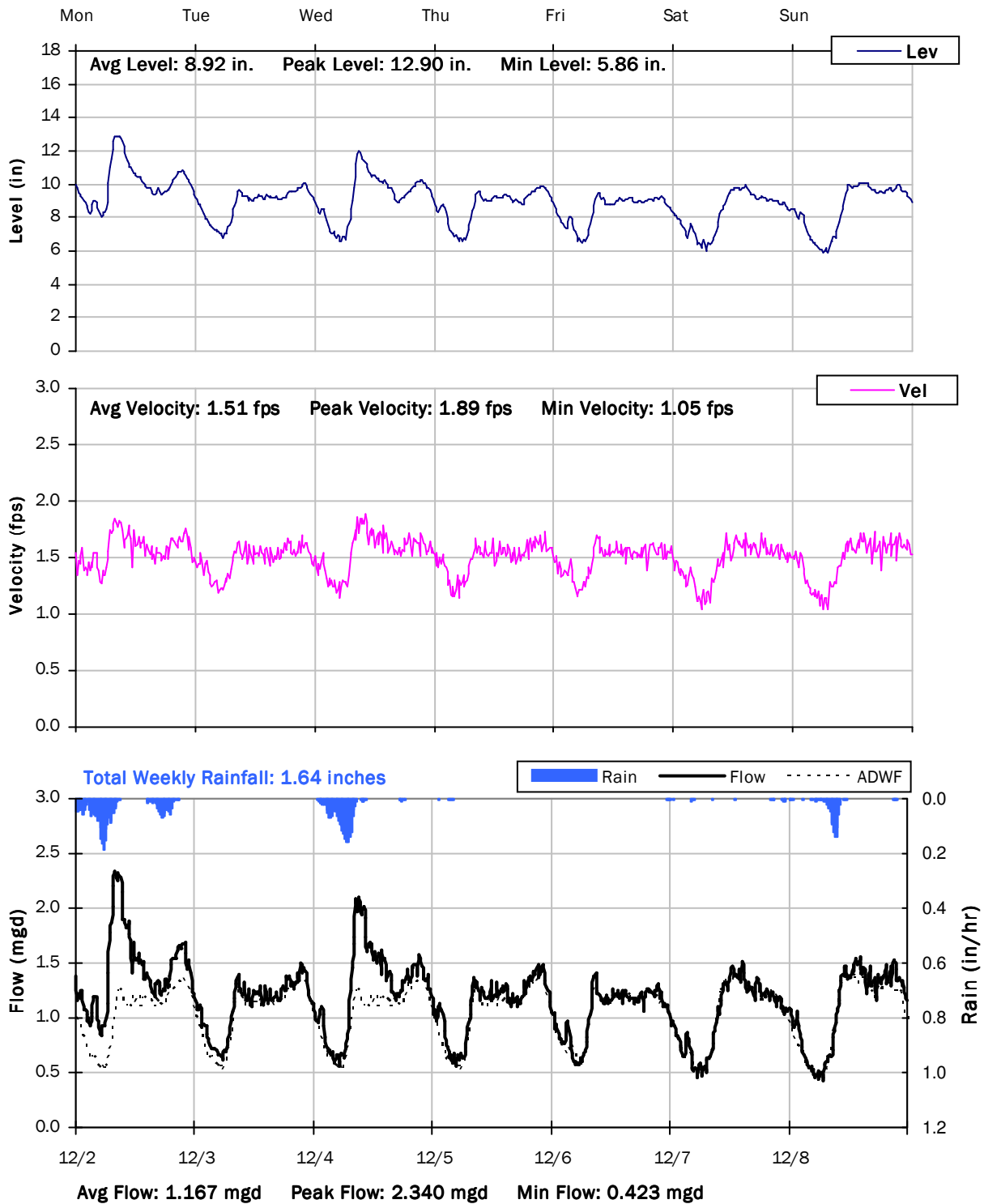
11/25/2019 to 12/2/2019



SITE 2

Weekly Level, Velocity and Flow Hydrographs

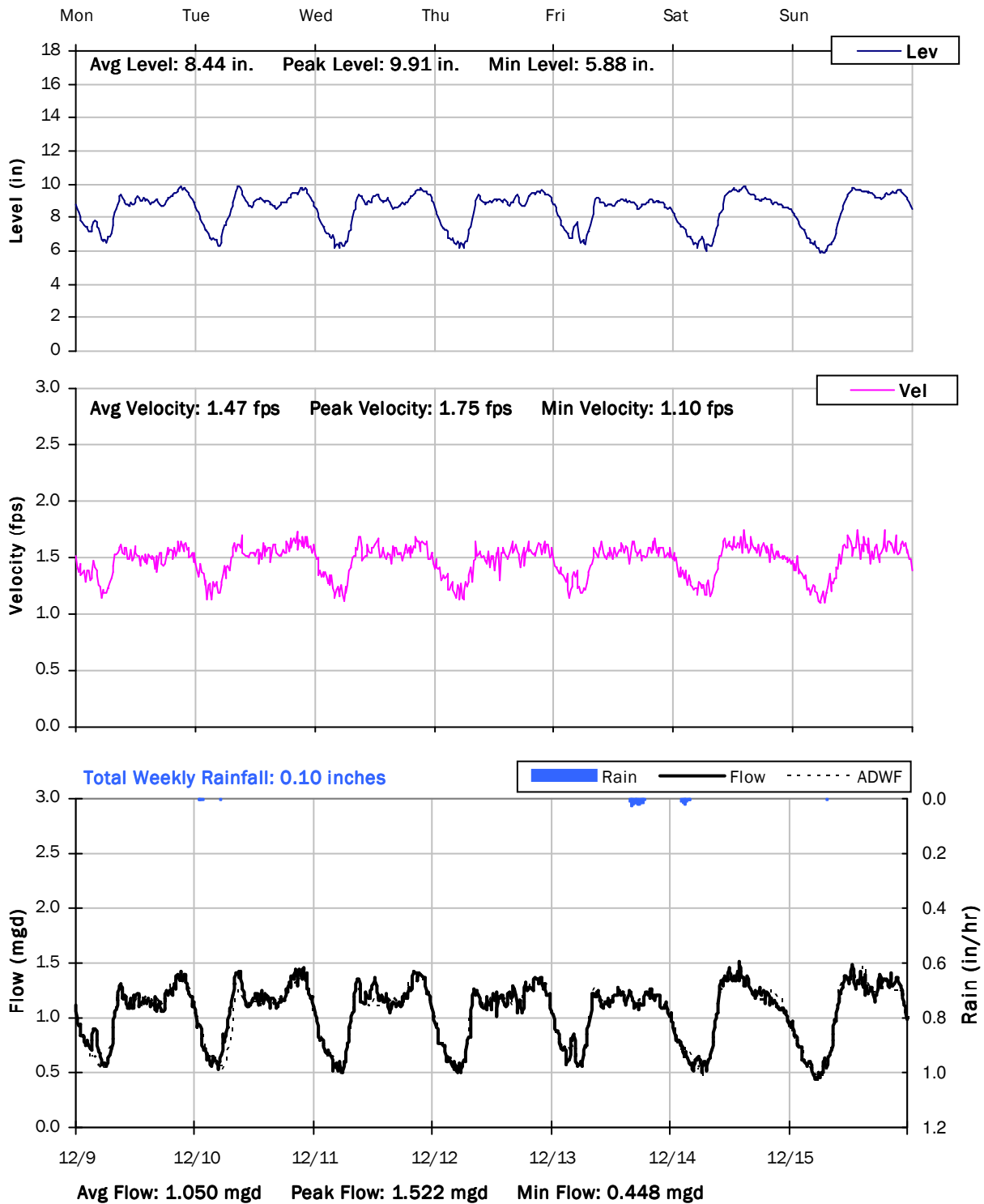
12/2/2019 to 12/9/2019



SITE 2

Weekly Level, Velocity and Flow Hydrographs

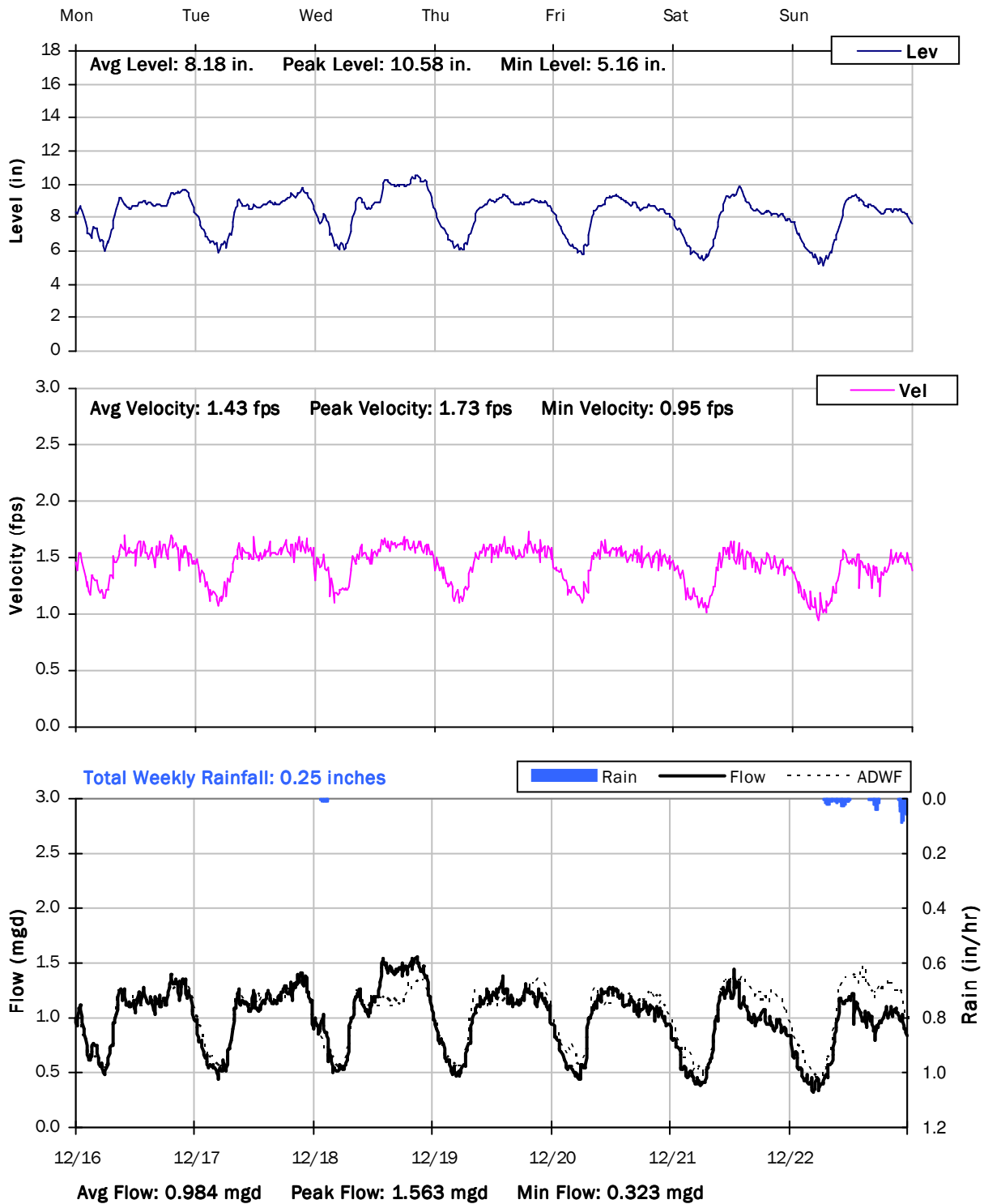
12/9/2019 to 12/16/2019



SITE 2

Weekly Level, Velocity and Flow Hydrographs

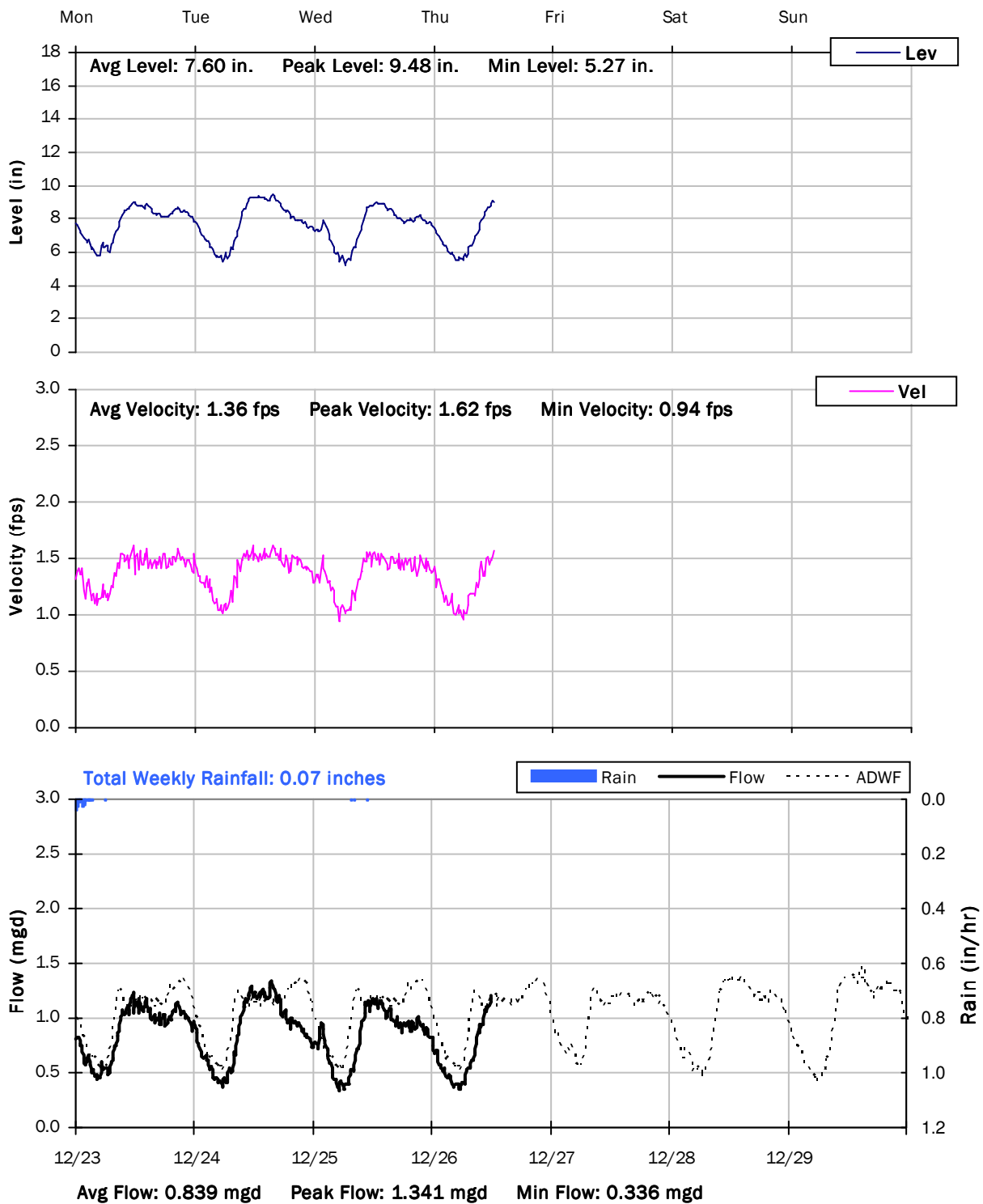
12/16/2019 to 12/23/2019



SITE 2

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

November 22 - December 26, 2019

Monitoring Site: Site 3

City Manhole: 6M376

Location: N State Hwy 59, south of train tracks

Data Summary Report



Vicinity Map: Site 3

SITE 3

Site Information

Location: N State Hwy 59, south of train tracks

City Manhole: 6M376

Coordinates: 120.5051° W, 37.3178° N

Rim Elevation (Earth): 166 feet

Pipe Diameter: 21 inches

ADWF: 0.899 mgd

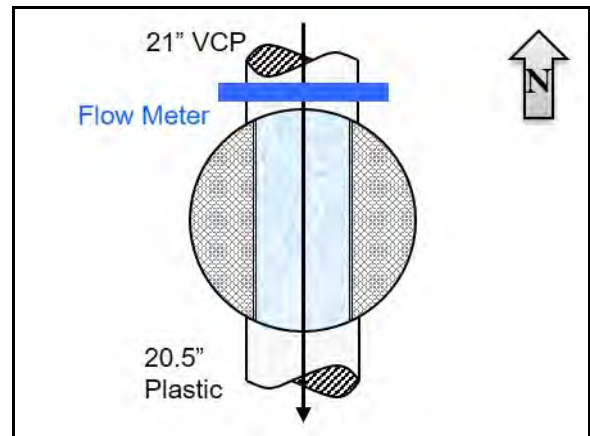
Peak Measured Flow: 2.170 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 3

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

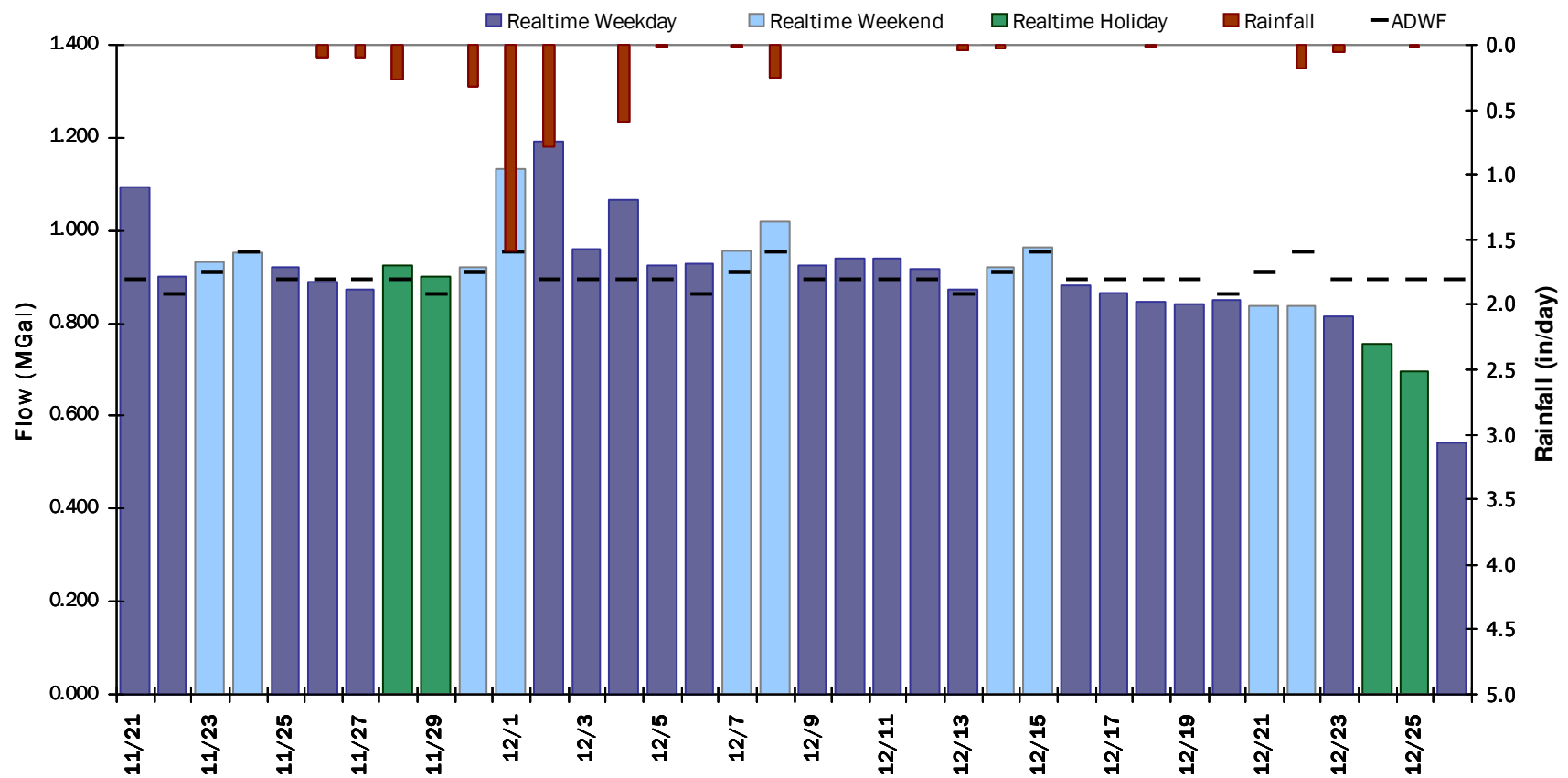


SITE 3

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.909 MGal Peak Daily Flow: 1.190 MGal Min Daily Flow: 0.543 MGal

Total Period Rainfall: 4.39 inches



SITE 3 (SM)

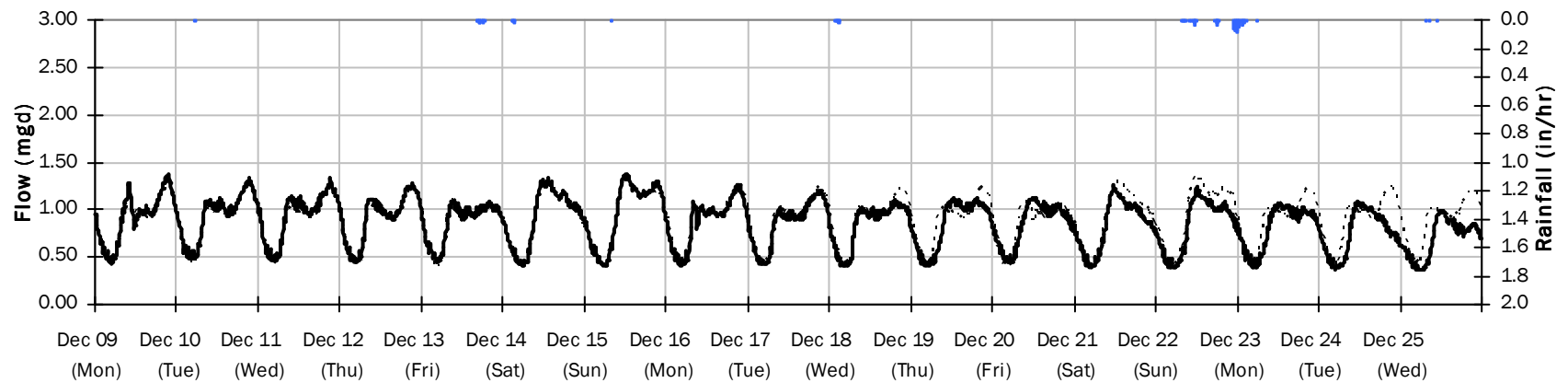
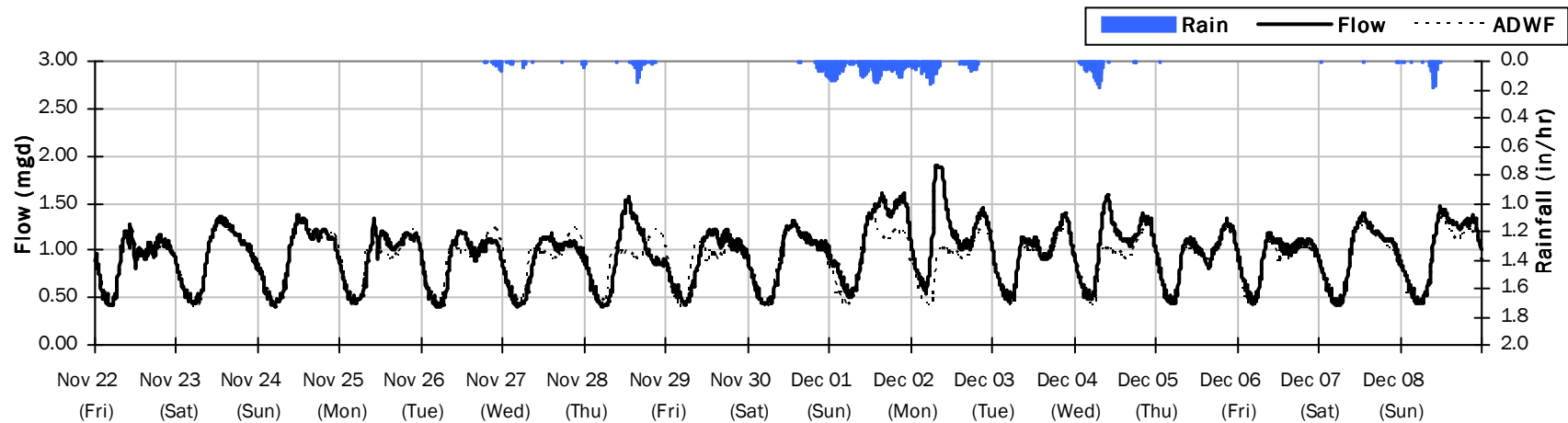
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.39 inches

Avg Flow: 0.915 mgd

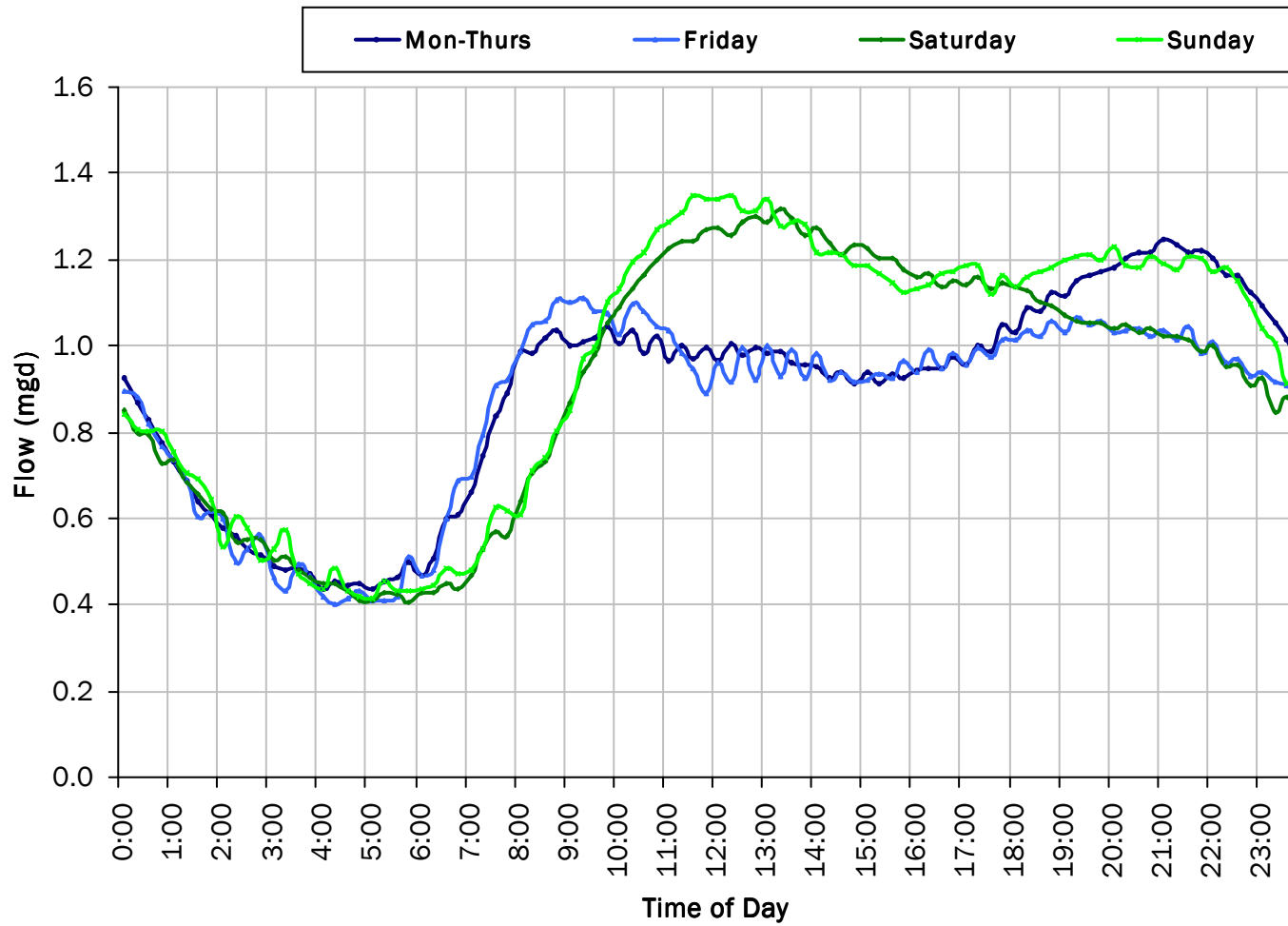
Peak Flow: 1.893 mgd

Min Flow: 0.369 mgd

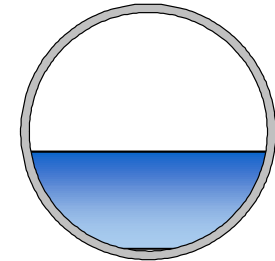


SITE 3

Average Dry Weather Flow Hydrographs

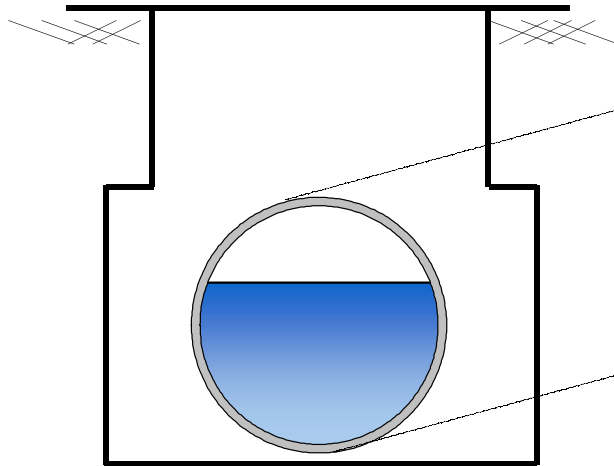
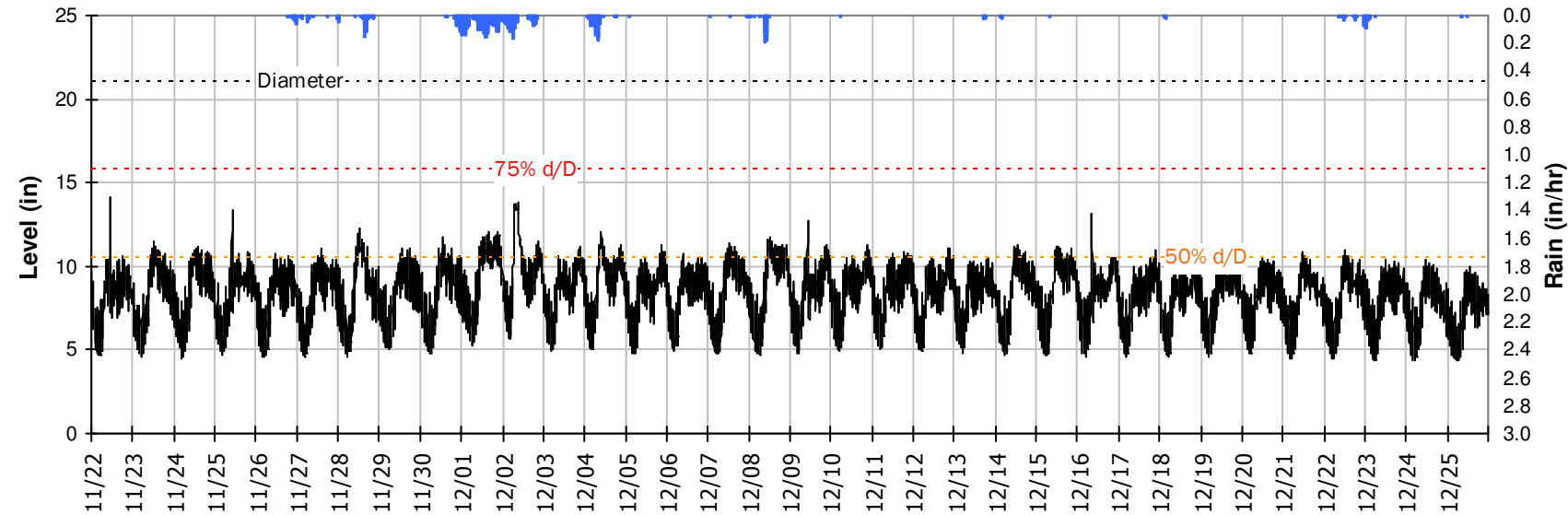


ADWF:
0.899 mgd



SITE 3
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

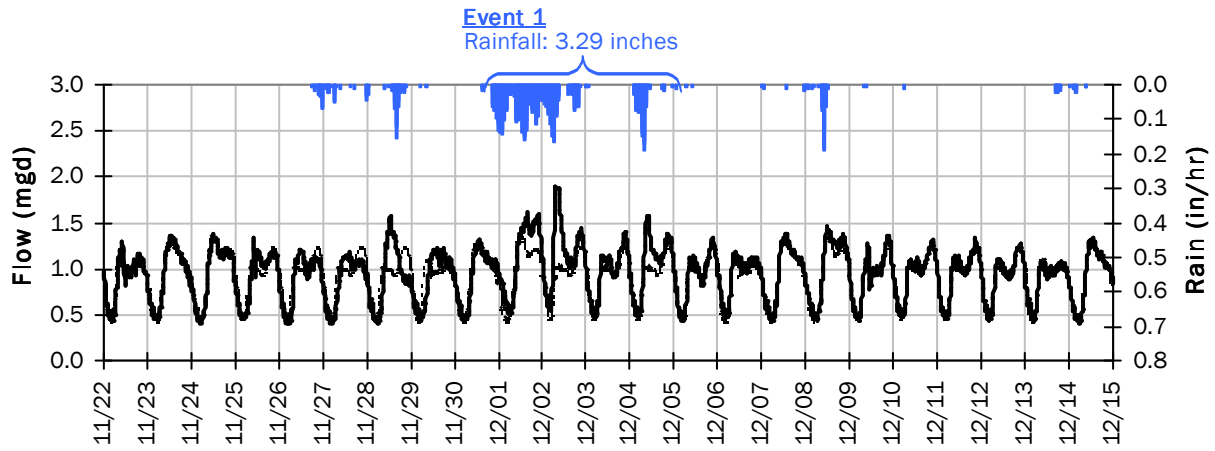


Pipe Diameter: 21 inches
Peak Measured Level: 14.1 inches
Peak d/D Ratio: 0.67

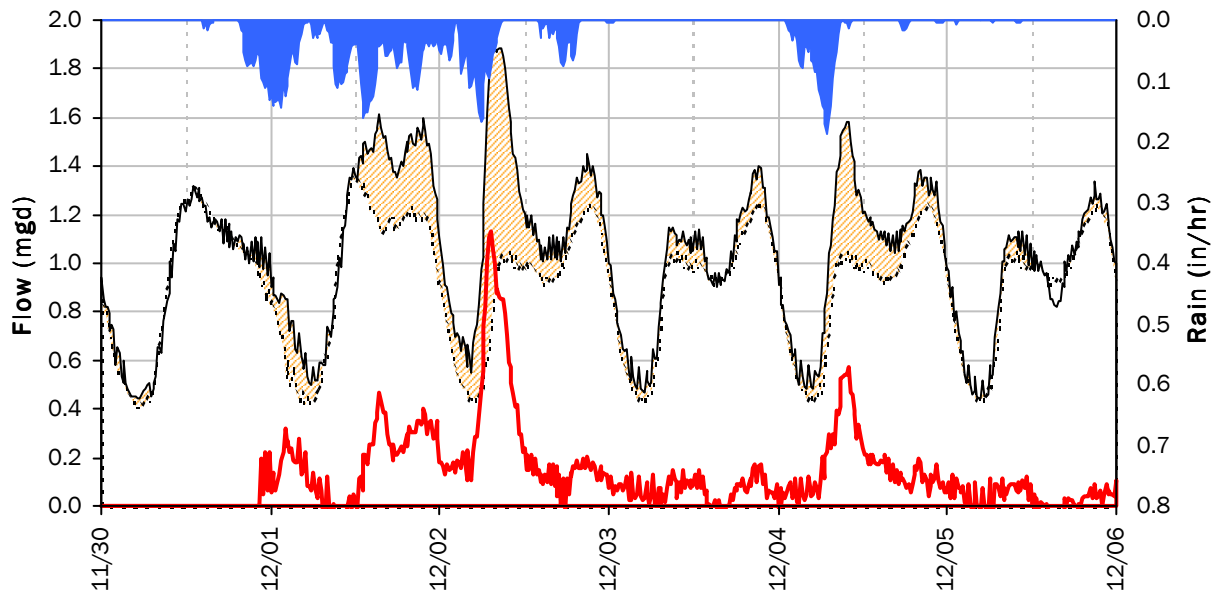
SITE 3 (SM)

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.29 inches)

Capacity

Peak Flow: 1.89 mgd
PF: 2.11

Peak Level: 13.56 in
d/D Ratio: 0.65

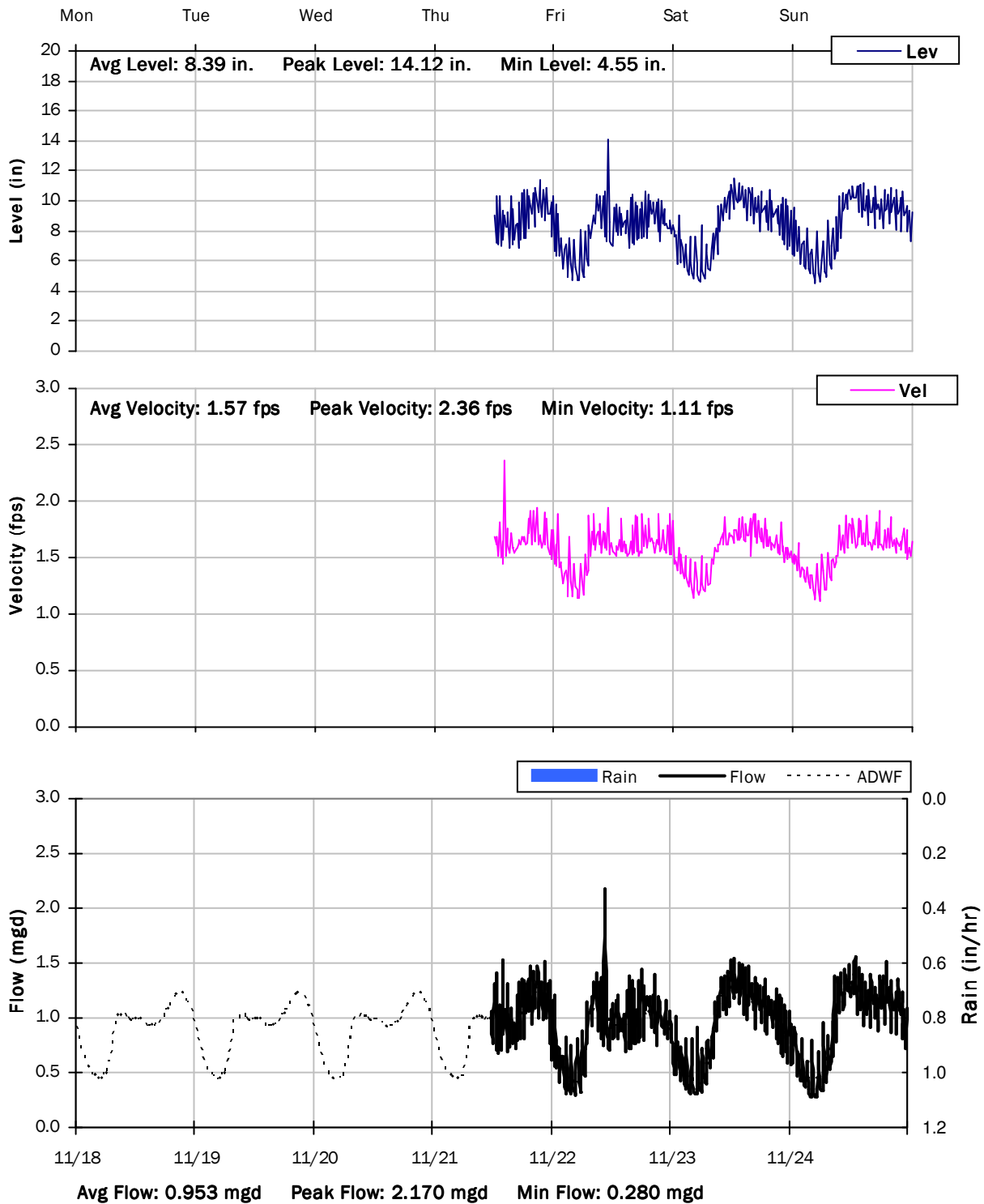
Inflow / Infiltration

Peak I/I Rate: 1.13 mgd
Total I/I: 758,000 gallons

SITE 3

Weekly Level, Velocity and Flow Hydrographs

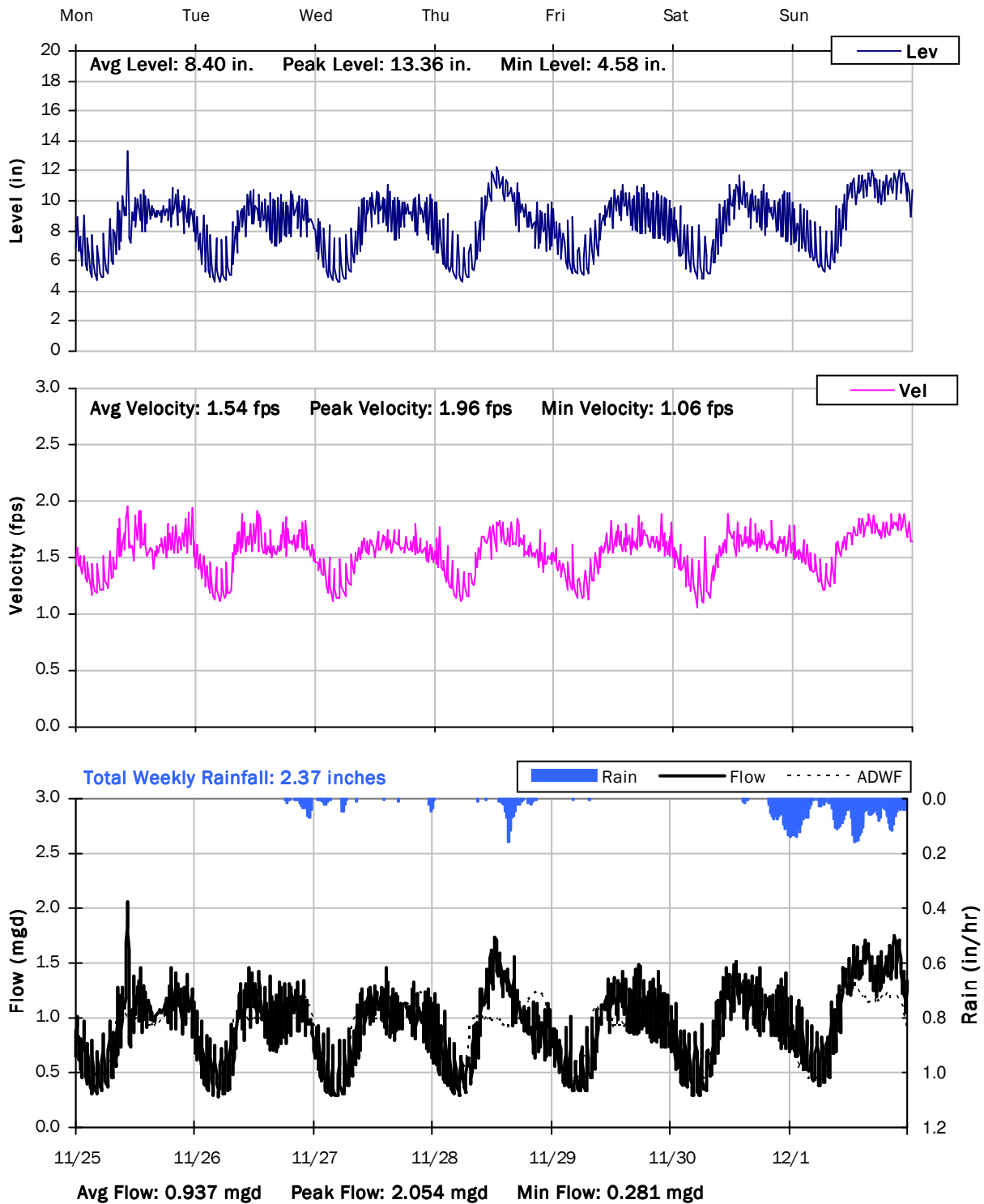
11/18/2019 to 11/25/2019



SITE 3

Weekly Level, Velocity and Flow Hydrographs

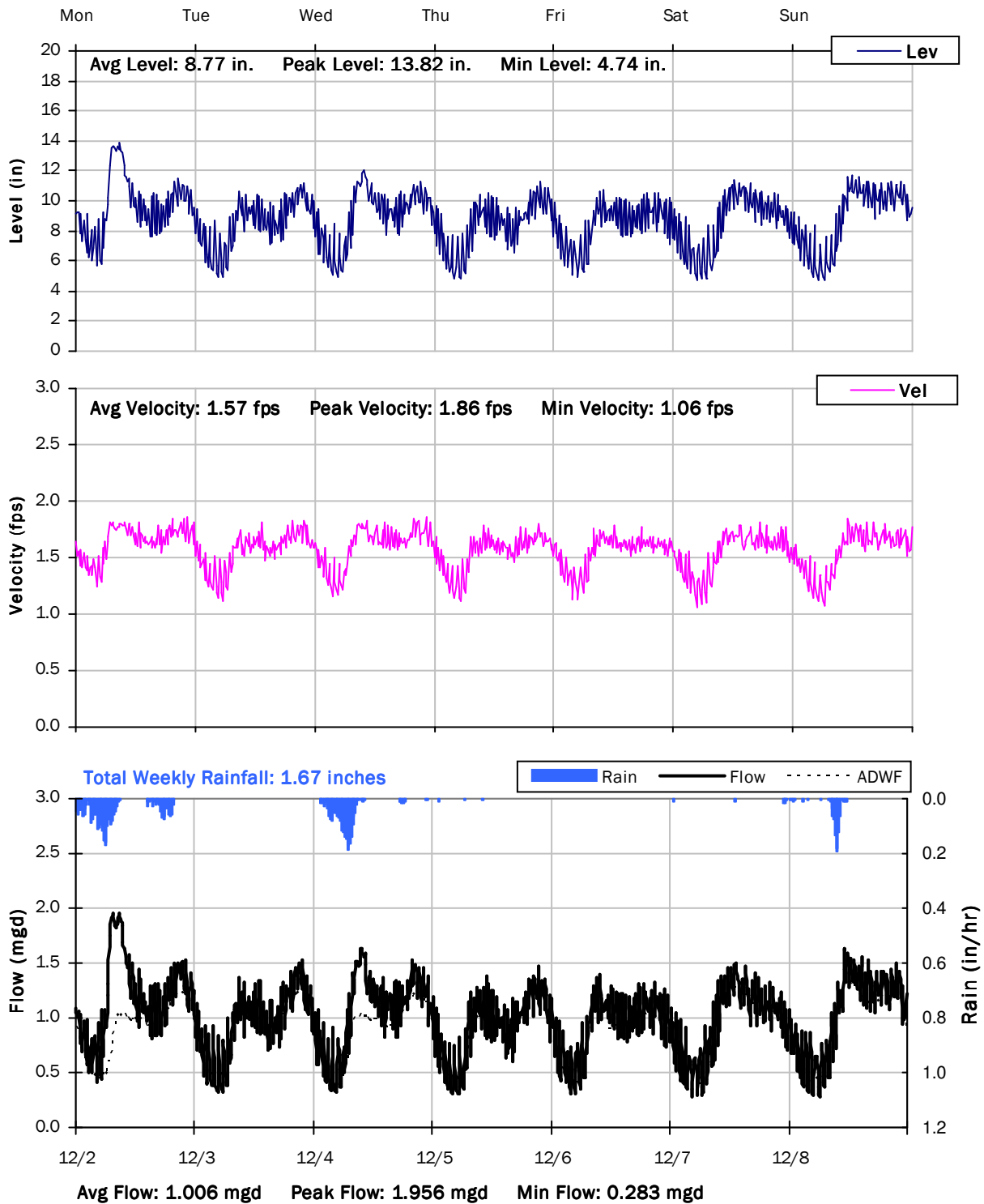
11/25/2019 to 12/2/2019



SITE 3

Weekly Level, Velocity and Flow Hydrographs

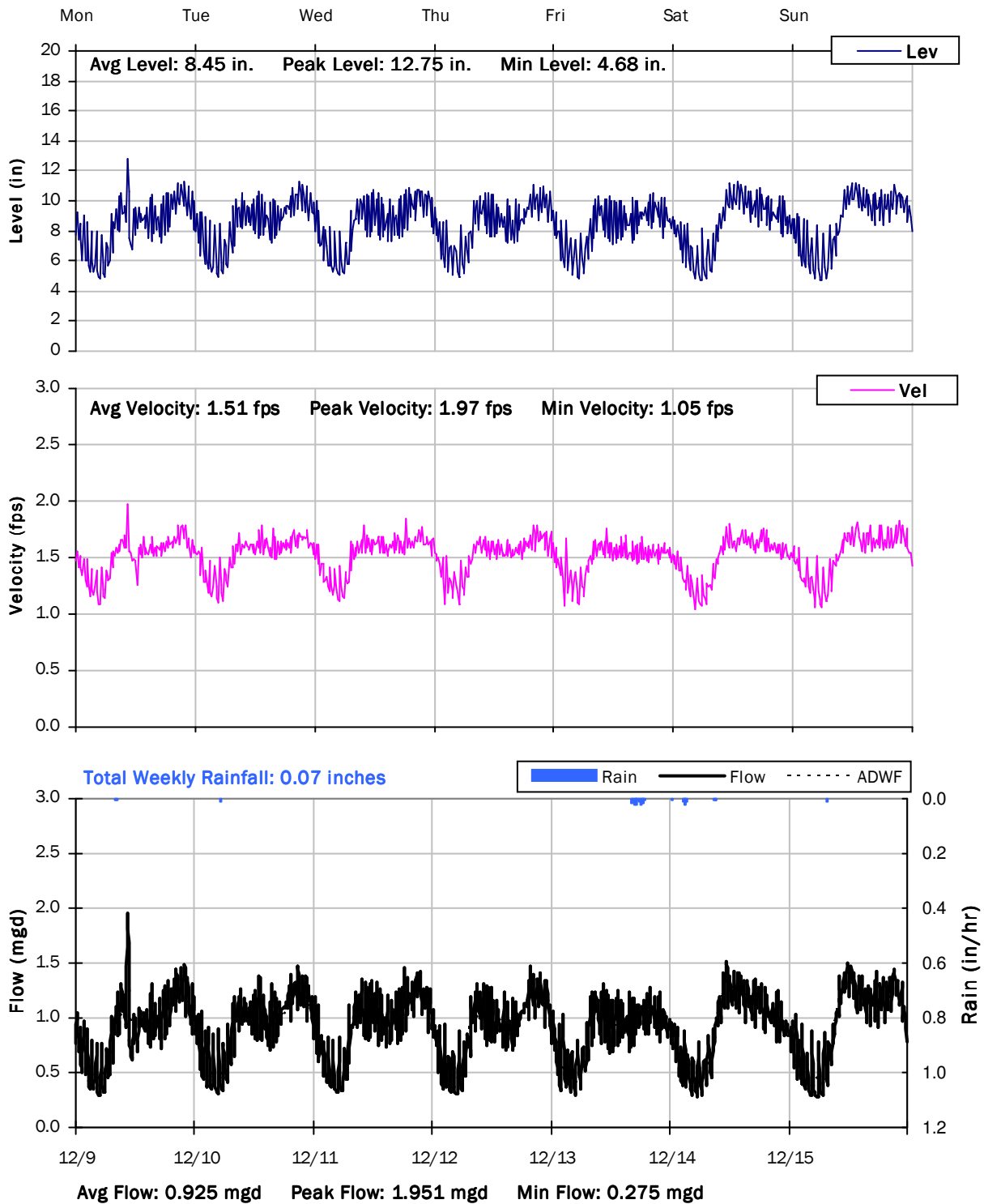
12/2/2019 to 12/9/2019



SITE 3

Weekly Level, Velocity and Flow Hydrographs

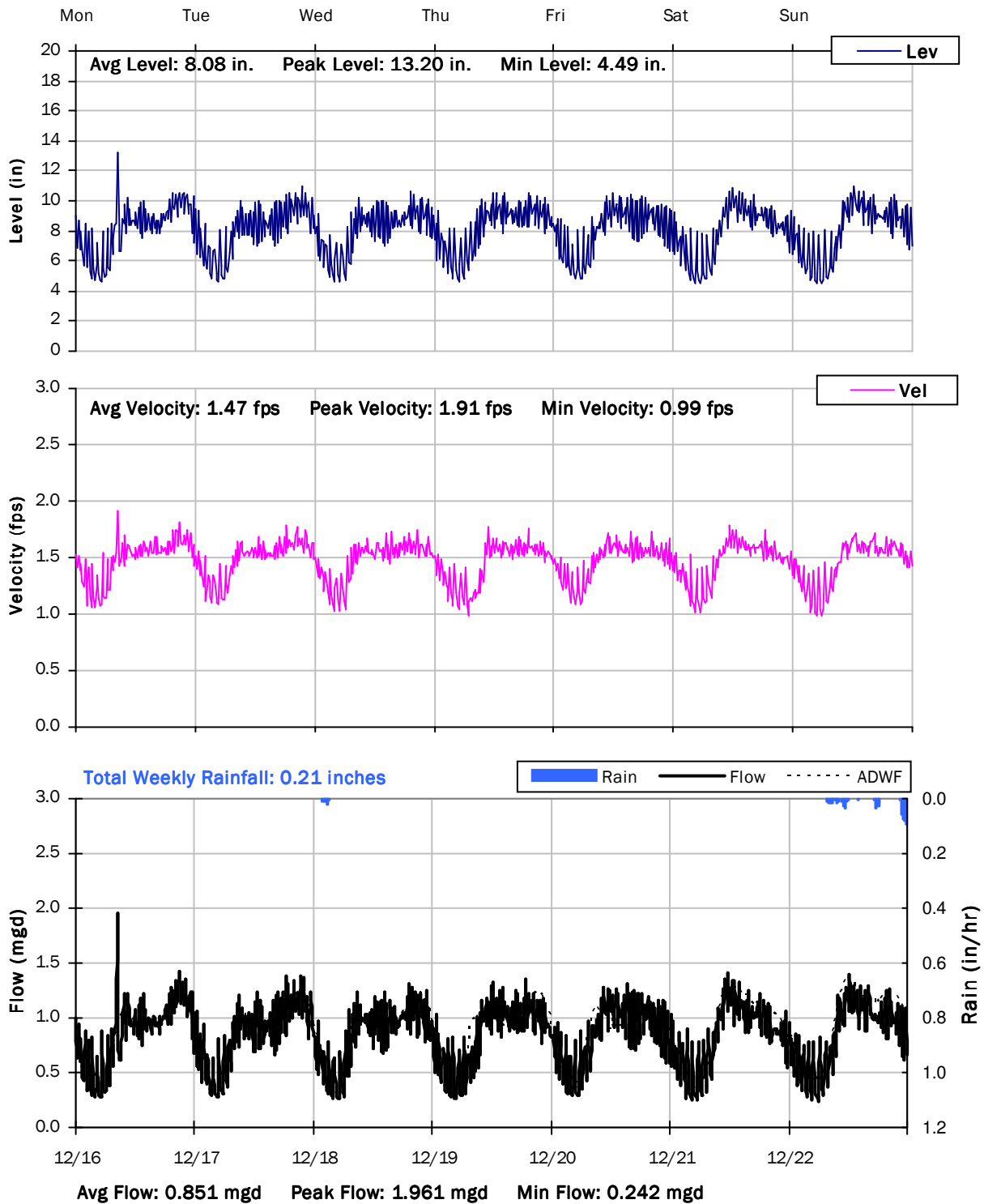
12/9/2019 to 12/16/2019



SITE 3

Weekly Level, Velocity and Flow Hydrographs

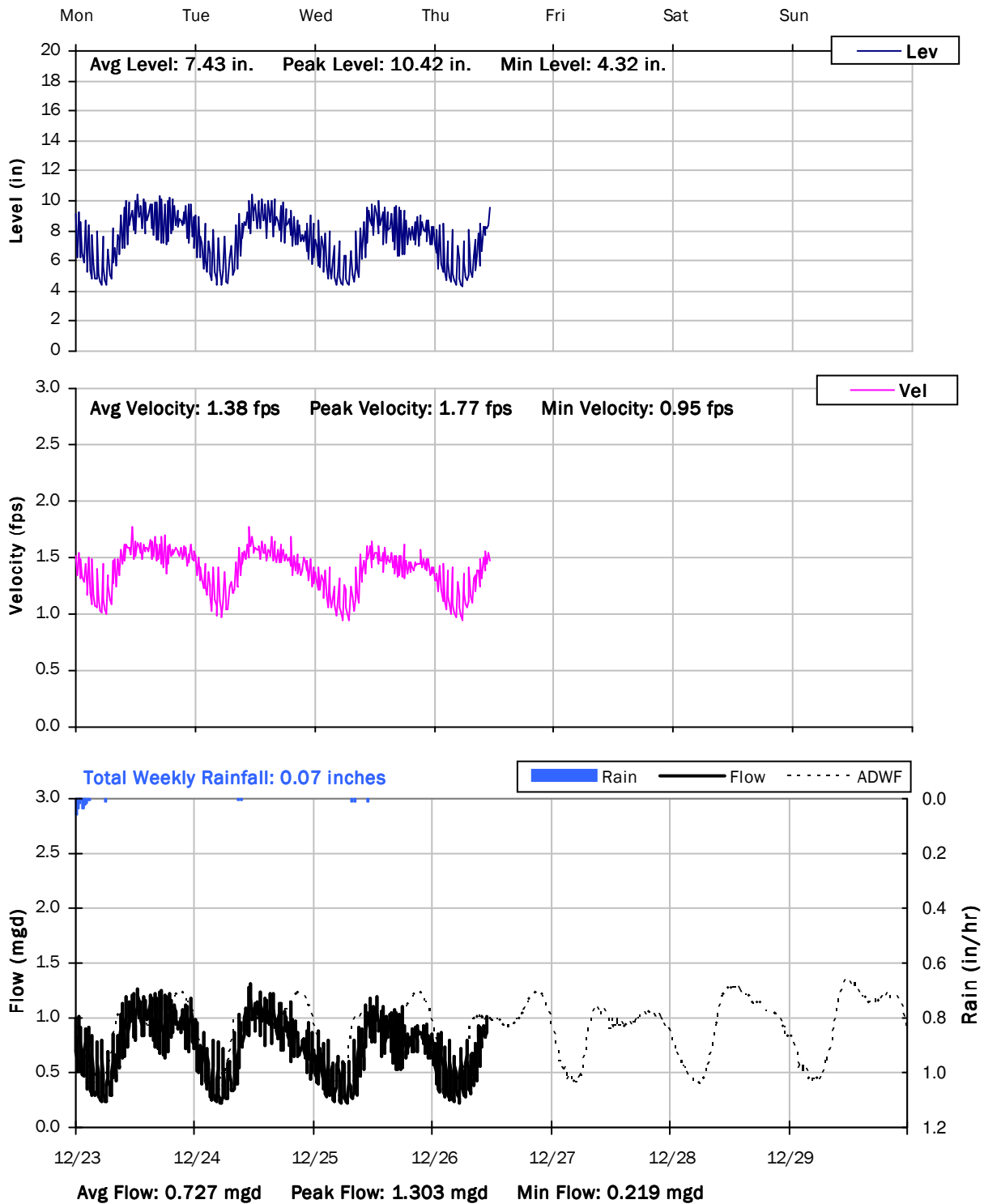
12/16/2019 to 12/23/2019



SITE 3

Weekly Level, Velocity and Flow Hydrographs

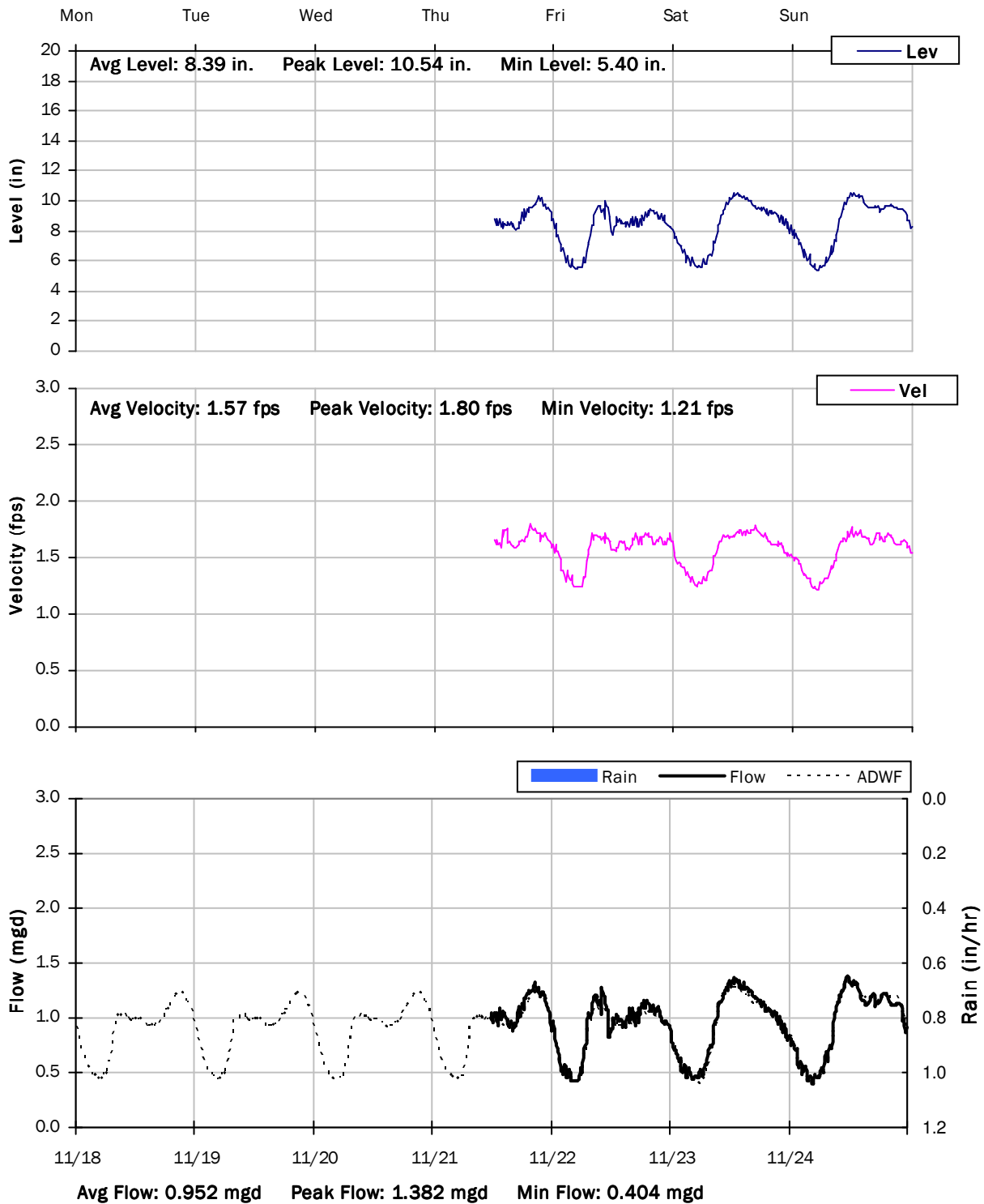
12/23/2019 to 12/30/2019



SITE 3 (SM)

Weekly Level, Velocity and Flow Hydrographs

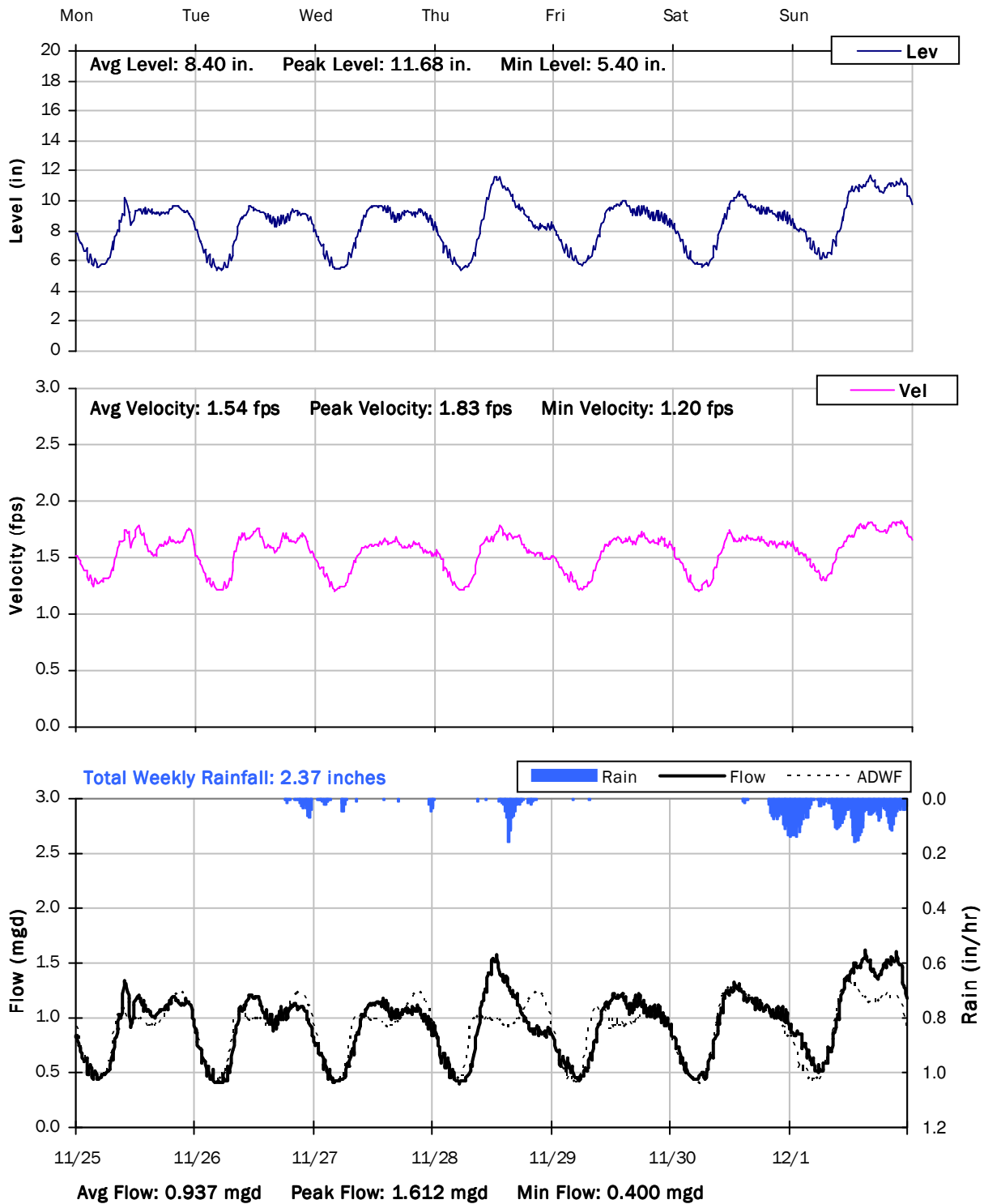
11/18/2019 to 11/25/2019



SITE 3 (SM)

Weekly Level, Velocity and Flow Hydrographs

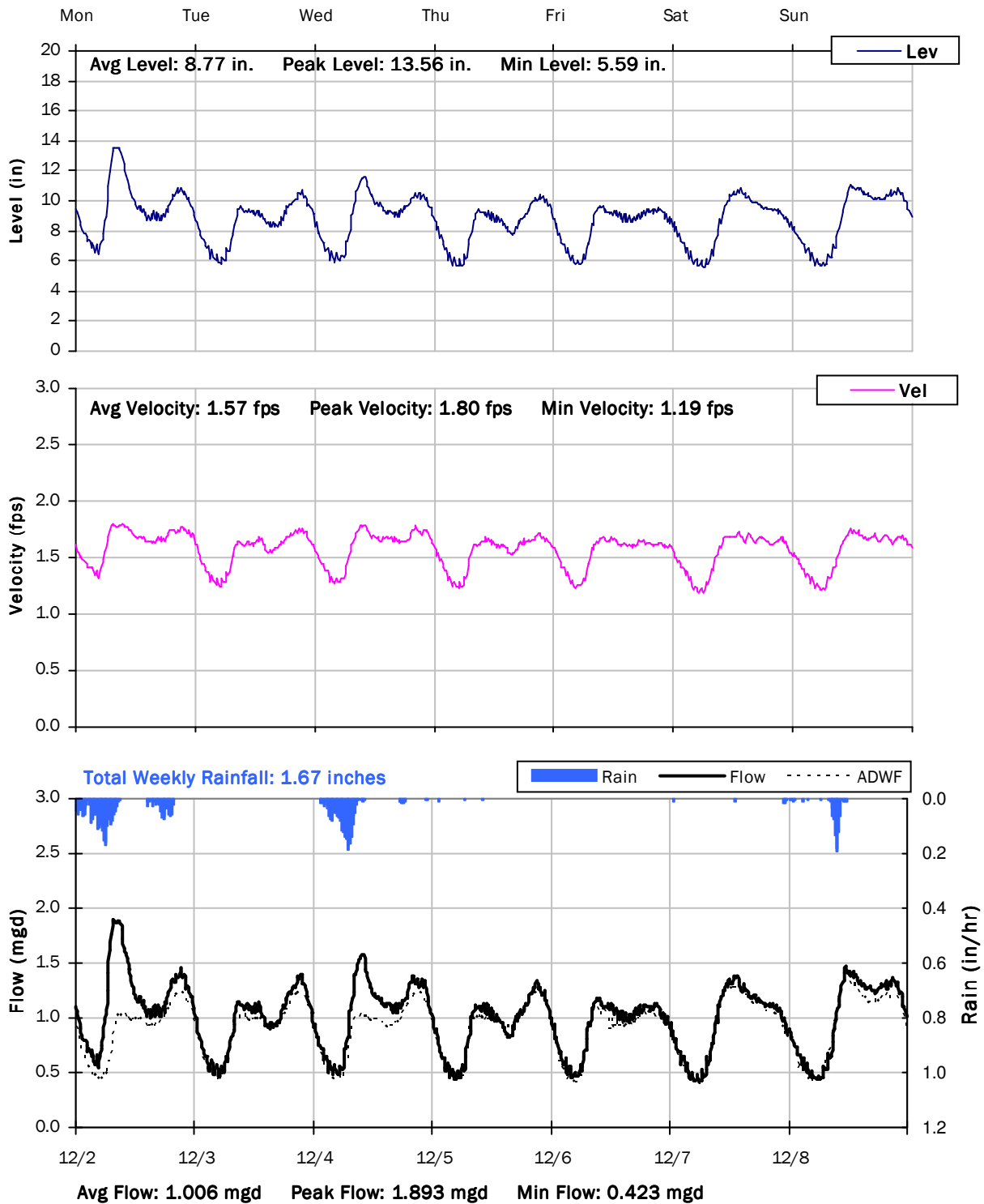
11/25/2019 to 12/2/2019



SITE 3 (SM)

Weekly Level, Velocity and Flow Hydrographs

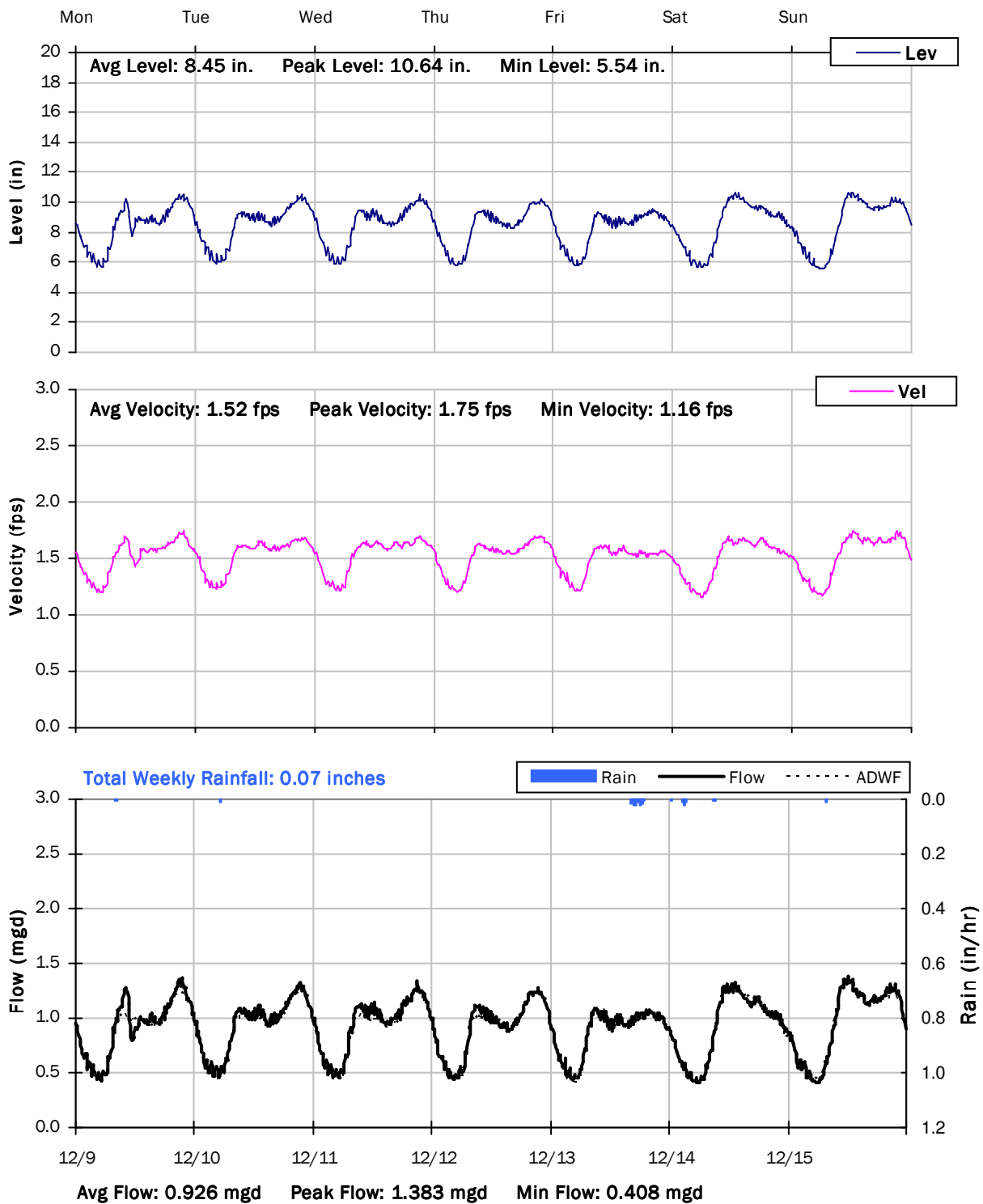
12/2/2019 to 12/9/2019



SITE 3 (SM)

Weekly Level, Velocity and Flow Hydrographs

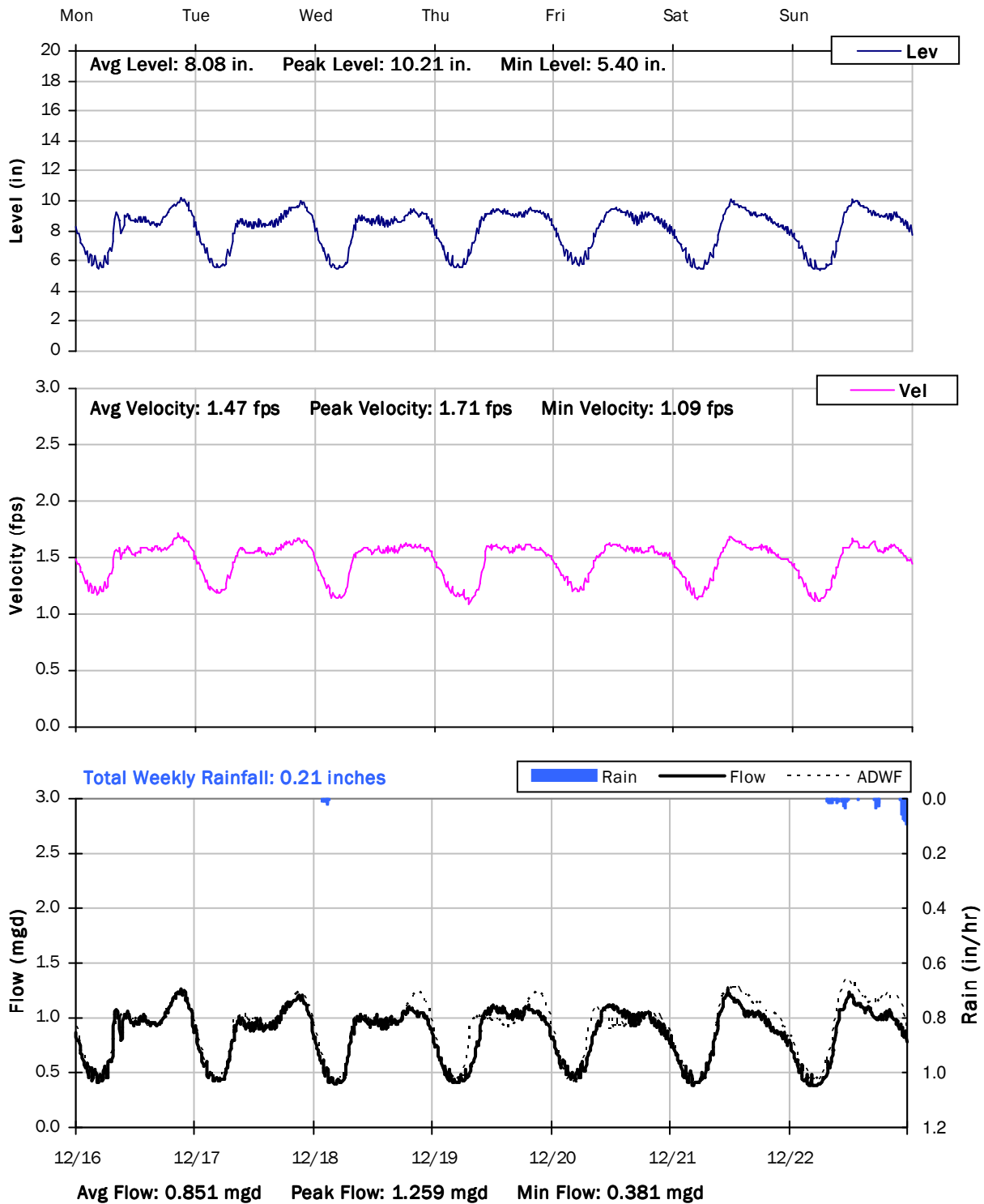
12/9/2019 to 12/16/2019



SITE 3 (SM)

Weekly Level, Velocity and Flow Hydrographs

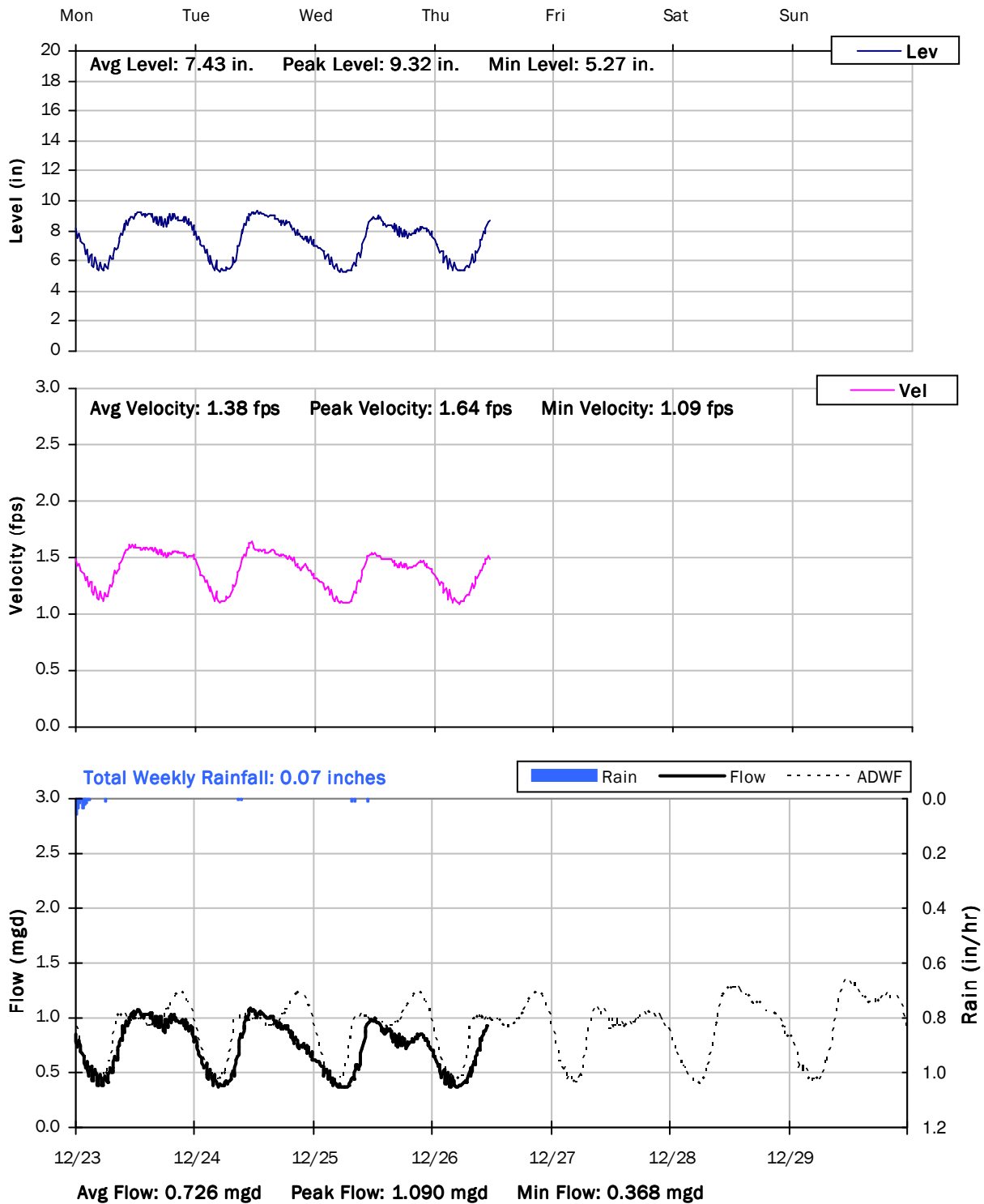
12/16/2019 to 12/23/2019



SITE 3 (SM)

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

November 22 - December 26, 2019

Monitoring Site: Site 4

City Manhole: 6M125

Location: Meadows Avenue north of W Olive Avenue

Data Summary Report



Vicinity Map: Site 4

SITE 4

Site Information

Location: Meadows Avenue north of W Olive Avenue

City Manhole: 6M125

Coordinates: 120.4904° W, 37.3206° N

Rim Elevation (Earth): 172 feet

Pipe Diameter: 43 inches

ADWF: 1.484 mgd

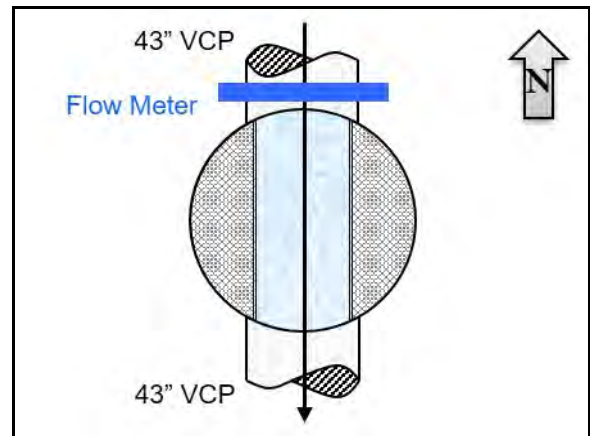
Peak Measured Flow: 3.147 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 4

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

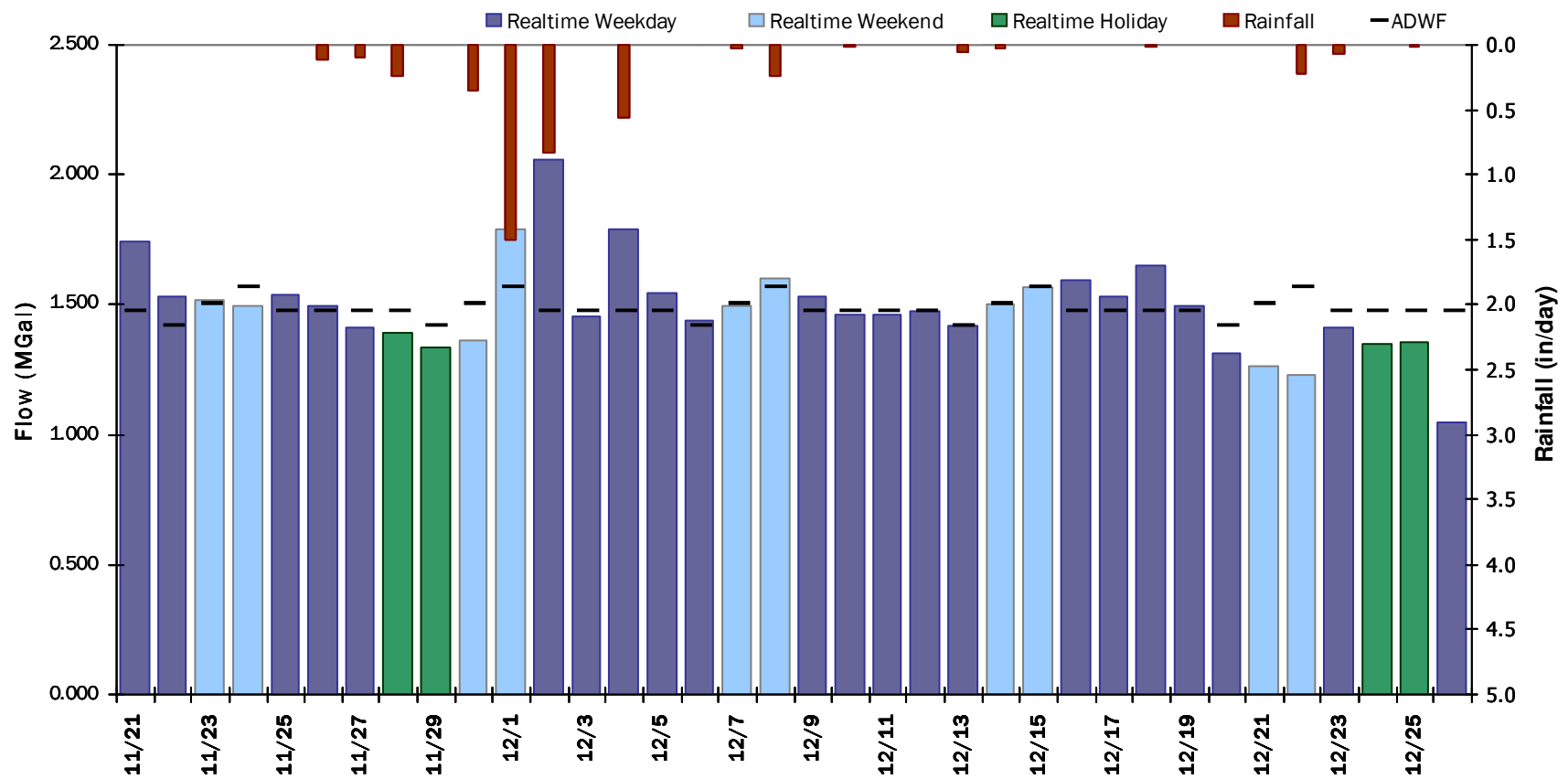


SITE 4

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 1.490 MGal Peak Daily Flow: 2.057 MGal Min Daily Flow: 1.047 MGal

Total Period Rainfall: 4.39 inches



SITE 4

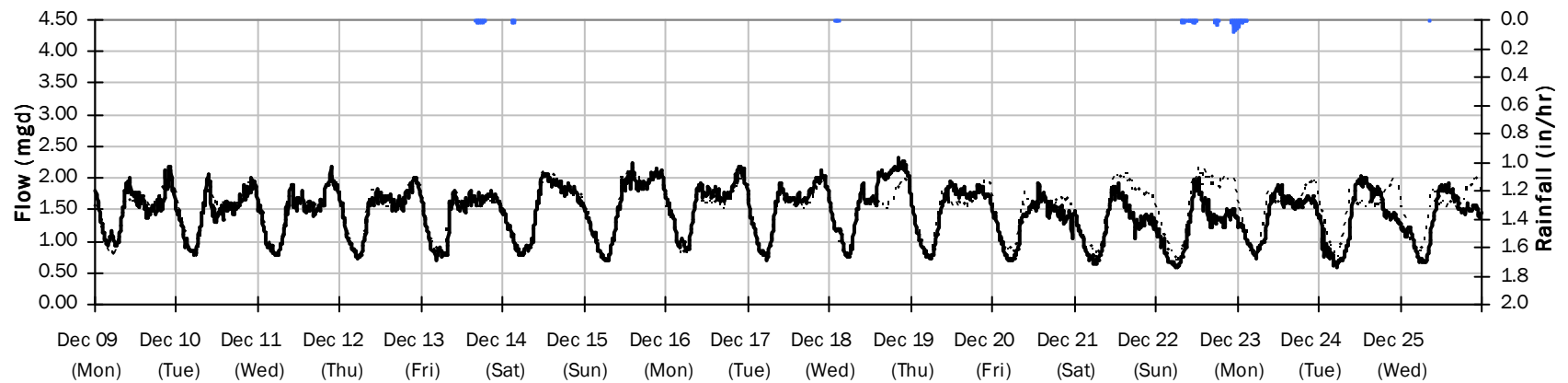
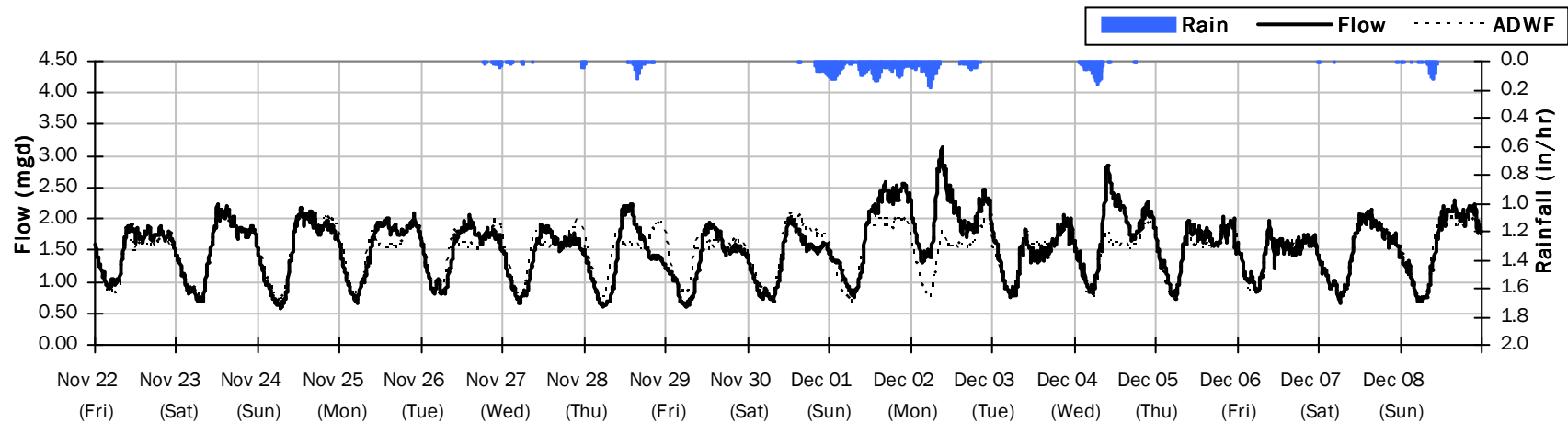
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.39 inches

Avg Flow: 1.496 mgd

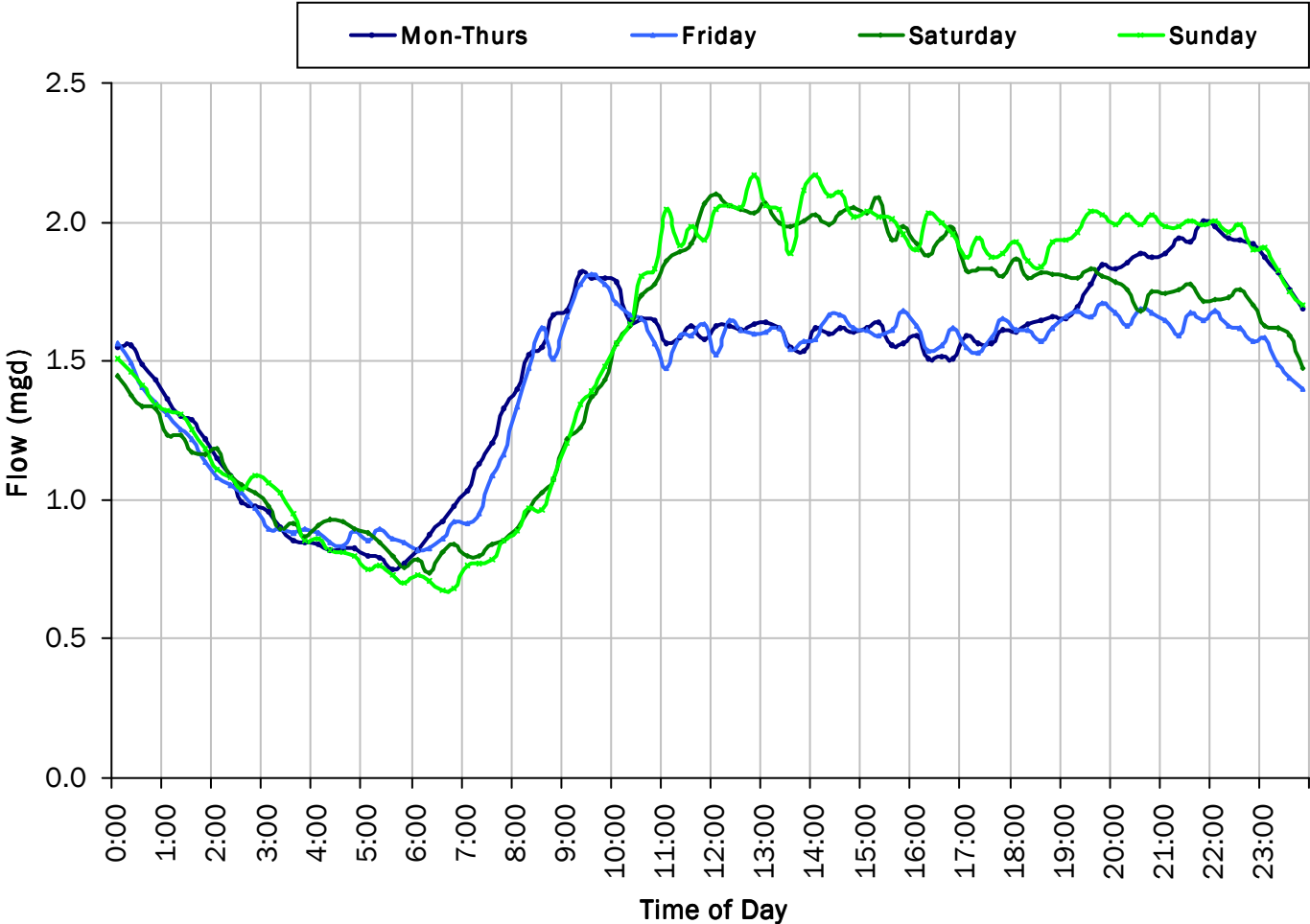
Peak Flow: 3.147 mgd

Min Flow: 0.573 mgd

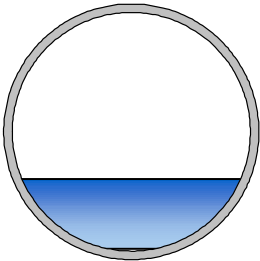


SITE 4

Average Dry Weather Flow Hydrographs

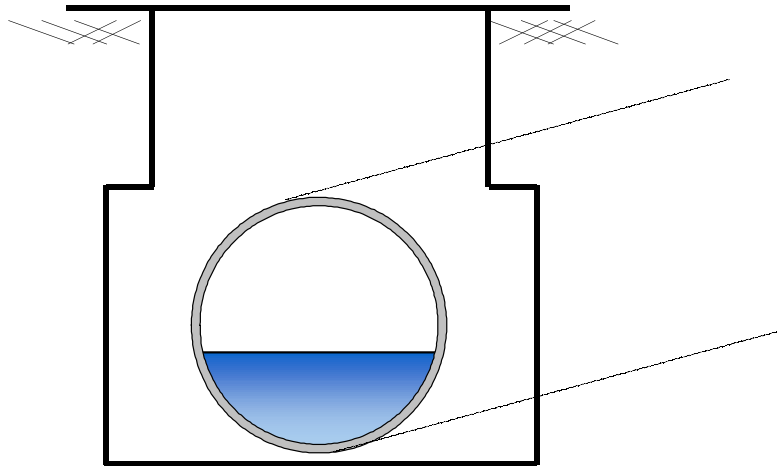
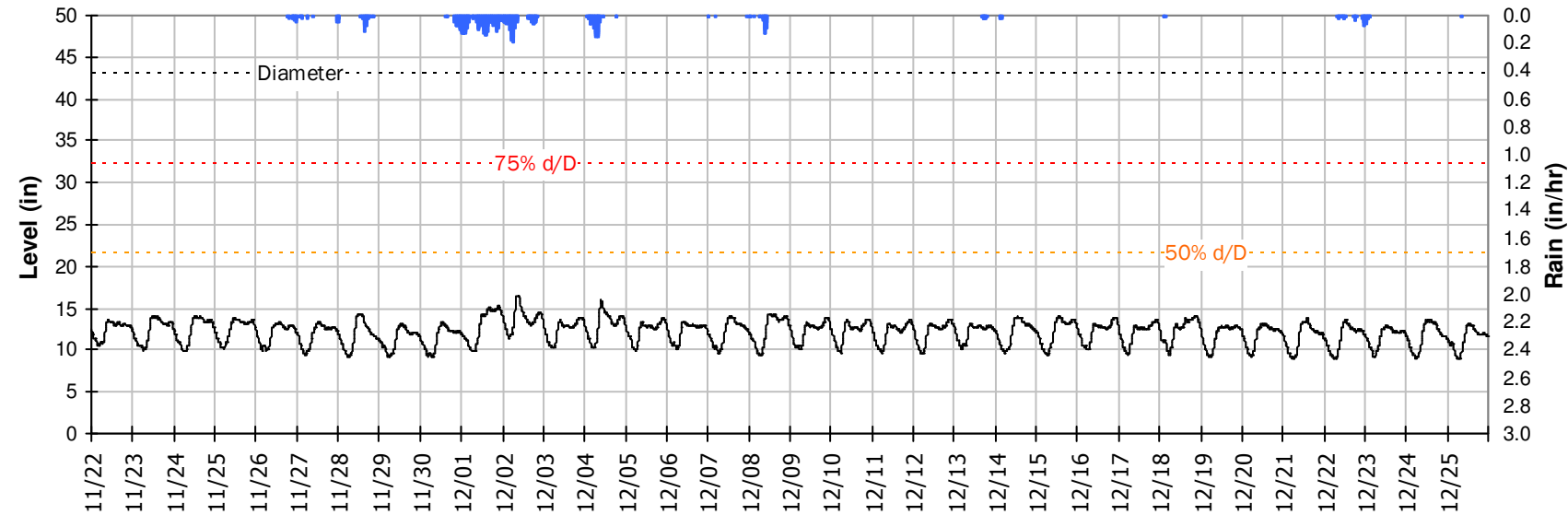


ADWF:
1.484 mgd



SITE 4
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

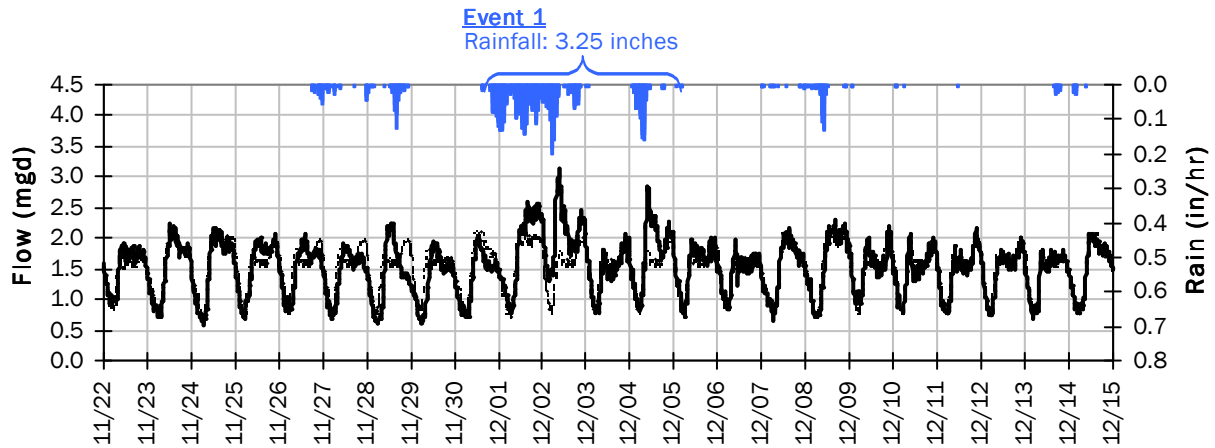


Pipe Diameter: 43 inches
Peak Measured Level: 16.5 inches
Peak d/D Ratio: 0.38

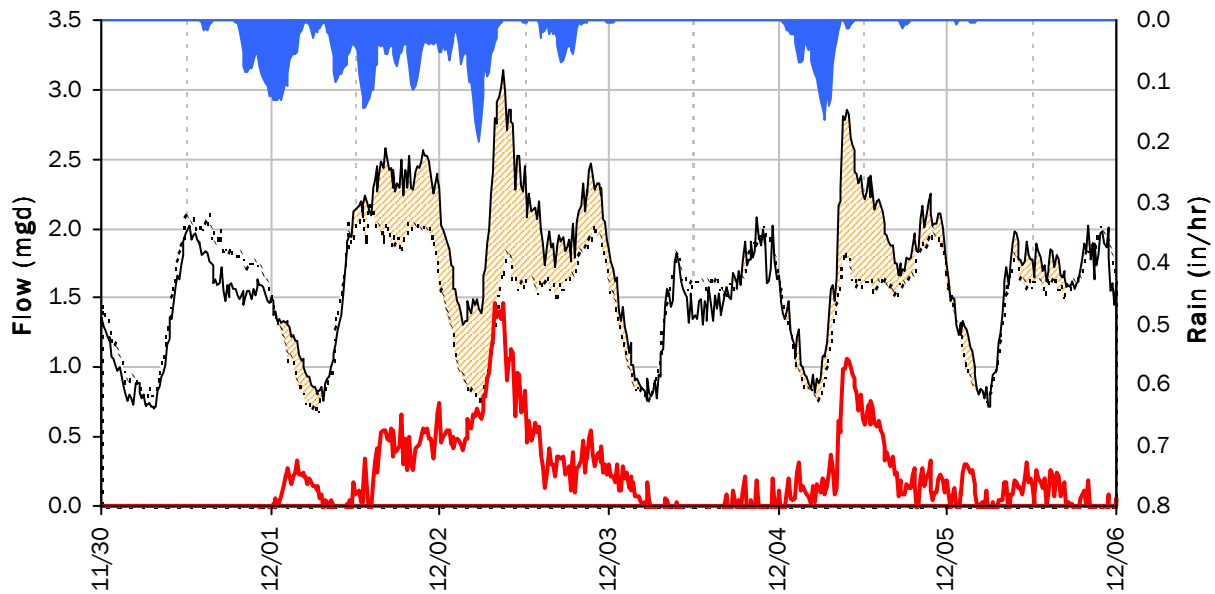
SITE 4

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.25 inches)

Capacity

Peak Flow: 3.15 mgd
PF: 2.12

Peak Level: 16.51 in
d/D Ratio: 0.38

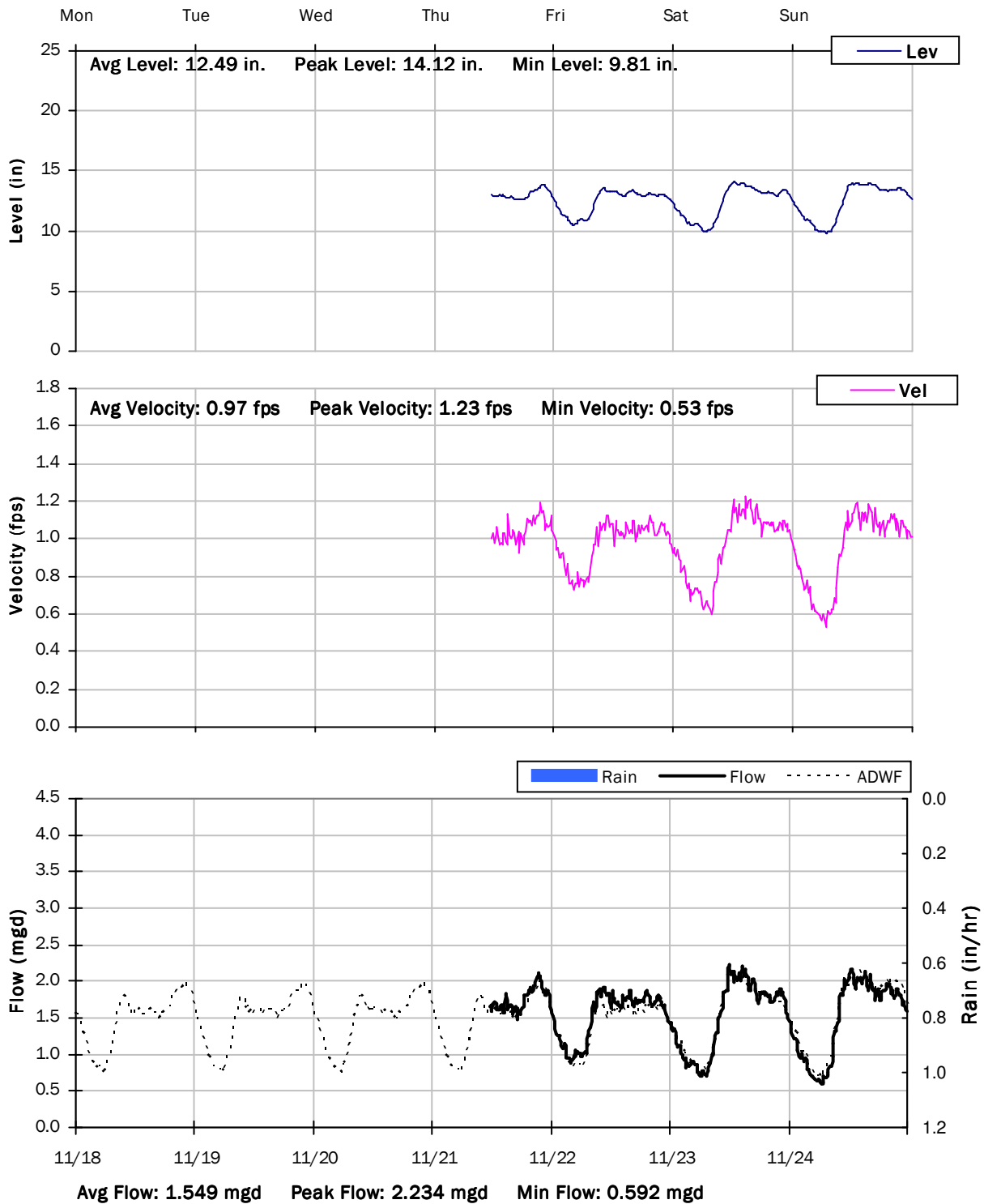
Inflow / Infiltration

Peak I/I Rate: 1.47 mgd
Total I/I: 1,164,000 gallons

SITE 4

Weekly Level, Velocity and Flow Hydrographs

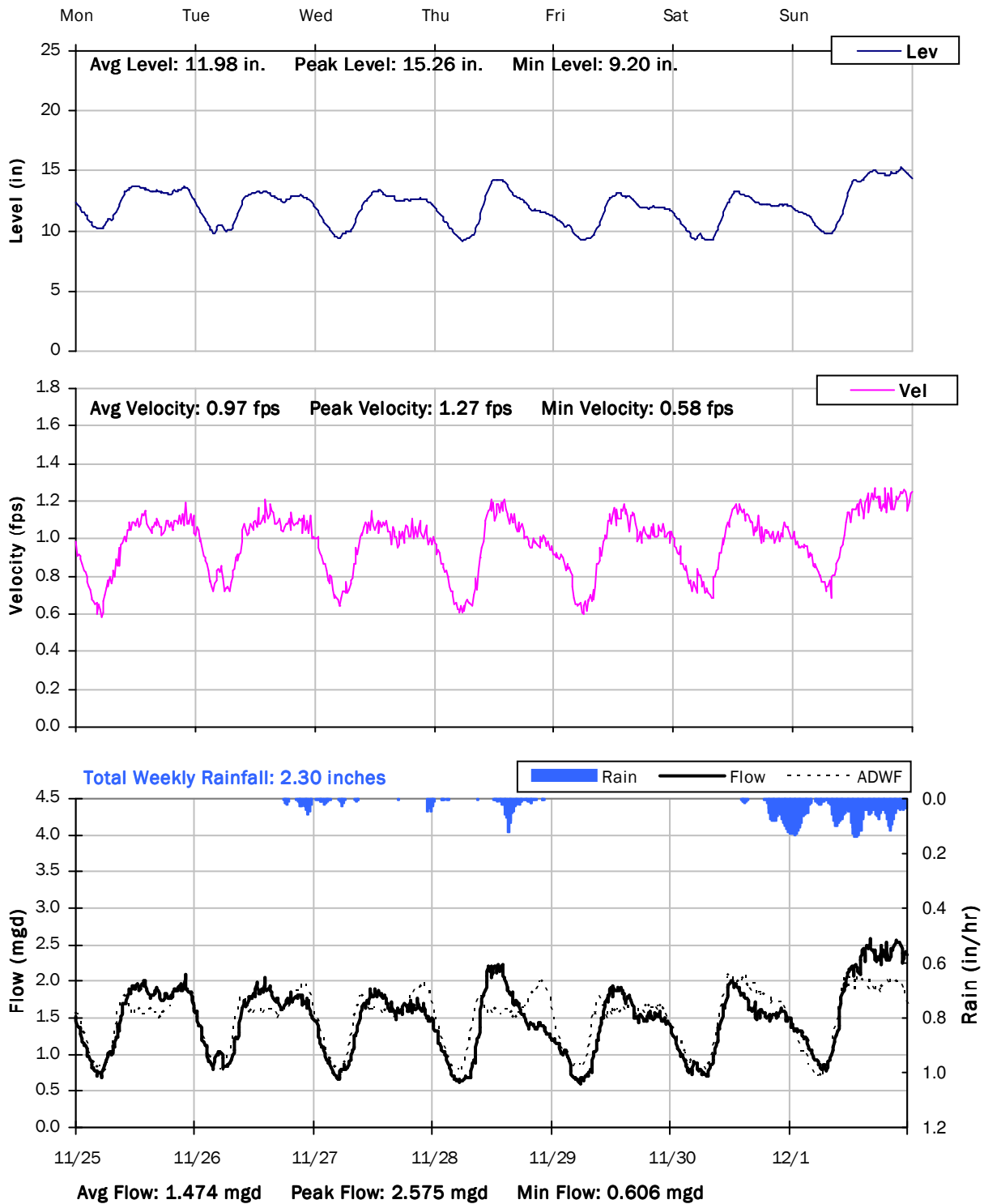
11/18/2019 to 11/25/2019



SITE 4

Weekly Level, Velocity and Flow Hydrographs

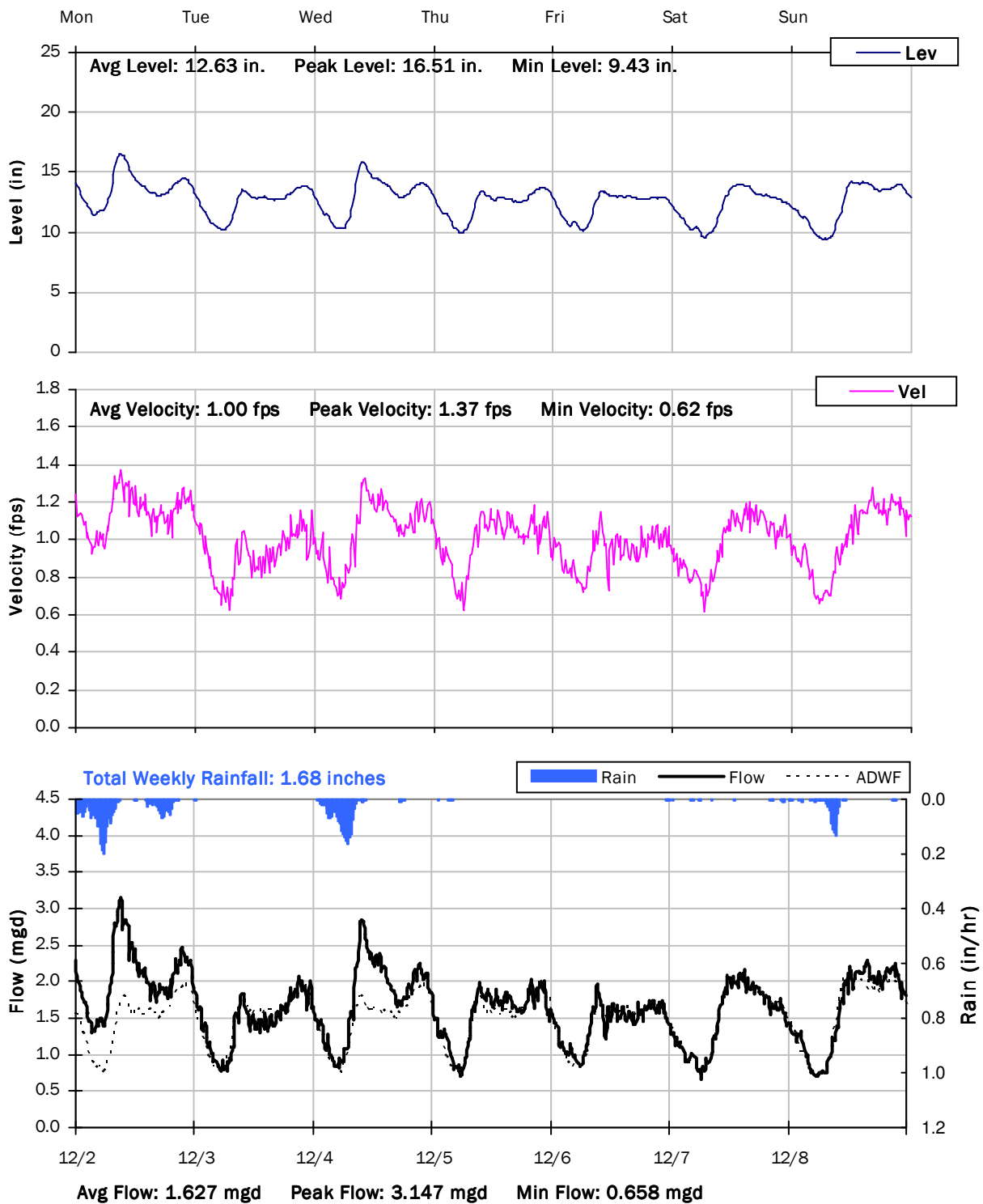
11/25/2019 to 12/2/2019



SITE 4

Weekly Level, Velocity and Flow Hydrographs

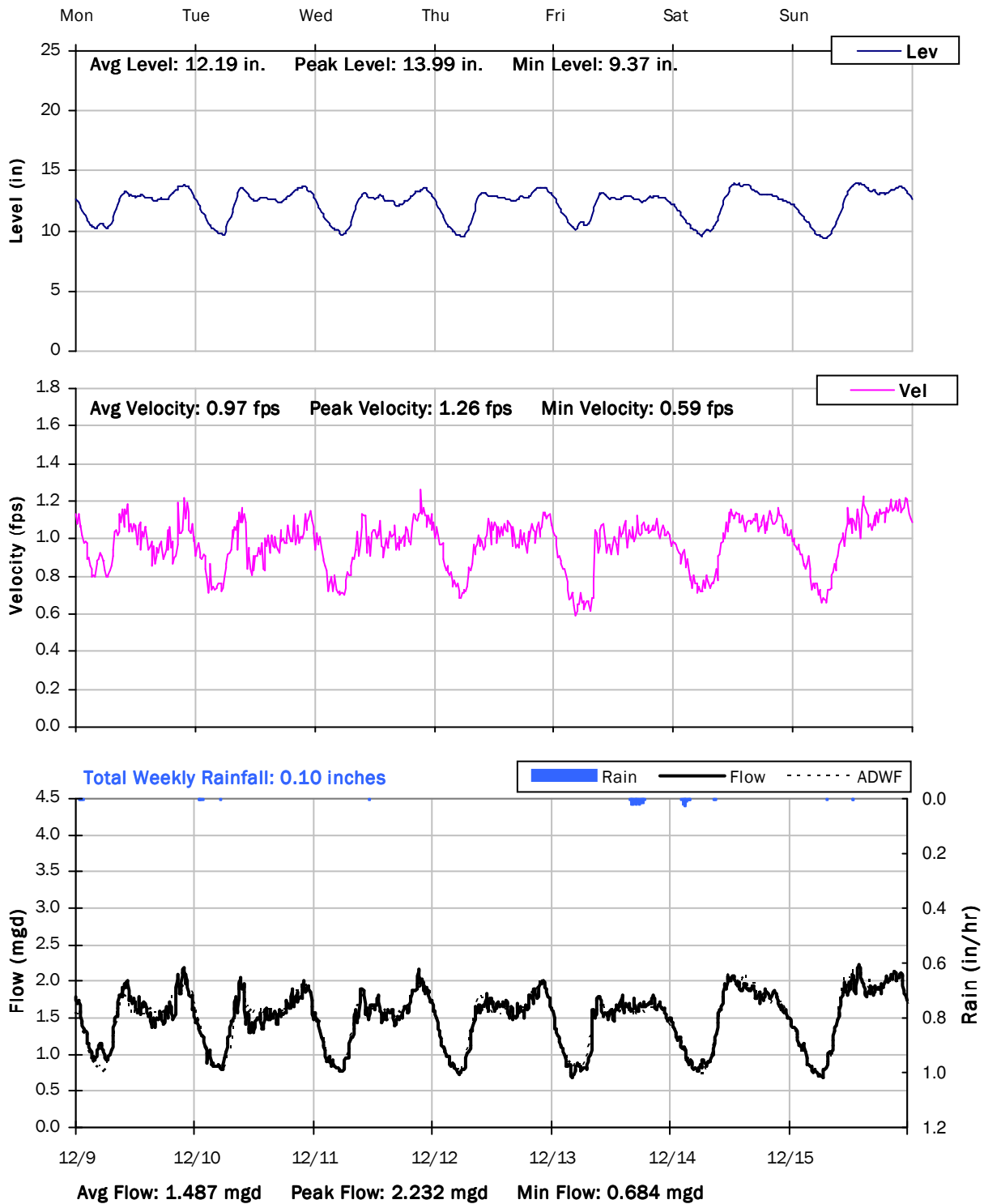
12/2/2019 to 12/9/2019



SITE 4

Weekly Level, Velocity and Flow Hydrographs

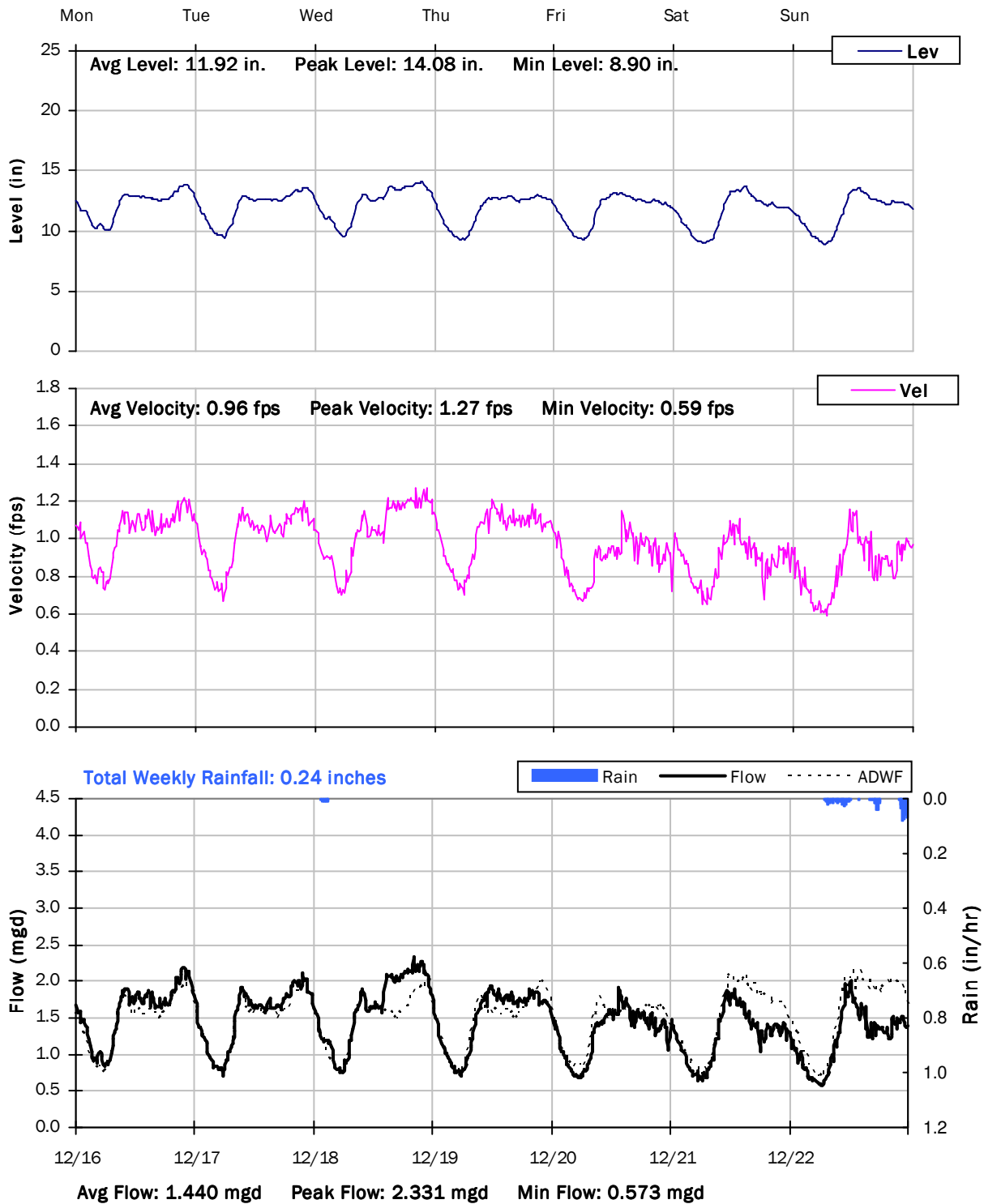
12/9/2019 to 12/16/2019



SITE 4

Weekly Level, Velocity and Flow Hydrographs

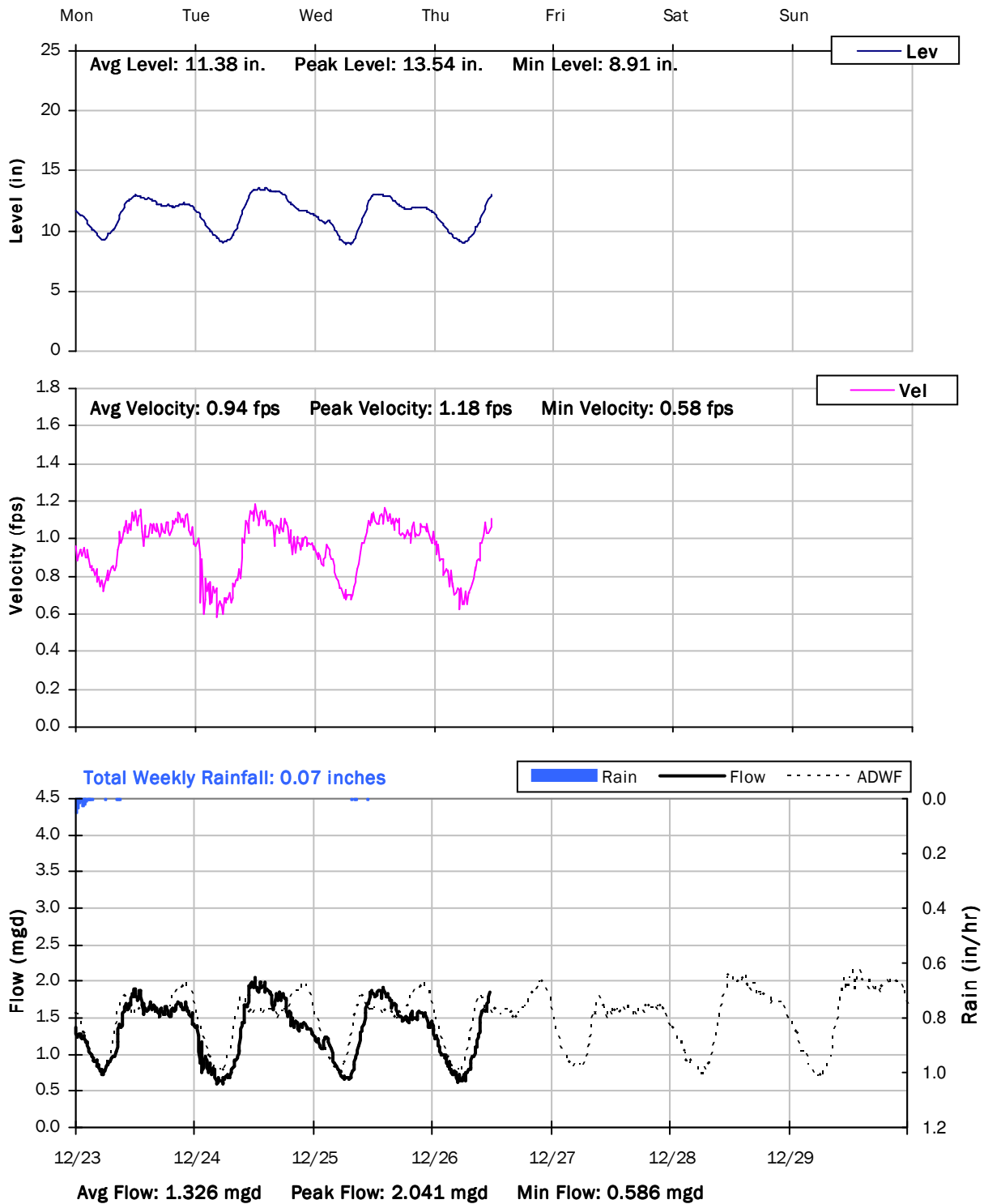
12/16/2019 to 12/23/2019



SITE 4

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

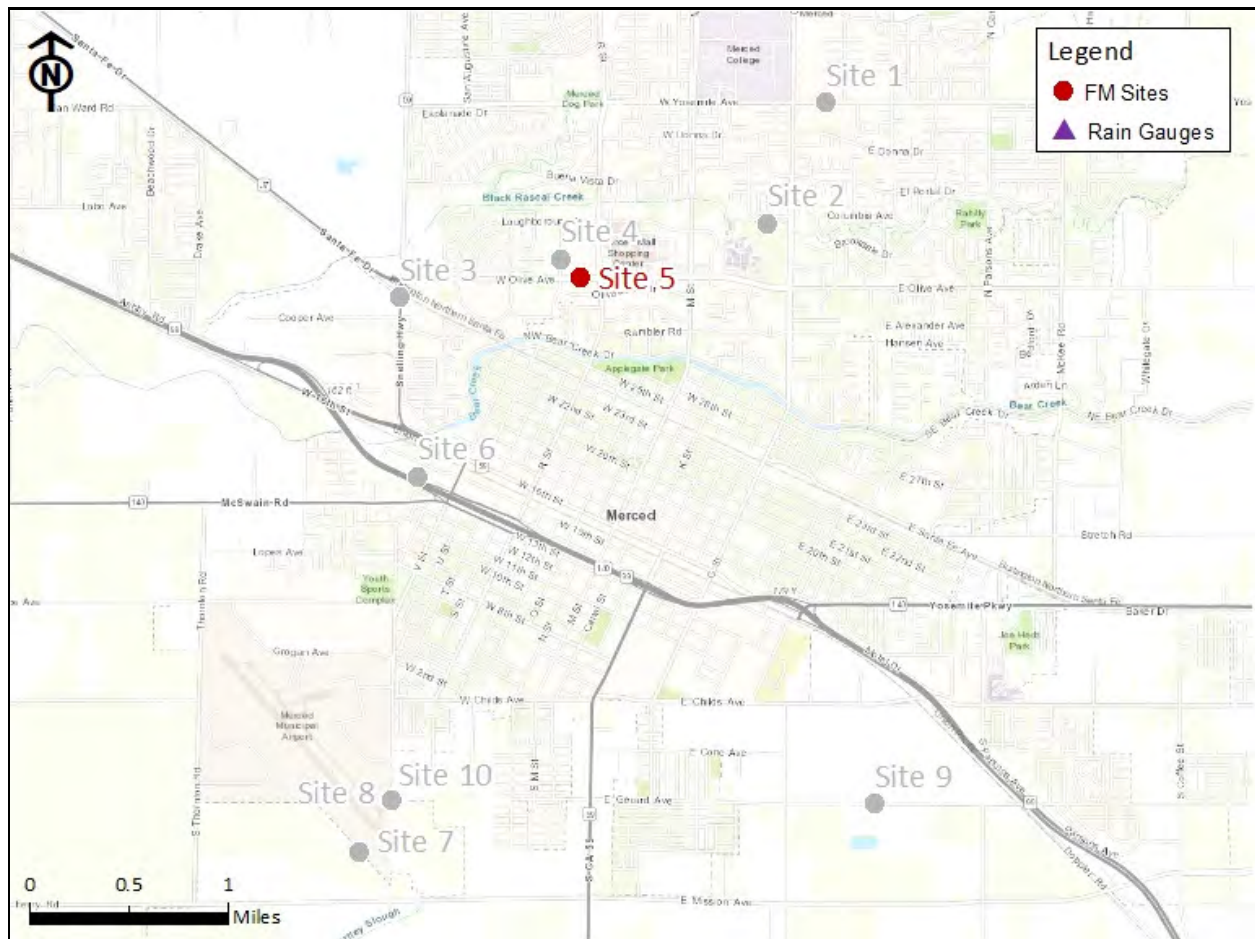
November 22 - December 26, 2019

Monitoring Site: Site 5

City Manhole: 6M161

Location: W Olive Avenue east of Meadows Avenue

Data Summary Report



Vicinity Map: Site 5

SITE 5

Site Information

Location: W Olive Avenue east of Meadows Avenue

City Manhole: 6M161

Coordinates: 120.4885° W, 37.3192° N

Rim Elevation (Earth): 174 feet

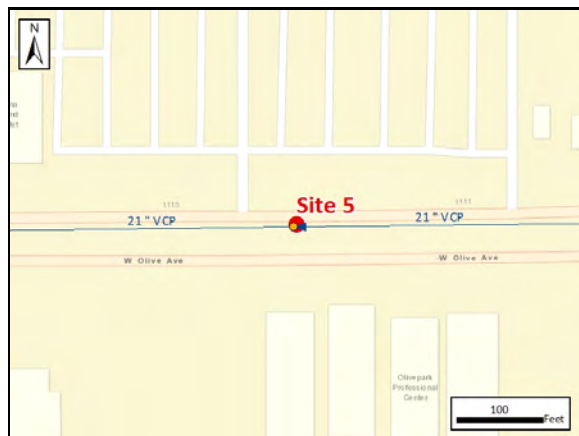
Pipe Diameter: 21 inches

ADWF: 0.671 mgd

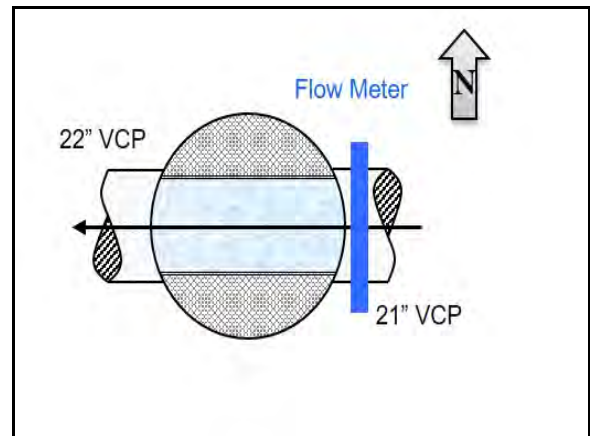
Peak Measured Flow: 1.460 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 5

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

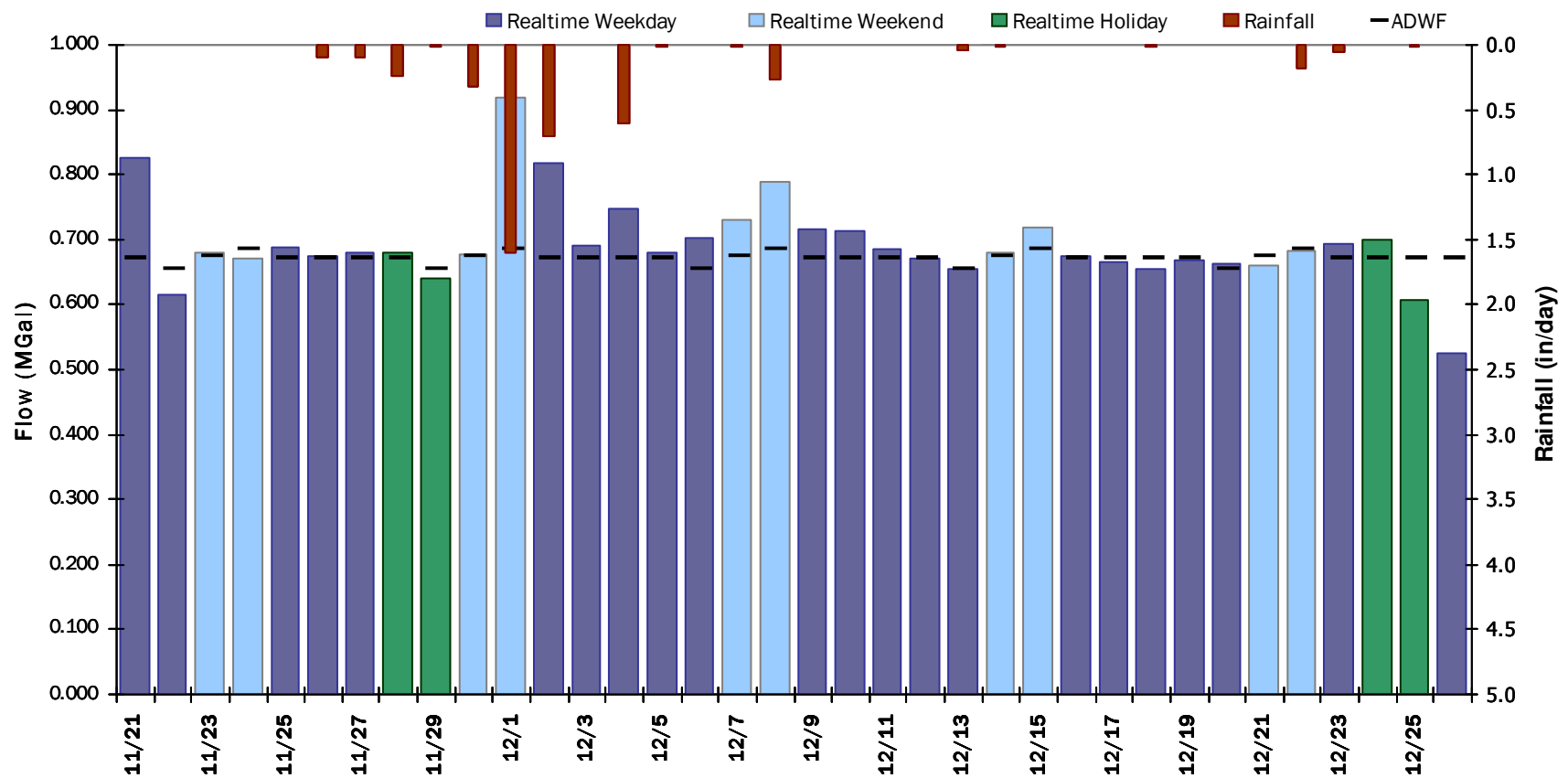


SITE 5

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.693 MGal Peak Daily Flow: 0.918 MGal Min Daily Flow: 0.525 MGal

Total Period Rainfall: 4.33 inches



SITE 5

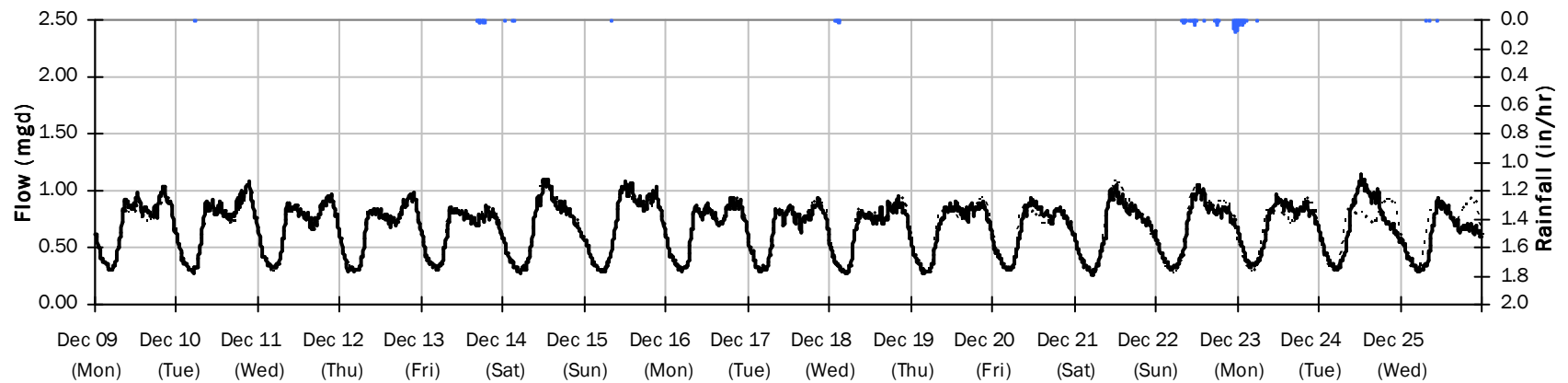
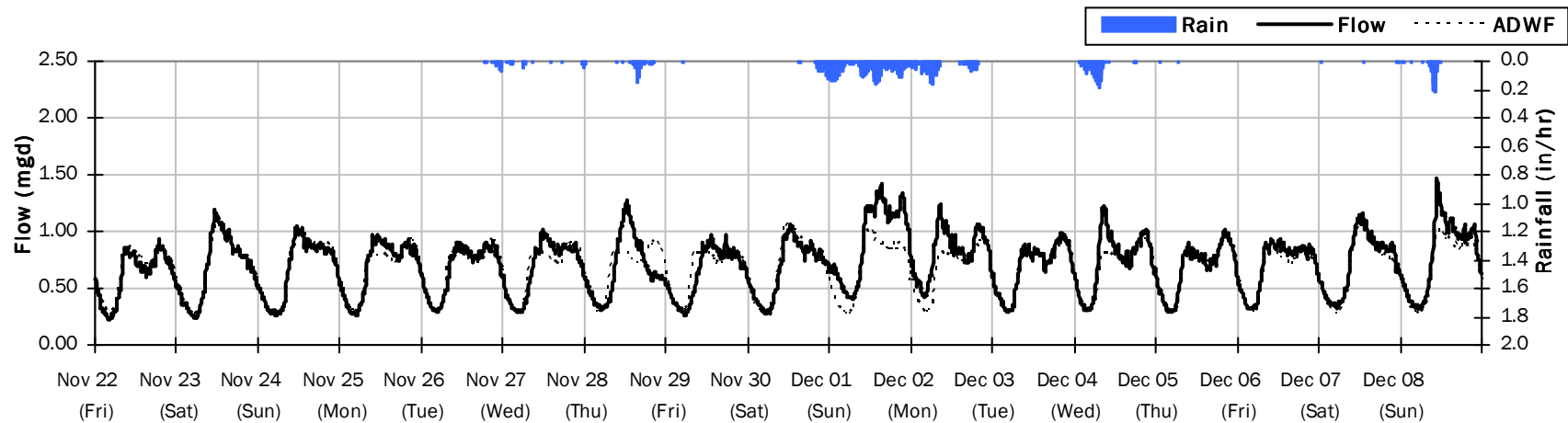
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.33 inches

Avg Flow: 0.694 mgd

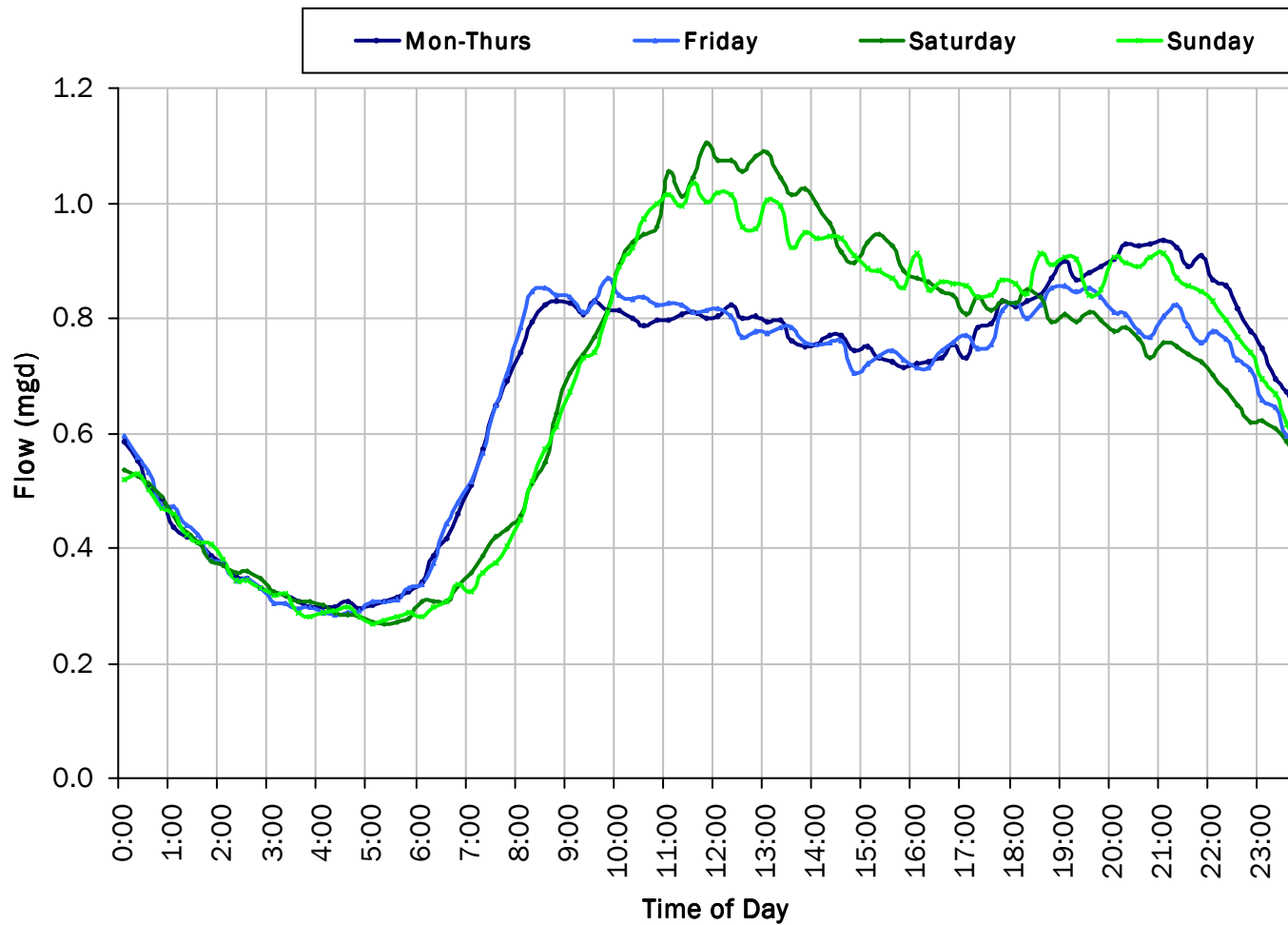
Peak Flow: 1.460 mgd

Min Flow: 0.228 mgd

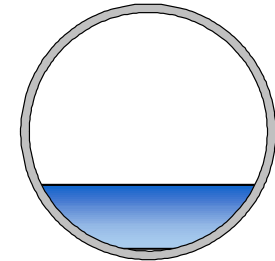


SITE 5

Average Dry Weather Flow Hydrographs

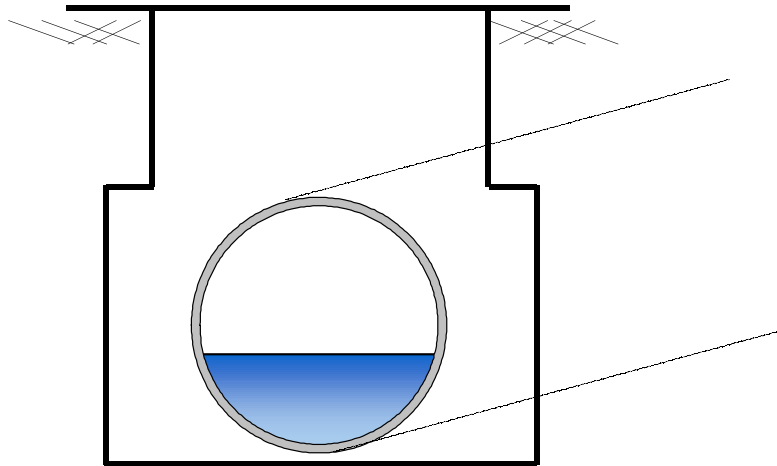
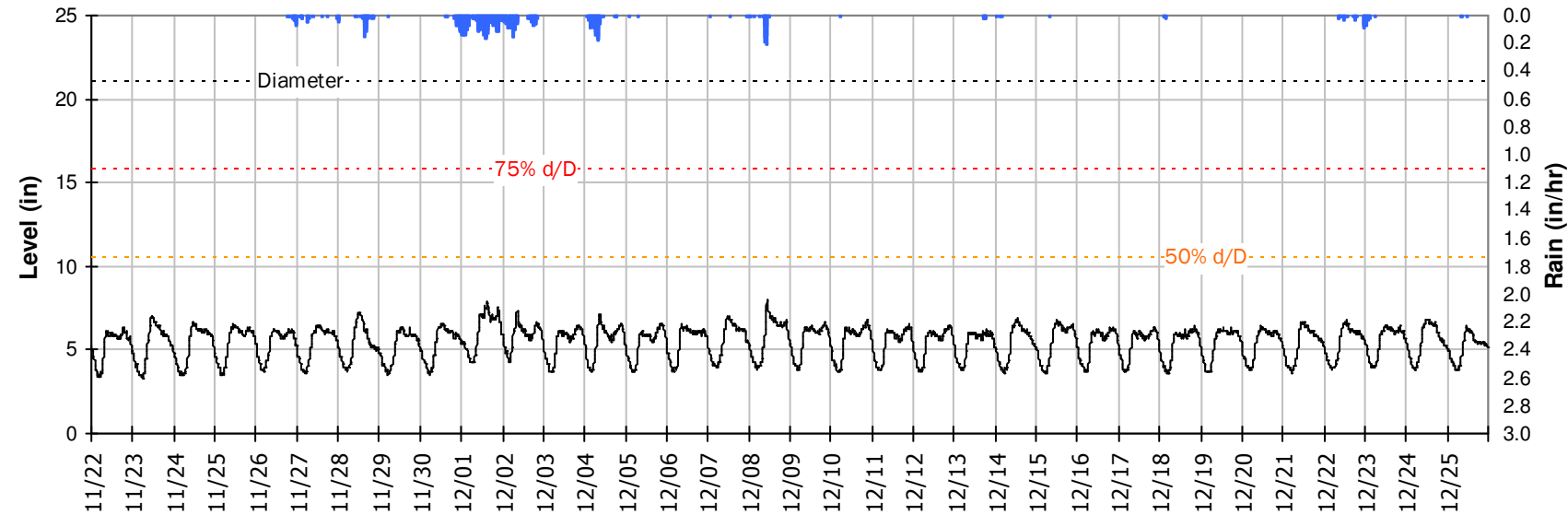


ADWF:
0.671 mgd



SITE 5
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

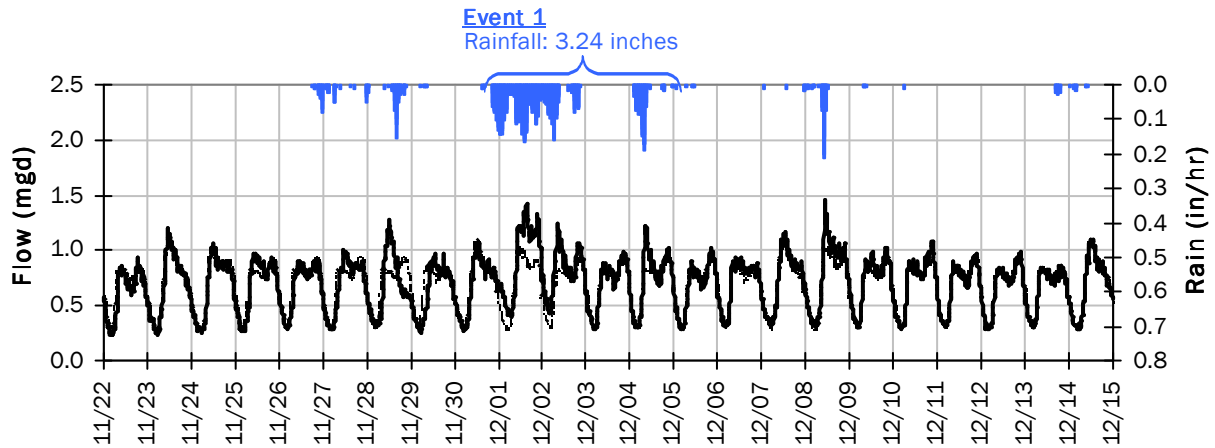


Pipe Diameter: 21 inches
Peak Measured Level: 8 inches
Peak d/D Ratio: 0.38

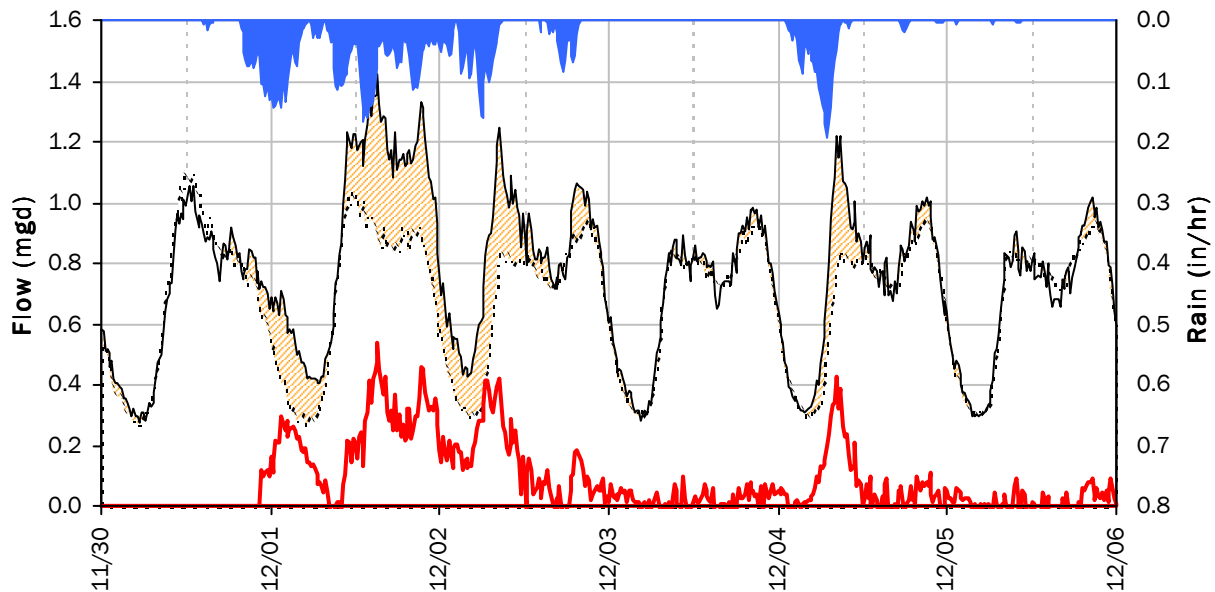
SITE 5

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.24 inches)

Capacity

Peak Flow: 1.42 mgd
PF: 2.11
Peak Level: 7.88 in
d/D Ratio: 0.38

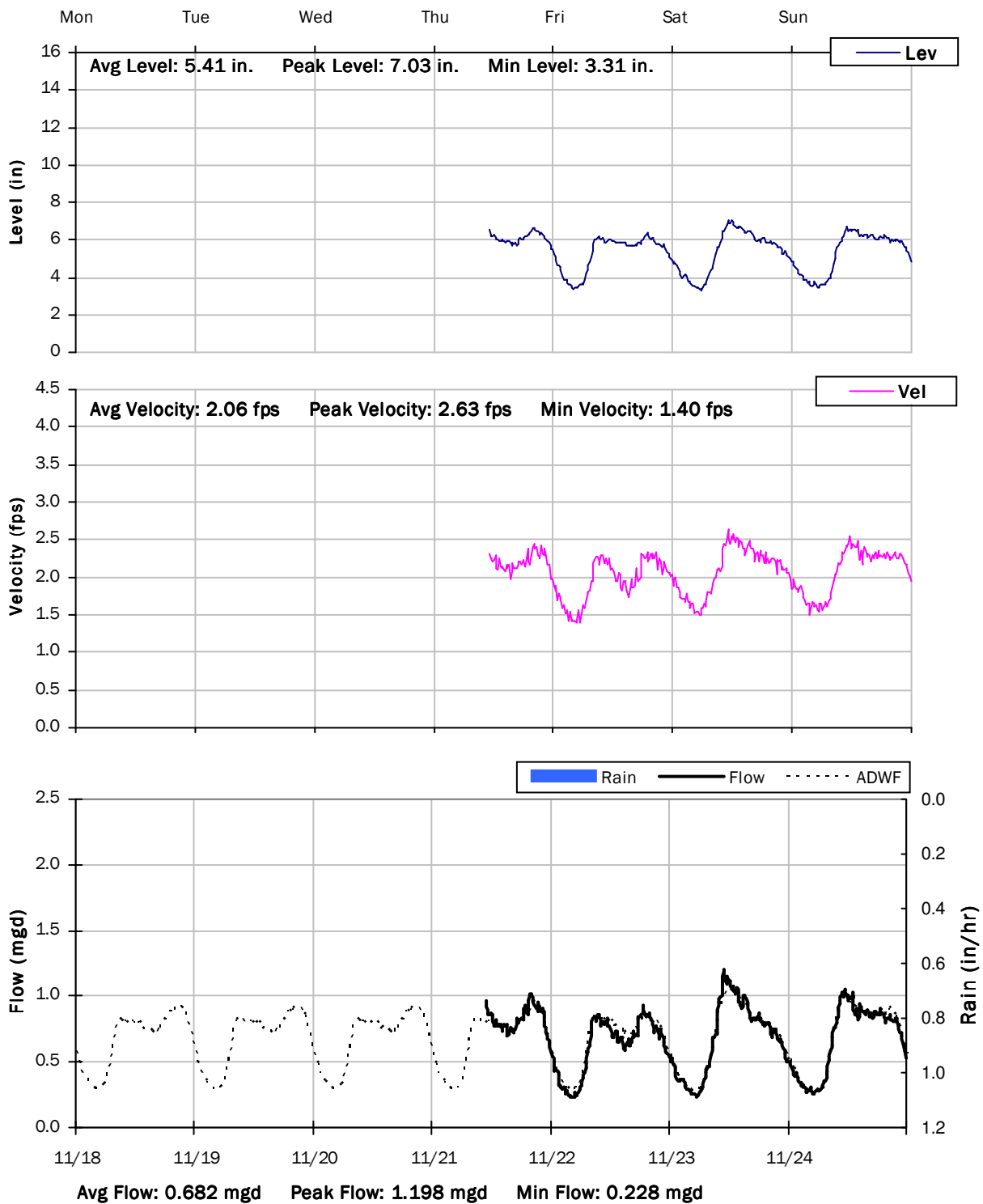
Inflow / Infiltration

Peak I/I Rate: 0.54 mgd
Total I/I: 489,000 gallons

SITE 5

Weekly Level, Velocity and Flow Hydrographs

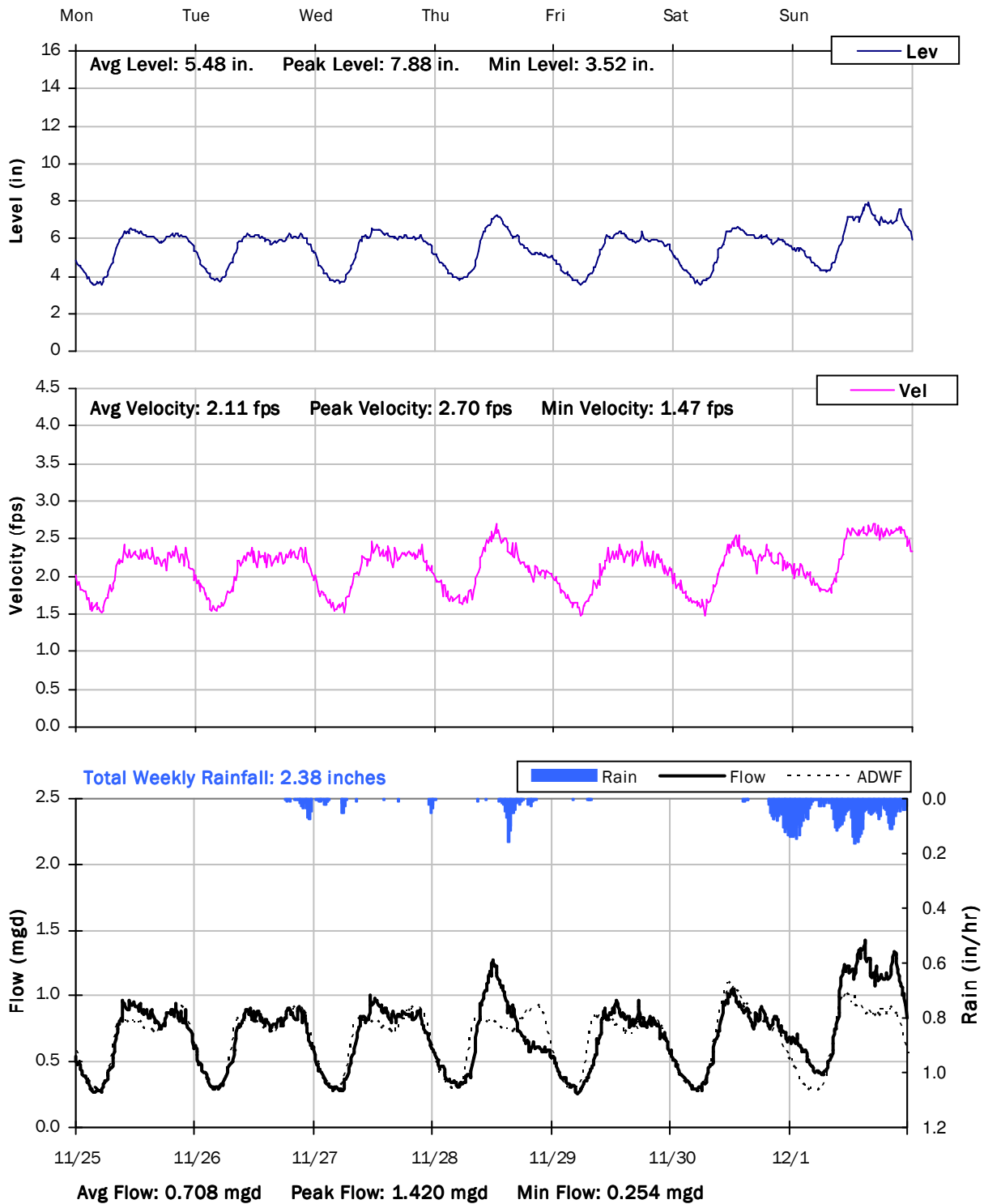
11/18/2019 to 11/25/2019



SITE 5

Weekly Level, Velocity and Flow Hydrographs

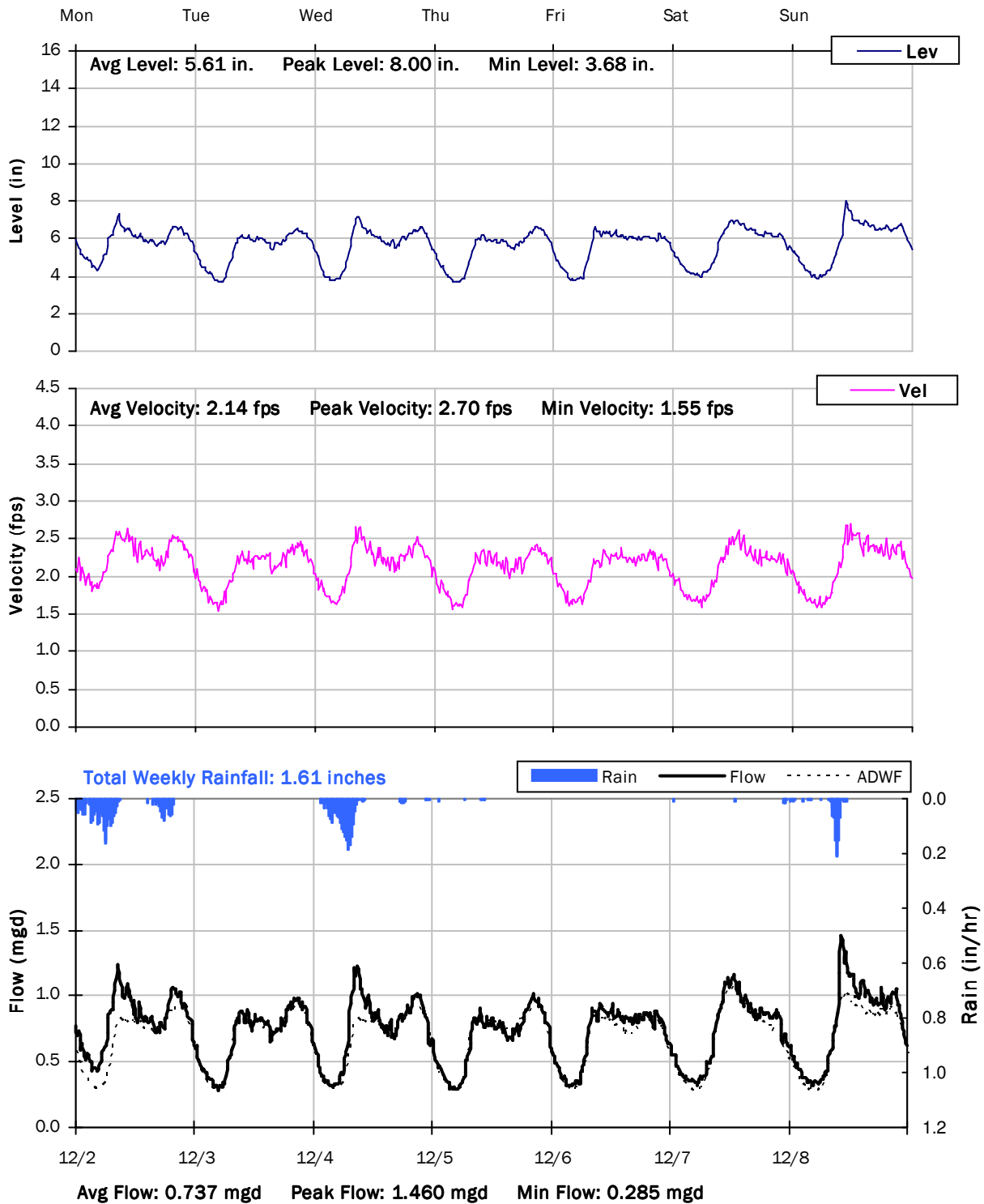
11/25/2019 to 12/2/2019



SITE 5

Weekly Level, Velocity and Flow Hydrographs

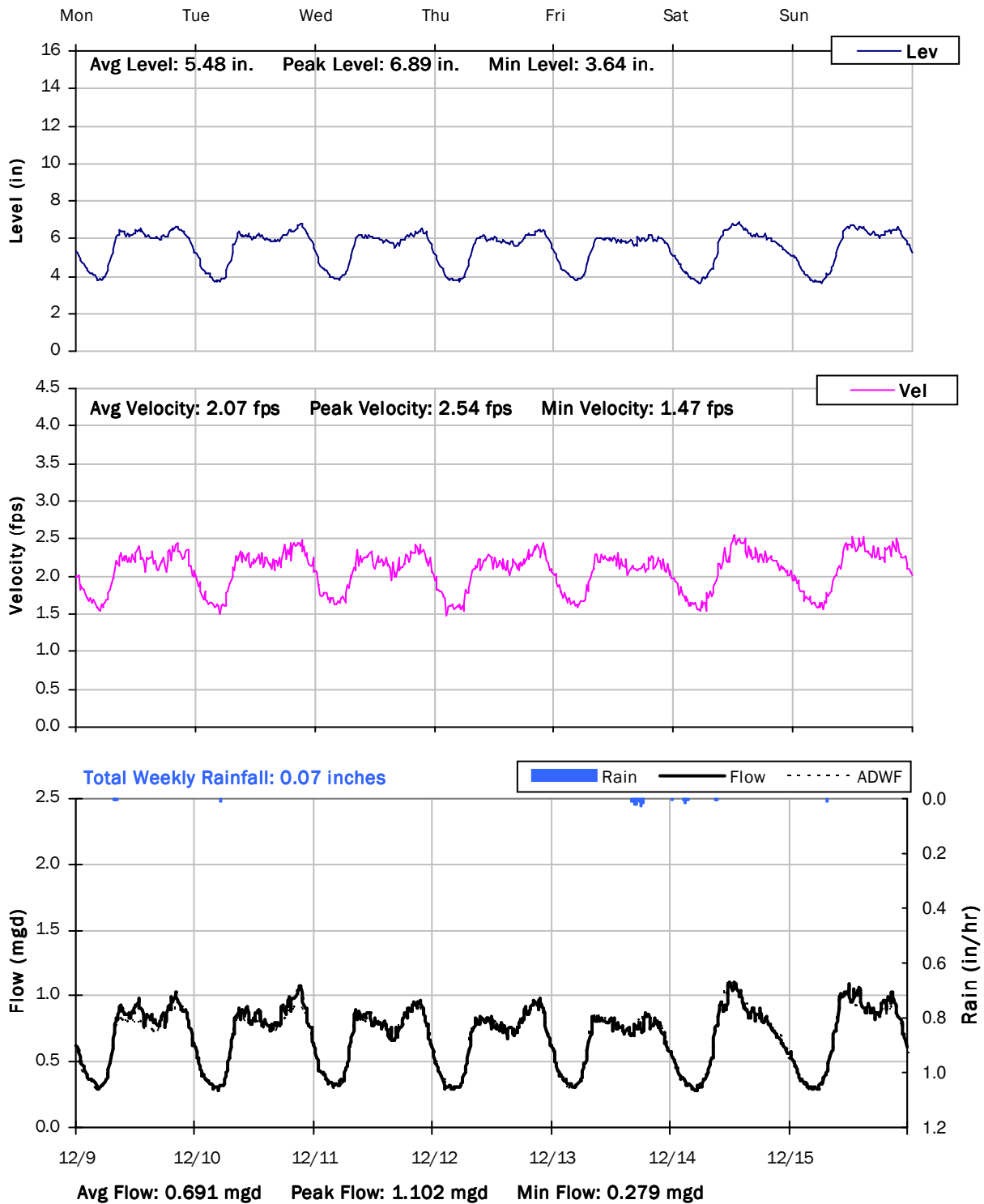
12/2/2019 to 12/9/2019



SITE 5

Weekly Level, Velocity and Flow Hydrographs

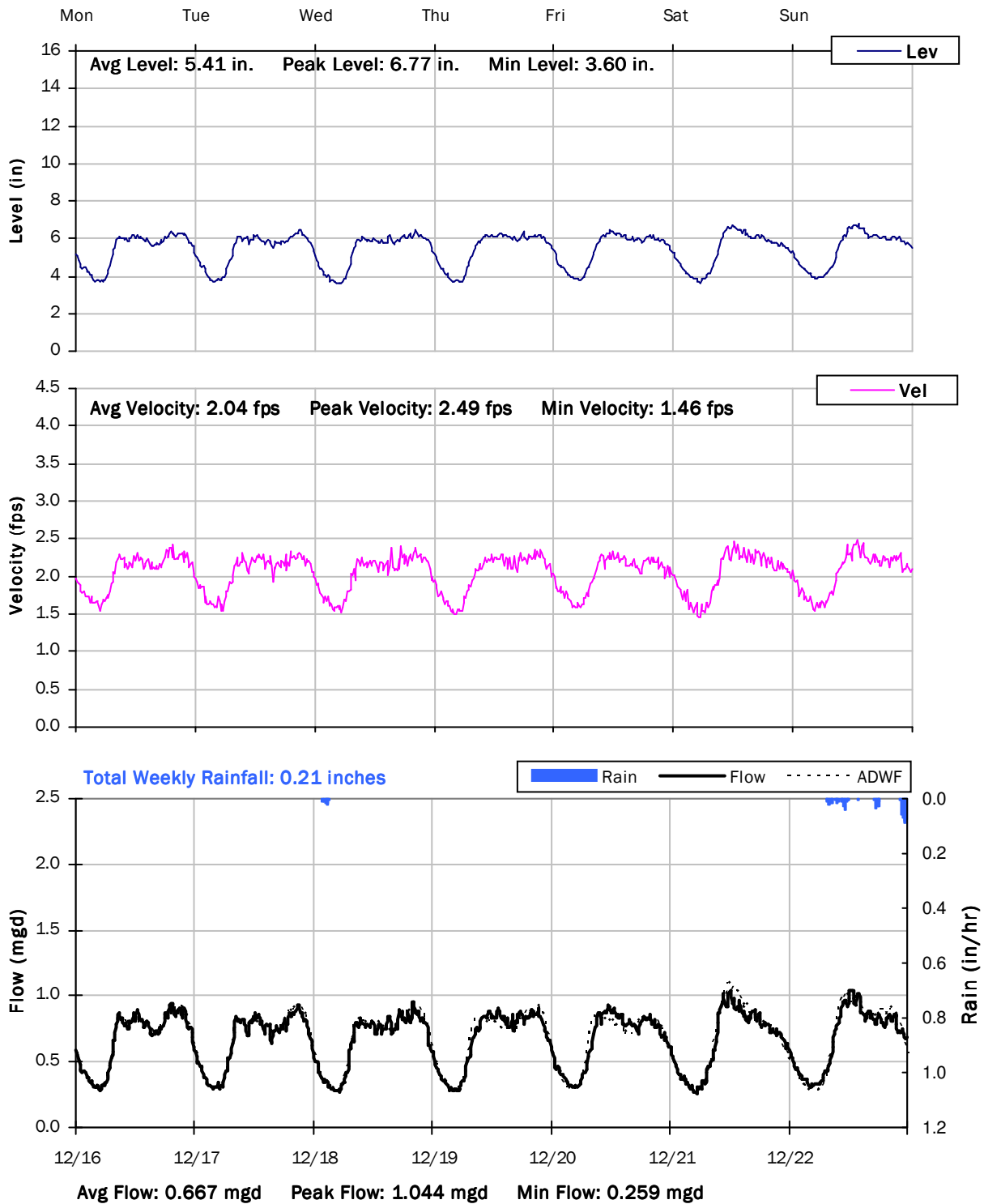
12/9/2019 to 12/16/2019



SITE 5

Weekly Level, Velocity and Flow Hydrographs

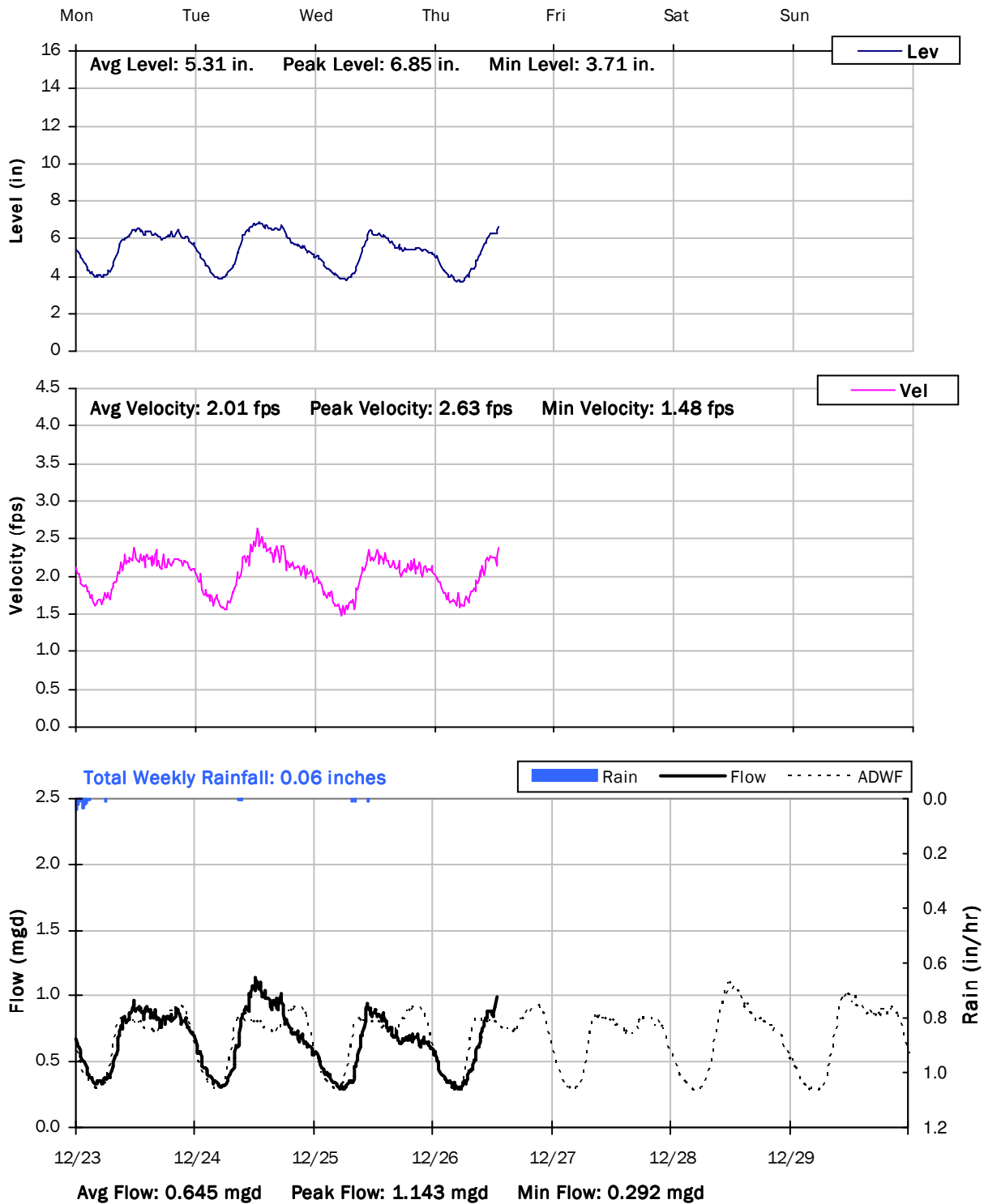
12/16/2019 to 12/23/2019



SITE 5

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

November 22 - December 26, 2019

Monitoring Site: Site 6

City Manhole: 16M071

Location: Razzari Ford, Auto Center Drive

Data Summary Report



Vicinity Map: Site 6

SITE 6

Site Information

Location: Razzari Ford, Auto Center Drive

City Manhole: 16M071

Coordinates: 120.5035° W, 37.3046° N

Rim Elevation (Earth): 168 feet

Pipe Diameter: 38.5 inches

ADWF: 3.433 mgd

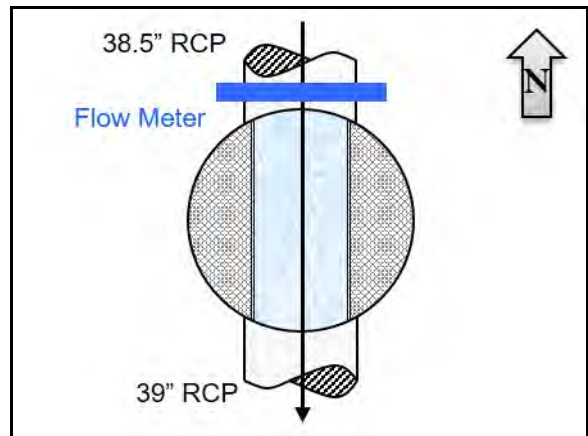
Peak Measured Flow: 6.589 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 6

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

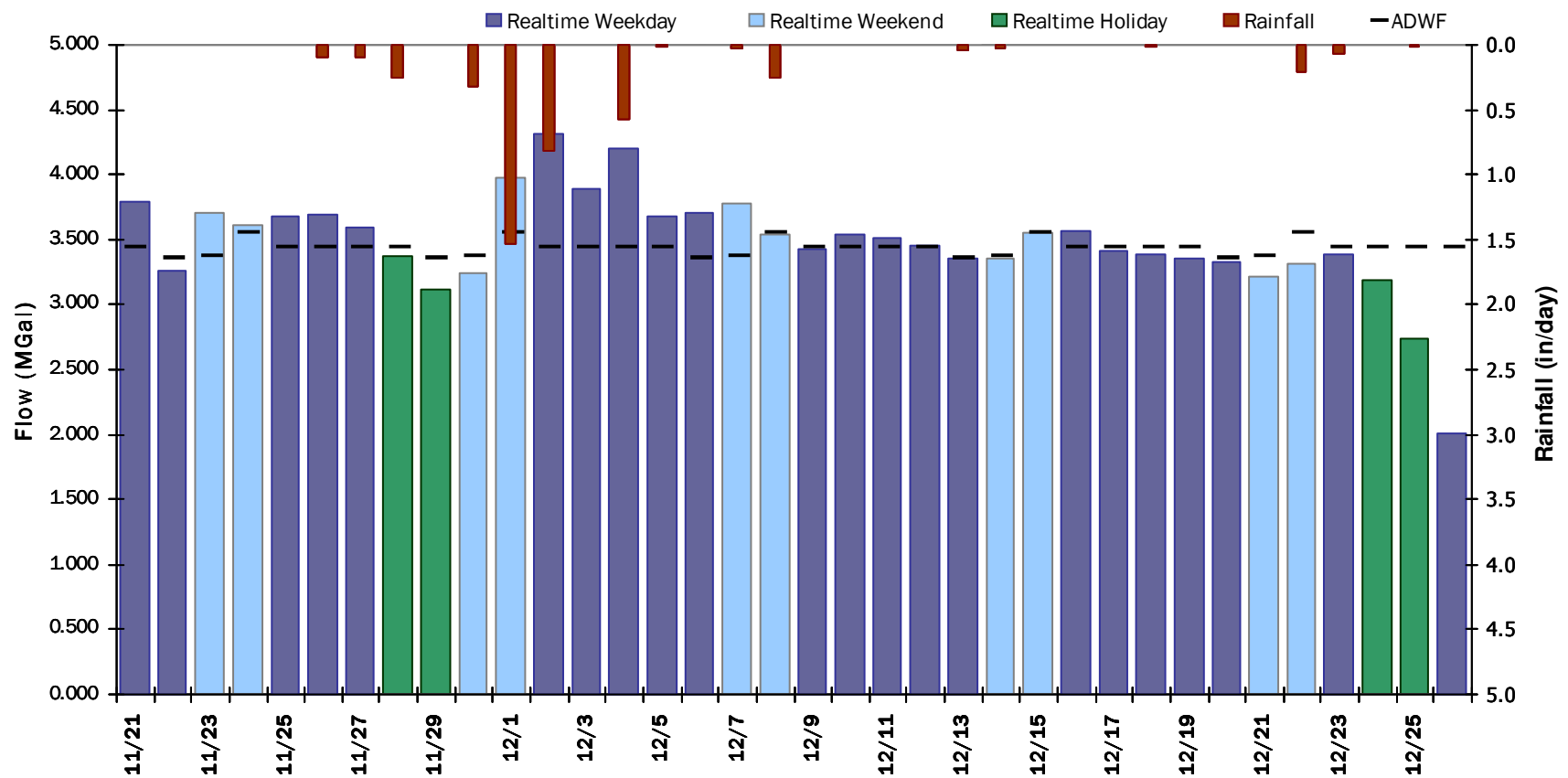


SITE 6

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 3.479 MGal Peak Daily Flow: 4.315 MGal Min Daily Flow: 2.003 MGal

Total Period Rainfall: 4.38 inches



SITE 6

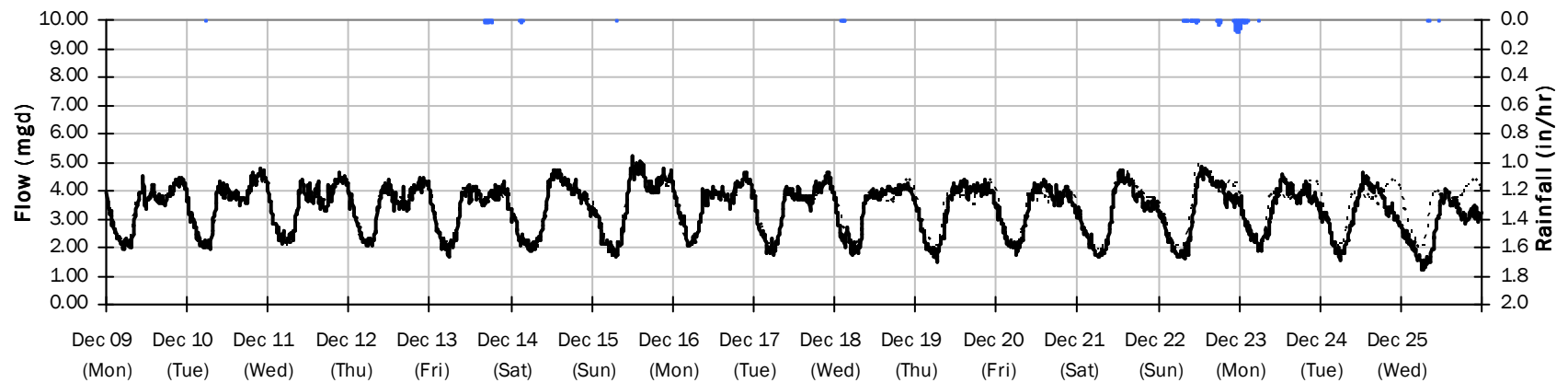
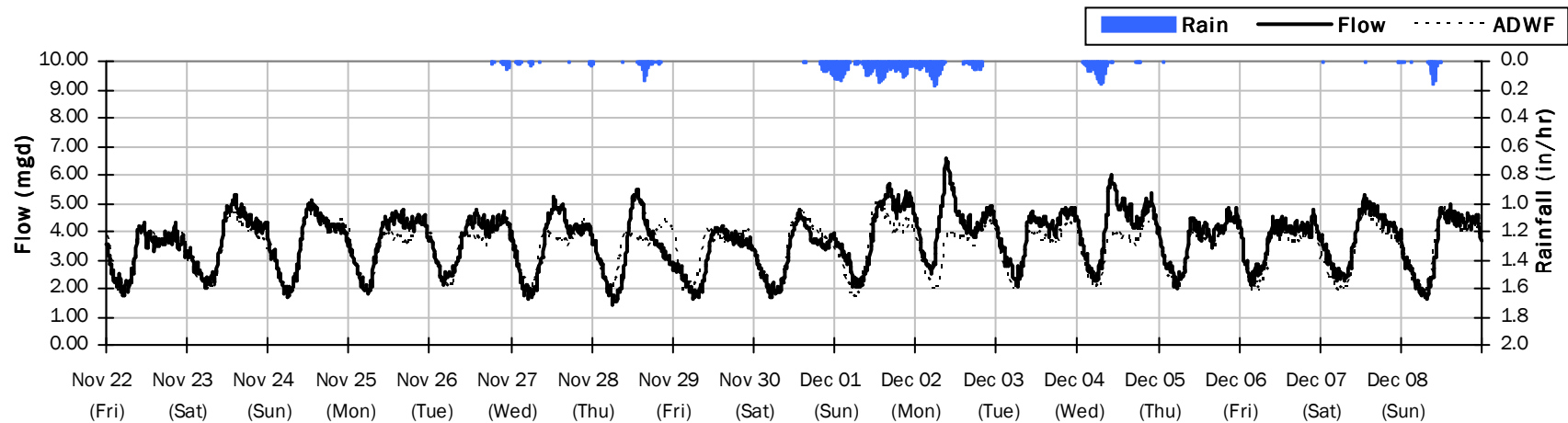
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.38 inches

Avg Flow: 3.513 mgd

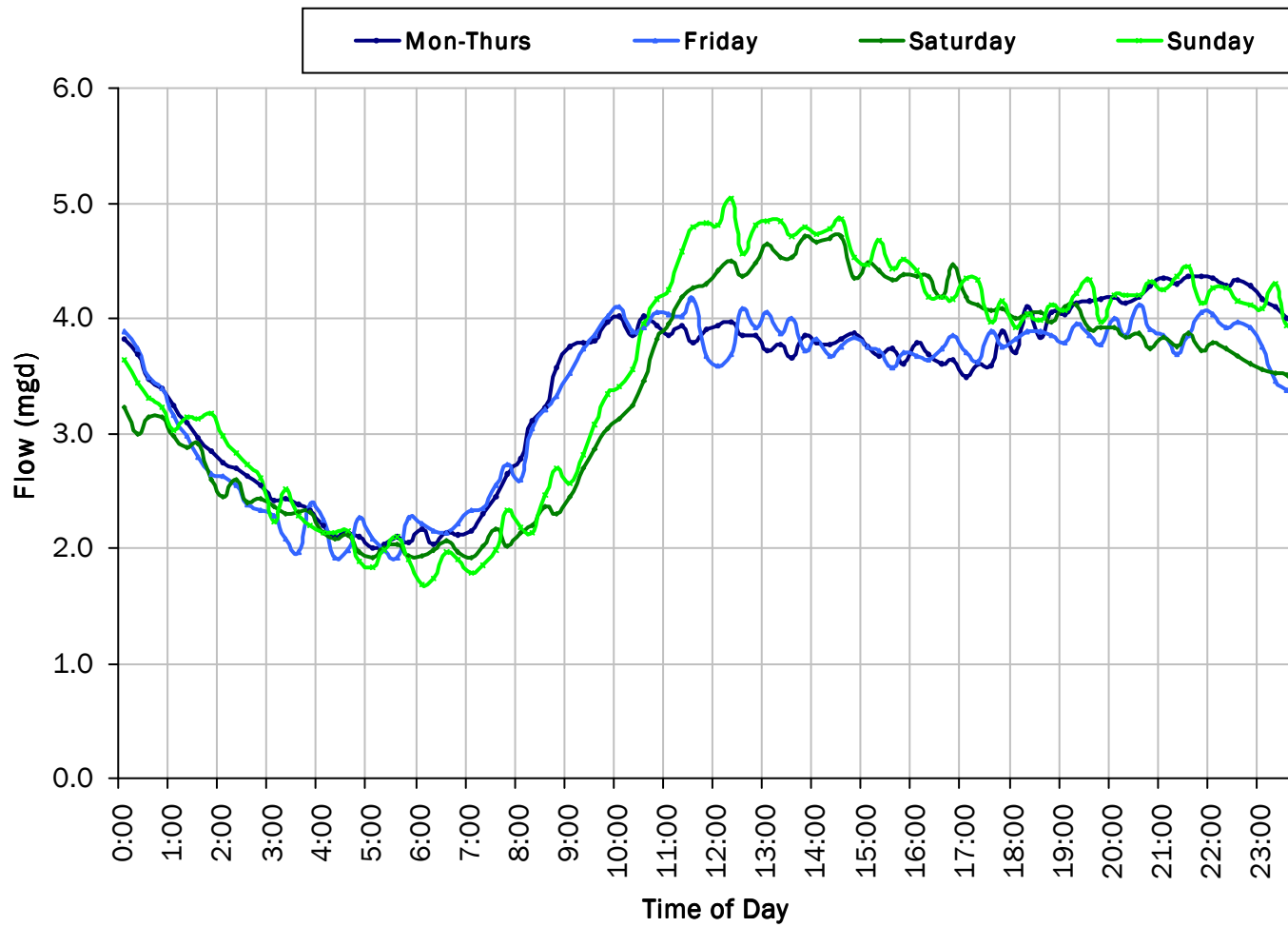
Peak Flow: 6.589 mgd

Min Flow: 1.230 mgd

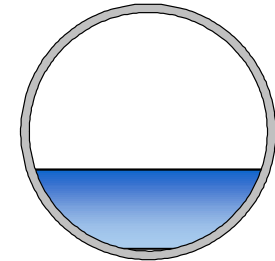


SITE 6

Average Dry Weather Flow Hydrographs

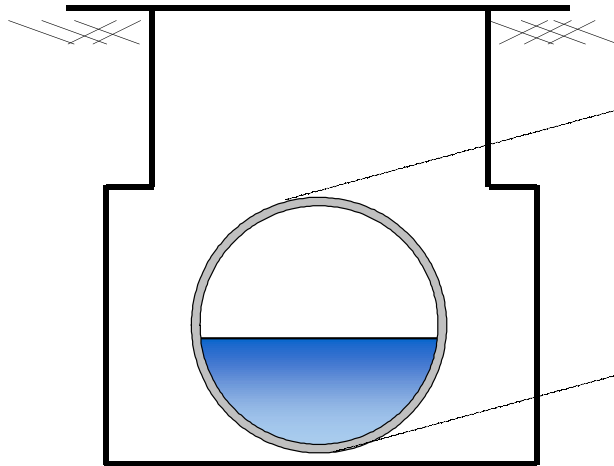
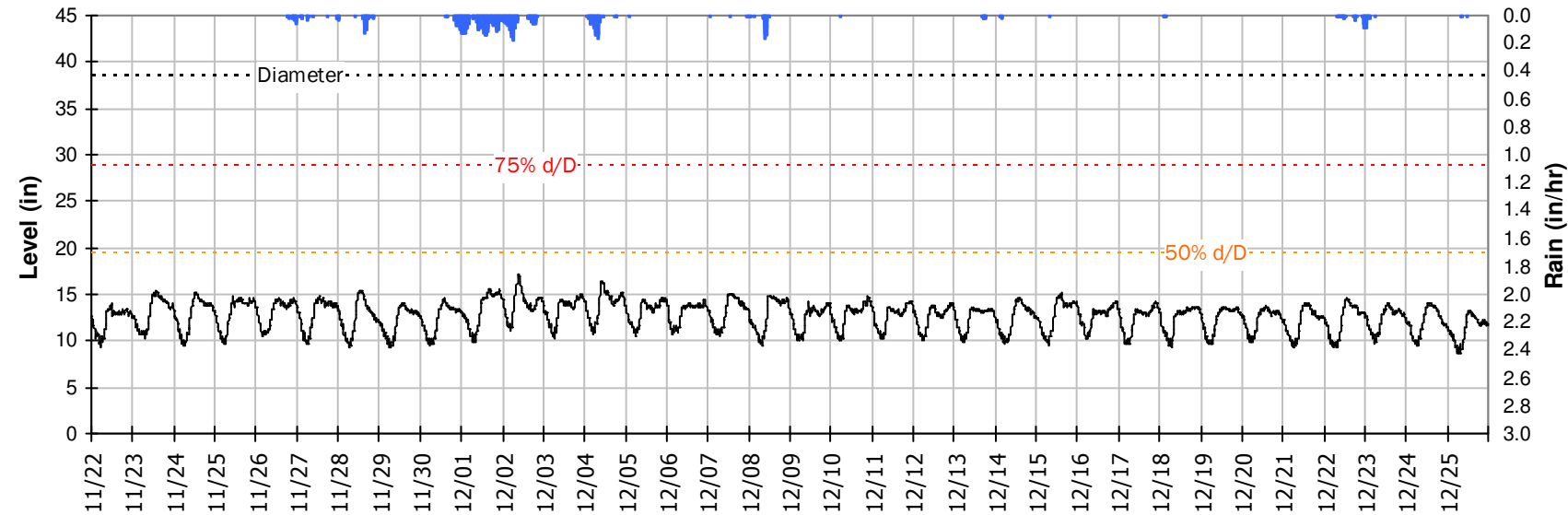


ADWF:
3.433 mgd



SITE 6
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

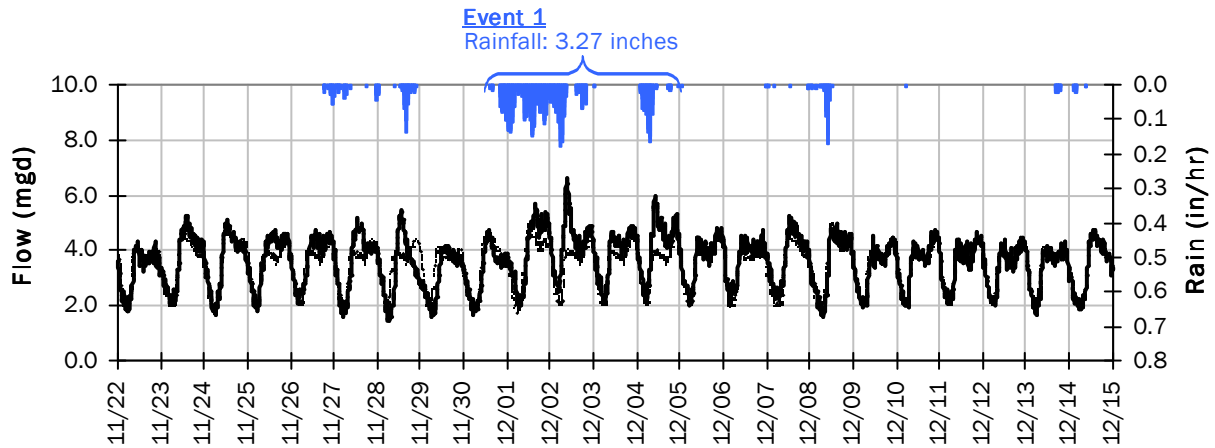


Pipe Diameter: 38.5 inches
Peak Measured Level: 17.2 inches
Peak d/D Ratio: 0.45

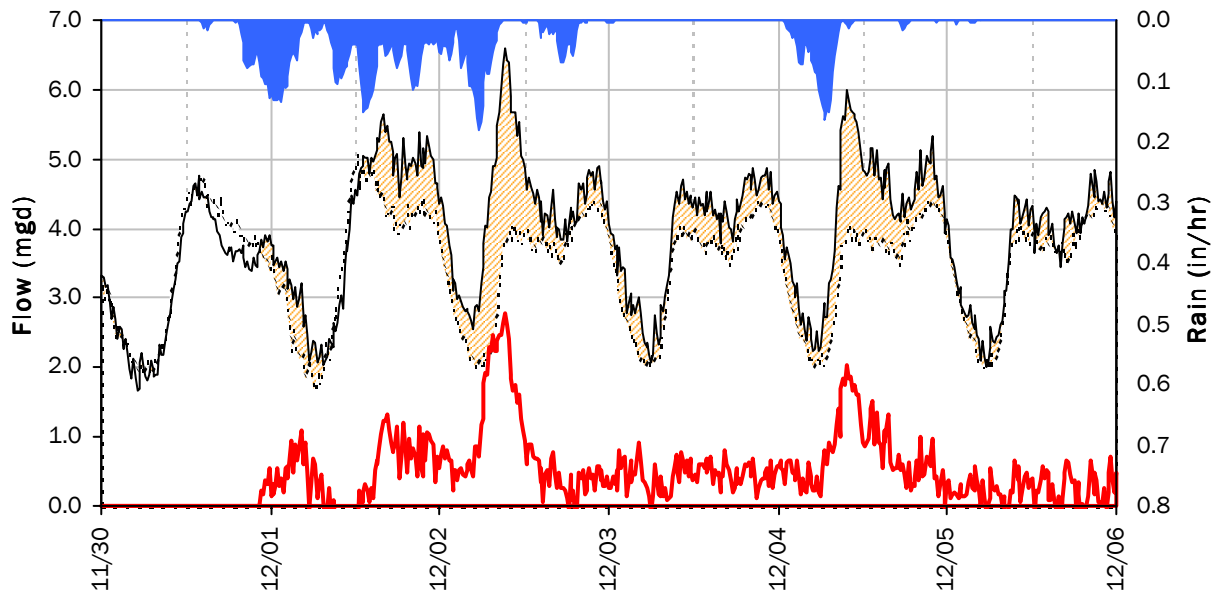
SITE 6

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.27 inches)

Capacity

Peak Flow: 6.59 mgd
PF: 1.92

Peak Level: 17.19 in
d/D Ratio: 0.45

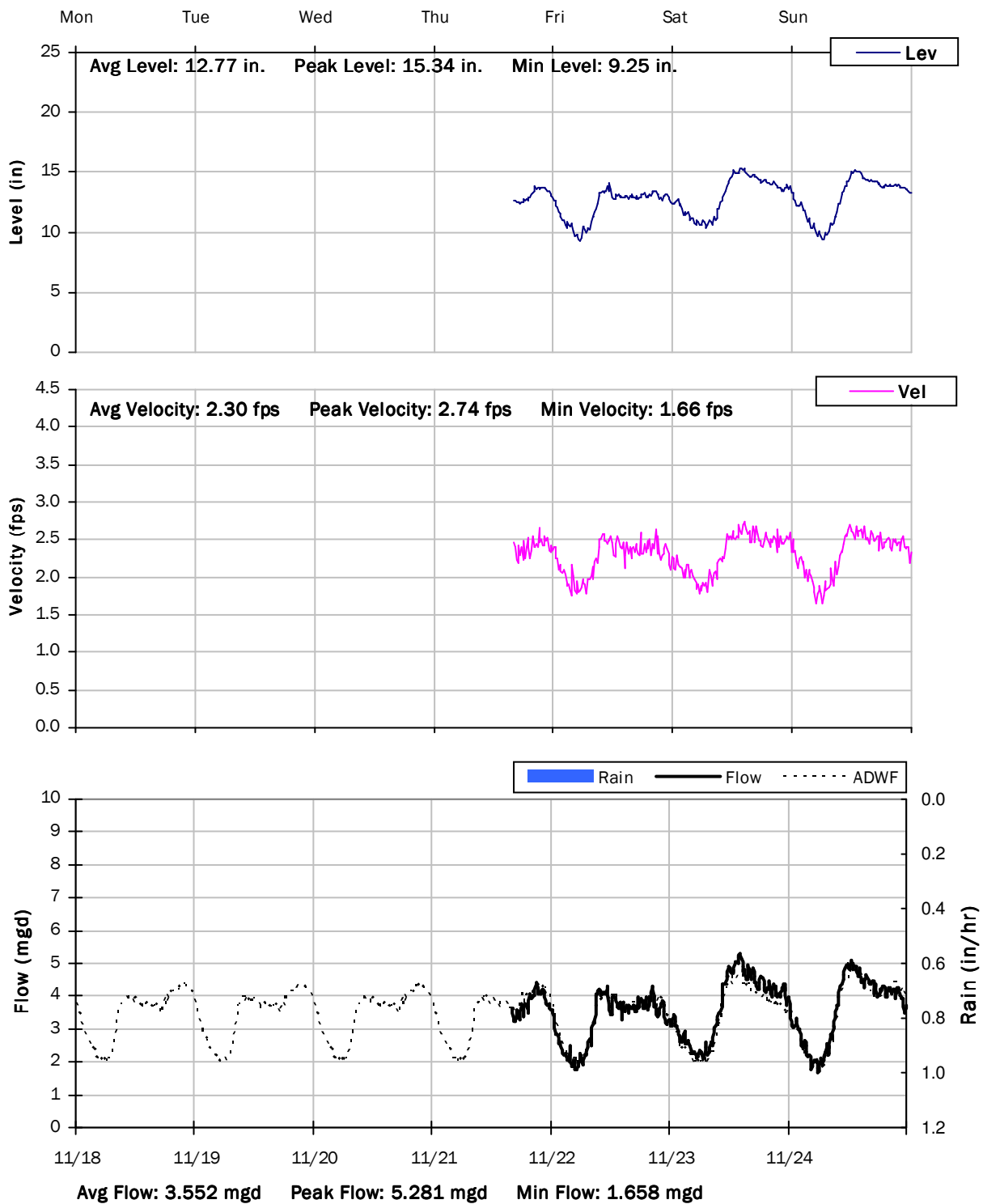
Inflow / Infiltration

Peak I/I Rate: 2.80 mgd
Total I/I: 2,768,000 gallons

SITE 6

Weekly Level, Velocity and Flow Hydrographs

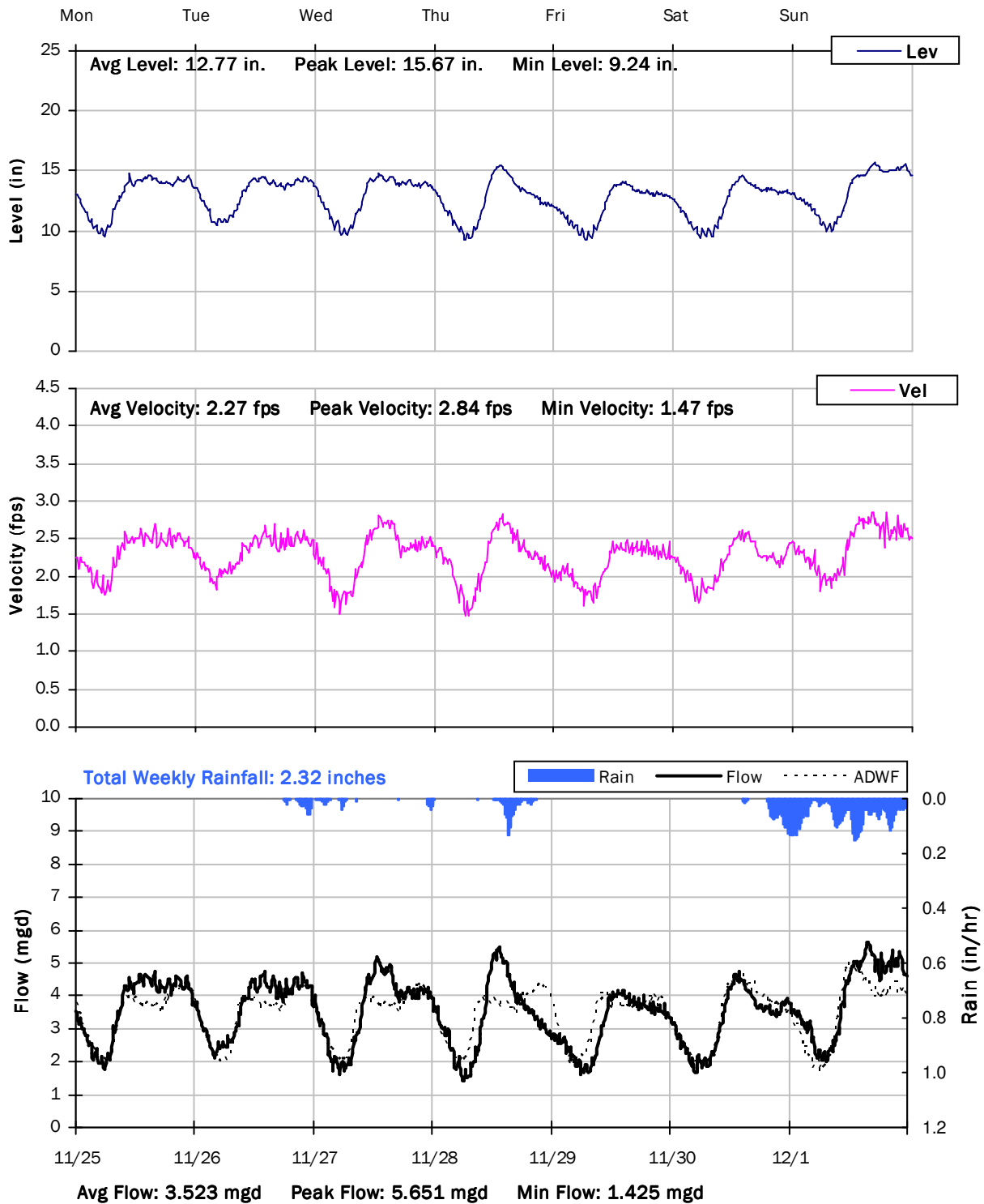
11/18/2019 to 11/25/2019



SITE 6

Weekly Level, Velocity and Flow Hydrographs

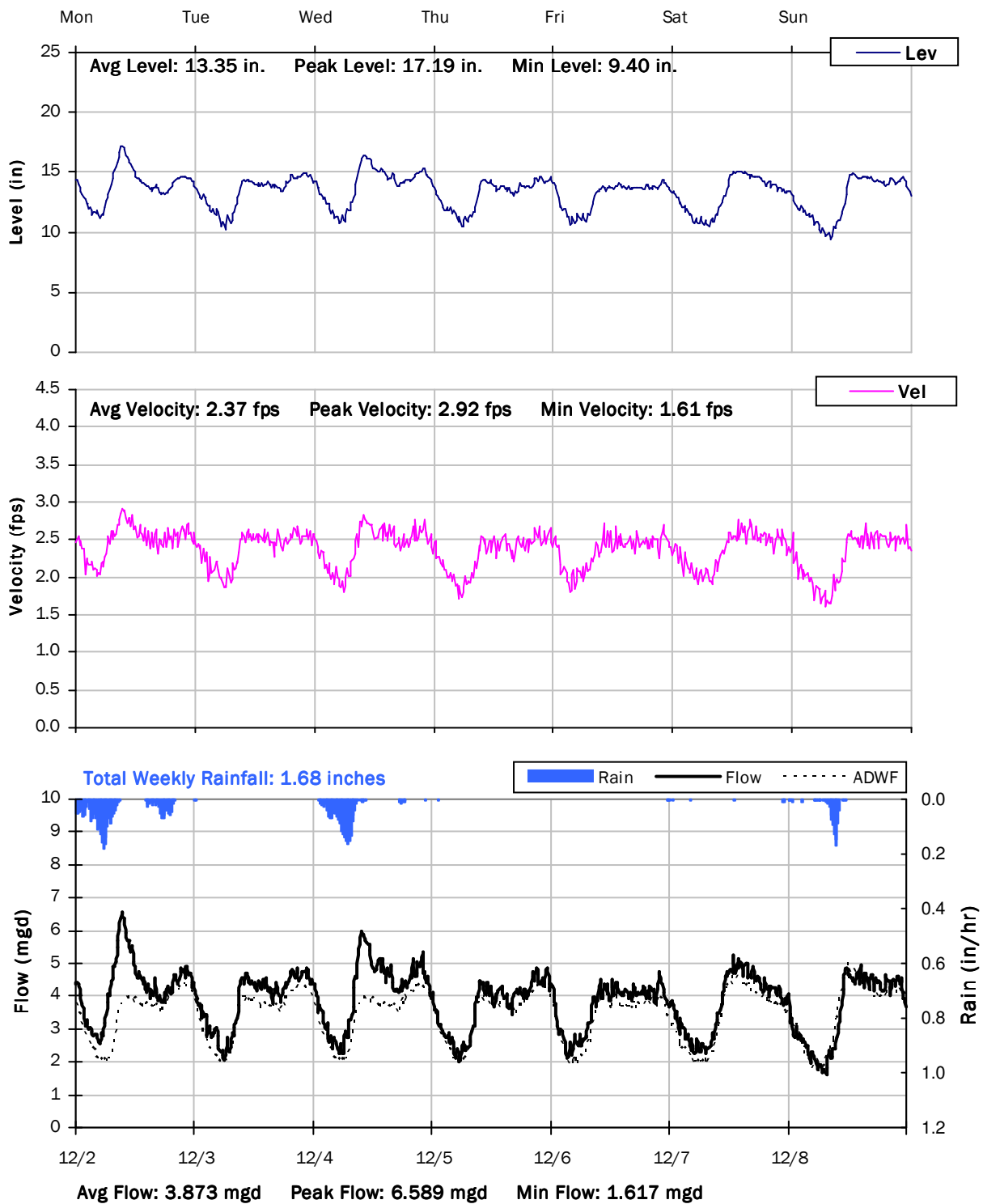
11/25/2019 to 12/2/2019



SITE 6

Weekly Level, Velocity and Flow Hydrographs

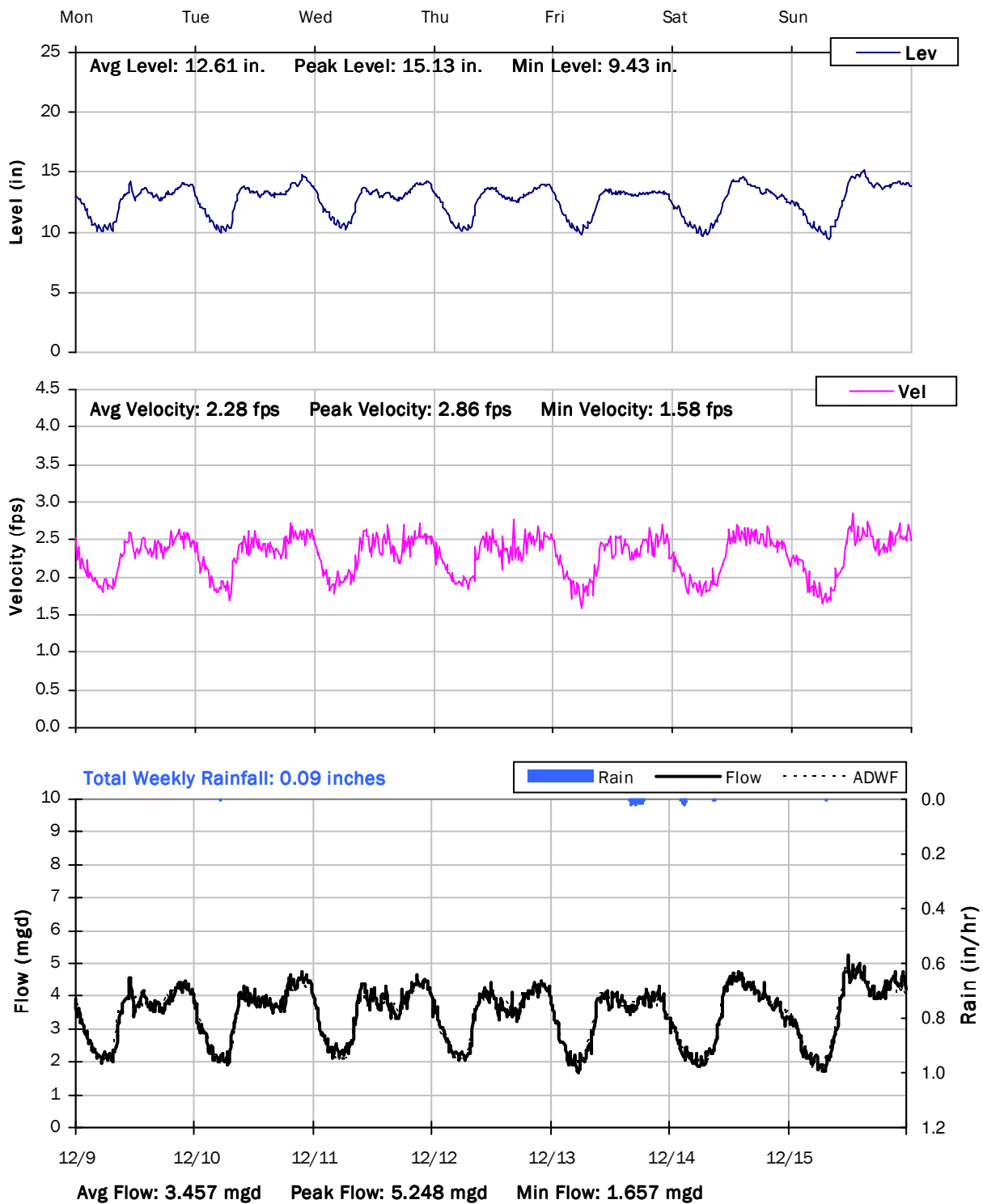
12/2/2019 to 12/9/2019



SITE 6

Weekly Level, Velocity and Flow Hydrographs

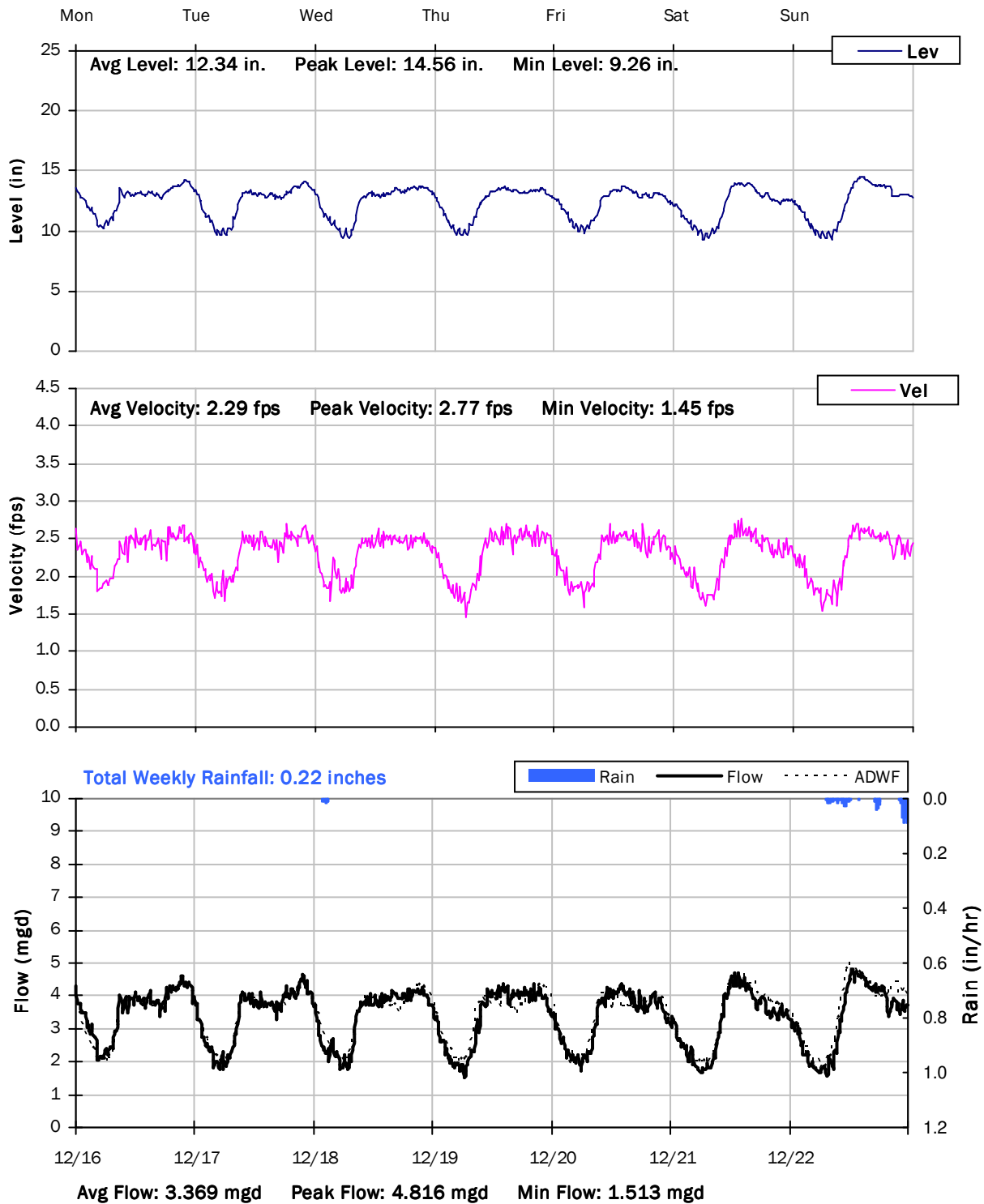
12/9/2019 to 12/16/2019



SITE 6

Weekly Level, Velocity and Flow Hydrographs

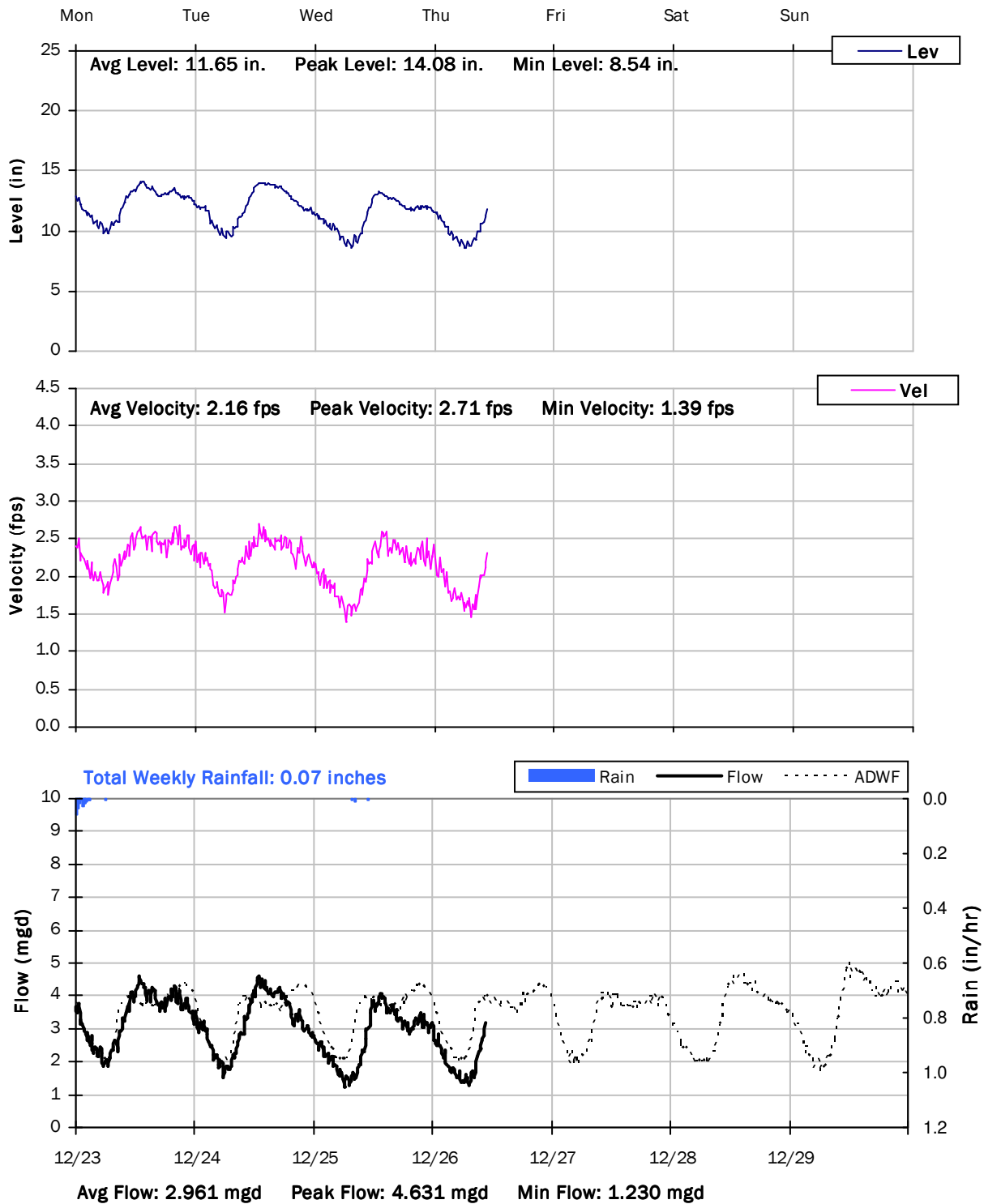
12/16/2019 to 12/23/2019



SITE 6

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

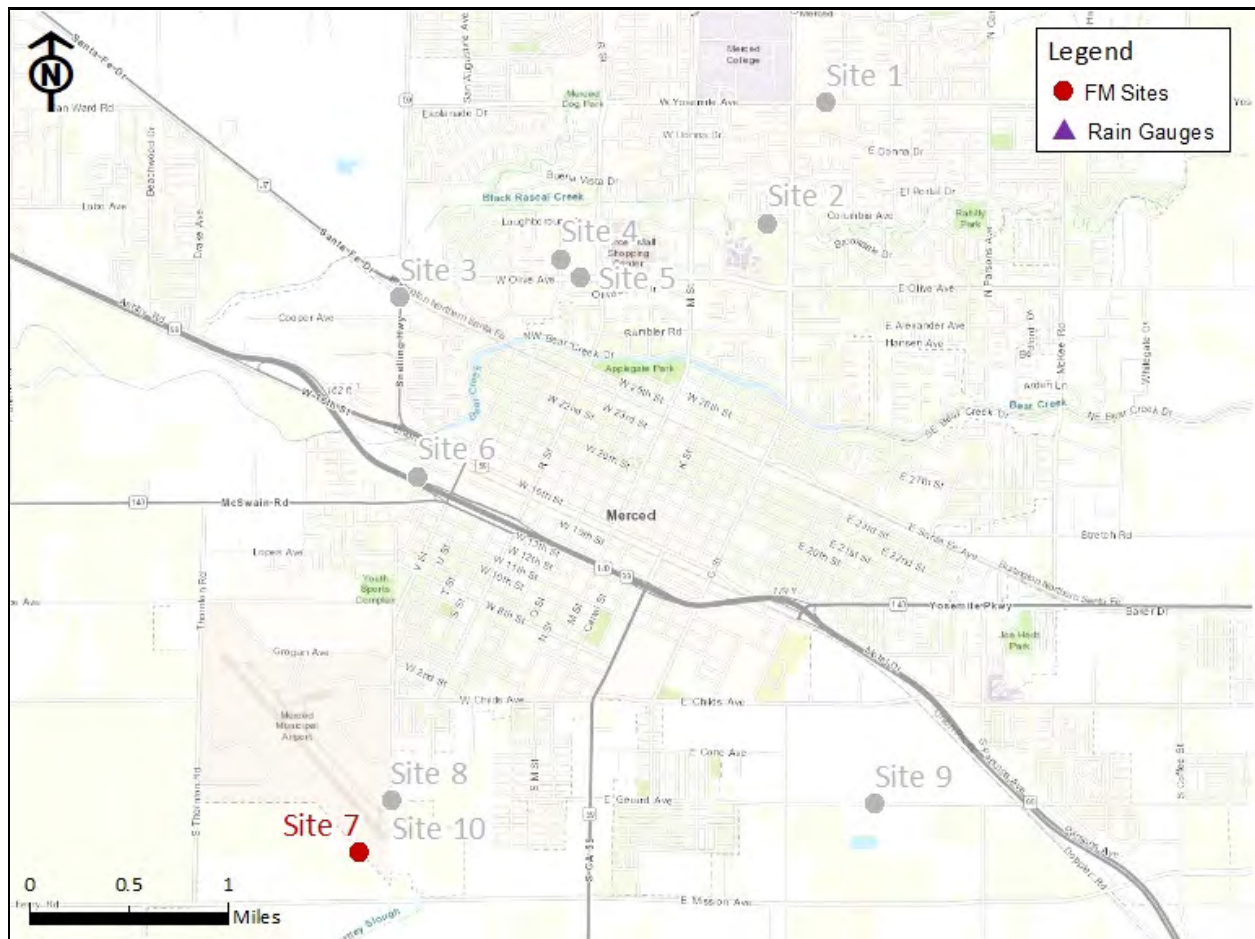
November 22 - December 26, 2019

Monitoring Site: Site 7

City Manhole: 16M050

Location: Field north of W Dickerson Ferry Road, along airport fence

Data Summary Report



Vicinity Map: Site 7

SITE 7

Site Information

Location: Field north of W Dickerson Ferry Road, along airport fence

City Manhole: 16M050

Coordinates: 120.5088° W, 37.2771° N

Rim Elevation (Earth): 154 feet

Pipe Diameter: 42 inches

ADWF: 3.362 mgd

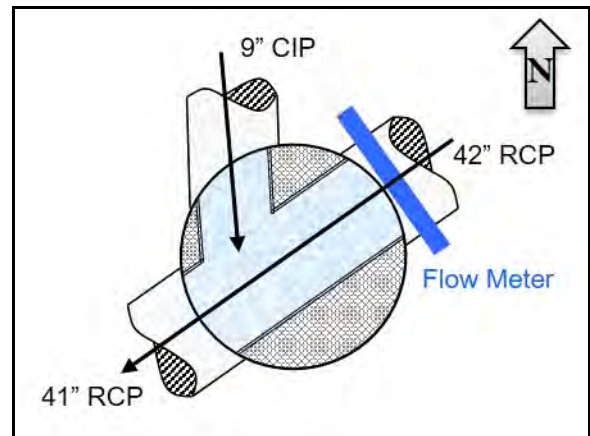
Peak Measured Flow: 7.293 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 7

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe



SITE 7

Additional Site Photos

North Lateral Pipe

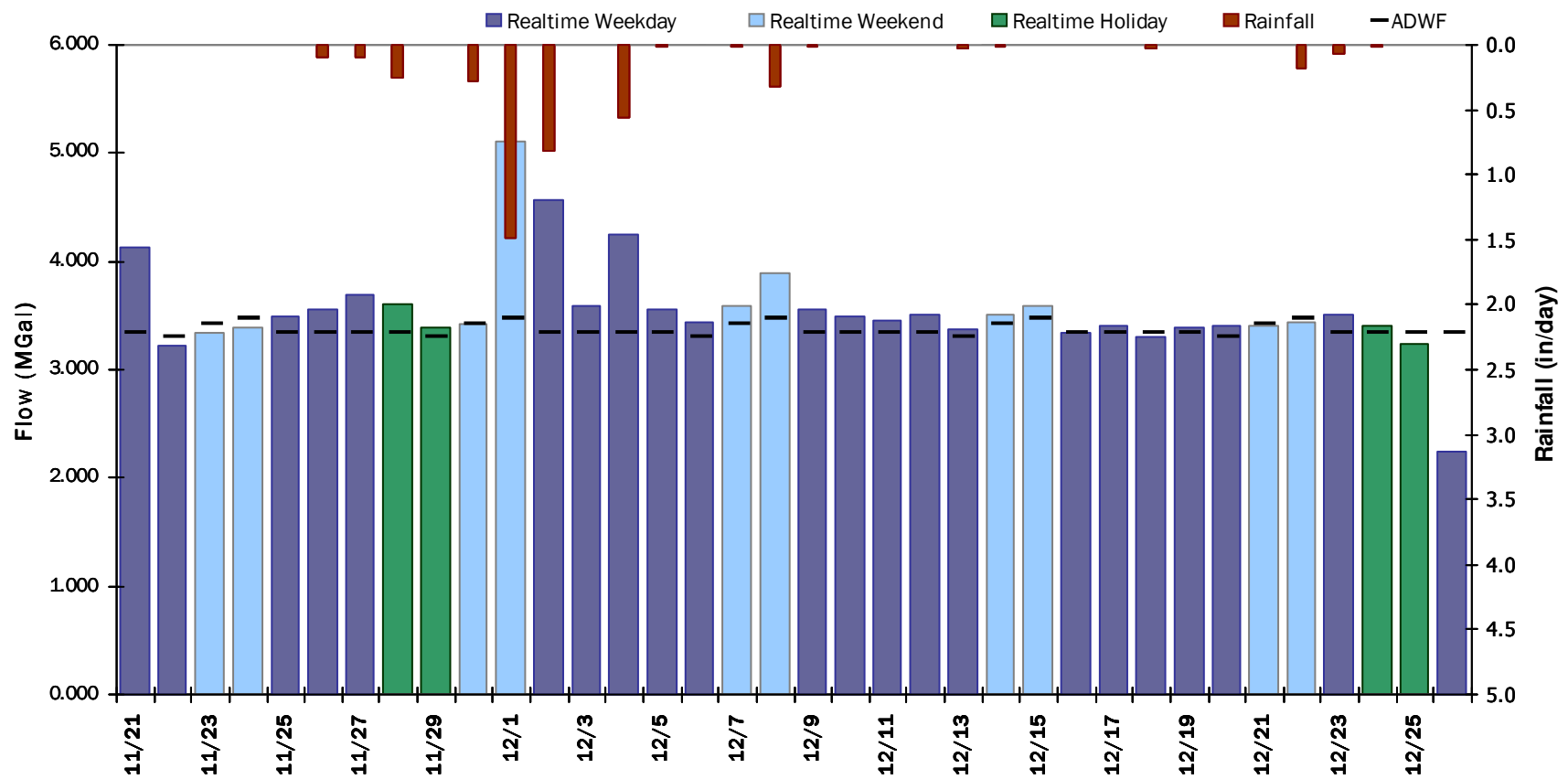


SITE 7

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 3.550 MGal Peak Daily Flow: 5.107 MGal Min Daily Flow: 2.239 MGal

Total Period Rainfall: 4.32 inches



SITE 7

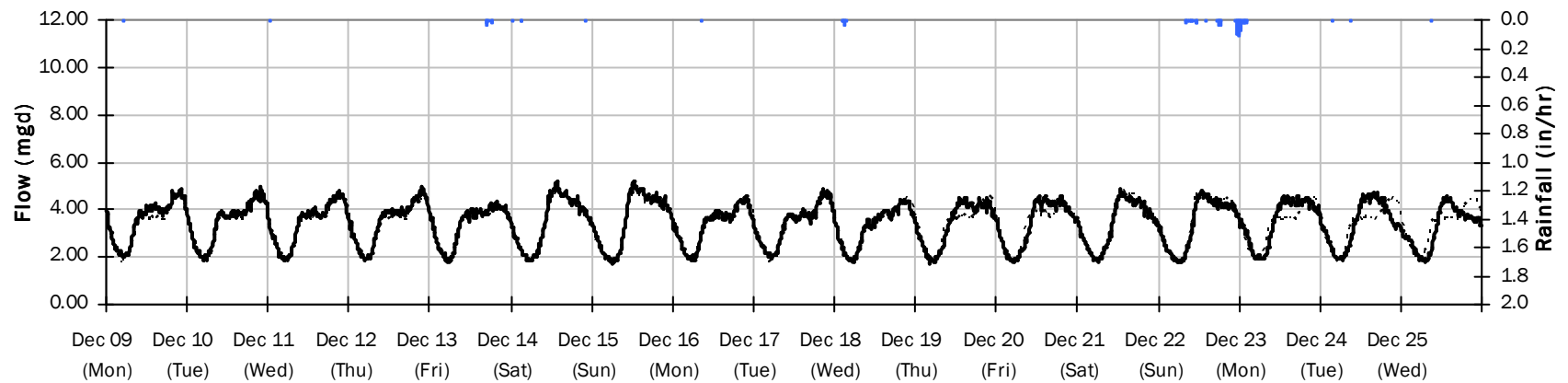
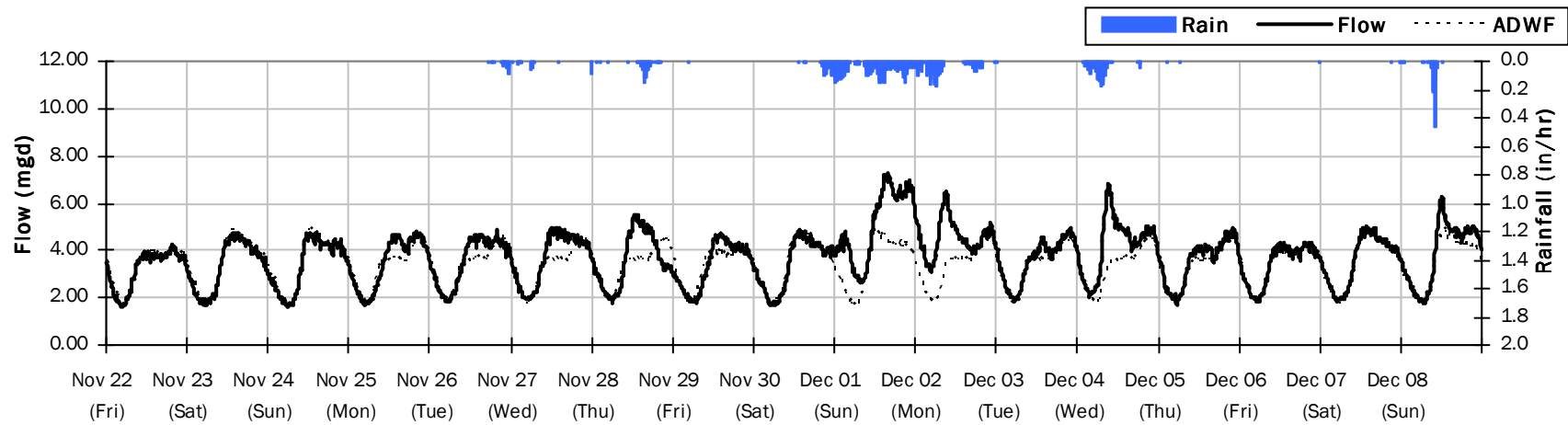
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.32 inches

Avg Flow: 3.571 mgd

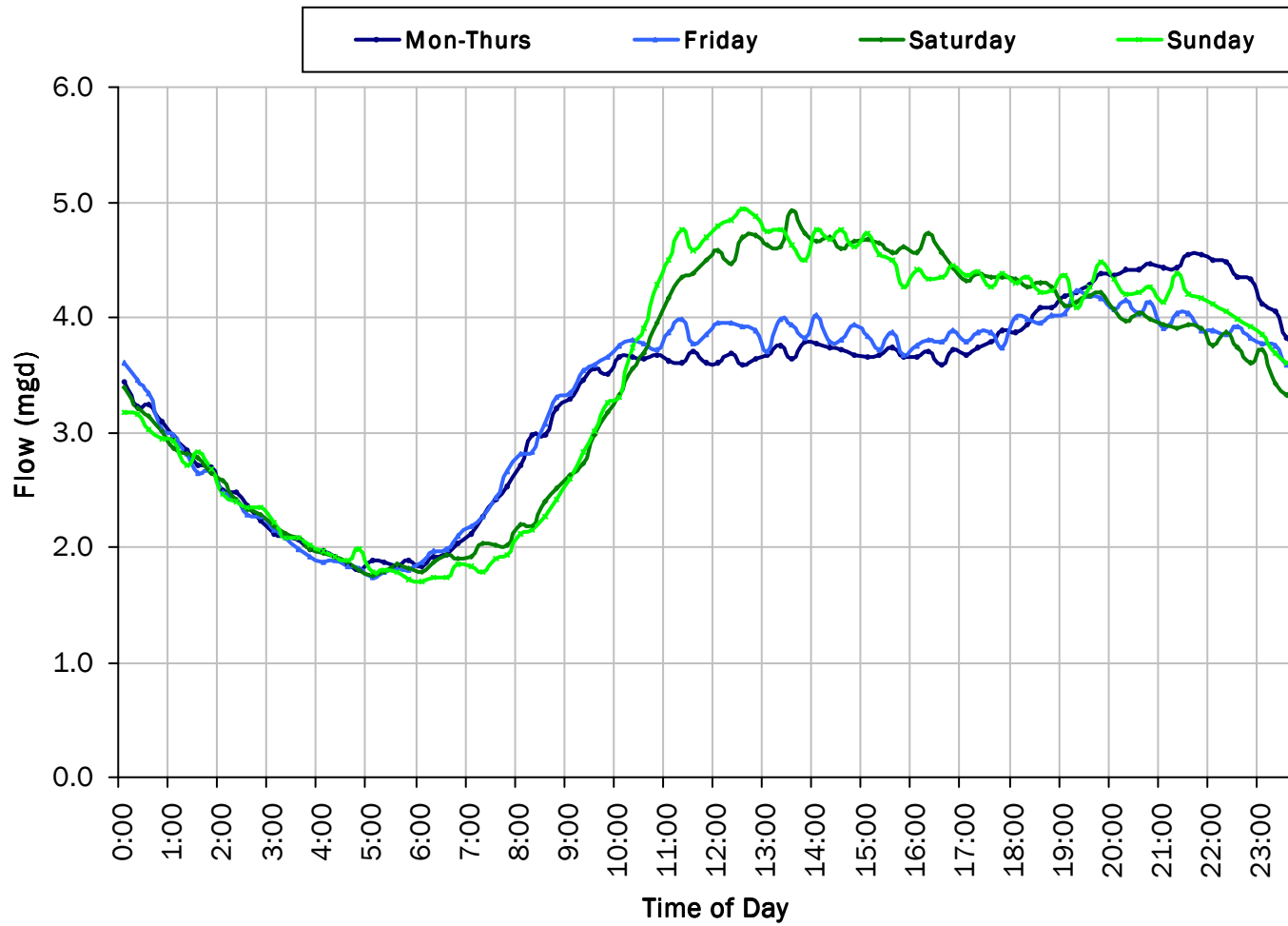
Peak Flow: 7.293 mgd

Min Flow: 1.606 mgd

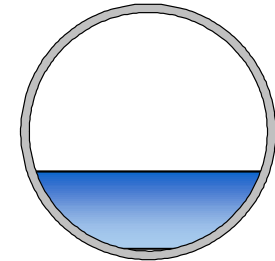


SITE 7

Average Dry Weather Flow Hydrographs

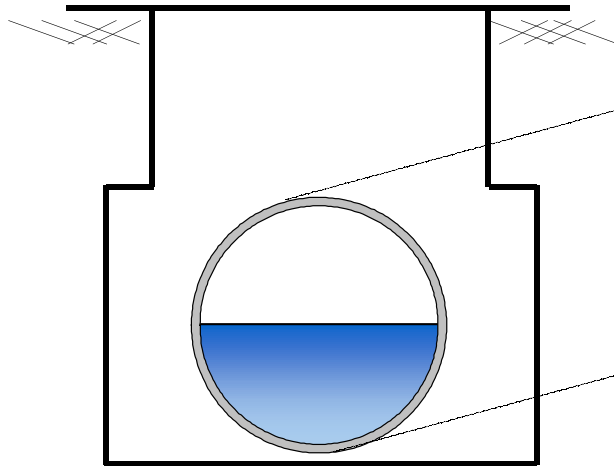
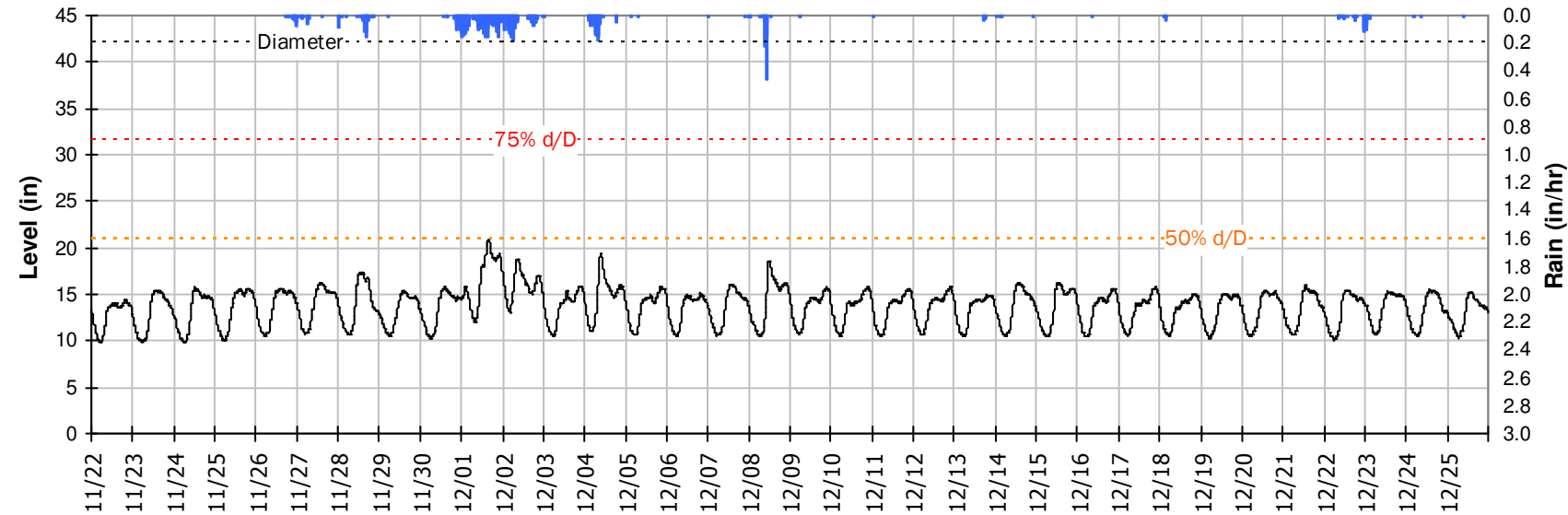


ADWF:
3.362 mgd



SITE 7
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

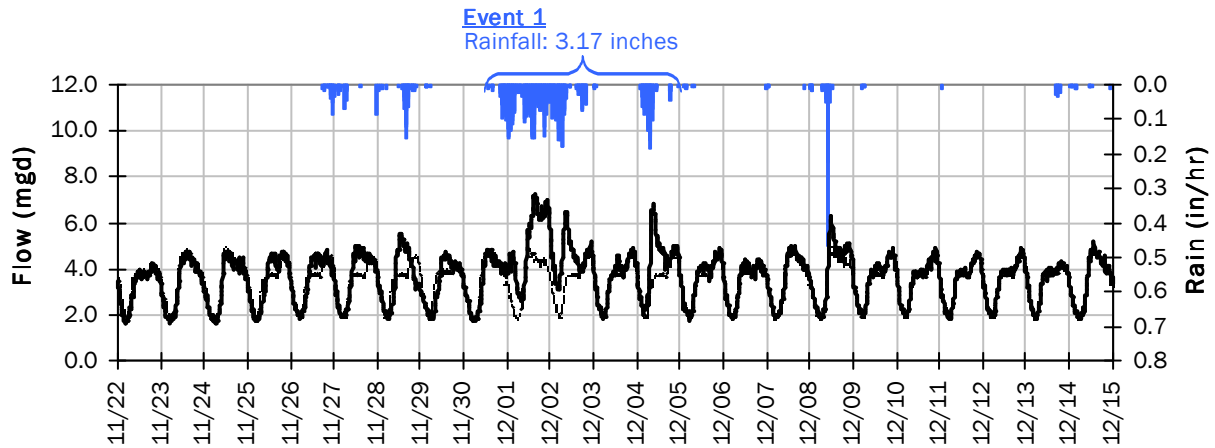


Pipe Diameter: 42 inches
Peak Measured Level: 21 inches
Peak d/D Ratio: 0.50

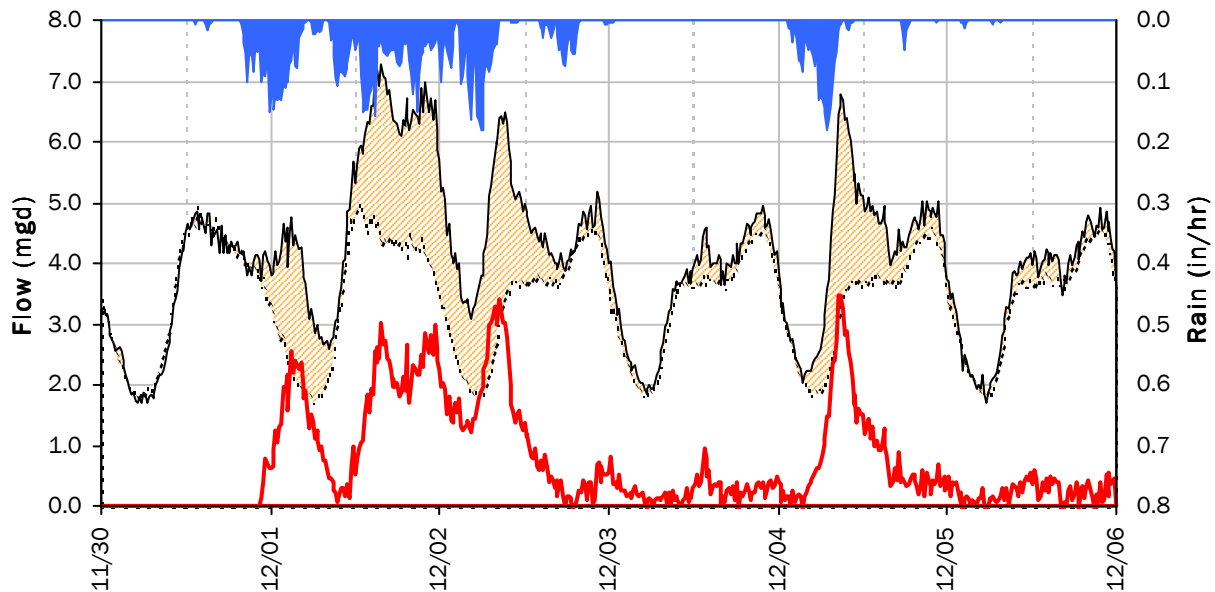
SITE 7

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.17 inches)

Capacity

Peak Flow: 7.29 mgd
PF: 2.17

Peak Level: 20.95 in
d/D Ratio: 0.50

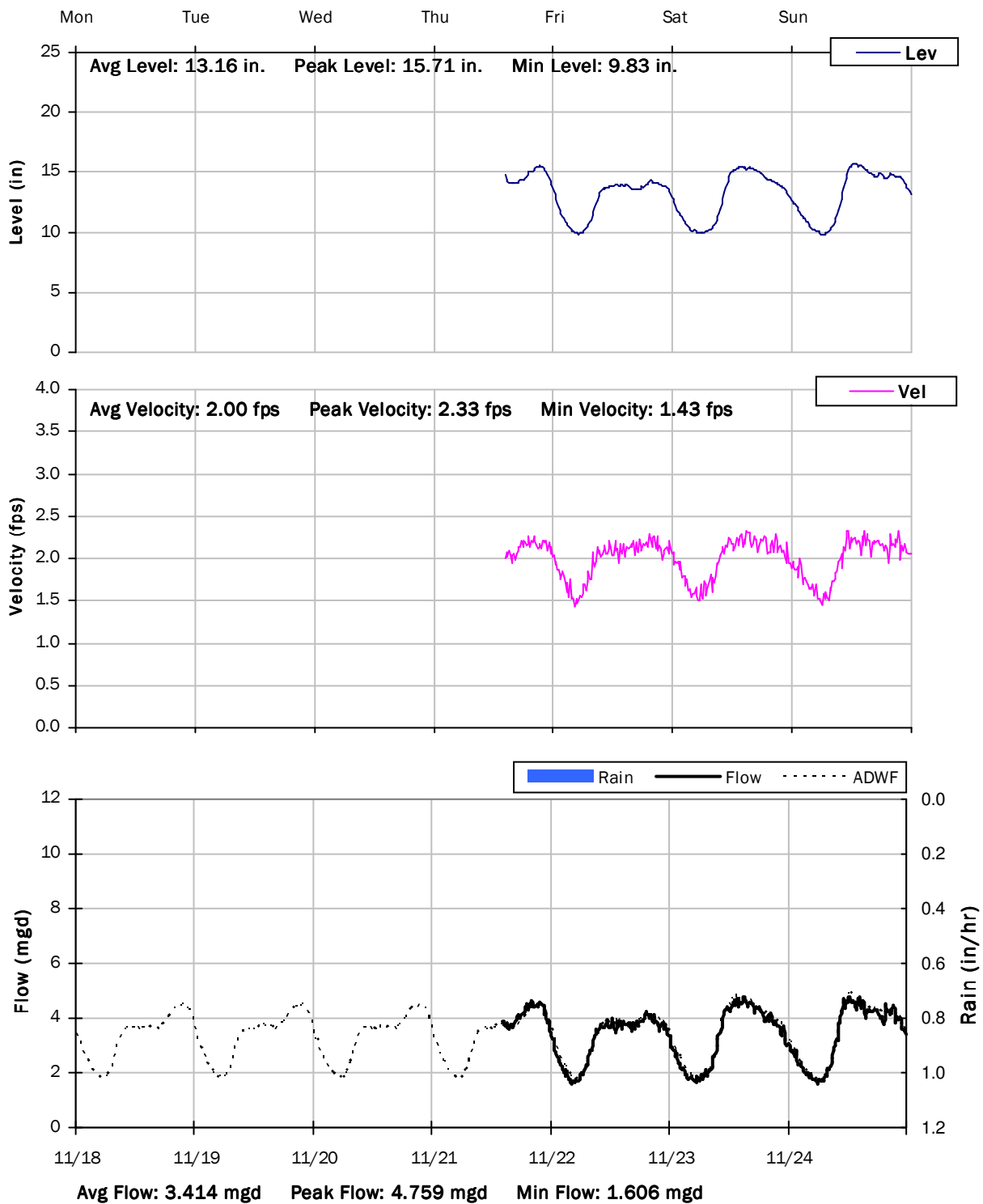
Inflow / Infiltration

Peak I/I Rate: 3.49 mgd
Total I/I: 4,287,000 gallons

SITE 7

Weekly Level, Velocity and Flow Hydrographs

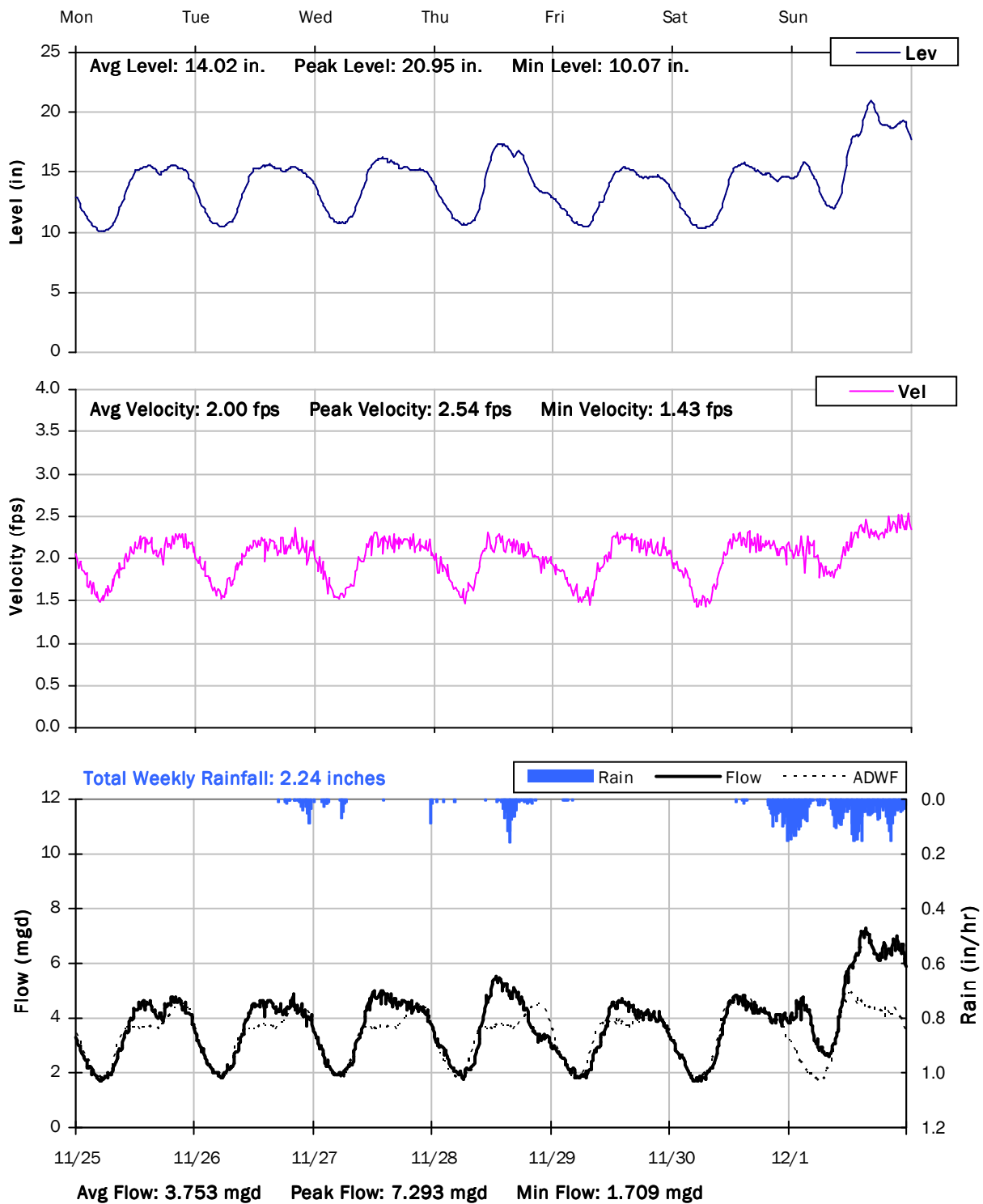
11/18/2019 to 11/25/2019



SITE 7

Weekly Level, Velocity and Flow Hydrographs

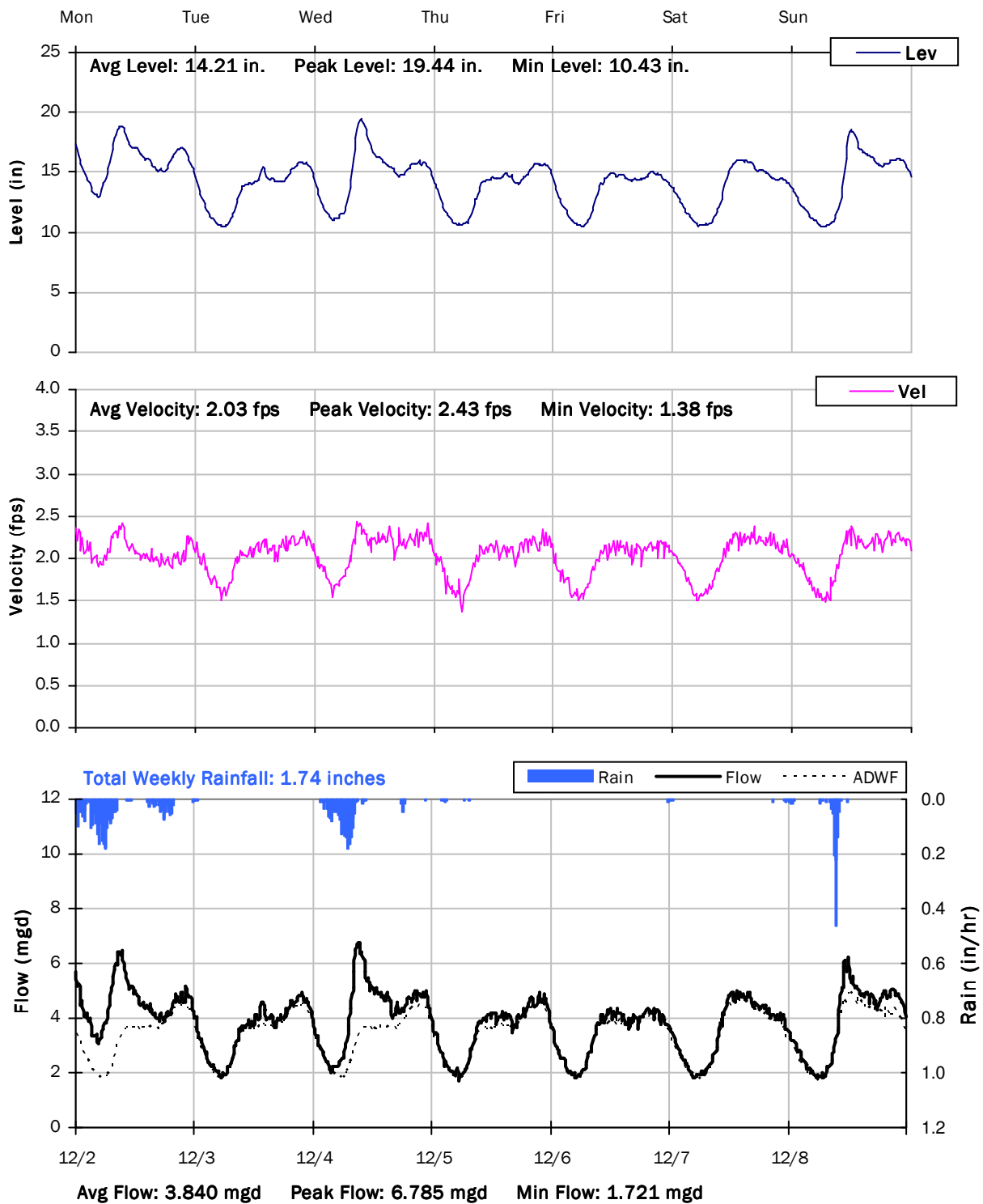
11/25/2019 to 12/2/2019



SITE 7

Weekly Level, Velocity and Flow Hydrographs

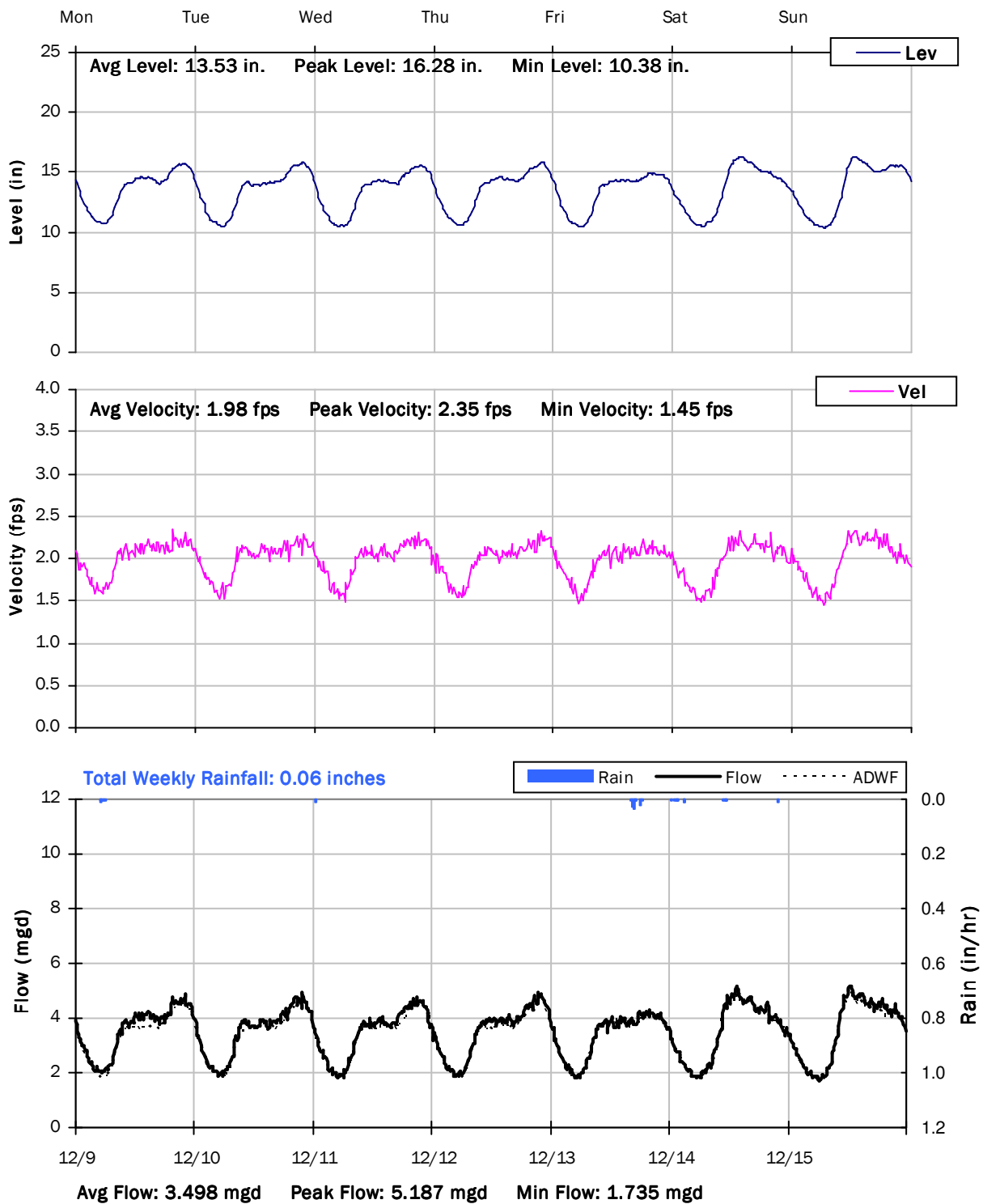
12/2/2019 to 12/9/2019



SITE 7

Weekly Level, Velocity and Flow Hydrographs

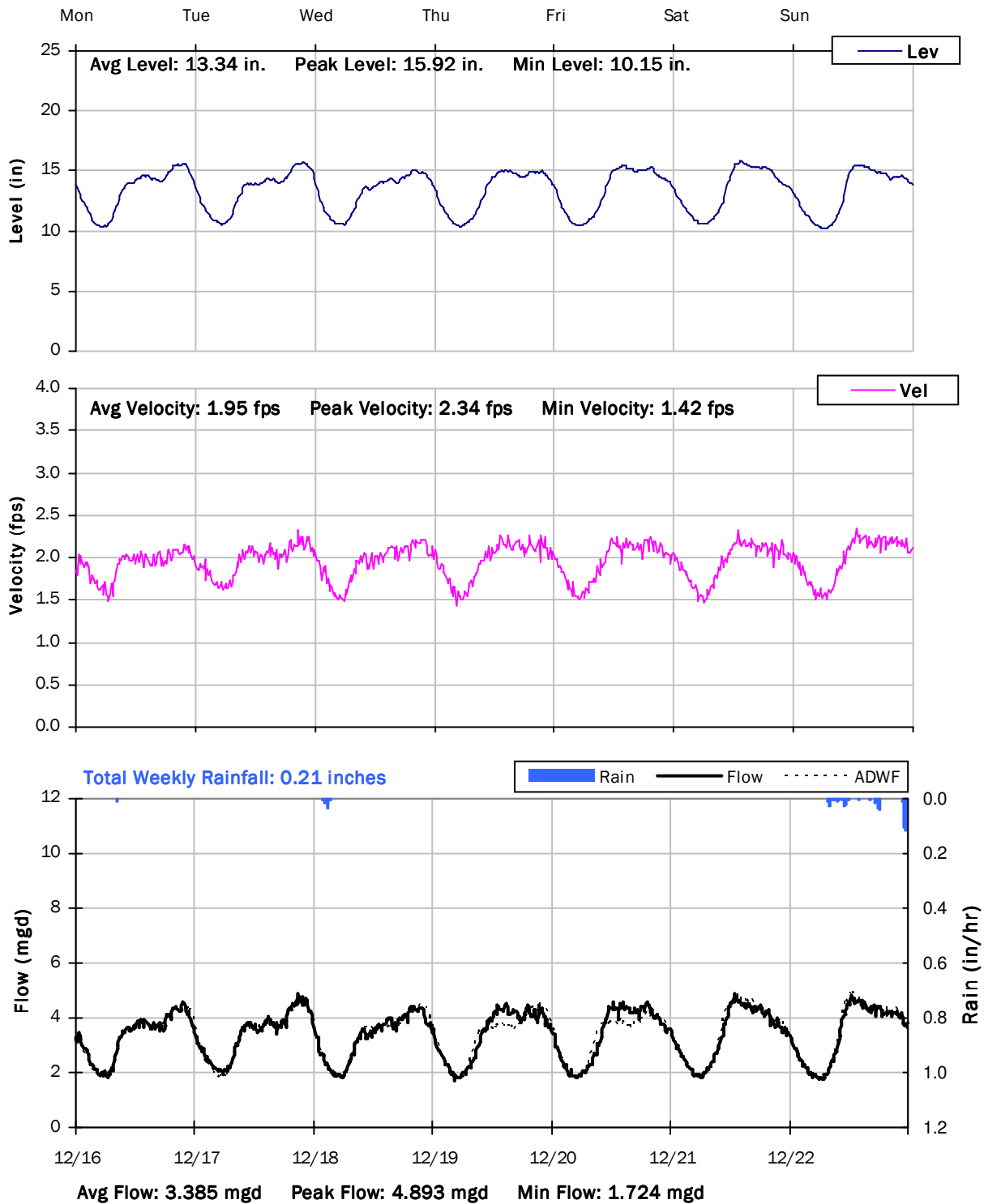
12/9/2019 to 12/16/2019



SITE 7

Weekly Level, Velocity and Flow Hydrographs

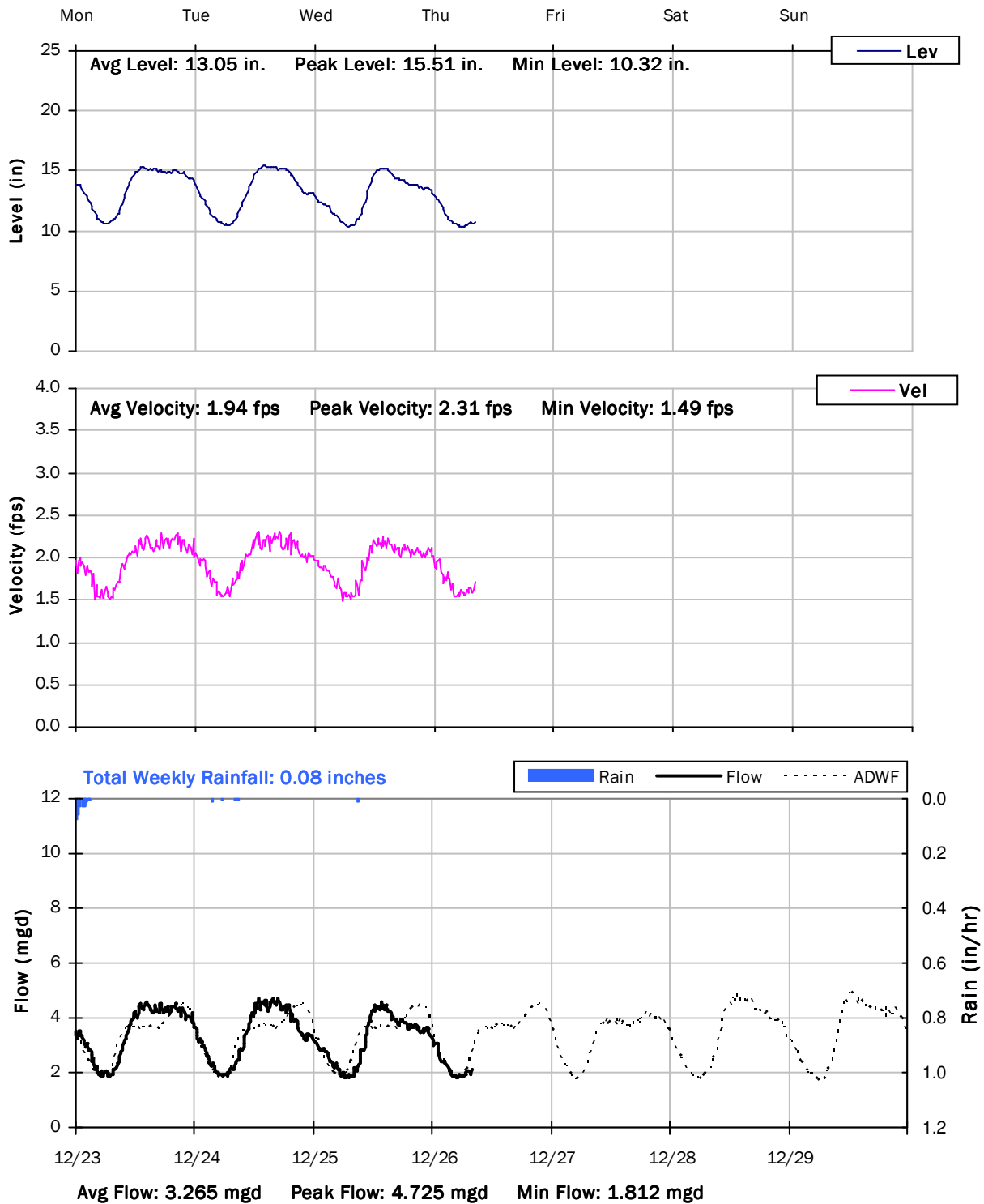
12/16/2019 to 12/23/2019



SITE 7

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

November 22 - December 26, 2019

Monitoring Site: Site 8

City Manhole: 16M192

Location: South of end of S West Avenue, south of Riggs Avenue

Data Summary Report



Vicinity Map: Site 8

SITE 8

Site Information

Location: South of end of S West Avenue,
south of Riggs Avenue

City Manhole: 16M192

Coordinates: 120.5060° W, 37.2808° N

Rim Elevation (Earth): 155 feet

Pipe Diameter: 36 inches

ADWF: 2.764 mgd

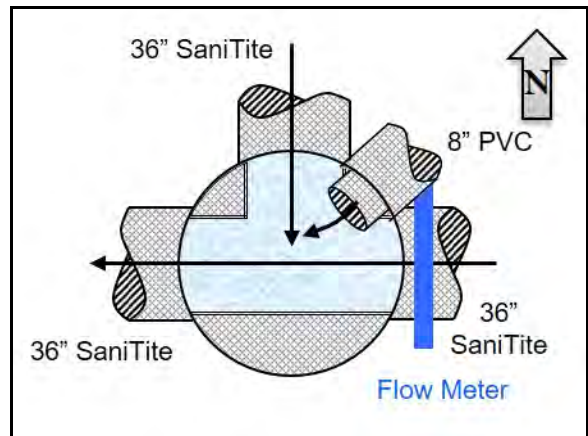
Peak Measured Flow: 5.997 mgd



Satellite Map



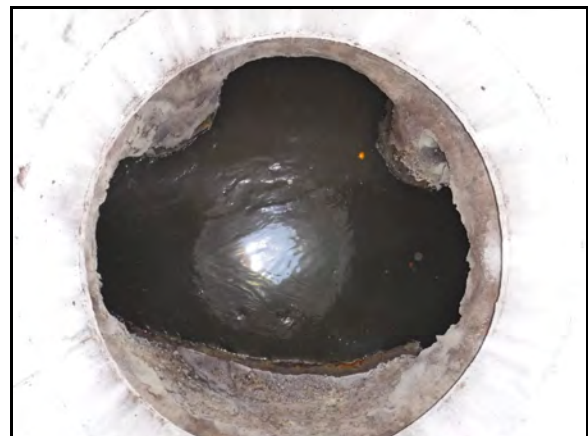
Sanitary Map



Flow Sketch



Street View



Plan View

SITE 8

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe



SITE 8

Additional Site Photos

North Lateral Pipe



Northeast Lateral Pipe

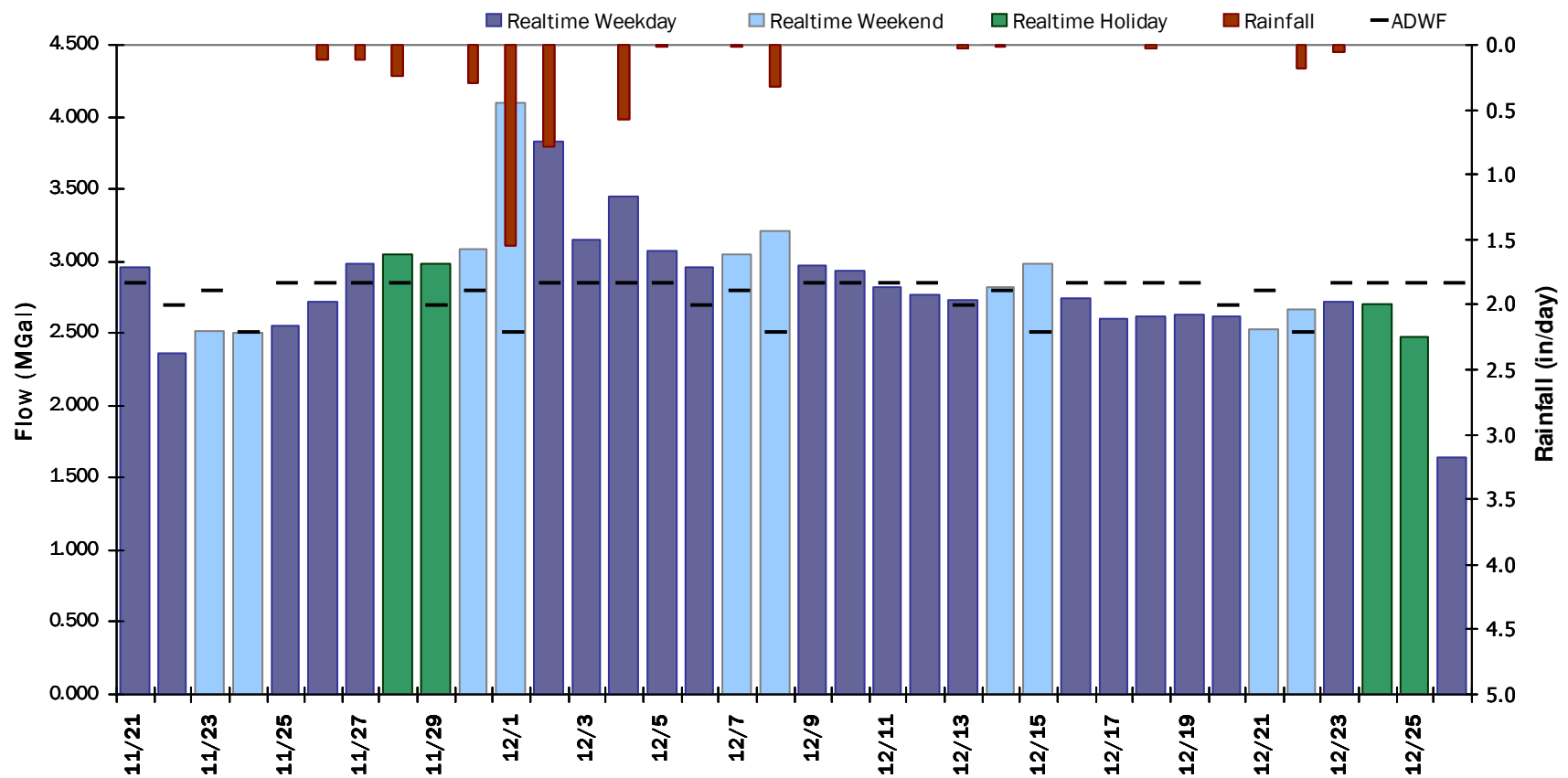


SITE 8

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 2.847 MGal Peak Daily Flow: 4.091 MGal Min Daily Flow: 1.643 MGal

Total Period Rainfall: 4.35 inches



SITE 8

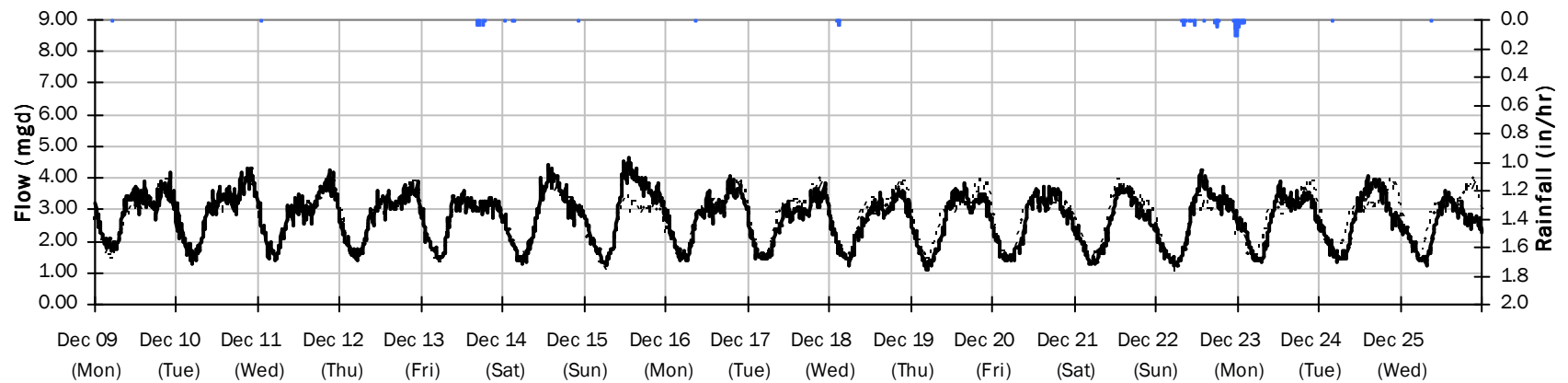
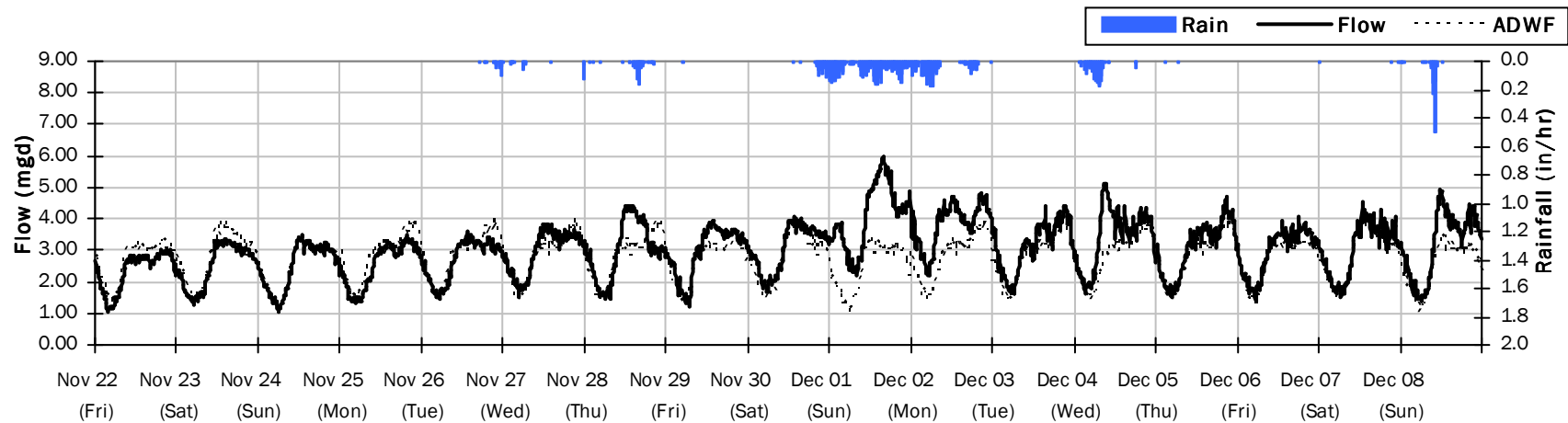
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.35 inches

Avg Flow: 2.879 mgd

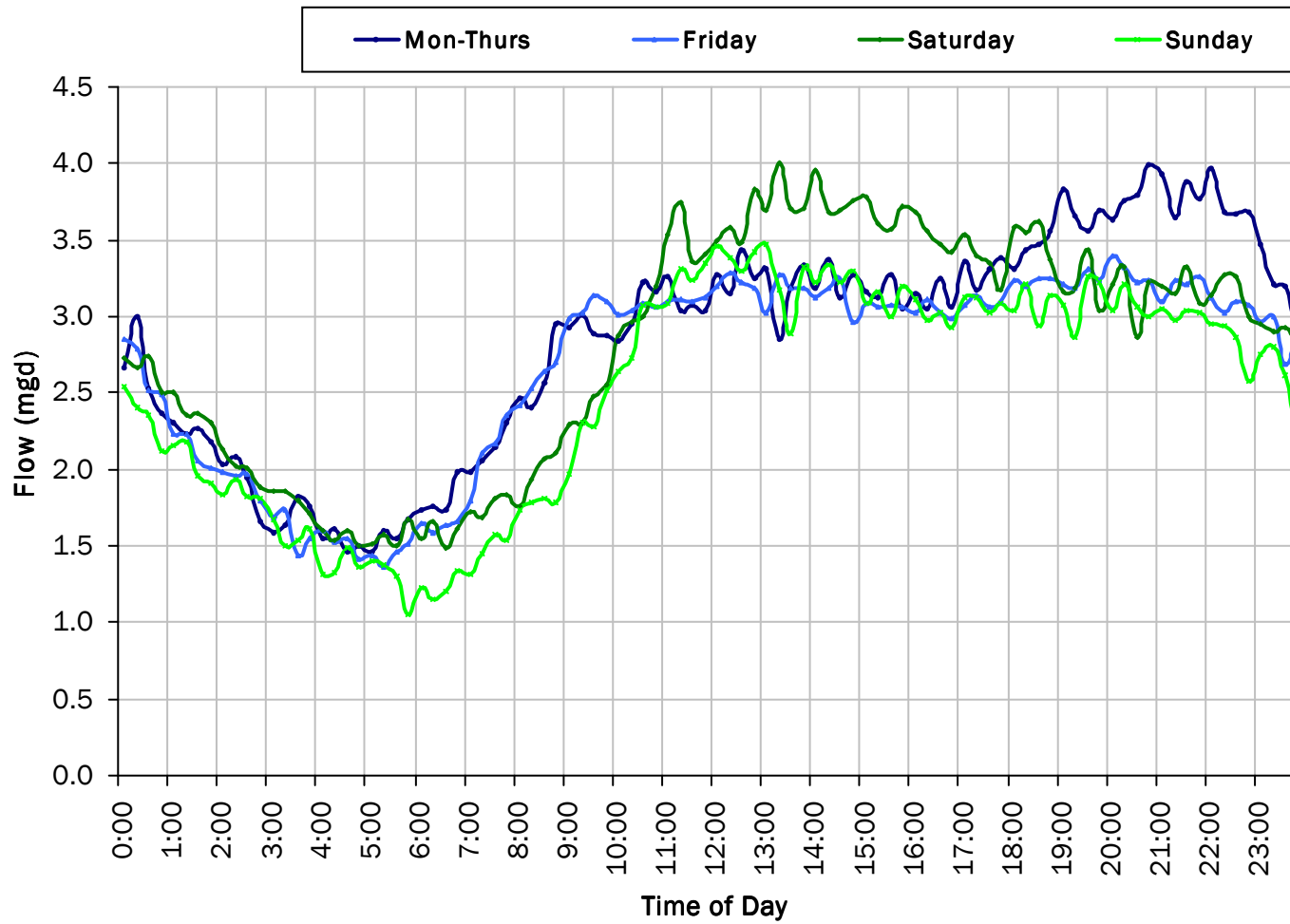
Peak Flow: 5.997 mgd

Min Flow: 1.027 mgd

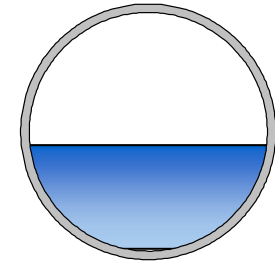


SITE 8

Average Dry Weather Flow Hydrographs

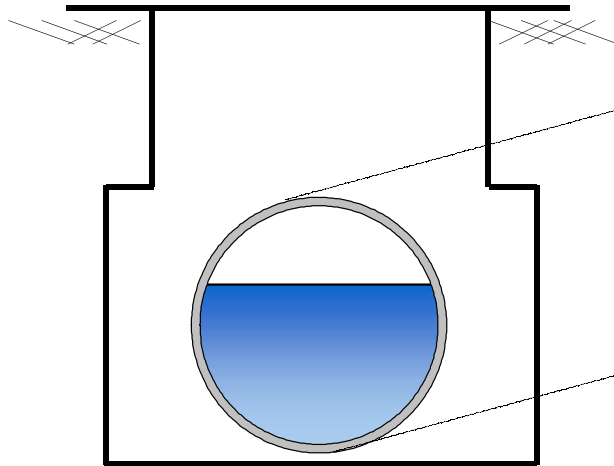
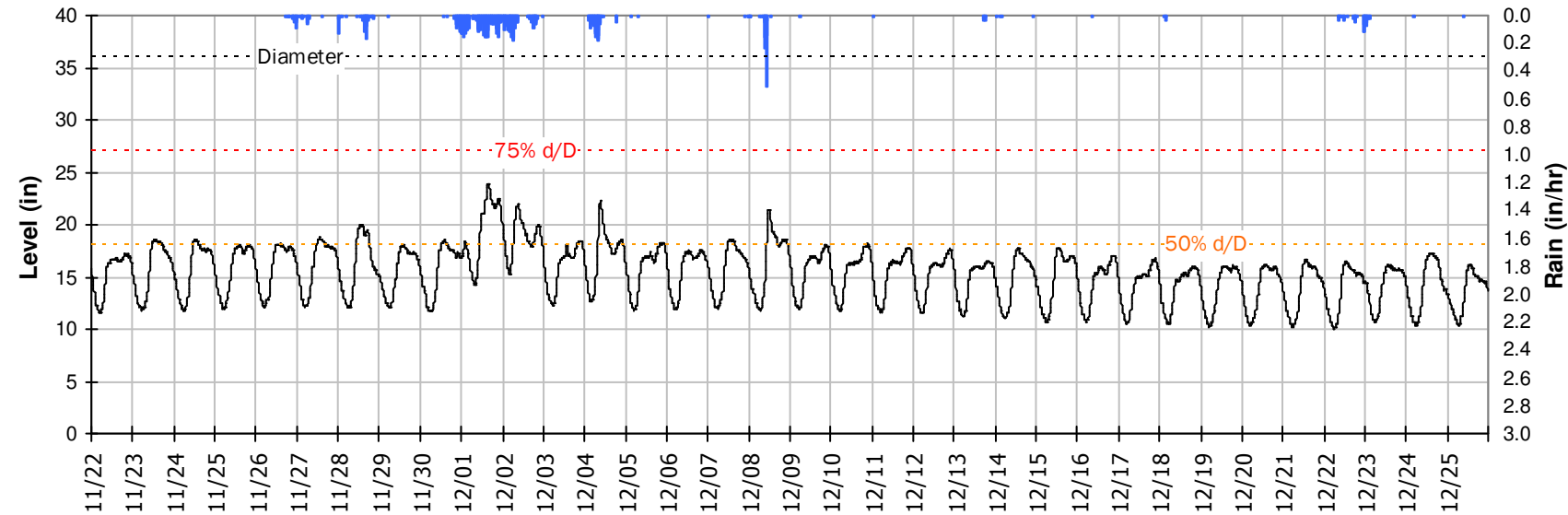


ADWF:
2.764 mgd



SITE 8
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

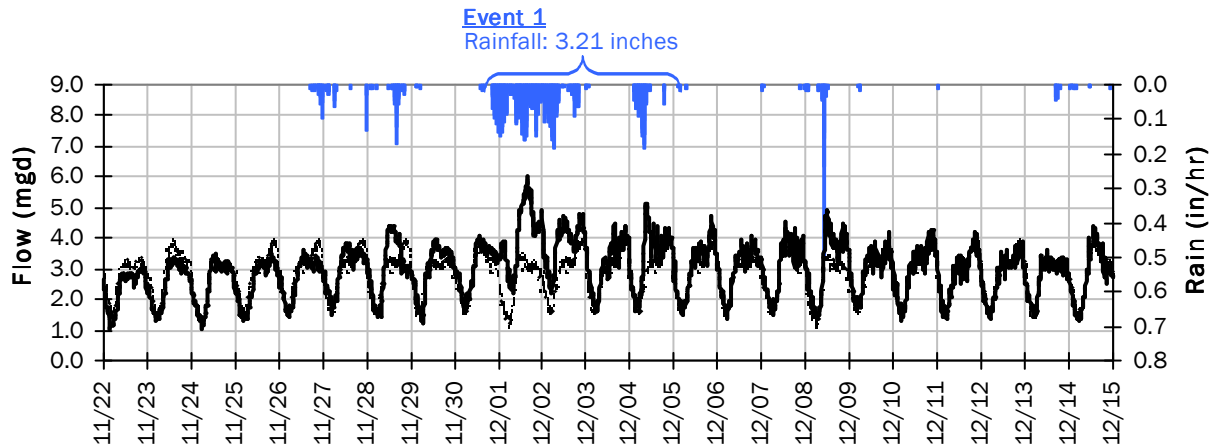


Pipe Diameter: 36 inches
Peak Measured Level: 23.9 inches
Peak d/D Ratio: 0.67

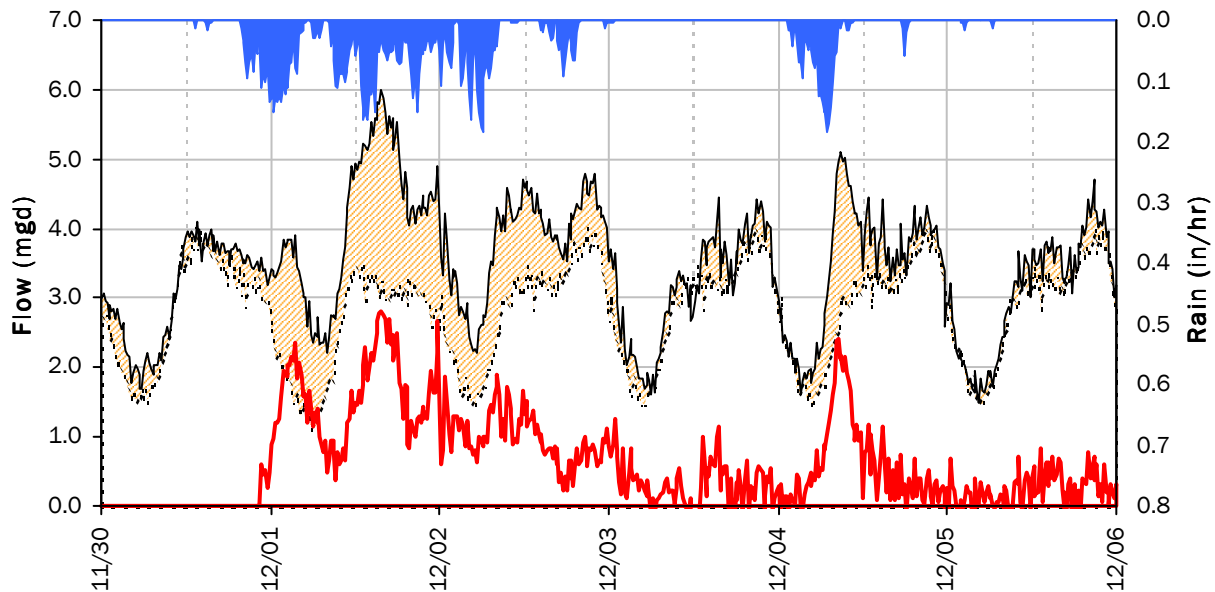
SITE 8

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.21 inches)

Capacity

Peak Flow: 6.00 mgd
PF: 2.17

Peak Level: 23.94 in
d/D Ratio: 0.67

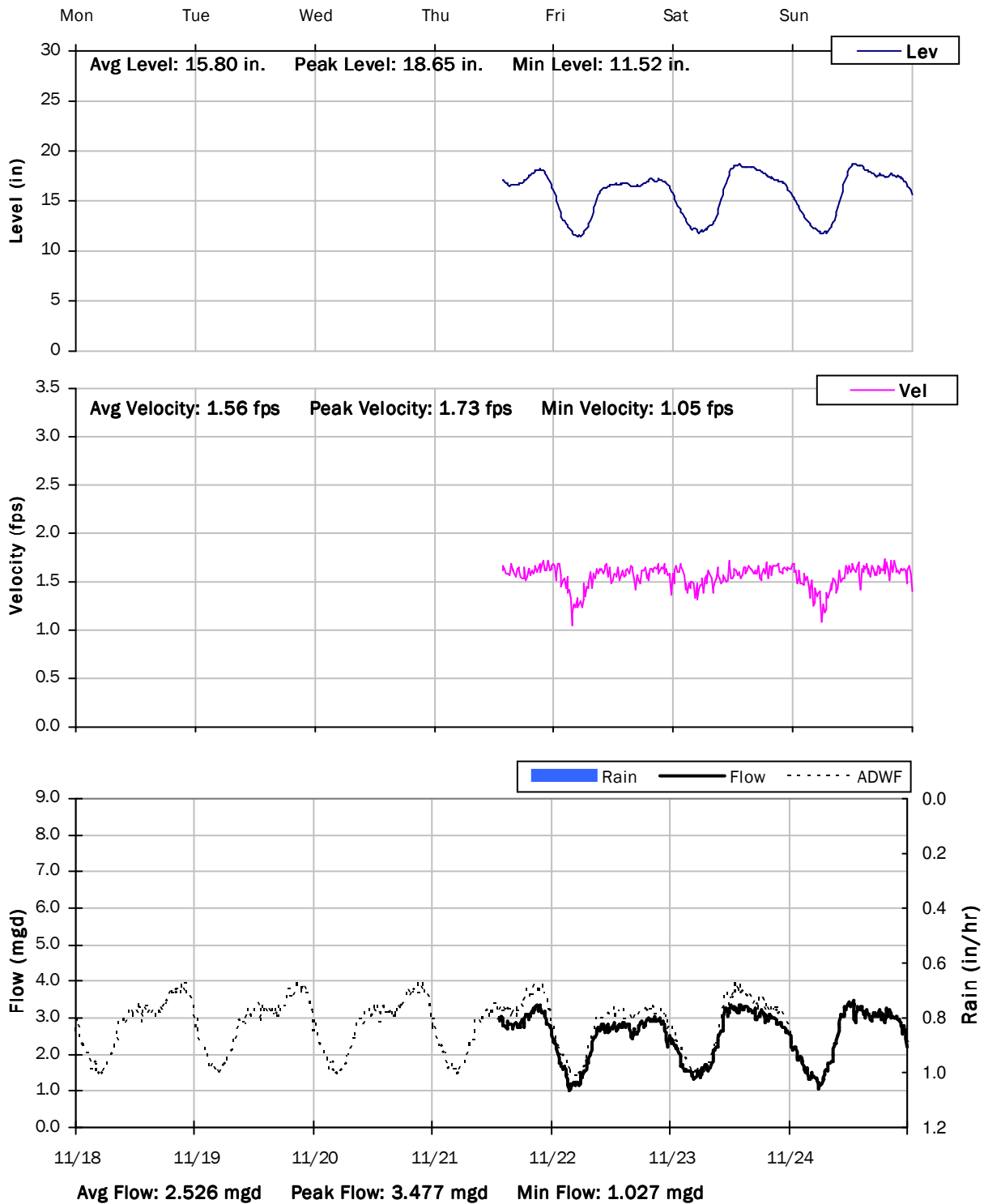
Inflow / Infiltration

Peak I/I Rate: 2.80 mgd
Total I/I: 3,766,000 gallons

SITE 8

Weekly Level, Velocity and Flow Hydrographs

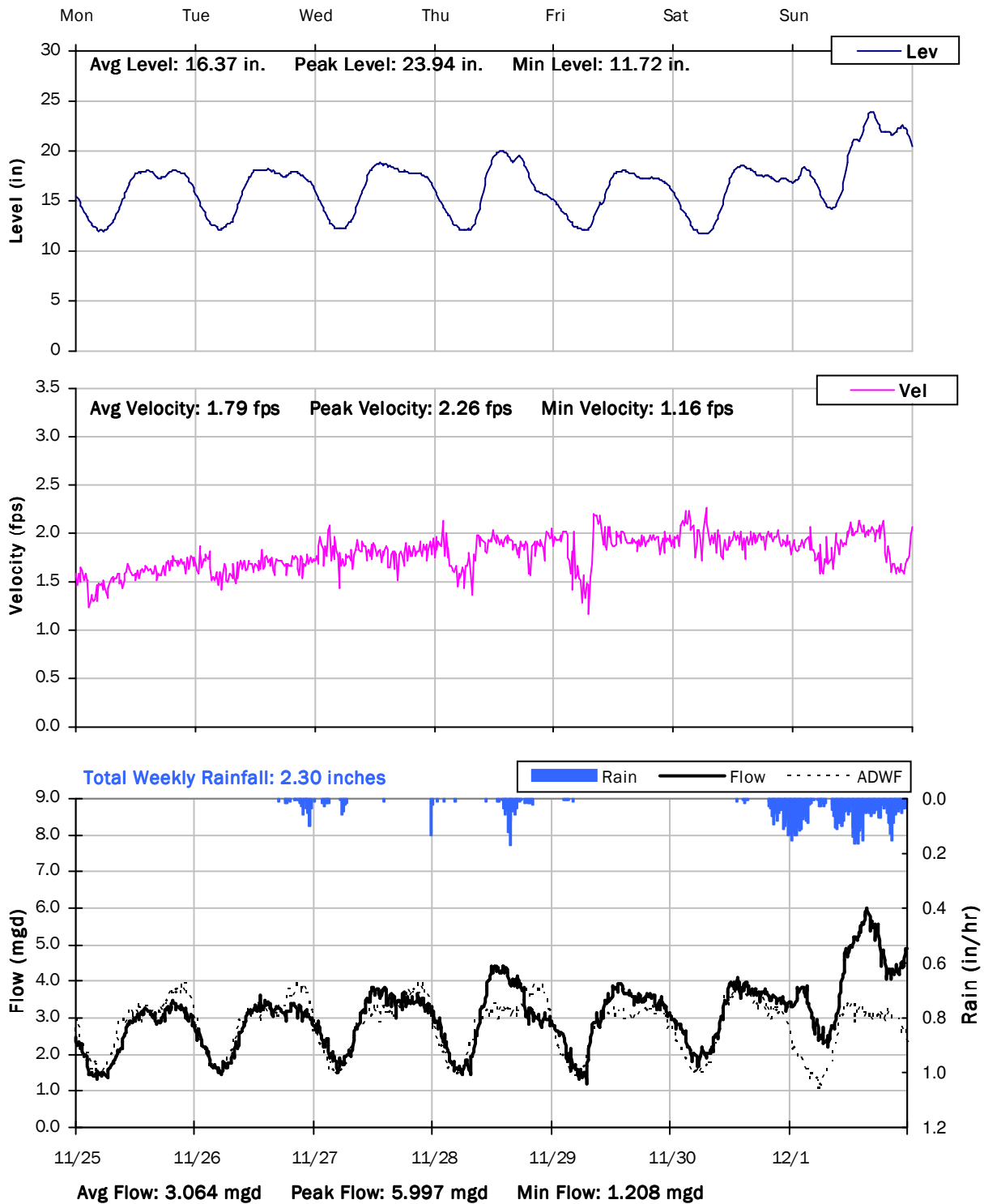
11/18/2019 to 11/25/2019



SITE 8

Weekly Level, Velocity and Flow Hydrographs

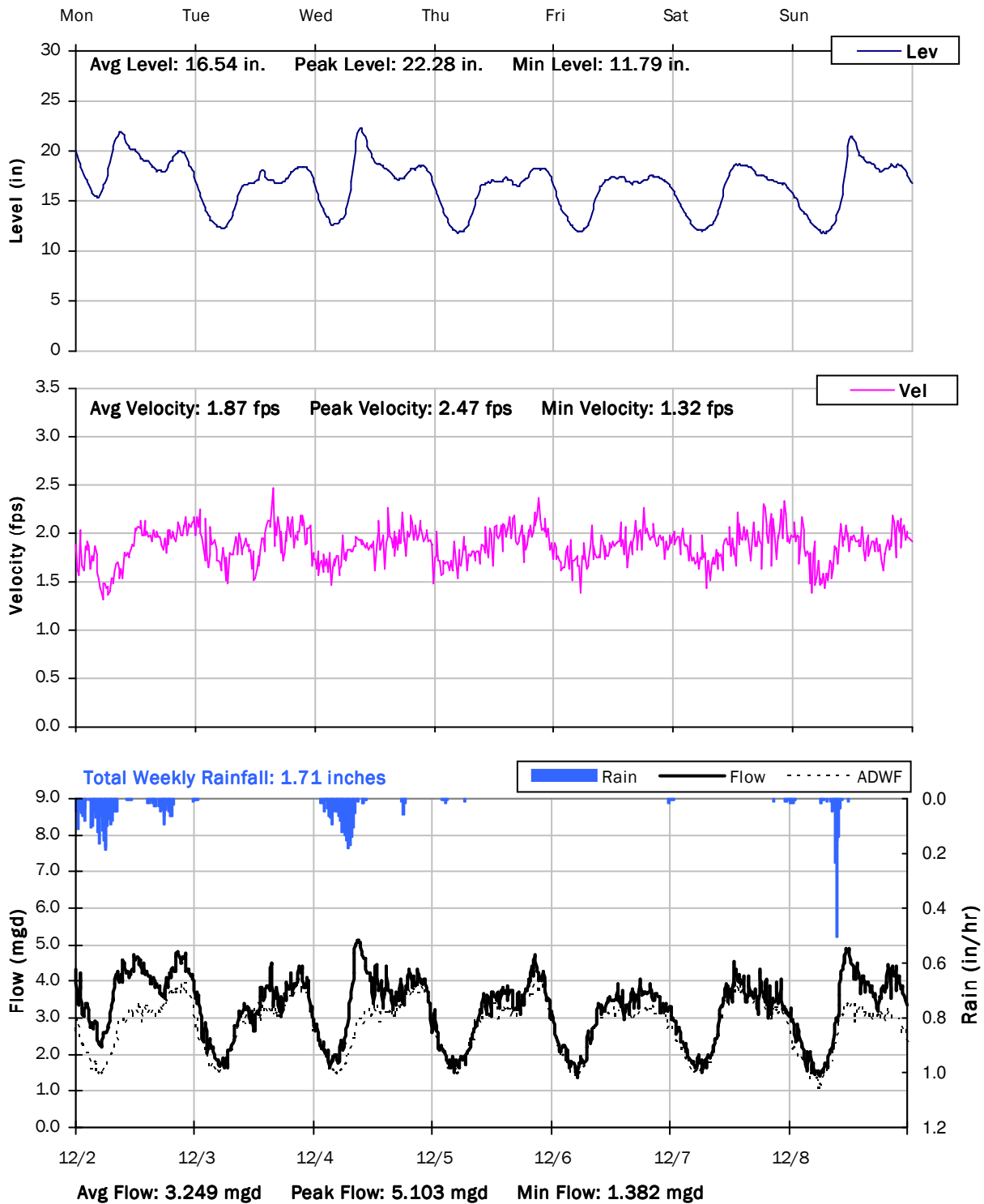
11/25/2019 to 12/2/2019



SITE 8

Weekly Level, Velocity and Flow Hydrographs

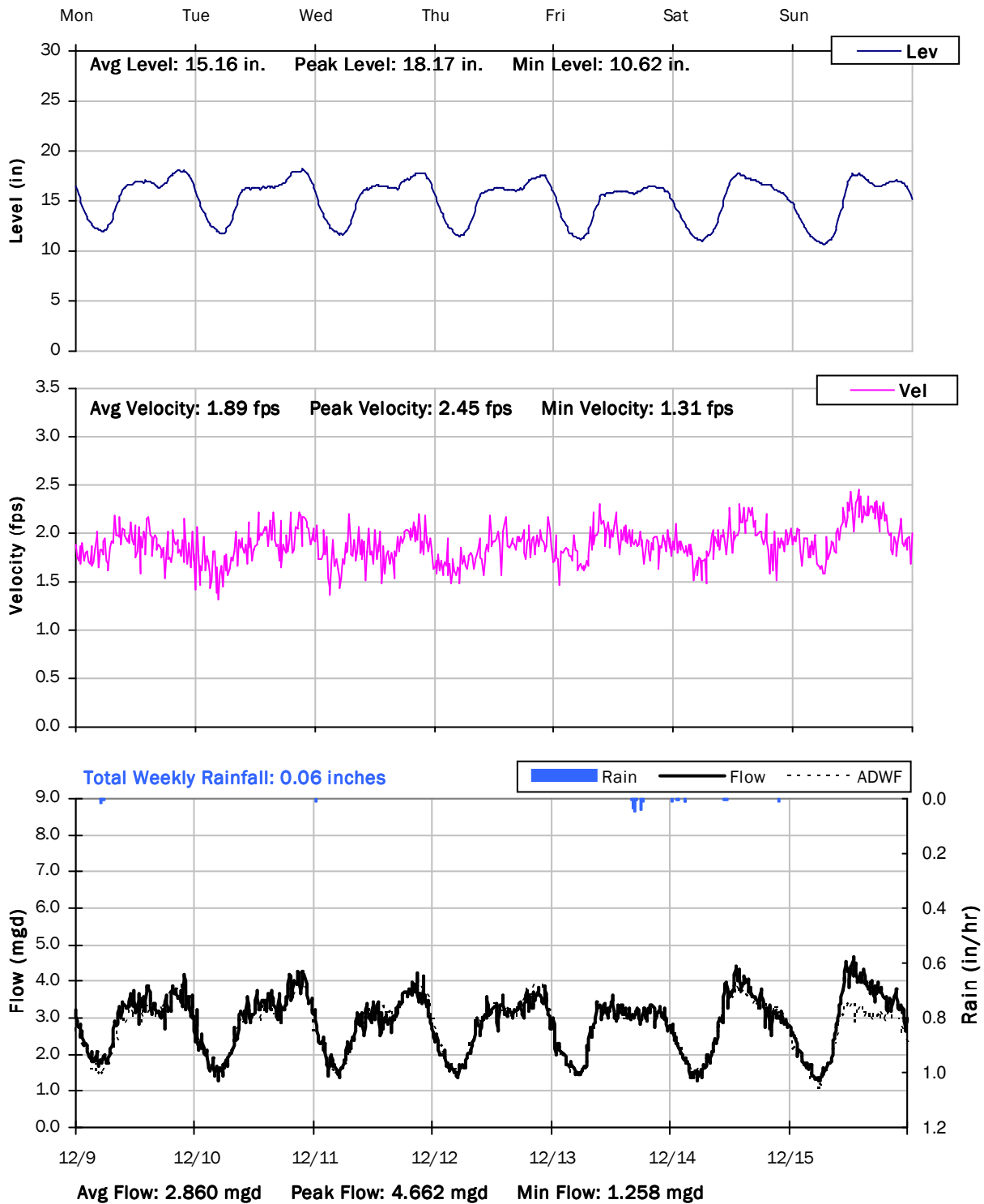
12/2/2019 to 12/9/2019



SITE 8

Weekly Level, Velocity and Flow Hydrographs

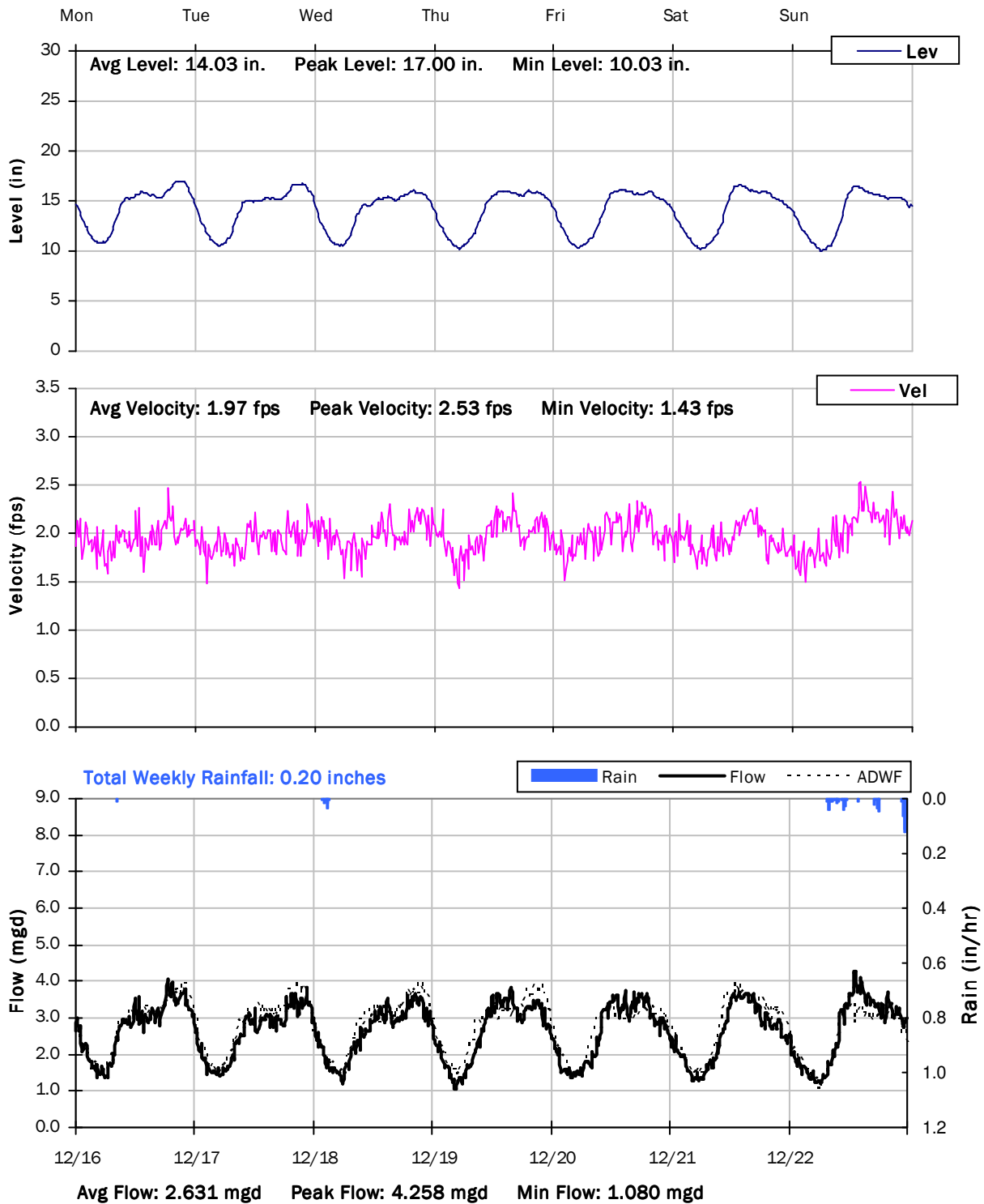
12/9/2019 to 12/16/2019



SITE 8

Weekly Level, Velocity and Flow Hydrographs

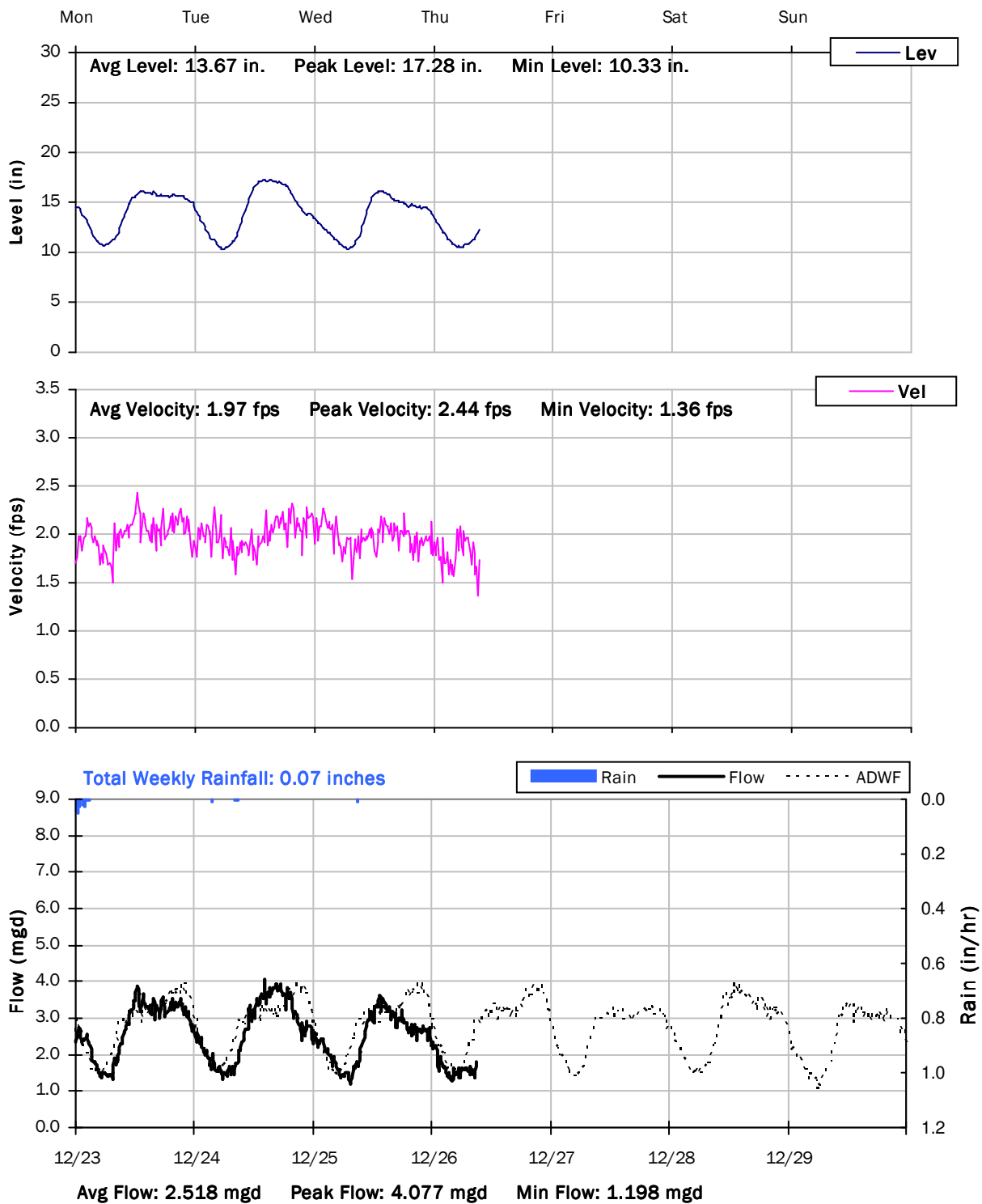
12/16/2019 to 12/23/2019



SITE 8

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

November 22 - December 26, 2019

Monitoring Site: Site 9

City Manhole: n/a

Location: E Gerard Avenue, east of Tyler Road

Data Summary Report



Vicinity Map: Site 9

SITE 9

Site Information

Location: E Gerard Avenue, east of Tyler Road

City Manhole: n/a

Coordinates: 120.4615° W, 37.2806° N

Rim Elevation (Earth): 173 feet

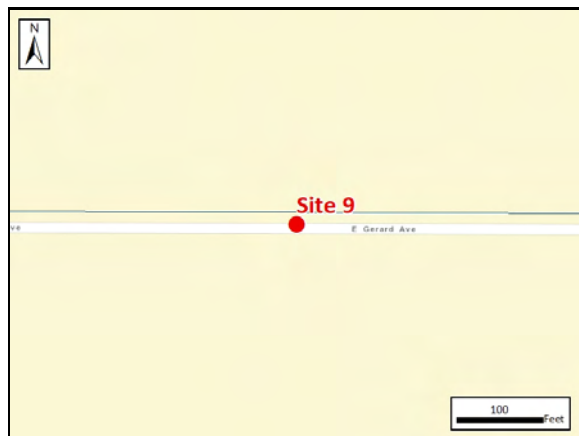
Pipe Diameter: 36.5 inches

ADWF: 0.522 mgd

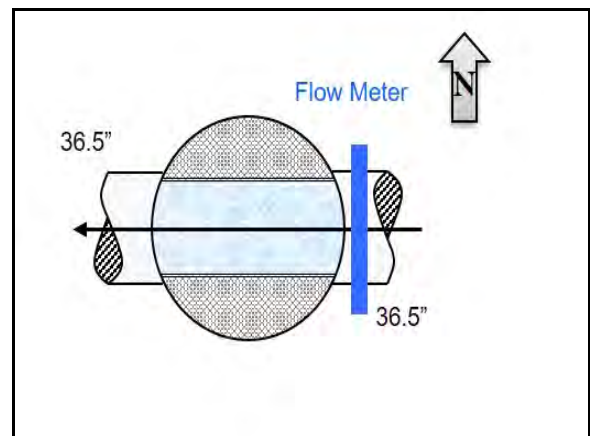
Peak Measured Flow: 1.373 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 9

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

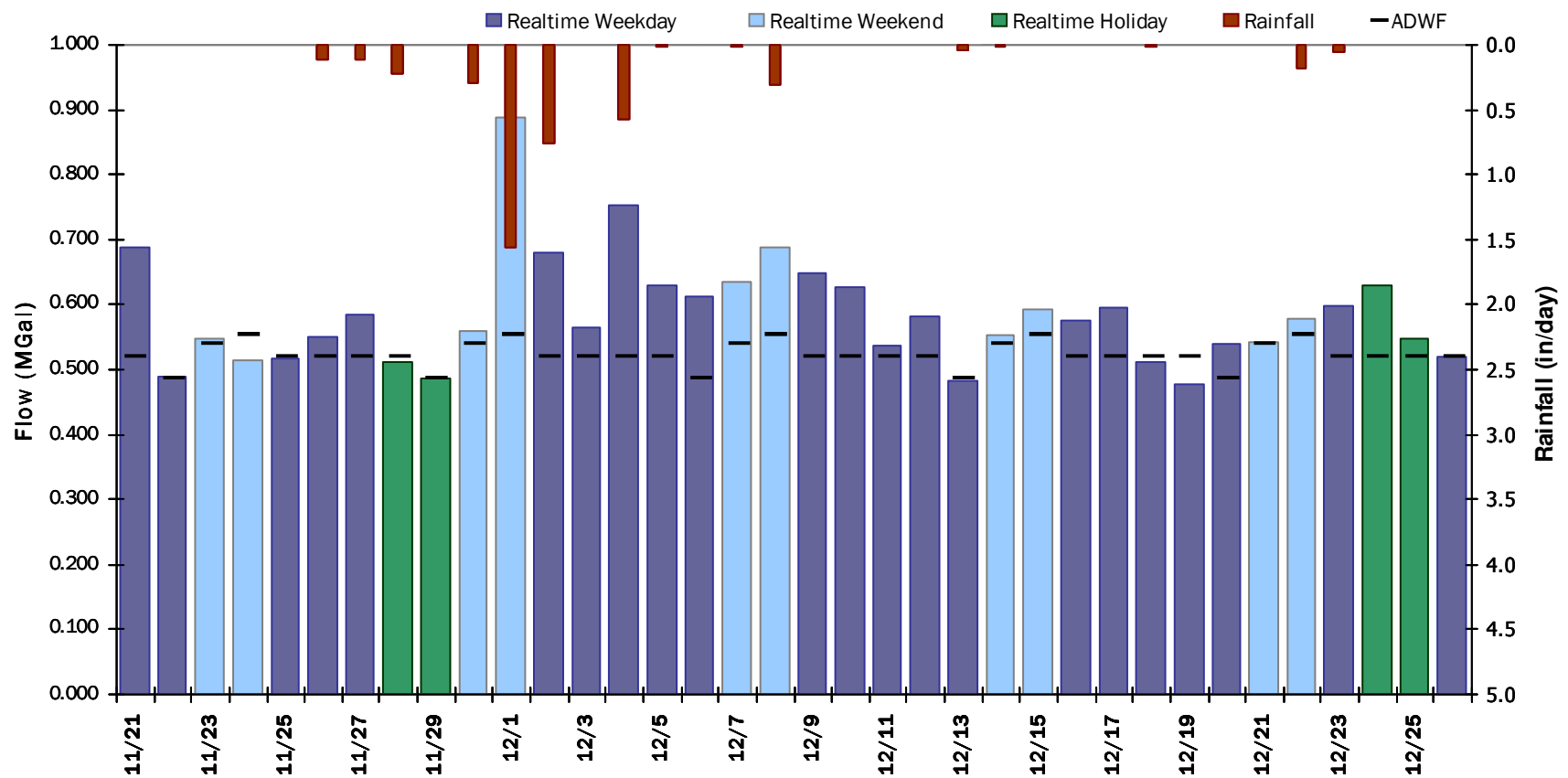


SITE 9

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.584 MGal Peak Daily Flow: 0.887 MGal Min Daily Flow: 0.476 MGal

Total Period Rainfall: 4.30 inches



SITE 9

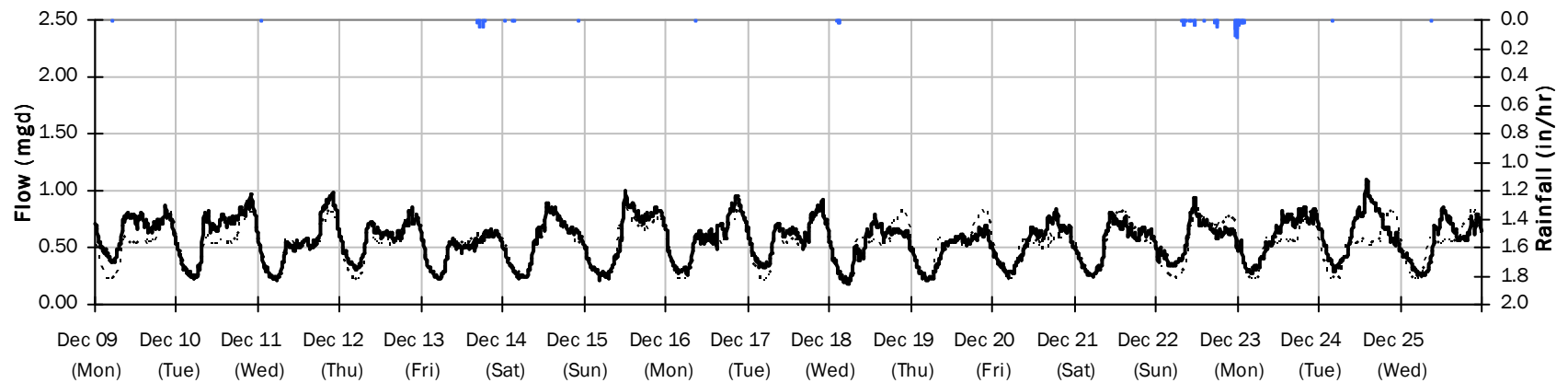
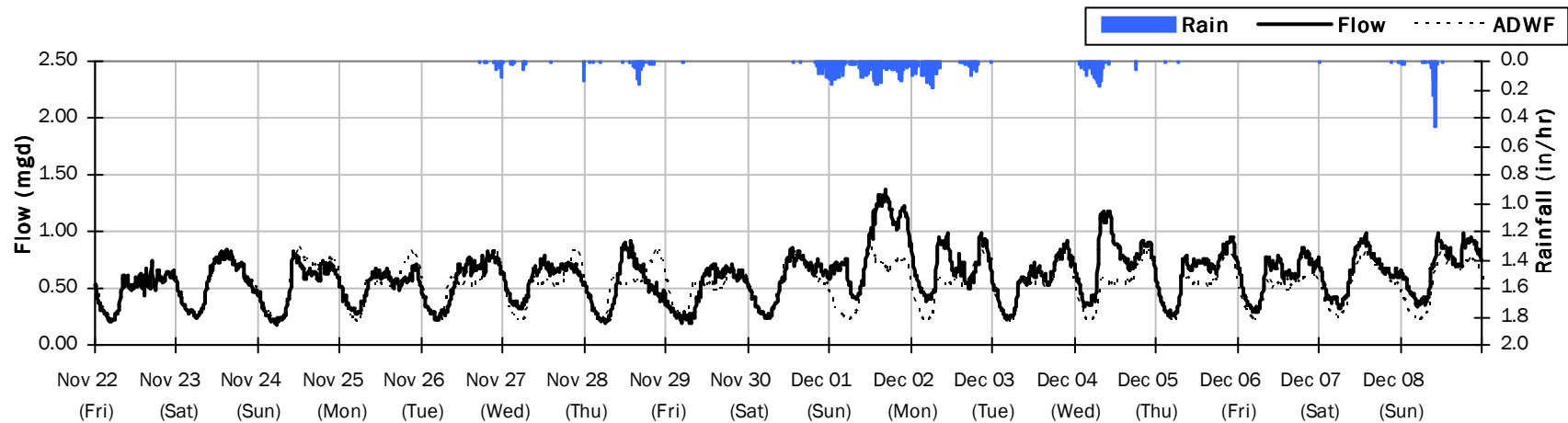
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.30 inches

Avg Flow: 0.583 mgd

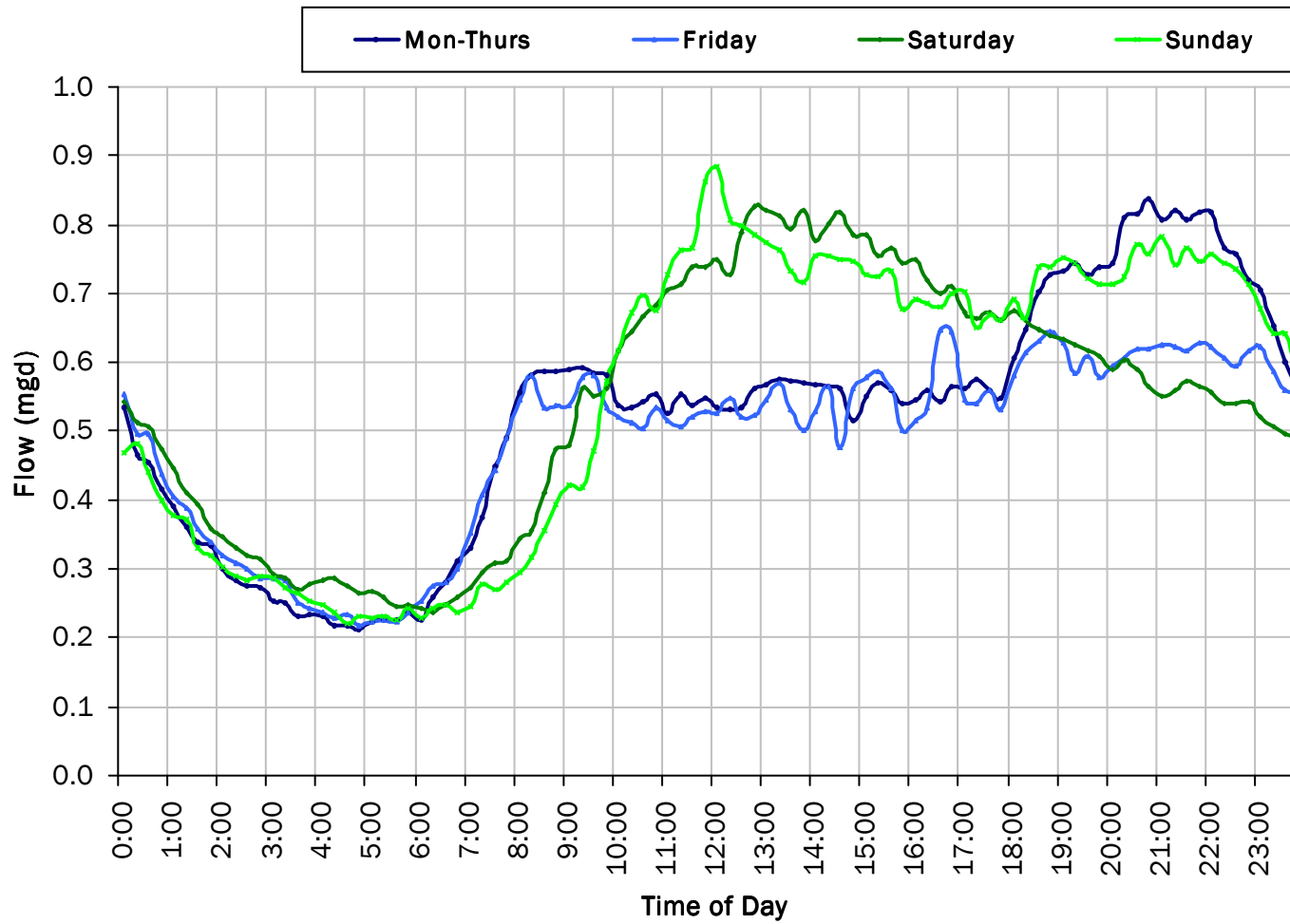
Peak Flow: 1.373 mgd

Min Flow: 0.180 mgd

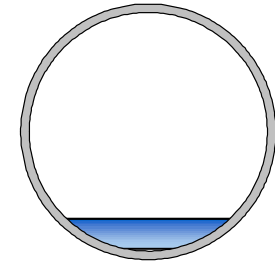


SITE 9

Average Dry Weather Flow Hydrographs

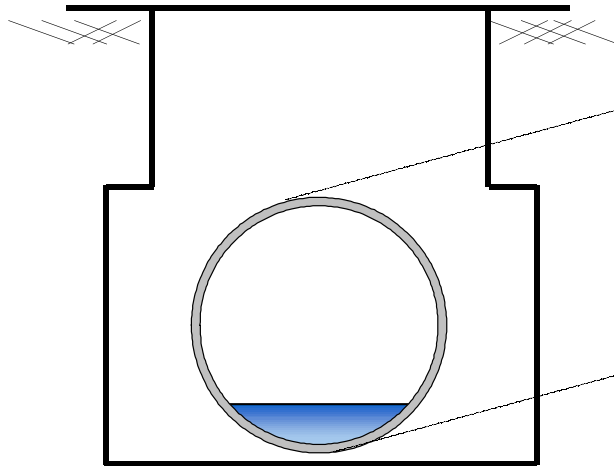
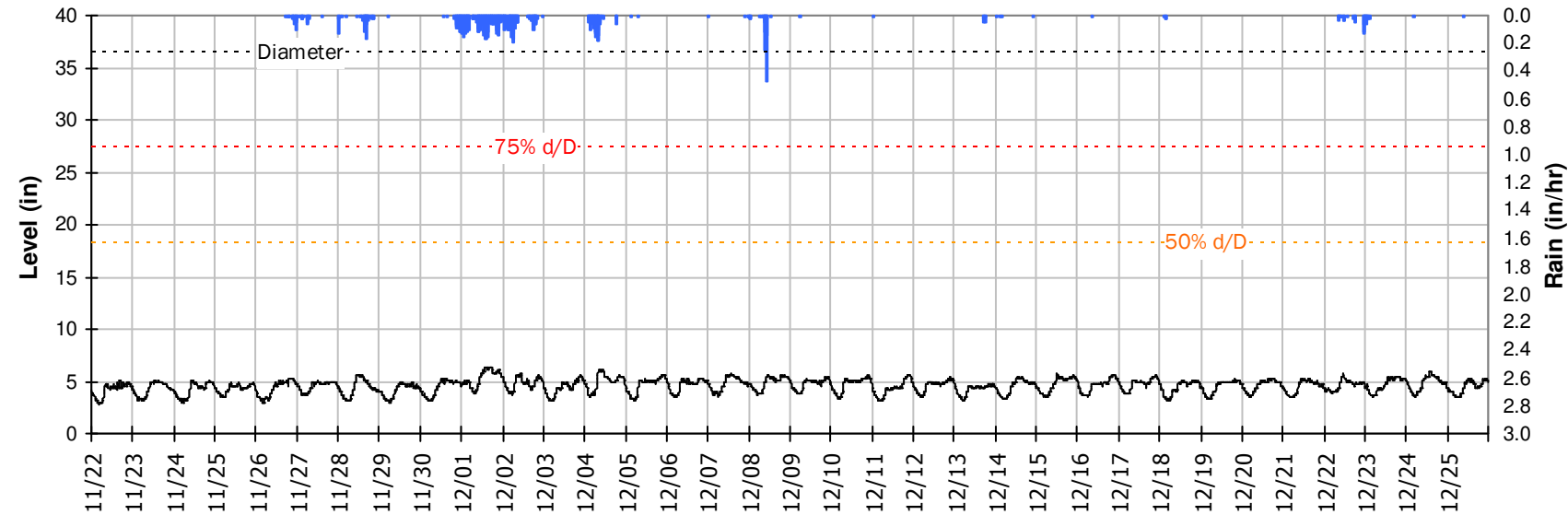


ADWF:
0.522 mgd



SITE 9
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

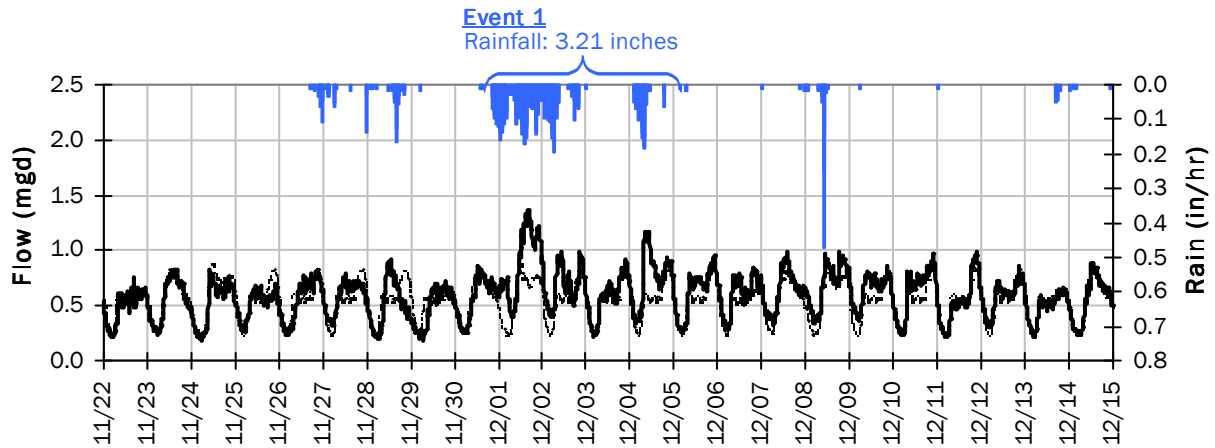


Pipe Diameter: 36.5 inches
Peak Measured Level: 6.4 inches
Peak d/D Ratio: 0.18

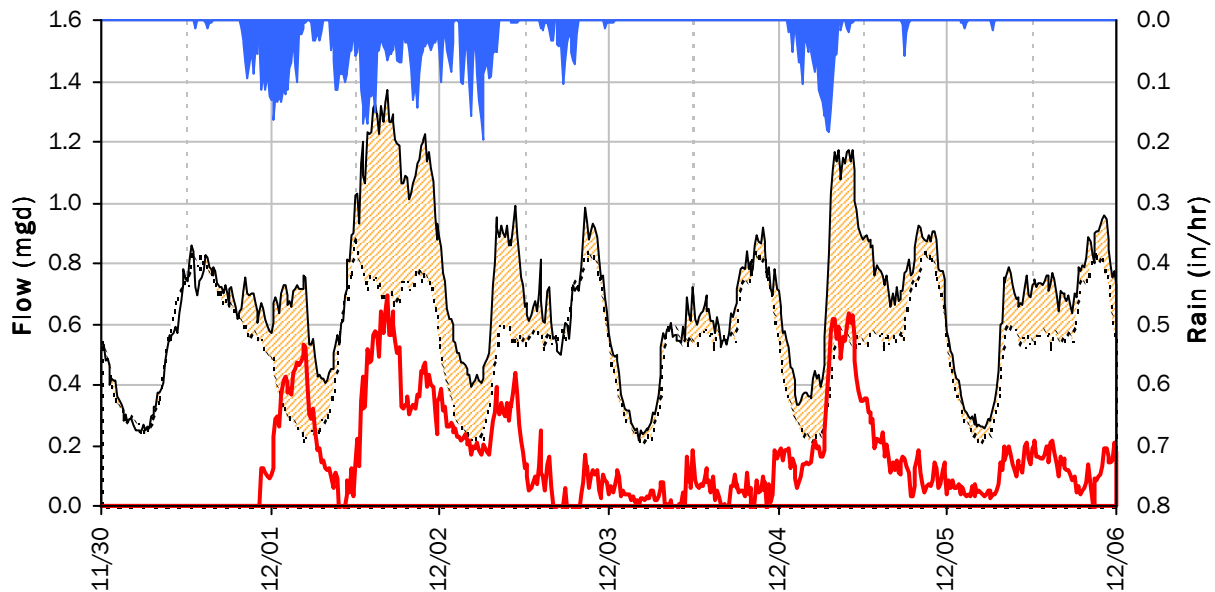
SITE 9

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.21 inches)

Capacity

Peak Flow: 1.37 mgd
PF: 2.63
Peak Level: 6.40 in
d/D Ratio: 0.18

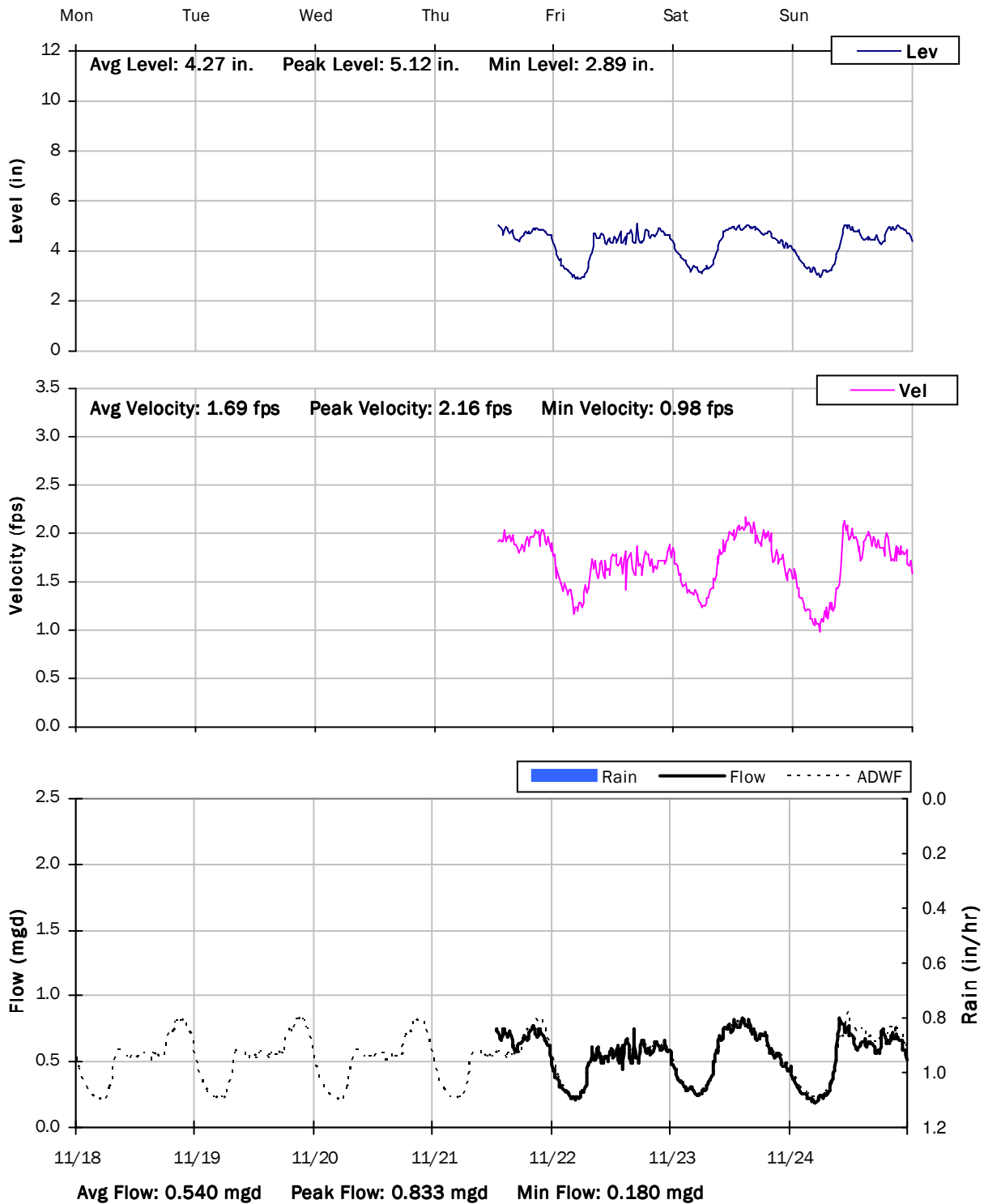
Inflow / Infiltration

Peak I/I Rate: 0.69 mgd
Total I/I: 888,000 gallons

SITE 9

Weekly Level, Velocity and Flow Hydrographs

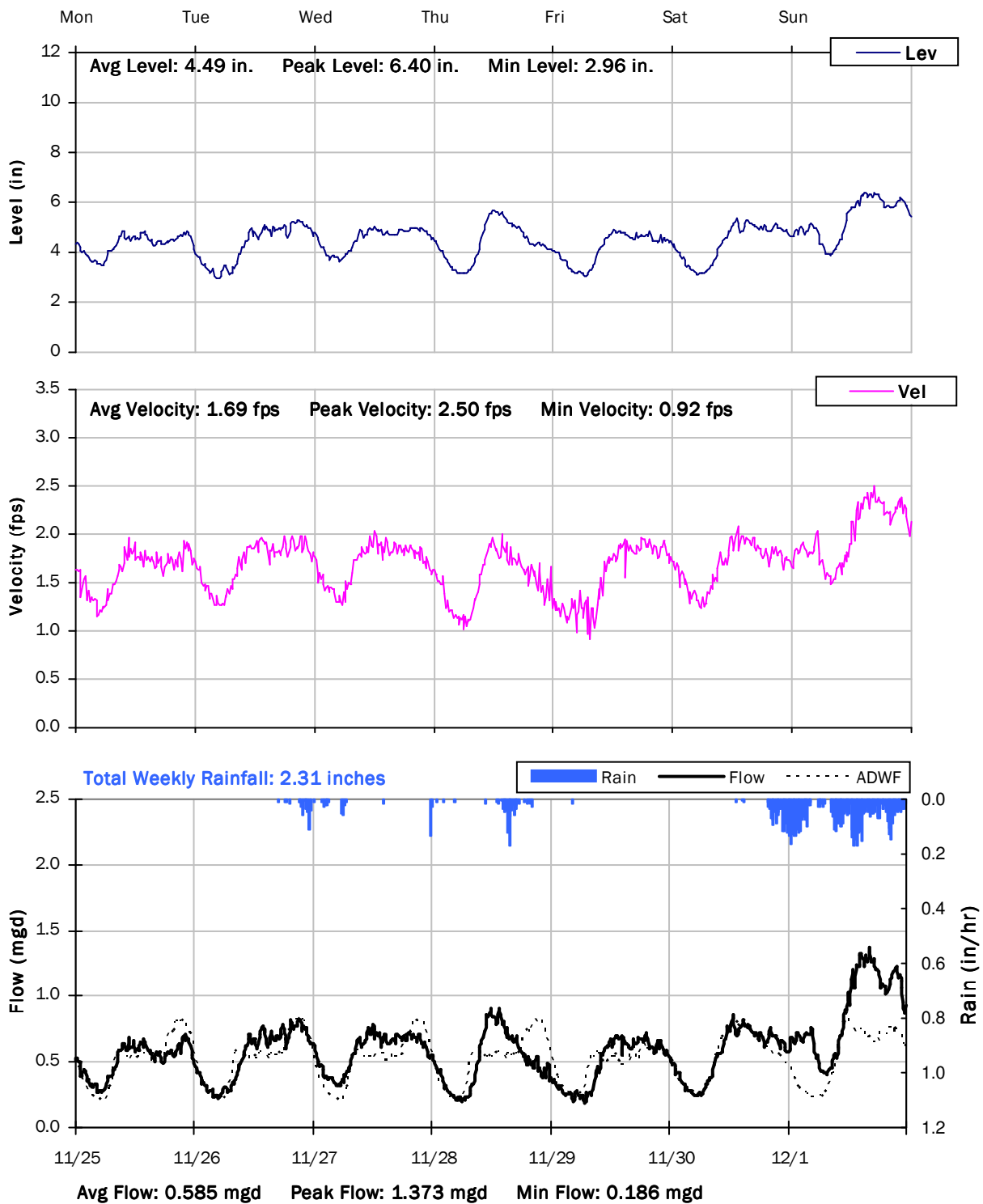
11/18/2019 to 11/25/2019



SITE 9

Weekly Level, Velocity and Flow Hydrographs

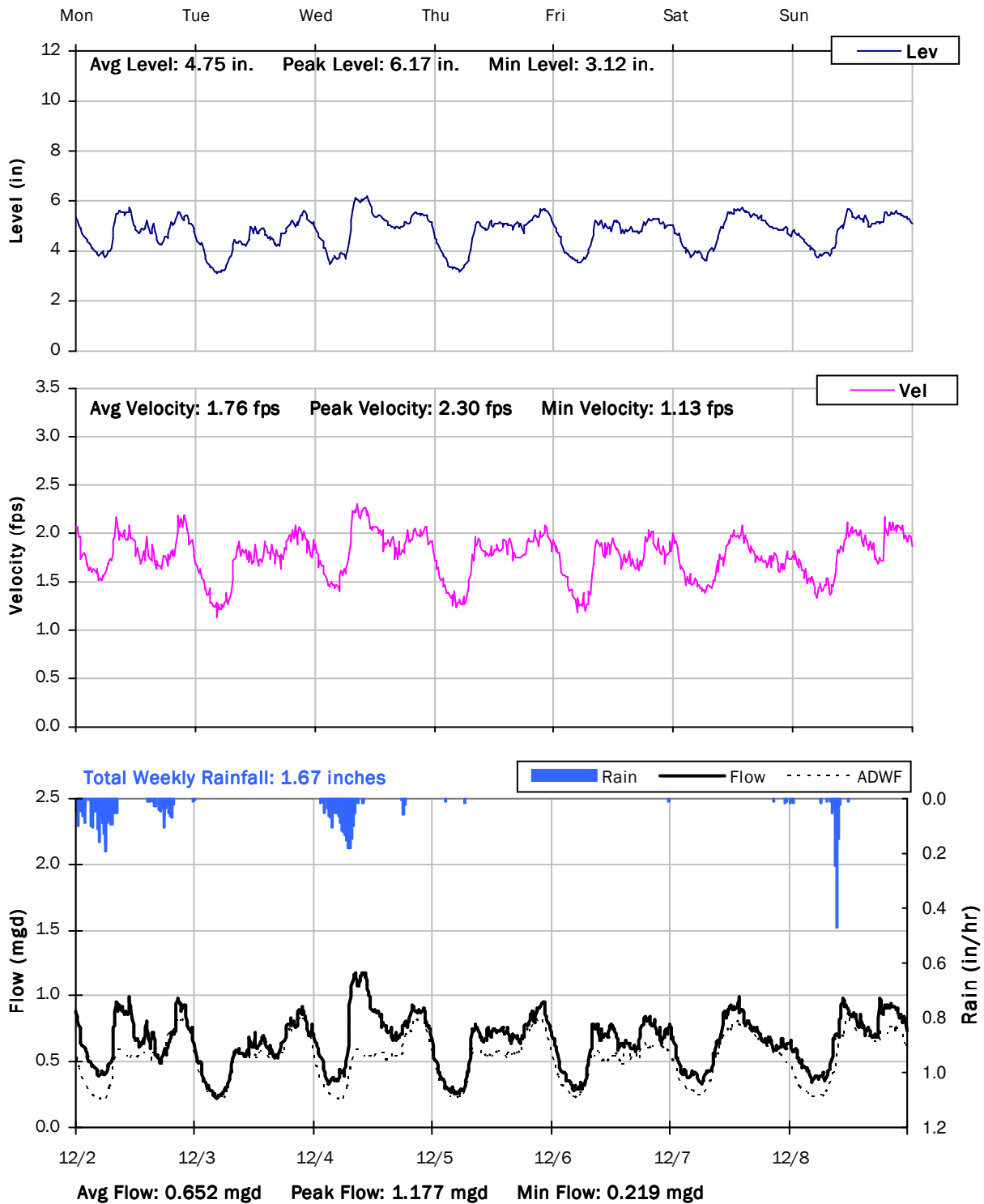
11/25/2019 to 12/2/2019



SITE 9

Weekly Level, Velocity and Flow Hydrographs

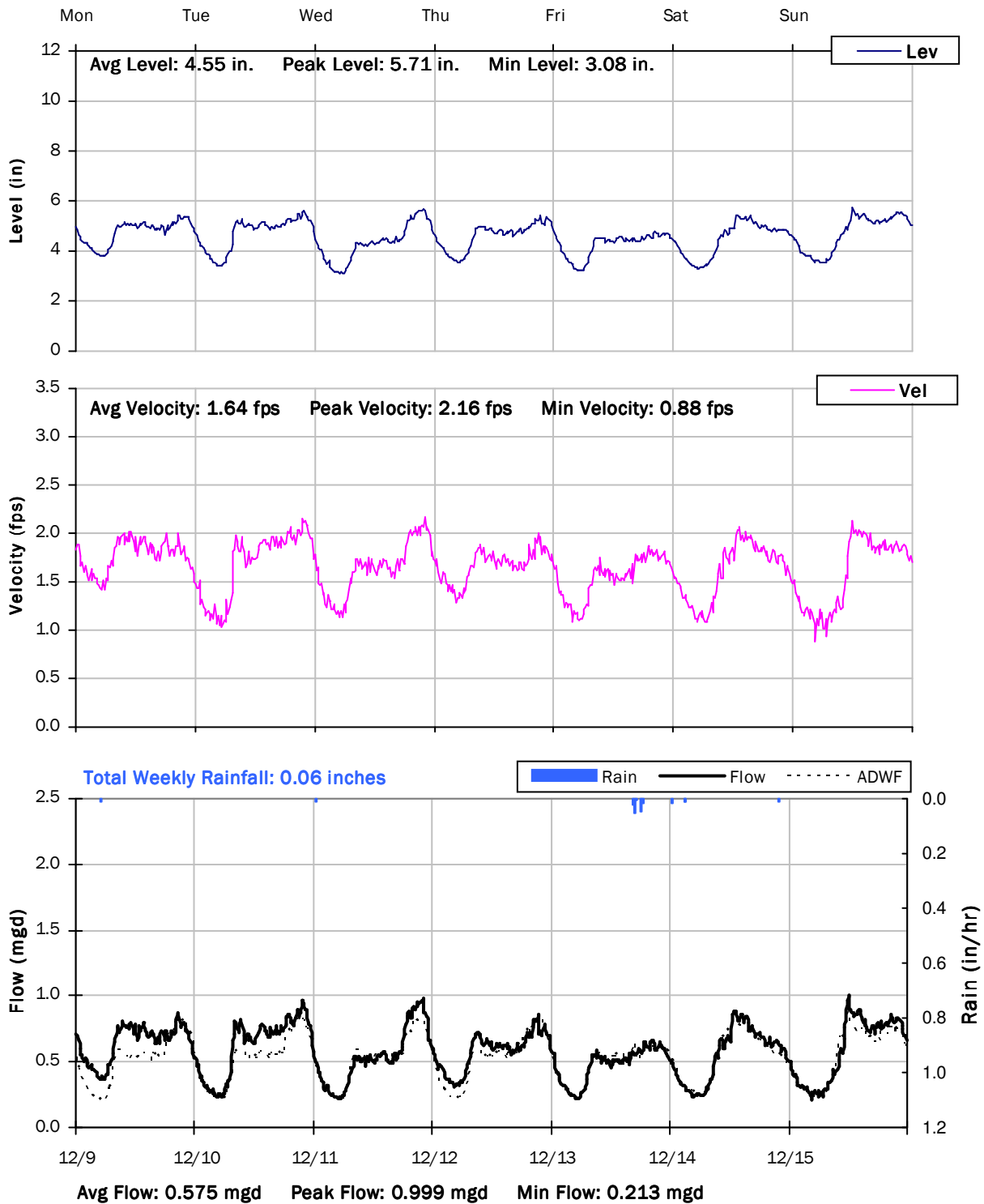
12/2/2019 to 12/9/2019



SITE 9

Weekly Level, Velocity and Flow Hydrographs

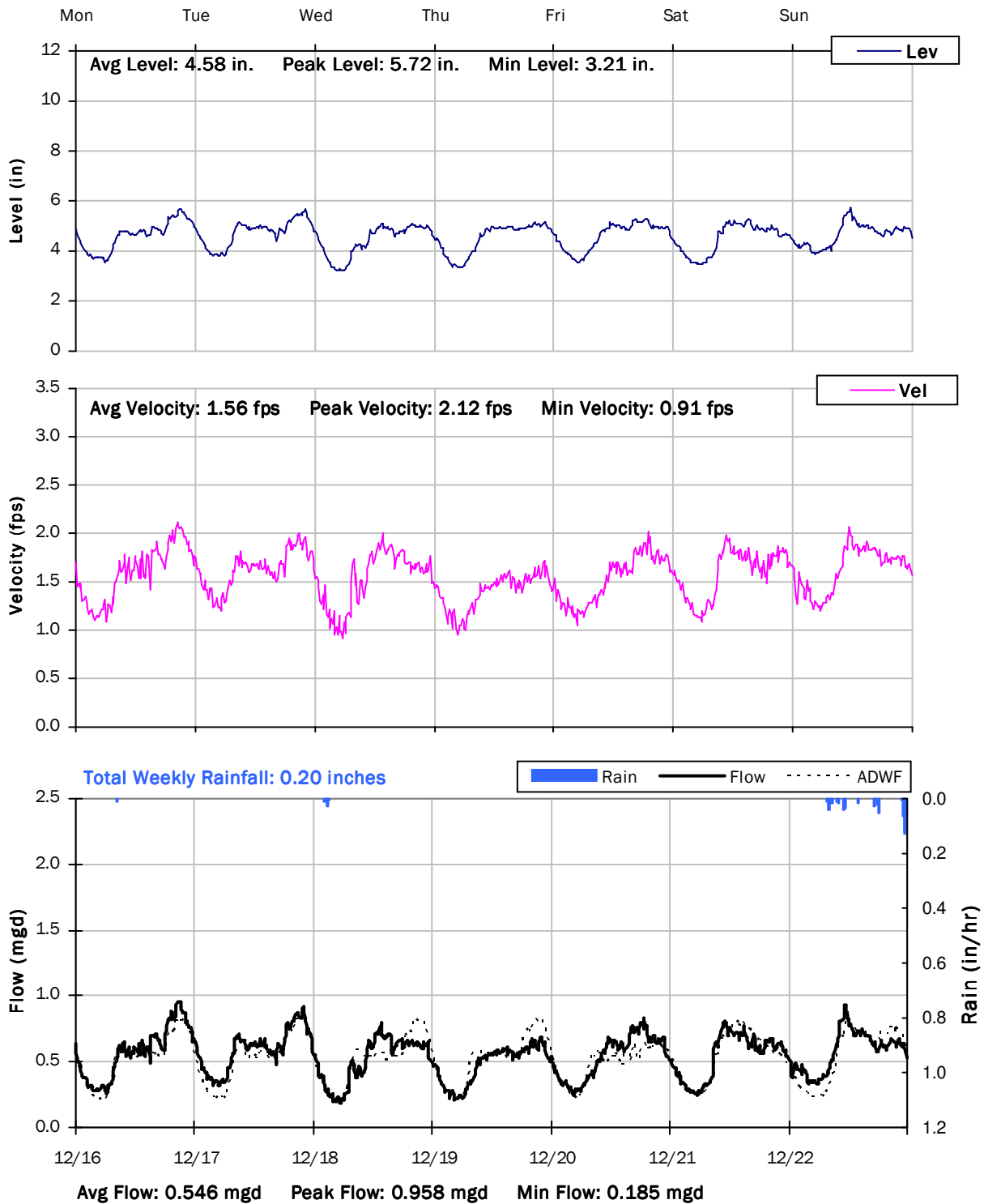
12/9/2019 to 12/16/2019



SITE 9

Weekly Level, Velocity and Flow Hydrographs

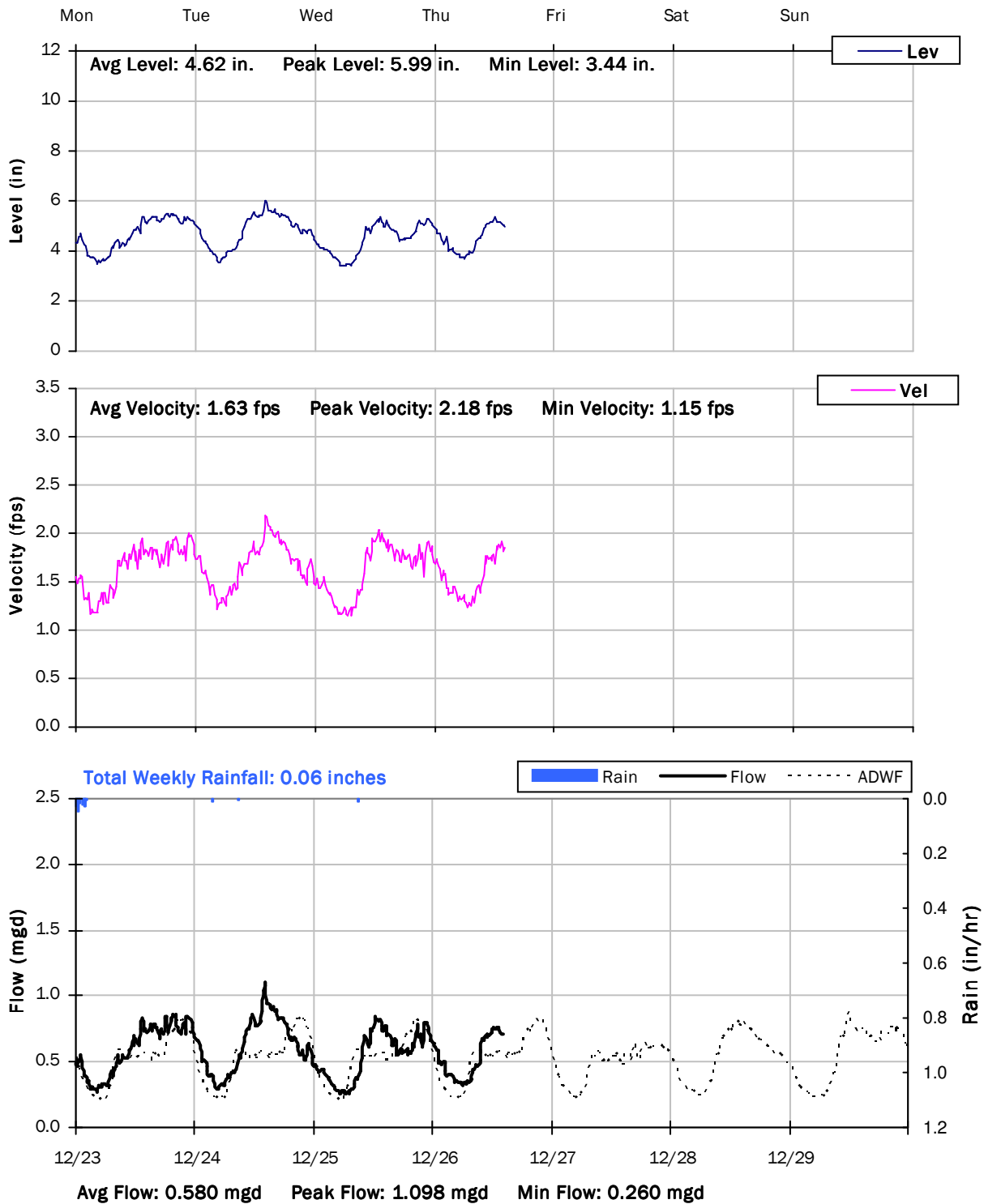
12/16/2019 to 12/23/2019



SITE 9

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring

November 22 - December 26, 2019

Monitoring Site: Site 10

City Manhole: 16M097

Location: South of end of S West Avenue, south of Riggs Avenue.
On north side of fence, about 15 feet from Site 8.

Data Summary Report



Vicinity Map: Site 10

SITE 10

Site Information

Location: South of end of S West Avenue, south of Riggs Avenue. On north side of fence, about 15 feet from Site 8.

City Manhole: 16M097

Coordinates: 120.5059° W, 37.2808° N

Rim Elevation (Earth): 155 feet

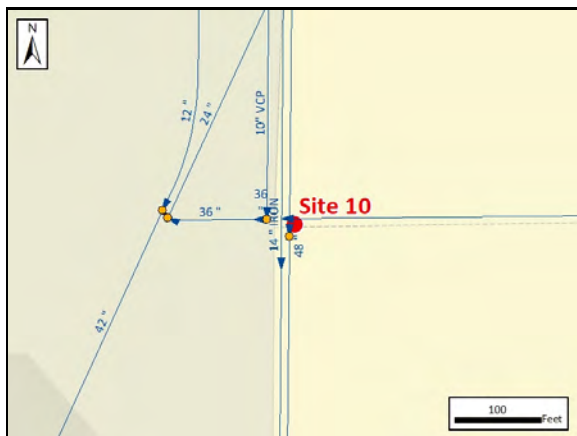
Pipe Diameter: 48 inches

ADWF: 3.523 mgd

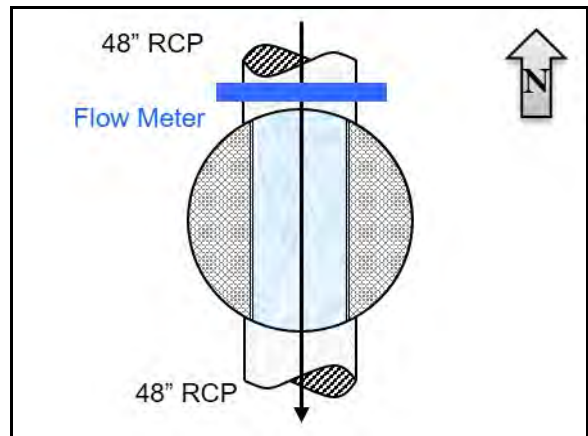
Peak Measured Flow: 6.708 mgd



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

SITE 10

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

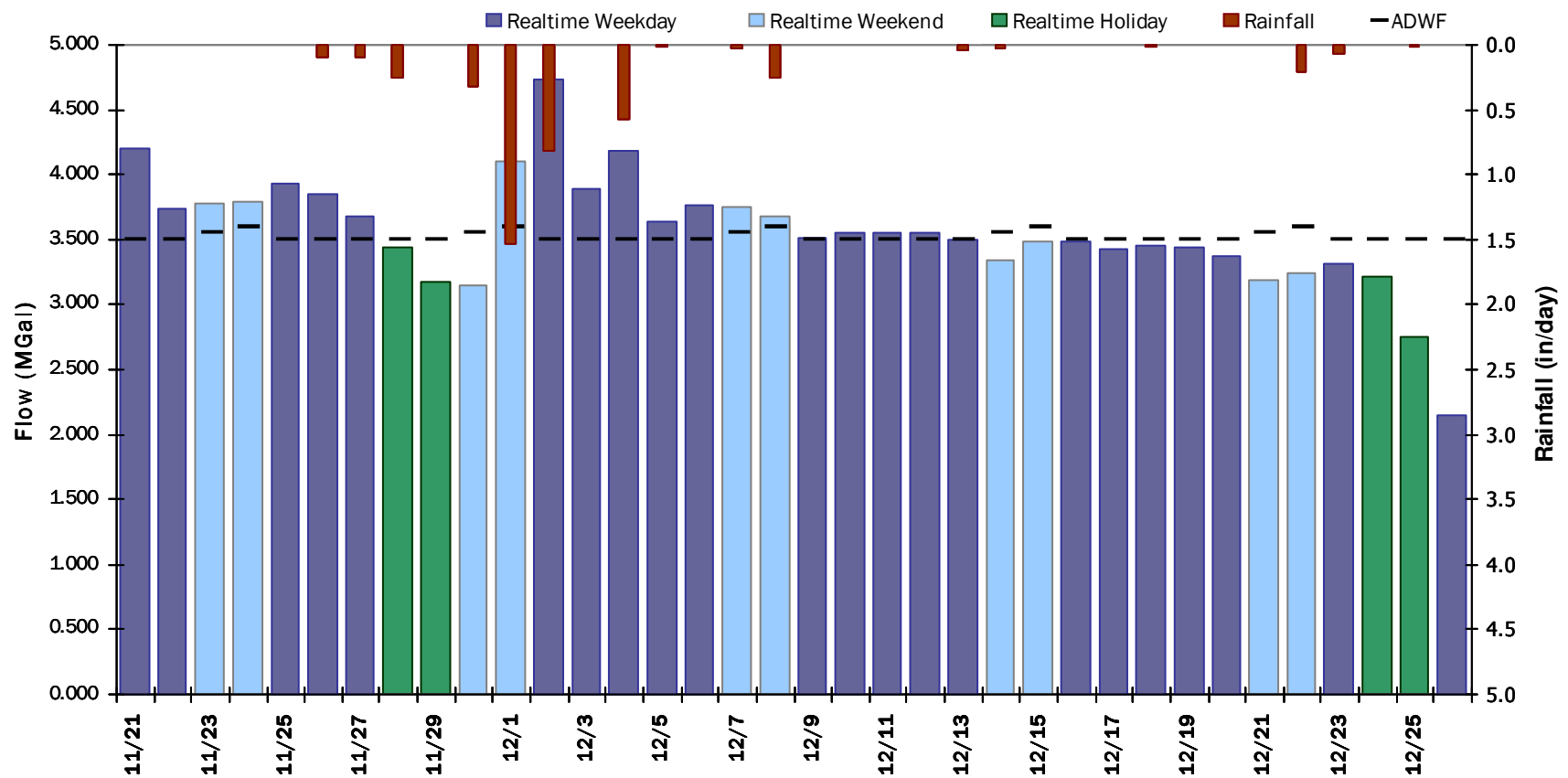


SITE 10

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 3.557 MGal Peak Daily Flow: 4.737 MGal Min Daily Flow: 2.147 MGal

Total Period Rainfall: 4.38 inches



SITE 10

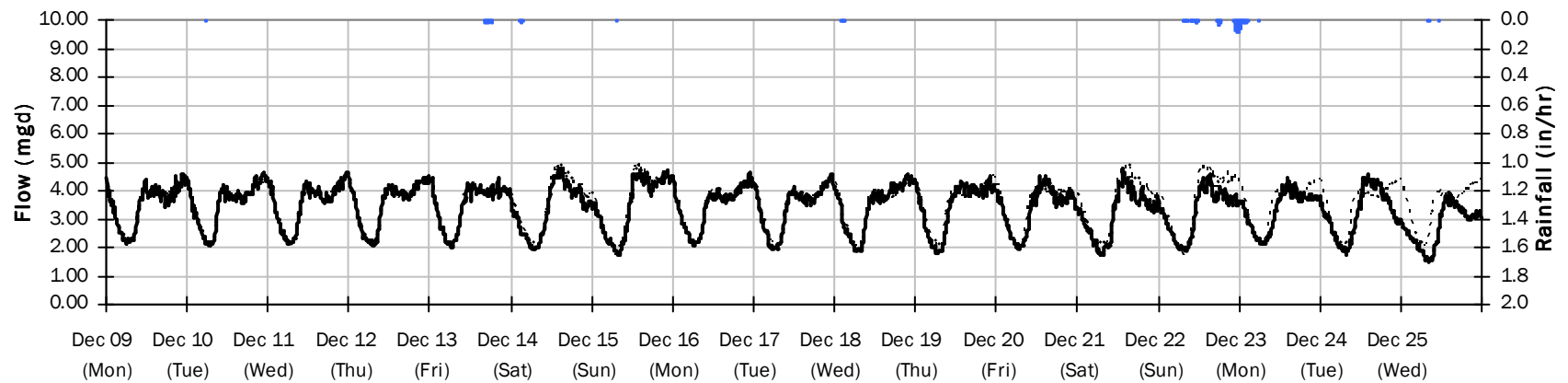
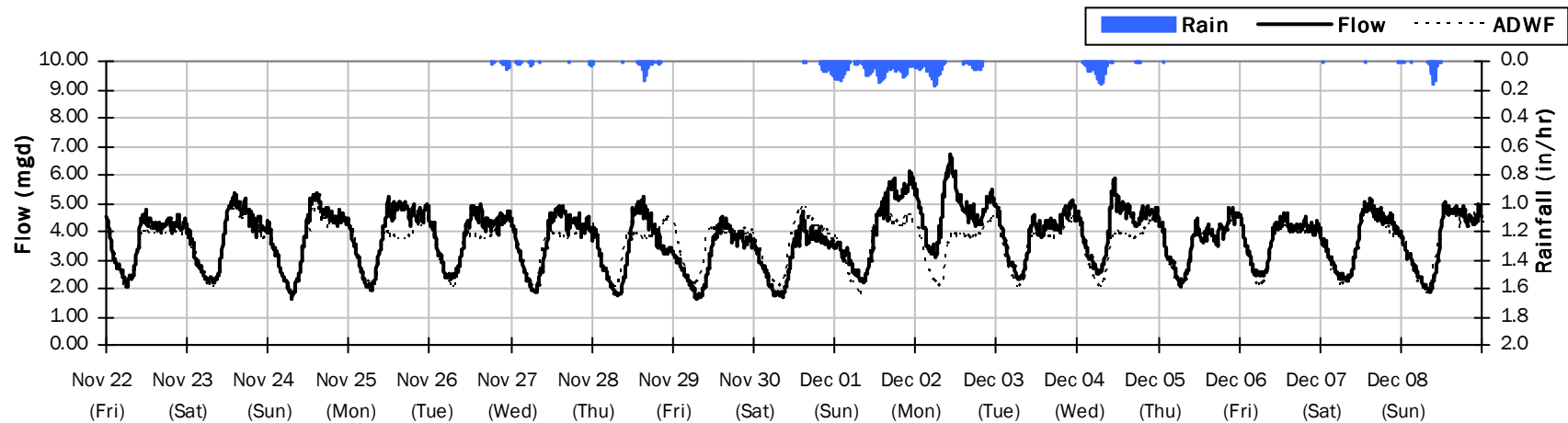
Flow Summary: 11/22/2019 to 12/25/2019

Total Period Rainfall: 4.38 inches

Avg Flow: 3.579 mgd

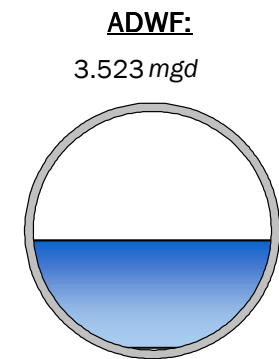
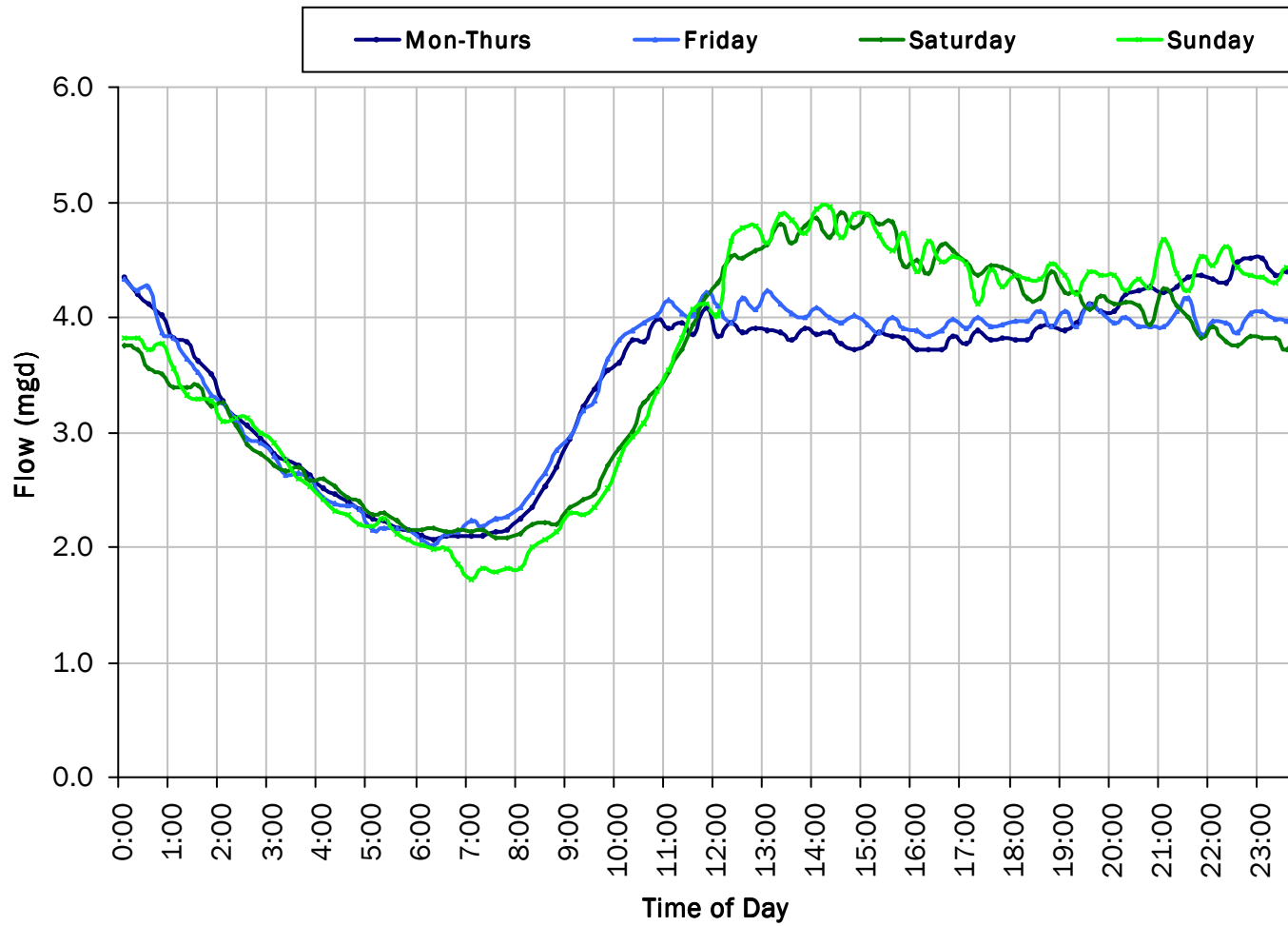
Peak Flow: 6.708 mgd

Min Flow: 1.471 mgd



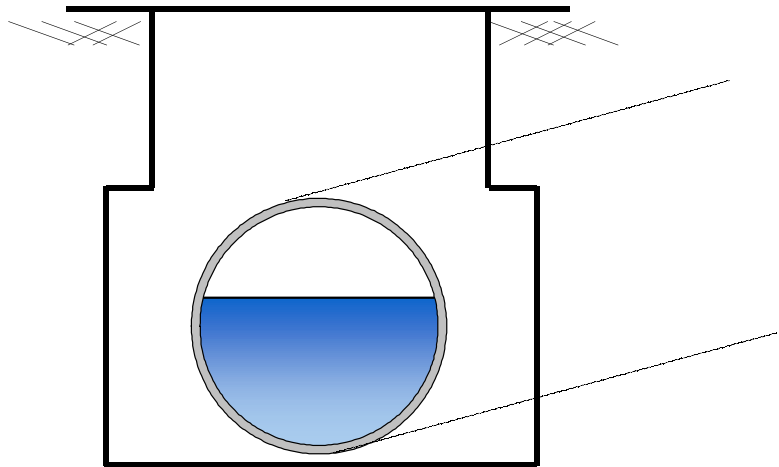
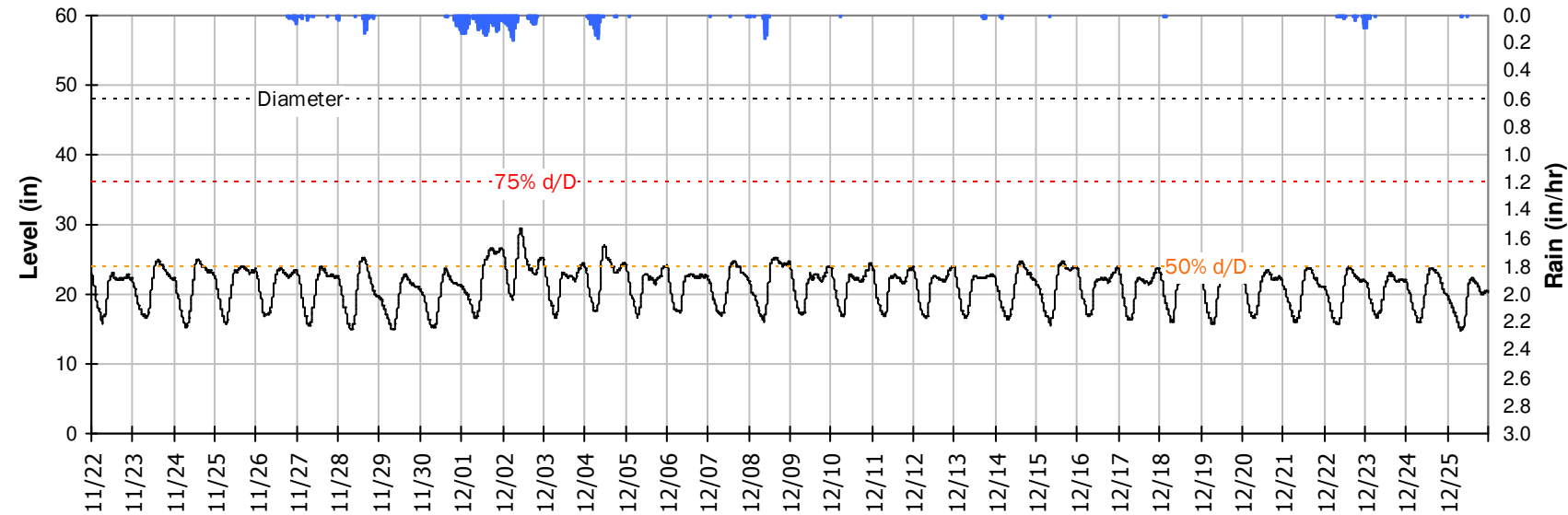
SITE 10

Average Dry Weather Flow Hydrographs



SITE 10
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

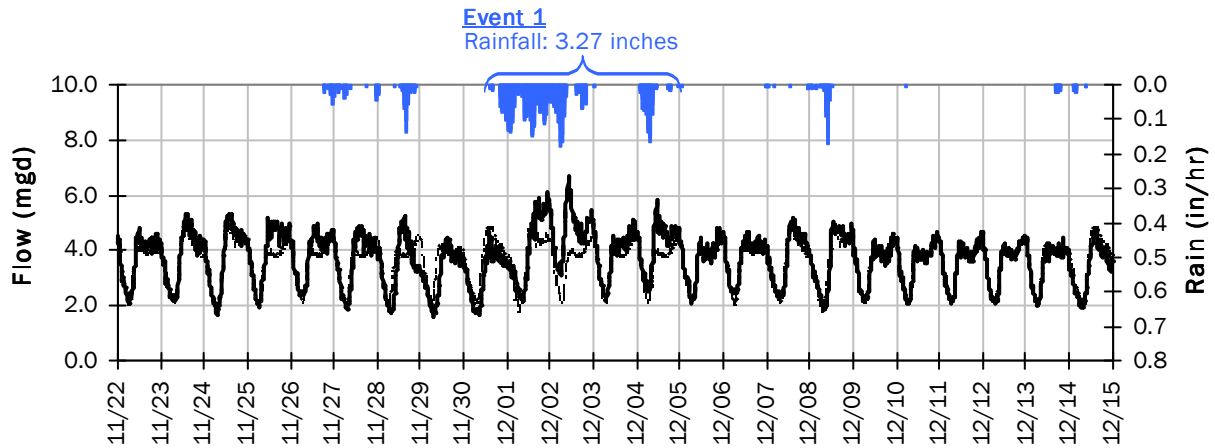


Pipe Diameter: 48 inches
Peak Measured Level: 29.6 inches
Peak d/D Ratio: 0.62

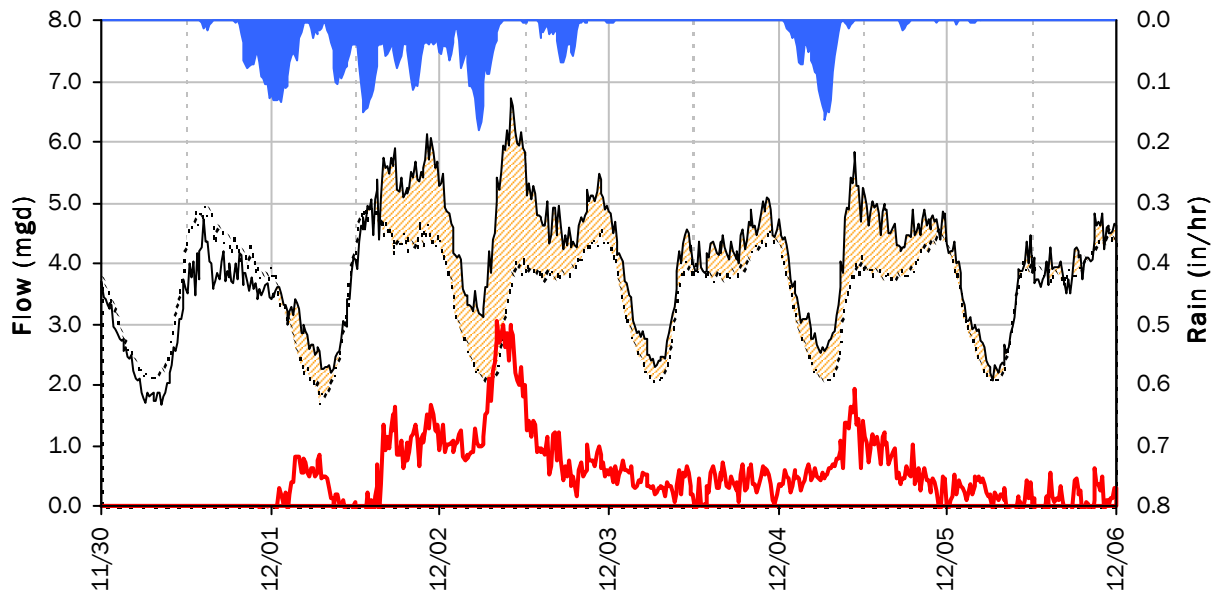
SITE 10

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 3.27 inches)

Capacity

Peak Flow: 6.71 mgd
PF: 1.90

Peak Level: 29.59 in
d/D Ratio: 0.62

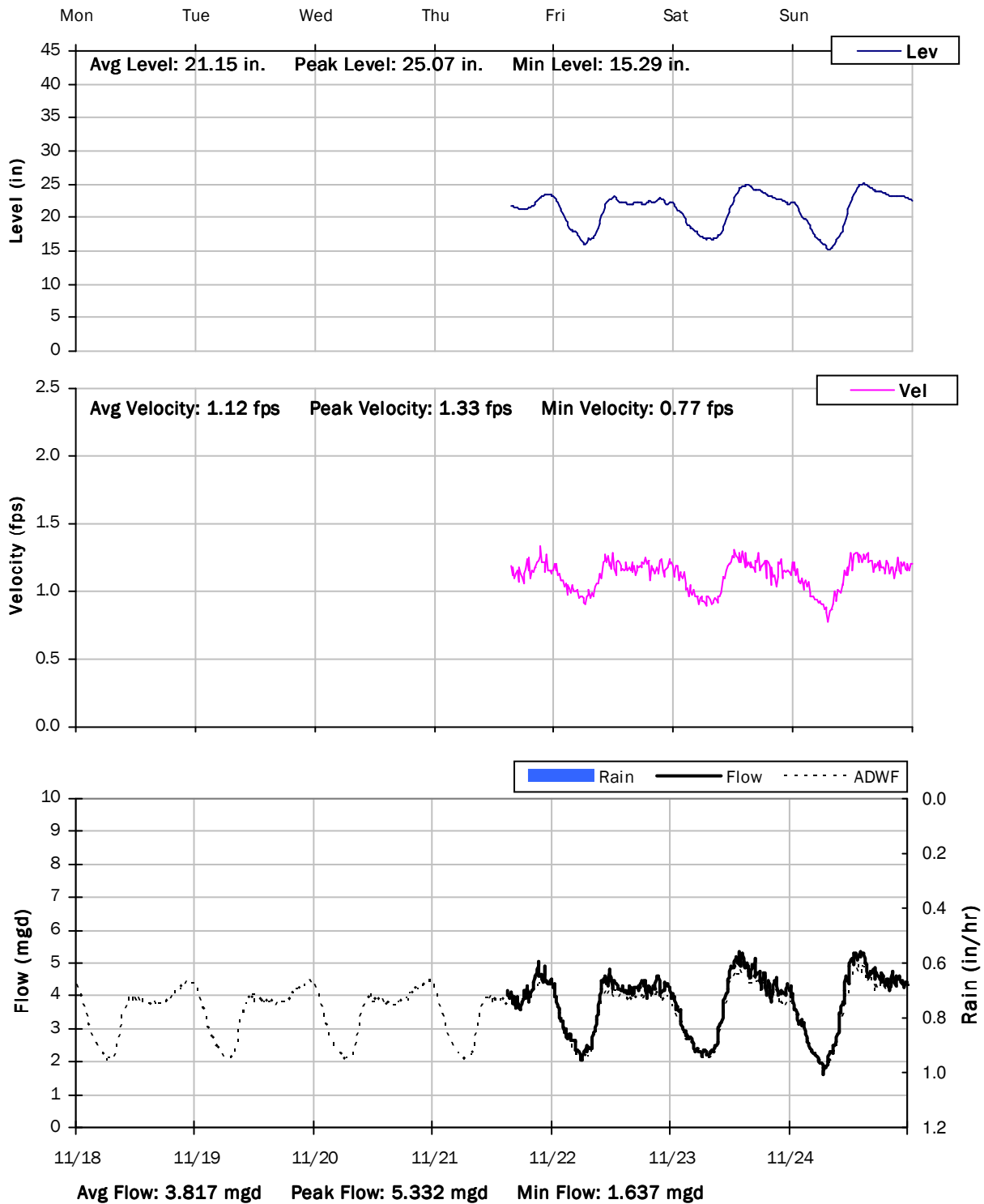
Inflow / Infiltration

Peak I/I Rate: 3.06 mgd
Total I/I: 2,932,000 gallons

SITE 10

Weekly Level, Velocity and Flow Hydrographs

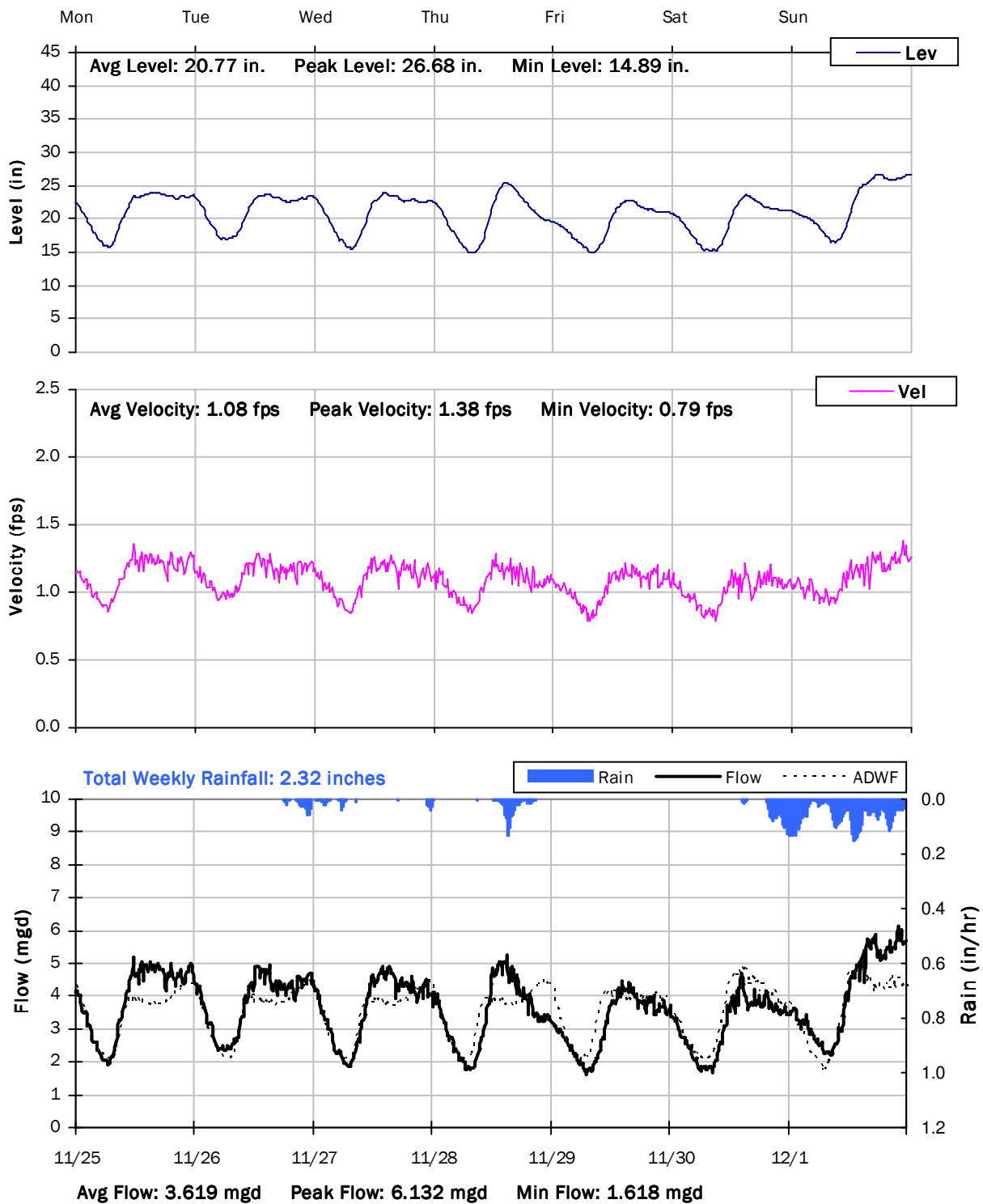
11/18/2019 to 11/25/2019



SITE 10

Weekly Level, Velocity and Flow Hydrographs

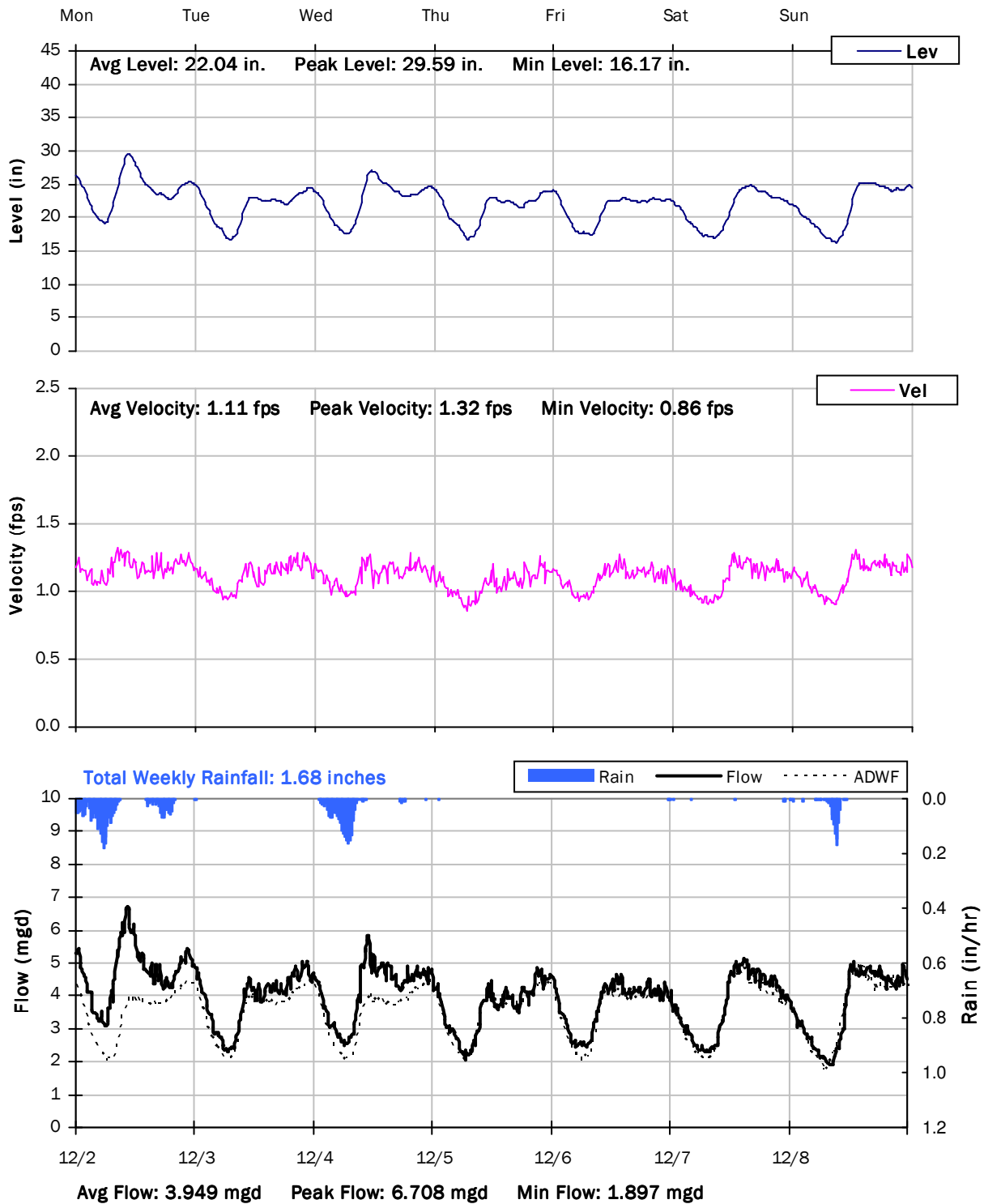
11/25/2019 to 12/2/2019



SITE 10

Weekly Level, Velocity and Flow Hydrographs

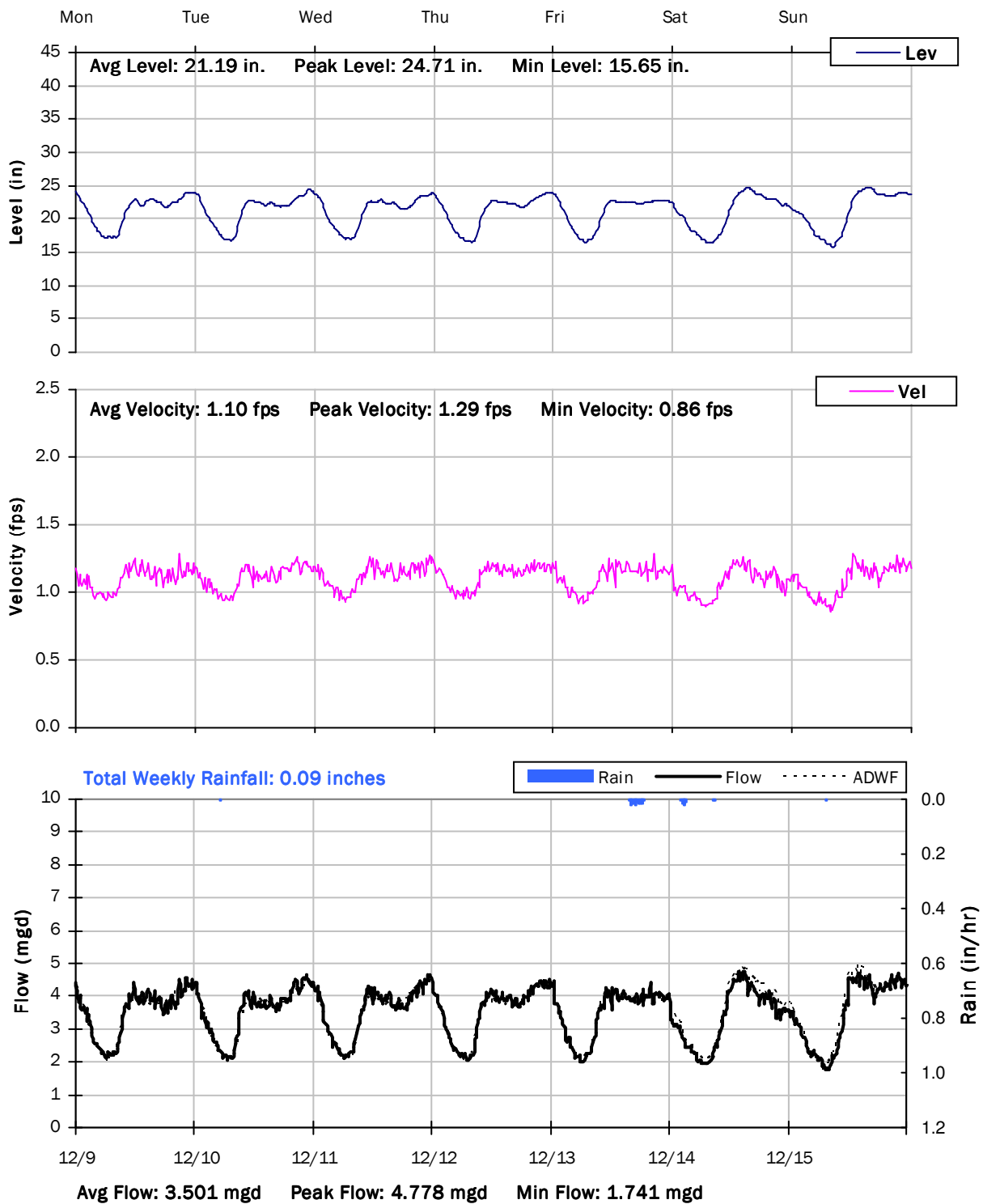
12/2/2019 to 12/9/2019



SITE 10

Weekly Level, Velocity and Flow Hydrographs

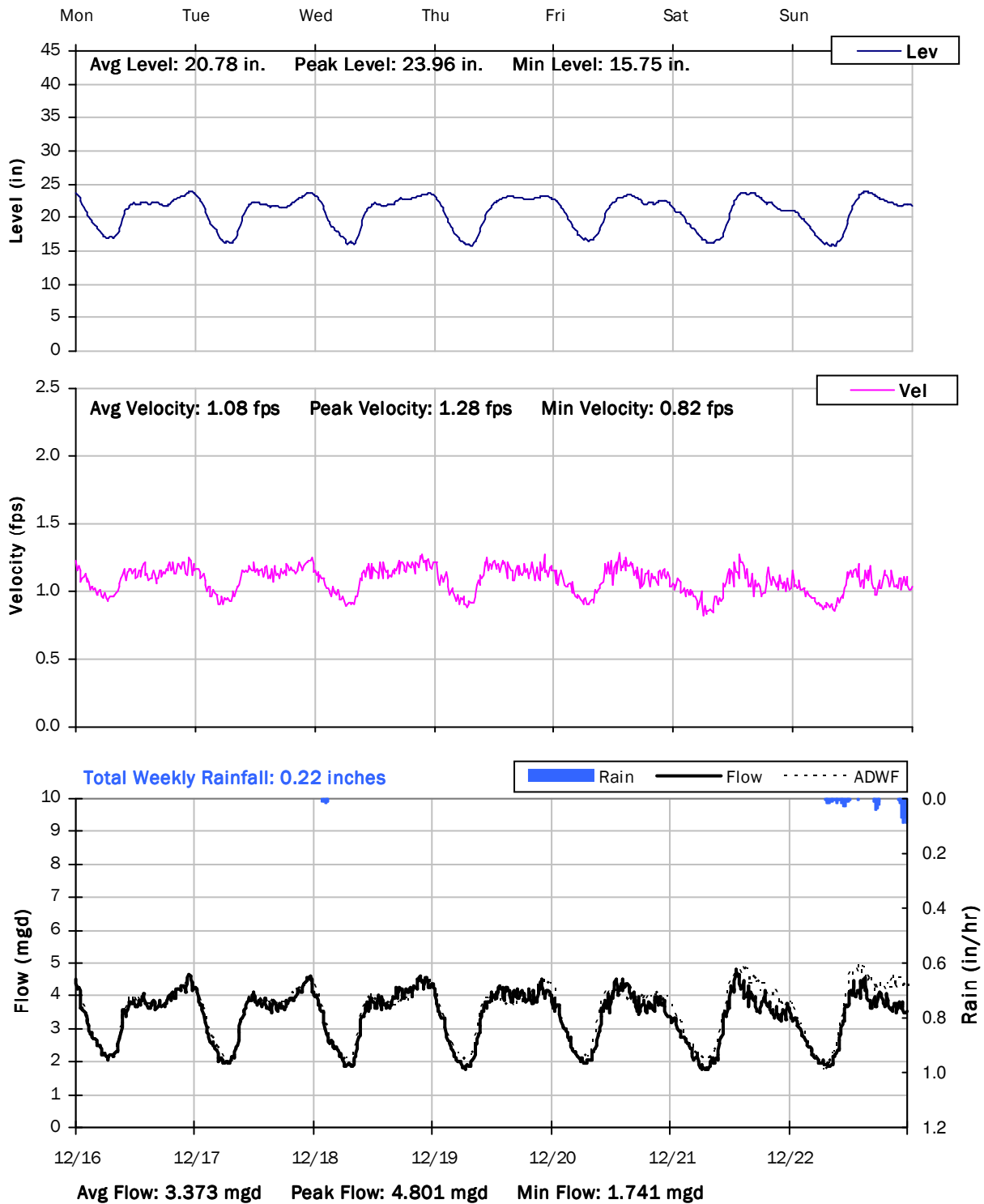
12/9/2019 to 12/16/2019



SITE 10

Weekly Level, Velocity and Flow Hydrographs

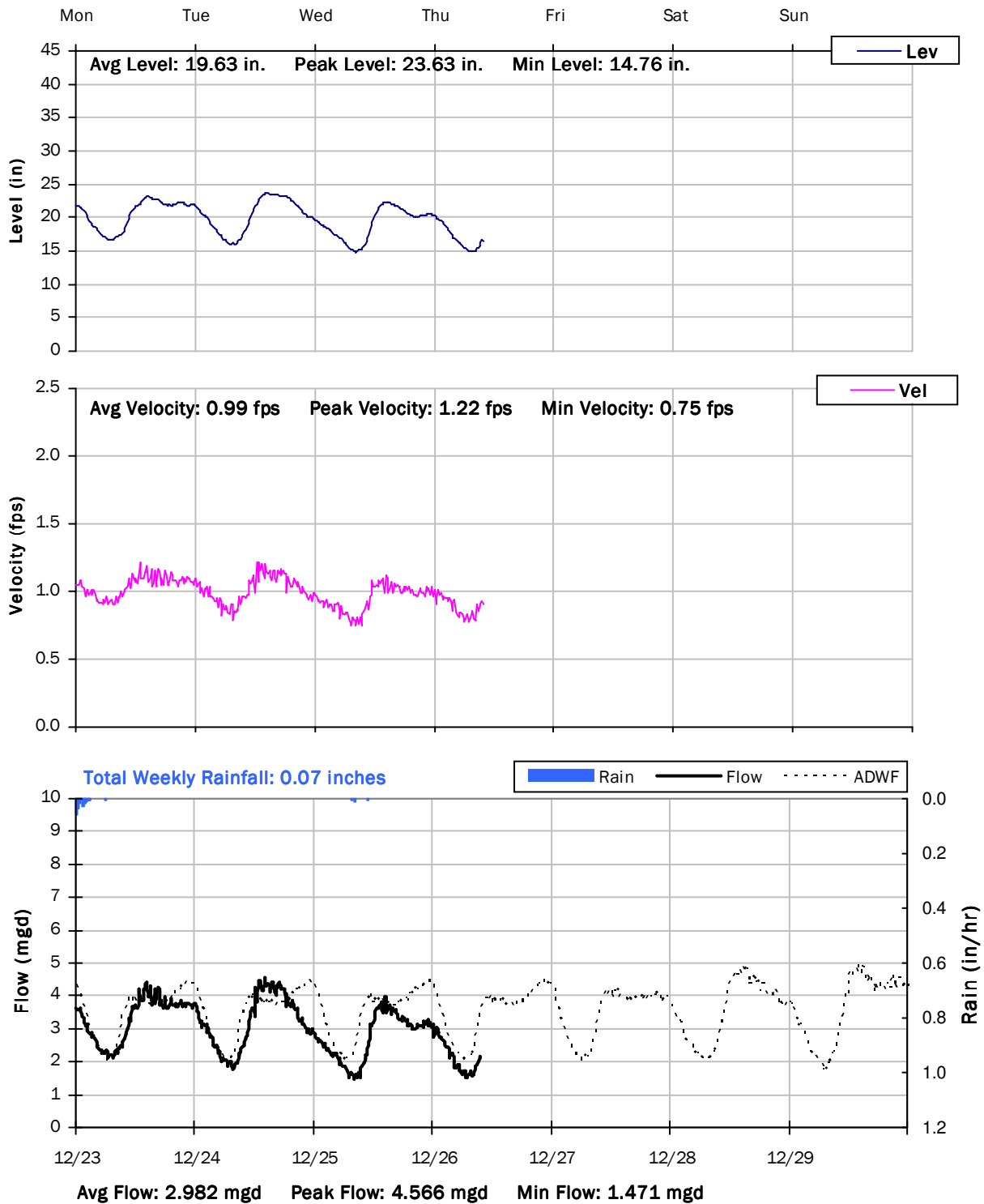
12/16/2019 to 12/23/2019



SITE 10

Weekly Level, Velocity and Flow Hydrographs

12/23/2019 to 12/30/2019



City of Merced

Sanitary Sewer Flow Monitoring Study



Prepared for:

City of Merced
Public Works Director
1776 Grogan Ave
Merced, CA 95341

Report Date:

February 2022

Prepared by:



V&A Project No. 20-0285

Table of Contents

Executive Summary	1
Scope and Purpose	1
Monitoring Sites	1
Peak Measured Flows and Pipeline Capacity Analysis	3
Flow per Sewer Account Analysis	5
1 Introduction	6
1.1 Scope and Purpose	6
1.2 Flow Monitoring Sites	6
1.3 Land Use Categories	8
2 Methods and Procedures	9
2.1 Confined Space Entry	9
2.2 Flow Meter Installation	10
2.2.1 Flow Calculation	11
2.3 Volumetric Flow Monitoring at Pump Stations	12
2.3.1 State Logger Installation	12
2.3.2 Pressure Logger Installation	12
2.3.3 Volumetric Flow Calculation	13
2.4 Measurement Error and Uncertainty	14
2.4.1 Flow Addition versus Flow Subtraction	14
2.5 Average Dry Weather Flow Determination	16
2.6 Flow Attenuation	17
3 Results and Analysis	18
3.1 Flow Monitoring Data	18
3.1.1 Rainfall Analysis	18
3.1.2 Inflow/Infiltration Observations	20
3.2 Average Flow Analysis	21
3.3 Flow Monitoring: Peak Measured Flows / Pipeline Capacity	22
3.4 Flow Monitoring: Flow per Sewer Account	25
Appendix A Flow Monitoring Sites: Data, Graphs, and Information	A-1
Appendix B Land Use Basin Maps	B-1

Tables

Table ES-1. List of Flow Monitoring & Pump Station Sites	1
Table ES-2. Capacity Analysis Summary	4
Table ES-3. Flow Per Sewer Account Summary	5
Table 1-1. List of Flow Monitoring & Pump Station Sites	6
Table 3-1. Summary of Rainfall Data	19
Table 3-2. Dry Weather Flow	21
Table 3-3. Capacity Analysis Summary.....	22
Table 3-4. Flow per Sewer Account Summary	25

Figures

Figure ES-1. Map of Flow Monitoring Sites – Overall	2
Figure ES-2. Map of Land Use Basins	3
Figure 1-1. Map of Flow Monitoring Sites	7
Figure 1-2. Map of Flow Monitoring Basins	8
Figure 2-1. Typical Installation for ISCO 2150 Flow Meter with Submerged Sensor.....	10
Figure 2-2. Hobo Motor On/Off State Logger.....	12
Figure 2-3. Volumetric Flow Monitoring Calculation	13
Figure 2-4. Sample ADWF Diurnal Flow Patterns	16
Figure 2-5. Attenuation Illustration.....	17
Figure 3-1. Location of Rain Gauges	18
Figure 3-2. Rainfall Event Classification – 24-Hour Period (KCAMERCE46 RG).....	19
Figure 3-3. LowDen-6 – Reaction to October 25, 2021 rainfall event.	20
Figure 3-4. Peaking Factors	23
Figure 3-5. Capacity Summary: Max d/D Ratios.....	24

Photo Log

Photo 2-1. Confined Space Entry	9
Photo 2-2. Typical Personal Four-Gas Monitor	9

Abbreviations and Acronyms

Abbreviations/Acronyms	Definition
ADWF	Average Dry Weather Flow
AVG.	Average
CCTV	Closed-Circuit Television
CDEC	California Data Exchange Center
CIP	Capital Improvement Plan
CO	Carbon Monoxide
CWOP	Citizen Weather Observing Program
DIA.	Diameter
d/D.....	Depth/Diameter Ratio
FT.	Feet
FM.....	Flow Monitor
GPD.....	Gallons per Day
GPM	Gallons per Minute
GWl	Groundwater Infiltration
H ₂ S	Hydrogen Sulfide
IN.	Inch
I/I.....	Inflow and Infiltration
IDM	Inch-Diameter Mile
IDW	Inverse Distance Weighting
LEL.....	Lower Explosive Limit
MAX.....	Maximum
MGD.....	Million Gallons per Day
MIN.	Minimum
NOAA	National Oceanic and Atmospheric Administration
N/A	Not applicable
PF.....	Peaking Factor
PWS	Private Weather Station
Q	Flow Rate
RDI	Rainfall-Dependent Infiltration
RG	Rain Gauge
V&A	V&A Consulting Engineers, Inc.
WEF.....	Water Environment Federation
WRCC	Western Regional Climate Center

Terms and Definitions

Term	Definition
Average dry weather flow (ADWF)	The average flow rate or pattern from days without noticeable inflow or infiltration response. ADWF usage patterns for weekdays and weekends differ and must be computed separately. ADWF is expressed as a numeric average and may include the influence of normal groundwater infiltration (not related to a rain event).
Basin	Sanitary sewer collection system upstream of a given location (often a flow meter), including all pipelines, inlets, and appurtenances. Also refers to the ground surface area near and enclosed by pipelines. A basin may refer to the entire collection system upstream from a flow meter or exclude separately monitored basins upstream.
Depth/diameter (d/D) ratio	Depth of water in a pipe as a fraction of the pipe's diameter. A measure of the fullness of the pipe used in the capacity analysis.
Infiltration and inflow	Infiltration and inflow (I/I) rates are calculated by subtracting the ADWF flow curve from the instantaneous flow measurements taken during and after a storm event. Flow in excess of the baseline consists of inflow, rainfall-responsive infiltration, and rainfall-dependent infiltration. Total I/I is the total sum in gallons of additional flow attributable to a storm event.
Infiltration, groundwater	Groundwater infiltration (GWI) is groundwater that enters the collection system through pipe defects. GWI depends on the depth of the groundwater table above the pipelines as well as the percentage of the system that is submerged. The variation of groundwater levels and subsequent groundwater infiltration rates are seasonal by nature. On a day-to-day basis, groundwater infiltration rates are relatively steady and will not fluctuate greatly.
Infiltration, rainfall-dependent	Rainfall-dependent infiltration (RDI) is similar to groundwater infiltration but occurs as a result of storm water. The storm water percolates into the soil, submerges more of the pipe system, and enters through pipe defects. RDI is the slowest component of storm-related infiltration and inflow, beginning gradually and often lasting 24 hours or longer. The response time depends on the soil permeability and saturation levels.
Inflow	Inflow is defined as water discharged into the sewer system, including private sewer laterals, from direct connections such as downspouts, yard, and area drains, holes in manhole covers, cross-connections from storm drains, or catch basins. Inflow creates a peak flow problem in the sewer system and often dictates the required capacity of downstream pipes and transport facilities to carry these peak instantaneous flows. Overflows are often attributable to high inflow rates.
Peak Wet Weather Flow	The highest daily flow during and immediately after a significant storm event. Includes sanitary flow, infiltration, and inflow.
Peaking factor (PF)	PF is the ratio of peak measured flow to average dry weather flow. This ratio expresses the degree of fluctuation in flow rate over the monitoring period and is used in the capacity analysis.
Surcharge	When the flow level is higher than the crown of the pipe, then the pipeline is said to be in a surcharged condition. The pipeline is surcharged when the d/D ratio is greater than 1.0.

Executive Summary

Scope and Purpose

V&A Consulting Engineers (V&A) was retained by the City of Merced (City) to perform sanitary sewer flow monitoring within the City. Flow monitoring was performed for approximately one month from September 27, 2021, to November 1, 2021 at 18 flow monitoring sites and 3 pump station locations. The sites were spread throughout a variety of land uses. There were three general purposes for this study.

1. Establish the baseline sanitary sewer flows at the flow monitoring sites.
2. Measure the peak flow characteristics of the subject pipes during the monitoring period.
3. Establish flow rates for the various categories of land uses.

Monitoring Sites

The flow monitoring site locations were selected and approved by the City and are listed in Table ES-1, and shown in Figure ES-1. The isolated basins are illustrated in Figure ES-2.

Table ES-1. List of Flow Monitoring & Pump Station Sites

Monitoring Site	City Manhole	Monitored Pipe	Pipe Dia. (in)	Location
PlanDev-1	19M075	East Inlet	27	W. Yosemite Ave., east of San Augustine Ave.
PlanDev-2	Bellevue PS	Pump Station	n/a	Corner of W. Cardella Rd. & Bancroft Dr.
UC Merced	21M072	East Inlet	21	Bellevue Rd, west of Lake Rd.
Industrial-1	n/a	East Inlet	33	E. Gerard Ave, west of Campus Pkwy
Industrial-2	n/a	Pump Station	n/a	In field west of West Ave.
Industrial-3	6M375	West Inlet	12	Intersection of Hwy 59 and Willowbrook Dr.
OfficeComm-2	1M187	East Inlet	10	Intersection of Mercy Ave. and G St.
Mobile-1	6M382	North Inlet	8	W. N. Bear Creek Dr. west of Hwy 59
Mobile-2	11M280	East Inlet	8	Southern edge of Joe Herb Park, west of Parsons Ave.
LowDen-1	1M149	East Inlet	18	E. Yosemite Ave., east of G St.
LowDen-2	4M002	East Inlet	10	W. Yosemite Ave., west of San Jose Ave.
LowDen-3	5M145	Northeast Inlet	10	Intersection of Buena Vista Dr. & Terri Ct.
LowDen-4	7M134	Southeast Inlet	16	E. Santa Fe Ave. just west of Glen Ave.
LowDen-5	12M093	South Inlet	11.5	Intersection of W. Gerard Ave. and S. G St.
LowDen-6	8M158	Northeast Inlet	12	E. Main St. between Orchard Ln and Cedar Ave.
LowDen-7	3M116	East Inlet	10	Off G St. just north of Craig Dr.

LowDen-8	Sydney PS	Pump Station	n/a	Hwy 140, west of Sydney Ln.
LowDen-9	?	South Inlet	7.75	Intersection of Hwy 140 & Shirley St.
HiMedDen-1	6M307	West Inlet	10	Intersection of Willowbrook Dr. & Stonybrook Ave.
HiDen-1	9M018	Northeast Inlet	10.25	Intersection of Martin Luther King Jr. Way and alley between W. 18 th St. and W. Main St.
WWTP Influent	?	Northeast Inlet	60	Off dirt road just north of WWTP

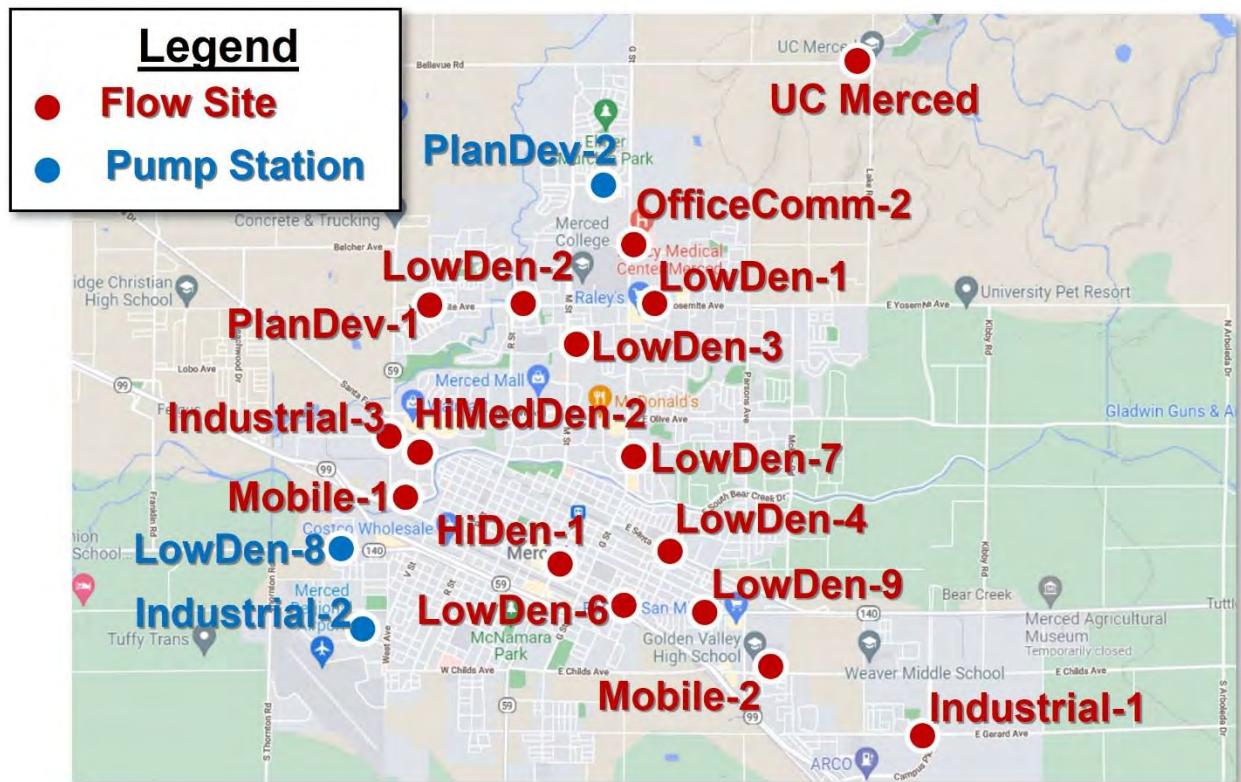


Figure ES-1. Map of Flow Monitoring Sites – Overall

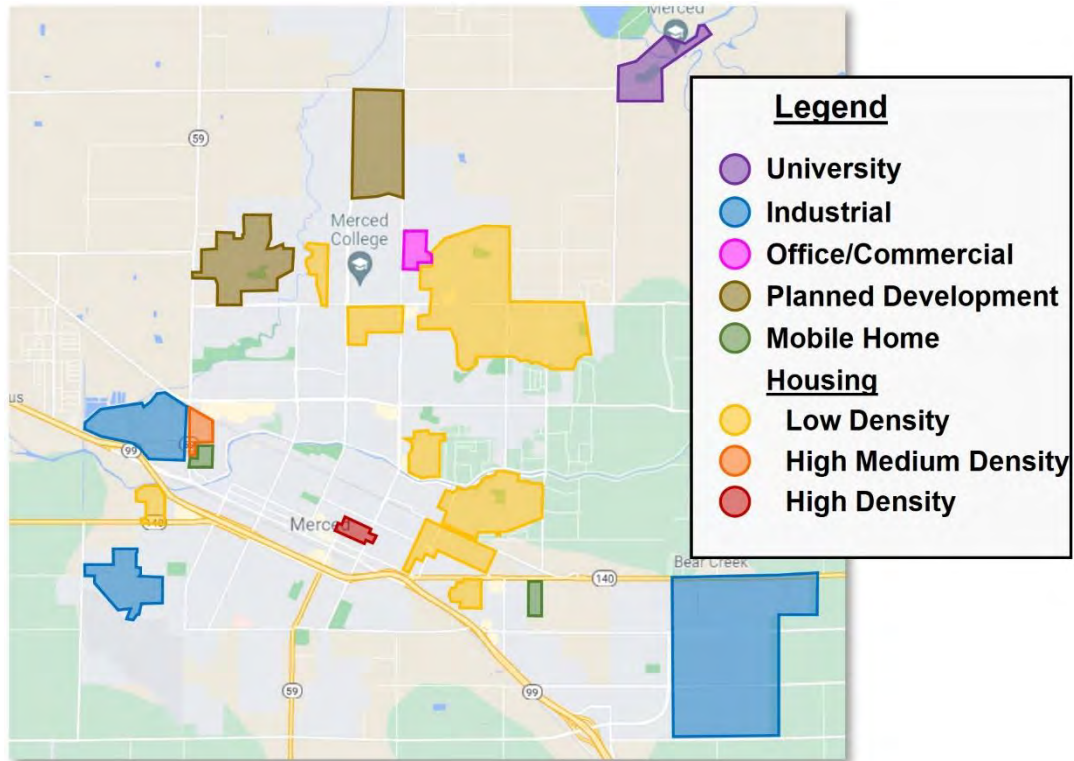


Figure ES-2. Map of Land Use Basins

Peak Measured Flows and Pipeline Capacity Analysis

Peak measured flows and the hydraulic grade line data (flow depths) are important to understanding the capacity limitations of a collection system. The capacity analysis terms used in the text below are defined as follows:

- Peaking Factor:** Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors, including size and topography of the tributary area, flow attenuation, flow restrictions, and characteristics of I/I entering the collection system. Municipal standards for peaking factor vary agency by agency; the District should refer to jurisdictional standards when evaluating peaking factors¹. For this study, peaking factors over 5.0 are highlighted **YELLOW** and over 10 are highlighted in **RED**.
- d/D Ratio:** The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). The d/D ratio for each site was computed based on the maximum depth of flow for the study. Standards for d/D ratio vary from agency to agency, but typically range between $d/D \geq 0.5$ and $d/D \leq 0.75$. The City should refer to jurisdictional standards when evaluating d/D ratios. For this study, d/D ratios over 0.75 are highlighted **YELLOW**. Surcharged sites are highlighted **RED**.

¹ WEF Manual of Practice FD-6 and ASCE Manual No. 62 suggests typical peaking factor ratios range between 3 and 4, with higher values possibly indicative of pronounced I/I flows.

Table ES-2 summarizes the peak recorded flows, levels, d/D ratios, and peaking factors per site during the flow monitoring period. Capacity analysis data is presented on a site-by-site basis and represents the hydraulic conditions only at the site locations; hydraulic conditions in other areas of the collection system will differ.

Table ES-2. Capacity Analysis Summary

Monitored Site	ADWF (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Pipe Diameter, <i>D</i> (in)	Max Depth, <i>d</i> (in)	Max <i>d/D</i> Ratio
PlanDev-1	0.354	0.688	1.9	27	6.5	0.24
PlanDev-2	0.284	0.541	1.9	n/a	n/a	n/a
UC Merced	0.115	0.561	4.9	21	4.47	0.21
Industrial-1	0.158	1.388	8.8	33	4.95	0.15
Industrial-2	0.030	0.163	5.3	n/a	n/a	n/a
Industrial-3	0.345	0.886	2.6	12	7.74	0.65
OfficeComm-2	0.0058	0.024	4.1	10	3.13	0.31
Mobile-1	0.028	0.058	2.1	8	2.19	0.27
Mobile-2	0.020	0.075	3.8	8	6.33	0.79
LowDen-1	0.430	0.836	1.9	18	7.18	0.40
LowDen-2	0.052	0.167	3.2	10	4.14	0.41
LowDen-3	0.043	0.119	2.8	10	2.78	0.28
LowDen-4	0.179	0.334	1.9	16	5.61	0.35
LowDen-5	0.085	0.211	2.5	11.5	2.99	0.26
LowDen-6	0.084	0.188	2.2	12	5.74	0.48
LowDen-7	0.050	0.154	3.1	10	4.26	0.43
LowDen-8	0.117	0.306	2.6	n/a	n/a	n/a
LowDen-9	0.020	0.072	3.6	7.75	2.31	0.30
HiMedDen-1	0.057	0.156	2.8	10	3.22	0.32
HiDen-1	0.052	0.249	4.8	10.25	3.64	0.36
WWTP Influent	6.881	9.778	1.4	60	13.64	0.23

n/a = not applicable.

The following capacity analysis results are noted:

- **Peaking Factors:** Two sites had peaking factors over 5.0. Industrial-1 and Industrial-2 were the only sites with a peaking factor over 5.0.
- **d/D Ratio:** No sites surcharged during the study; only the Mobile-2 site had a d/D higher than 0.75

Flow per Sewer Account Analysis

The City provided V&A with basin maps that showed the amount of active sewer accounts per basin. V&A counted these individual accounts and compared these amounts against the average dry weather flows (ADWF). The basin maps provided to V&A are shown in Appendix B and the results of this comparison are shown in Table ES-3.

Table ES-3. Flow Per Sewer Account Summary

Monitored Site	ADWF (mgd)	# of Sewer Accounts	Flow per Account (gpd)
PlanDev-1	0.354	1084	327
PlanDev-2	0.284	1694	168
Industrial-1	0.158	5	31,600
Industrial-2	0.030	41	732
Industrial-3	0.345	12	28750
OfficeComm-2	0.0058	4	1450
Mobile-1	0.028	215	129
Mobile-2	0.020	155	127
LowDen-1	0.430	2641	163
LowDen-2	0.052	170	306
LowDen-3	0.043	267	161
LowDen-4	0.179	749	239
LowDen-5	0.085	342	249
LowDen-6	0.084	400	210
LowDen-7	0.050	254	197
LowDen-8	0.117	328	356
LowDen-9	0.020	149	134
HiMedDen-1	0.057	5	11,400
HiDen-1	0.052	87	598

The following sewer flow per account results are noted:

- **LowDen-2:** This basin has 2 multi-family developments that are not counted individually, skewing the flow/account number.
- **HiMedDen-1:** This basin has a large number of apartments and condominiums that are represented by only 5 accounts. If the actual number of dwellings were determined, a more accurate flow per account number could be calculated.

1 Introduction

1.1 Scope and Purpose

V&A Consulting Engineers (V&A) was retained by the City of Merced (City) to perform sanitary sewer flow monitoring within the City. Flow monitoring was performed for approximately one month from September 27, 2021 to November 1, 2021 at 18 flow monitoring sites and 3 pump station locations. The sites were spread throughout a variety of land uses. There were three general purposes for this study.

1. Establish the baseline sanitary sewer flows at the flow monitoring sites.
2. Measure the peak flow characteristics of the subject pipes during the monitoring period.
3. Establish flow rates for the various categories of land uses.

1.2 Flow Monitoring Sites

Flow monitoring sites are identified as the manholes where the flow monitors were secured and the pipelines in which the flow sensors were placed. Capacity analysis and flow rate information is presented on a site-by-site basis. The flow monitoring site locations were selected and approved by the City and VWHA. Information regarding the flow monitoring locations is listed in Table 1-1. Figure 1-1 illustrates the flow monitoring locations. Detailed descriptions of the individual flow monitoring sites, including photographs, are included in *Appendix A*.

Table 1-1. List of Flow Monitoring & Pump Station Sites

Monitoring Site	City Manhole	Monitored Pipe	Pipe Dia. (in)	Location
PlanDev-1	19M075	East Inlet	27	W. Yosemite Ave., east of San Augustine Ave.
PlanDev-2	Bellevue PS	Pump Station	n/a	Corner of W. Cardella Rd. & Bancroft Dr.
UC Merced	21M072	East Inlet	21	Bellevue Rd, west of Lake Rd.
Industrial-1	n/a	East Inlet	33	E. Gerard Ave, west of Campus Pkwy
Industrial-2	n/a	Pump Station	n/a	In field west of West Ave.
Industrial-3	6M375	West Inlet	12	Intersection of Hwy 59 and Willowbrook Dr.
OfficeComm-2	1M187	East Inlet	10	Intersection of Mercy Ave. and G St.
Mobile-1	6M382	North Inlet	8	W. N. Bear Creek Dr. west of Hwy 59
Mobile-2	11M280	East Inlet	8	Southern edge of Joe Herb Park, west of Parsons Ave.
LowDen-1	1M149	East Inlet	18	E. Yosemite Ave., east of G St.
LowDen-2	4M002	East Inlet	10	W. Yosemite Ave., west of San Jose Ave.
LowDen-3	5M145	Northeast Inlet	10	Intersection of Buena Vista Dr. & Terri Ct.
LowDen-4	7M134	Southeast Inlet	16	E. Santa Fe Ave. just west of Glen Ave.

LowDen-5	12M093	South Inlet	11.5	Intersection of W. Gerard Ave. and S. G St.
LowDen-6	8M158	Northeast Inlet	12	E. Main St. between Orchard Ln and Cedar Ave.
LowDen-7	3M116	East Inlet	10	Off G St. just north of Craig Dr.
LowDen-8	Sydney PS	Pump Station	n/a	Hwy 140, west of Sydney Ln.
LowDen-9	?	South Inlet	7.75	Intersection of Hwy 140 & Shirley St.
HiMedDen-1	6M307	West Inlet	10	Intersection of Willowbrook Dr. & Stonybrook Ave.
HiDen-1	9M018	Northeast Inlet	10.25	Intersection of Martin Luther King Jr. Way and alley between W. 18 th St. and W. Main St.
WWTP Influent	?	Northeast Inlet	60	Off dirt road just north of WWTP

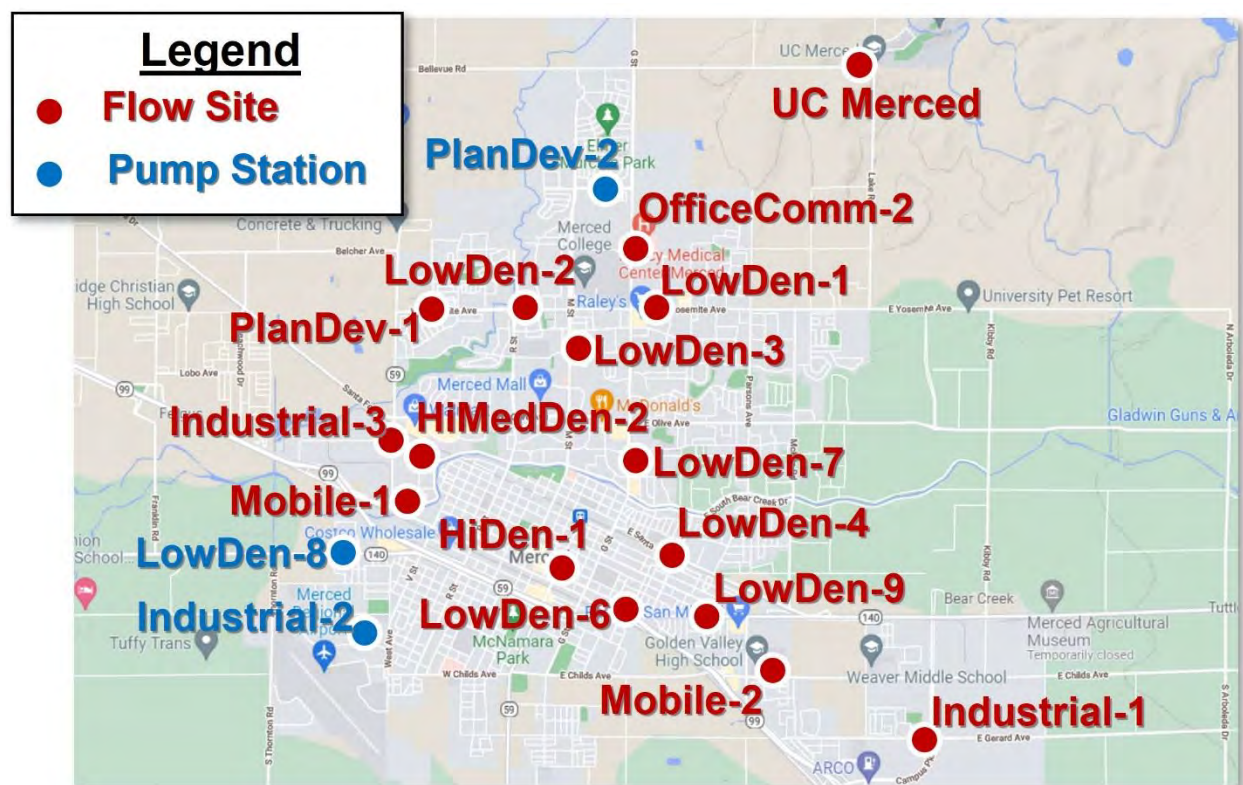


Figure 1-1. Map of Flow Monitoring Sites

1.3 Land Use Categories

This study's primary purpose was to study the flow rates for various land use types distributed throughout the City. These 'basins' were chosen in locations where the chosen land use was the primary land use and other land uses were minimal or non-existent. Figure 1-2 illustrates these basins and their locations throughout the City.

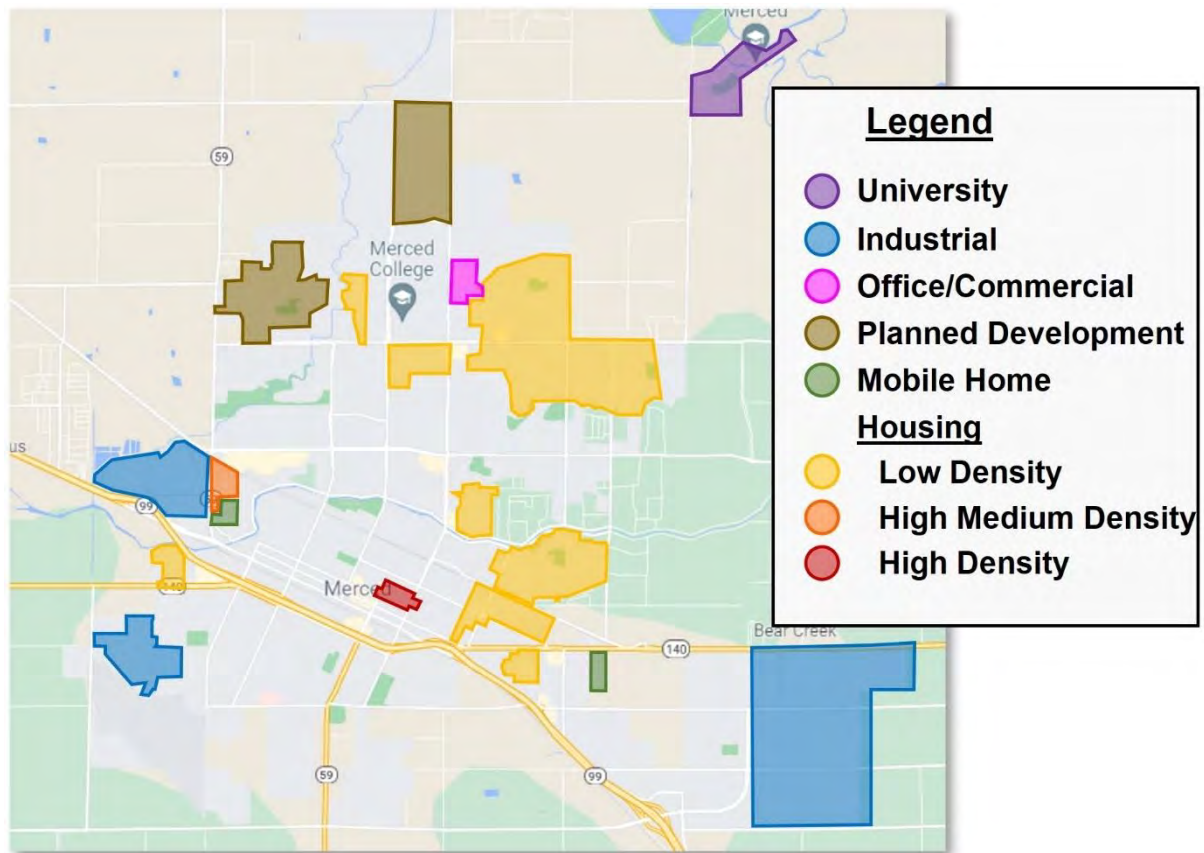


Figure 1-2. Map of Flow Monitoring Basins

2 Methods and Procedures

2.1 Confined Space Entry

A confined space (Photo 2-1) is defined as any space that is large enough and so configured that a person can bodily enter and perform assigned work, has limited or restricted means for entry or exit and is not designed for continuous employee occupancy. In general, the atmosphere must be constantly monitored for sufficient levels of oxygen (19.5% to 23.5%), and the presence of hydrogen sulfide (H₂S) gas, carbon monoxide (CO) gas, and lower explosive limit (LEL) levels. A typical confined space entry crew has members with OSHA-defined responsibilities of Entrant, Attendant, and Supervisor. The Entrant is the individual performing the work. He or she is equipped with the necessary personal protective equipment needed to perform the job safely, including a personal four-gas monitor (Photo 2-2). If it is not possible to maintain line-of-sight with the Entrant, then more Entrants are required until line-of-sight can be maintained. The Attendant is responsible for maintaining contact with the Entrants to monitor the atmosphere using another four-gas monitor and maintaining records of all Entrants if there is more than one. The Supervisor is responsible for developing the safe work plan for the job at hand prior to entering.



Photo 2-1. Confined Space Entry



Photo 2-2. Typical Personal Four-Gas Monitor

2.2 Flow Meter Installation

V&A installed eighteen (18) Teledyne ISCO 2150 flow meters for temporary monitoring within the collection system. Both types of meters use submerged sensors with a pressure transducer to collect depth readings and an ultrasonic Doppler sensor to determine the average fluid velocity. The ultrasonic sensor emits high-frequency sound waves, which are reflected by air bubbles and suspended particles in the flow. The sensor receives the reflected signal and determines the Doppler frequency shift, which indicates the estimated average flow velocity. The sensor is typically mounted at a manhole inlet to take advantage of smoother upstream flow conditions. The sensor may be offset to one side to lessen the chances of fouling and sedimentation where these problems are expected to occur. Manual level and velocity measurements were taken during the installation of the flow meters and again when they were removed and compared to simultaneous level and velocity readings from the flow meters to ensure proper calibration and accuracy. Figure 2-1 shows a typical installation for a flow meter with a submerged sensor.

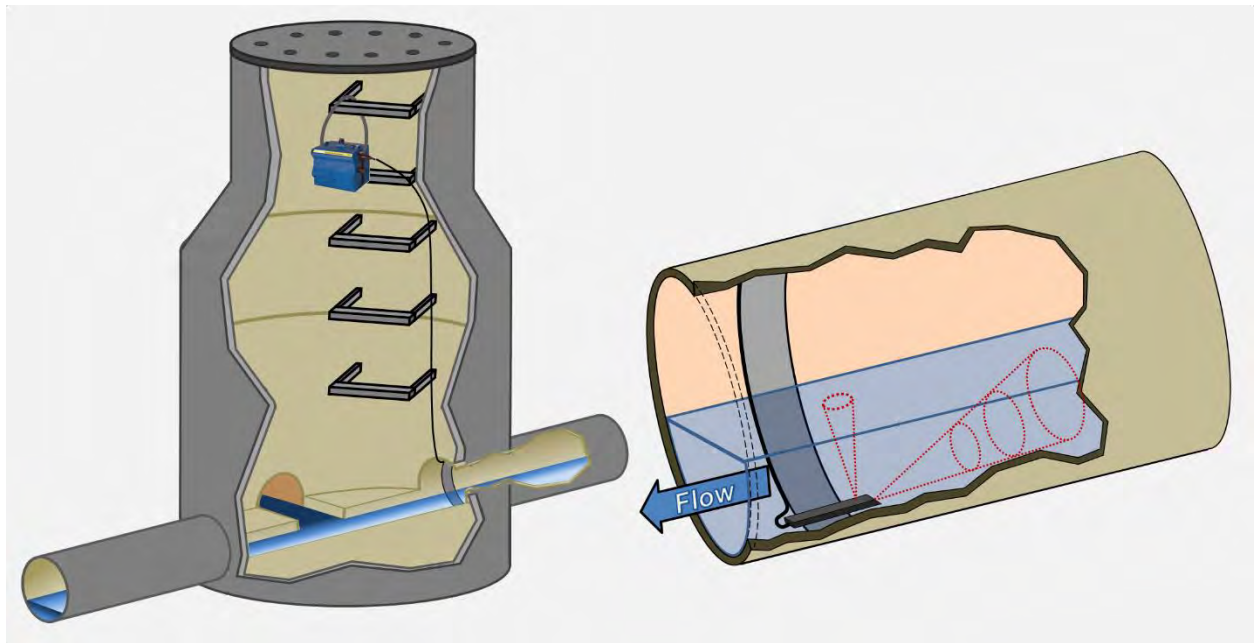


Figure 2-1. Typical Installation for ISCO 2150 Flow Meter with Submerged Sensor

2.2.1 Flow Calculation

Data retrieved from the flow meters were placed into a spreadsheet program for analysis. Data analysis includes data comparison to field calibration measurements, as well as necessary geometric adjustments as required for sediment (sediment reduces the pipe's wetted cross-sectional area available to carry flow). Area-velocity flow metering uses the continuity equation,

$$Q = v \cdot A = v \cdot (A_T - A_S)$$

where Q : volume flow rate

v : average velocity as determined by the ultrasonic sensor

A : cross-sectional area available to carry the flow

A_T : total cross-sectional area with both wastewater and sediment

A_S : cross-sectional area of sediment.

For circular pipe,

$$A_T = \left[\frac{D^2}{4} \cos^{-1} \left(1 - \frac{2d_w}{D} \right) \right] - \left[\left(\frac{D}{2} - d_w \right) \left(\frac{D}{2} \right) \sin \left(\cos^{-1} \left(1 - \frac{2d_w}{D} \right) \right) \right]$$

$$A_S = \left[\frac{D^2}{4} \cos^{-1} \left(1 - \frac{2d_s}{D} \right) \right] - \left[\left(\frac{D}{2} - d_s \right) \left(\frac{D}{2} \right) \sin \left(\cos^{-1} \left(1 - \frac{2d_s}{D} \right) \right) \right]$$

where d_w : distance between wastewater level and pipe invert

d_s : depth of sediment

D : pipe diameter

2.3 Volumetric Flow Monitoring at Pump Stations

State loggers and level loggers were also installed at the three pump stations to monitor the on/off state of the pumps and the flow level in the wet wells to calculate flow.

2.3.1 State Logger Installation

V&A installed state loggers on each pump at each pump stations. Hobo “On/Off” state data loggers (Figure 2-2) were installed on the electrical cables at the control panel for each pump. The state data loggers time stamp when the pumps turn on and off. Using the time elapsed during the wet well fill cycle when both pumps were off (not the pumping cycle) and knowing the volume of the wet well being filled, the influent flow rate is calculated. This flow rate is assigned a date/time at the midpoint of the fill cycle interval. The flow rate with date/time stamp is calculated for every fill cycle and plotted.



Figure 2-2. Hobo Motor On/Off State Logger

Note that state logger flow monitoring does not work for pump stations with variable frequency drives; it only works for pump stations using On/Off pump cycles, typically smaller pump stations. This application is a great substitute for the traditional open-channel flow metering methods which can become less accurate near pump stations and in smaller diameter pipelines and lower flow levels.

2.3.2 Pressure Logger Installation

V&A installed a pressure “level” logger within the pump station wet wells. The sensor was attached to extendable rods that was then deployed a certain depth in the wet well and secured to an anchorage point on the wet well wall. The logger was deployed a certain depth to ensure anchorage, being able to gather the full range of water levels and avoid sediment buildup. Manual level measurements were taken during the installation of the meters and again when they were removed and compared to simultaneous level readings from the meters to ensure proper calibration and accuracy.

The pressure sensor compensates for barometric pressure, temperature and water density, and converts the recorded pressure readings into water level. The sensor was connected by a cable to a top-end logger unit.

Similar to state logger flow monitoring, pressure logger flow monitoring does not work for pump stations with variable frequency drives and the flow rate is based on volumetric calculations. However, the pressure logger uses volume change per set time interval instead of time per fill cycle.

2.3.3 Volumetric Flow Calculation

This method is based on the principle that measuring the elapsed time to fill a measured volume will determine the flow rate. It can be thought of as filling up a graduated cylinder over and over again (Figure 2-3).

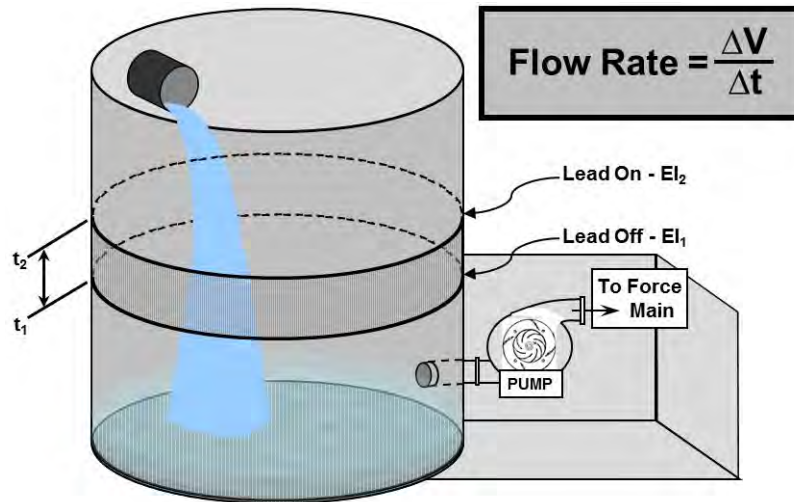


Figure 2-3. Volumetric Flow Monitoring Calculation

Volumetric flow measurement can be very accurate compared to other methods because there are no analog sensors that can “drift.”

2.4 Measurement Error and Uncertainty

For traditional engineering applications, measurement “error” is explained as a difference between a computed, estimated, or measured value and the generally accepted true or theoretically correct value. It can also be thought of as a difference between the desired and the actual performance of equipment. For equipment, error is usually expressed as a percentage relative to accuracy (i.e., “...the velocity sensor has an accuracy of $\pm 2\%$ of the reading...”).

However, for this study and flow monitoring applications, the cause of the measurement difference is important, and a distinction will be made between the equipment not performing to industry standards (“error”) and expected inaccuracies (“uncertainty”) associated with monitoring technology limitations.

Gauging “error” occurs when the equipment is not performing to industry standards. This can occur as a result of the following common categories of conditions that can be encountered at a wastewater monitoring site.

- Malfunctioning equipment (i.e. a sensor is damaged, battery life ends, or a desiccant canister becomes saturated)
- Improper equipment choice or maintenance (i.e. the selected gauging equipment technologies are incompatible with hydraulic conditions within the sewer, or excessive gravel deposits are allowed to accumulate around the sensors without being removed)
- Improper equipment calibration (i.e. depth and/or velocity measurements are incorrectly taken within the sewer, or equipment is allowed to drift out of calibration)
- Field conditions within the sewer, (i.e. foaming at the water surface that “blinds” an ultrasonic depth sensor, or toilet paper catching and accumulating on a combination sensor, blinding the acoustic Doppler velocity meter)

For flow monitoring applications, gauging “uncertainty” is used to describe and quantify the expected inaccuracies that result from the limitations of the technologies that utilize indirect measurements to quantify wastewater flow.

It is important to try and install flow meters in “ideal” flow conditions. Ideal flow conditions are generally defined by as laminar flow in a straight-through, constant-slope pipeline with no disturbances (elbows, tees, hydraulic shifts, etc.) 10 diameters upstream and 5 diameters downstream from the flow monitoring location. If ideal flow conditions are met, then an expected uncertainty of final flow calculation from an open-channel flow meter may be approximately $\pm 5\%$. For many situations, ideal flow conditions cannot be met, and uncertainties increase.

2.4.1 Flow Addition versus Flow Subtraction

Due to the uncertainties involved in subtracting flows of similar magnitudes, the addition of flows at multiple monitoring sites is usually preferred over subtraction of flows. Subtraction becomes an issue especially when the flow difference from the subtraction falls within the measurement uncertainty range of the two larger flow data sets (i.e. subtracting a large flow from another large flow to obtain a small difference).

This concept is best demonstrated per the following example:

1. Meter A measures 2.00 MGD of flow and has an expected uncertainty of $\pm 5\%$, thus the uncertainty range of the flow measurement is ± 0.10 MGD.
2. Meter B measures 2.50 MGD of flow and has an expected uncertainty of $\pm 6\%$, thus the uncertainty range of the flow measurement is ± 0.15 MGD.

3. Meter C measures 0.50 MGD of flow and has an expected uncertainty of $\pm 8\%$, thus the uncertainty range of the flow measurement is ± 0.04 MGD.

▪ **Scenario 1 – Flow Addition**

- Meter A + Meter B = 2.00 MGD (± 0.10) + 2.50 MGD (± 0.15) = 4.50 MGD (± 0.25)
- Overall uncertainty = $\pm 0.25 / 4.50 = \pm 5.6\%$
- For flow addition, the final uncertainty is essentially a weighted average of the component uncertainties.

▪ **Scenario 2 – Flow Subtraction, Large Flow less Small Flow**

- Meter B - Meter C = 2.50 MGD (± 0.15) - 0.50 MGD (± 0.04) = 2.00 MGD (± 0.19)
- Overall uncertainty = $\pm 0.19 / 2.00 = \pm 9.5\%$
- For flow subtraction, the final uncertainty will always be greater than the component uncertainties.
- When subtracting a small flow from a large flow, the resulting uncertainties can still be manageable.

▪ **Scenario 3 – Flow Subtraction, Large Flow less a similarly Large Flow**

- Meter B - Meter A = 2.50 MGD (± 0.15) - 2.00 MGD (± 0.10) = 0.50 MGD (± 0.25)
- Overall uncertainty = $\pm 0.25 / 0.50 = \pm 50\%$
- When subtracting a similarly sized flow rates, the resulting uncertainties may not be manageable. In this example, an uncertainty of $\pm 50\%$ may be considered unacceptable for confident analyses.

Scenario 3 is a very “real-world” situation. The uncertainties for Meter A and Meter B are extremely reasonable (indeed, most flow monitoring service providers would be extremely pleased with true meter uncertainties of $\pm 5\%$ to $\pm 6\%$). However, the reality of the math is clear, and the above example demonstrates the concept of flow subtraction and compounding or inflating uncertainty ranges.

The following points are emphasized in relation to the items of this section:

- For subtraction of flows, the overall uncertainty can be an inflated value that far exceeds the component uncertainties.
- The smaller the resultant flow from the subtraction equation, the larger the percentage uncertainty.
- Whenever possible, basins flows should be directly measured, rather than calculated as a subtraction of two or more flow meters.
- If flow subtraction cannot be avoided, it is better to have the magnitudes of the component flows be as dissimilar as possible.

2.5 Average Dry Weather Flow Determination

For this study, four distinct average dry weather flow curves were established for each site location:

- Mondays – Thursdays
- Fridays
- Saturdays
- Sundays

Flows for many sites differ on Friday evenings compared to Mondays through Thursdays. Starting around 7 pm, the flows are often decreased (compared to Monday through Thursday). Similarly, flow patterns for Saturday and Sunday were also separated due to their unique evening flow pattern. This type of differentiation can be important when determining I/I response, especially if a rain event occurs on a Friday, Saturday, or Sunday evening.

Figure 2-4 illustrates a sample of varying flow patterns within a typical dry week.

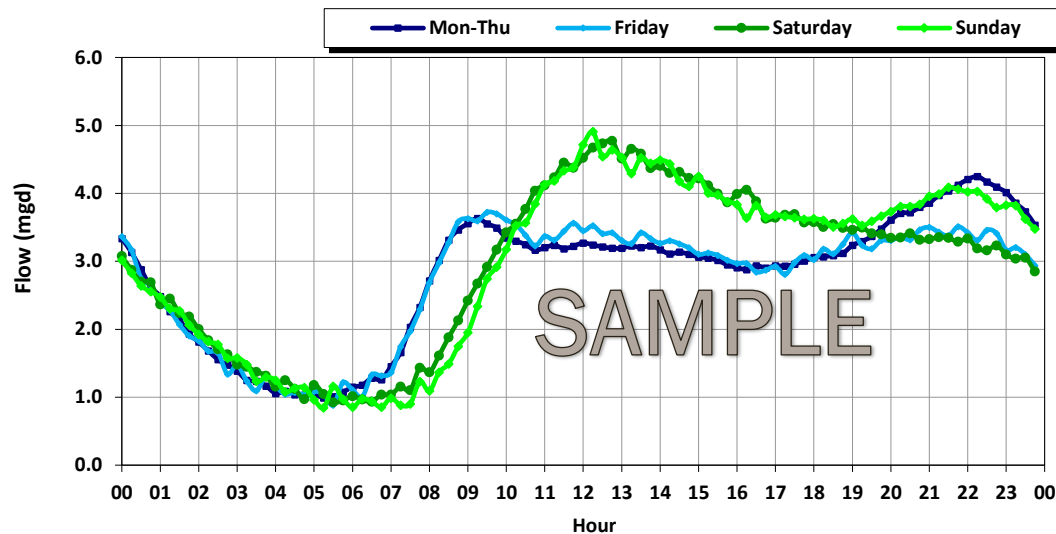


Figure 2-4. Sample ADWF Diurnal Flow Patterns

ADWF curves are taken from “Dry Days” when RDI had the least impact on the baseline flow. The overall average dry weather flow (ADWF) was calculated per the following equation:

$$ADWF = \left(ADWF_{Mon-Thu} \times \frac{4}{7} \right) + \left(ADWF_{Fri} \times \frac{1}{7} \right) + \left(ADWF_{Sat} \times \frac{1}{7} \right) + \left(ADWF_{Sun} \times \frac{1}{7} \right),$$

2.6 Flow Attenuation

Flow attenuation in a sewer collection system is the natural process of the reduction of the peak flow rate through redistribution of the same volume of flow over a longer period of time. This occurs as a result of friction (resistance), internal storage and diffusion along the sewer pipes. Fluids are constantly working towards equilibrium. For example, a volume of fluid poured into a static vessel with no outside turbulence will eventually stabilize to a static state, with a smooth fluid surface without peaks and valleys. Attenuation within a sanitary sewer collection system is based upon this concept. A flow profile with a strong peak will tend to stabilize towards equilibrium, as shown in Figure 2-5.

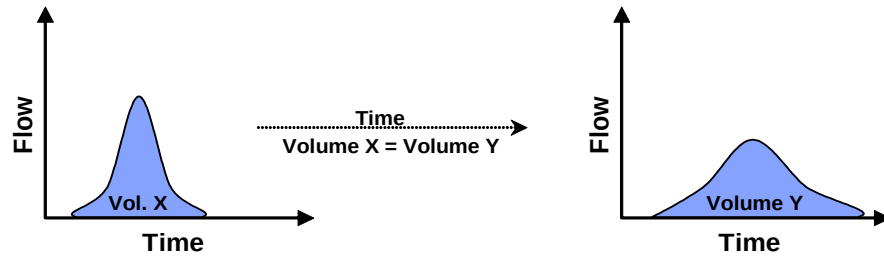


Figure 2-5. Attenuation Illustration

Within a sanitary sewer collection system, each individual basin will have a specific flow profile. As the flows from the basins combine within the trunk sewer lines, the peaks from each basin will (a) not necessarily coincide at the same time, and (b) due to the length and time of travel through the trunk sewers, peak flows will attenuate prior to reaching the treatment facility. The sum of the peak flows of the individual basins within a collection system will usually be greater than the peak flows observed at the treatment facility.

3 Results and Analysis

3.1 Flow Monitoring Data

3.1.1 Rainfall Analysis

Rainfall analysis was not part of the scope of this project. However, on October 25, 2019, a fairly large rainfall event impacted Northern California. The City saw a good amount of rain during this event. V&A collected and analyzed rainfall data from a total of 10 publicly available private weather stations (PWS) on Weather Underground², and chose 7 for solid coverage over the collection system. Figure 3-1 illustrates the locations of the 7 rain gauges.

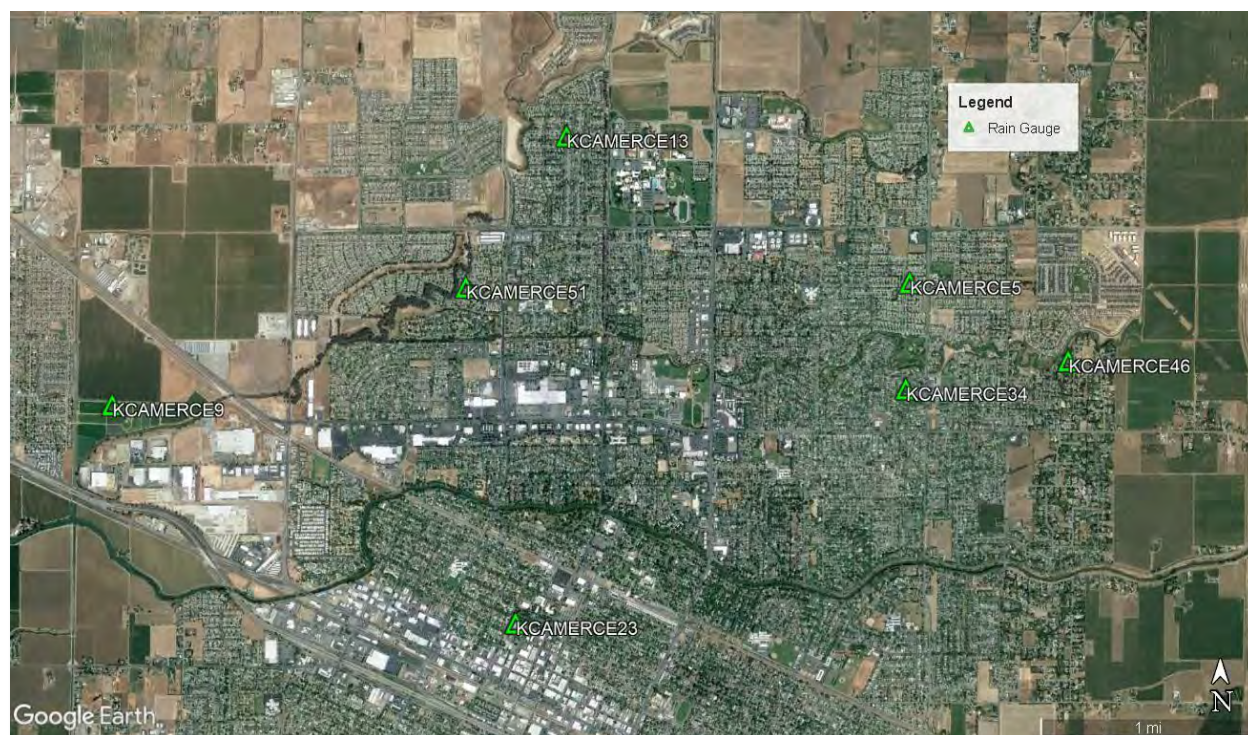


Figure 3-1. Location of Rain Gauges

There was one primary rainfall event during the flow monitoring period as summarized in

Table 3-1, which shows the precipitation of the rainfall event for each rain gauge. It is important to classify the relative size of a major storm event that occurs over the course of a flow monitoring period³.

² Weather Underground (wunderground.com) collects data from 180,000+ weather stations across the country, including Automated Surface Observation System (ASOS) at airports, personal weather stations (PWS), and Meteorological Assimilation Data Ingest System (MADIS) managed by the National Oceanic and Atmospheric Administration (NOAA). While V&A has no direct control over the rain gauges, V&A performs additional QA/QC on the data to ensure its suitability for use.

³ Sanitary sewers are often designed to withstand I/I contribution to sanitary flows for specific-sized “design” storm events.

Rainfall events are classified by intensity and duration. The October 25, 2021 rainfall event at the KCAMERCE46 rain gauge was classified as a 25-year, 6 hour event in peak intensity (Figure 3-2).

Table 3-1. Summary of Rainfall Data

Rain Gauge	Rain Event 1: October 25, 2021	Monitoring Period Total
KCAMERCE23	1.35	1.54
KCAMERCE13	2.02	2.22
KCAMERCE9	1.70	1.90
KCAMERCE51	1.55	1.65
KCAMERCE5	1.76	1.99
KCAMERCE34	1.44	1.79
KCAMERCE46	1.74	2.00

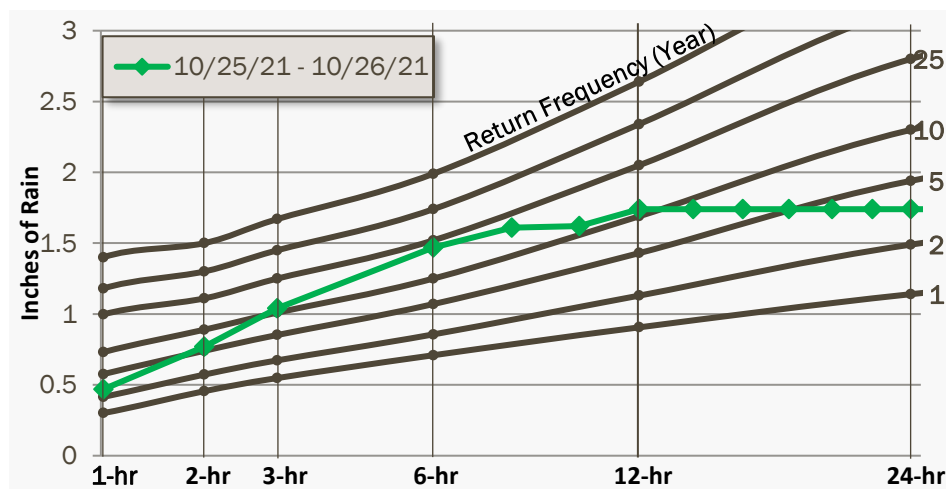


Figure 3-2. Rainfall Event Classification – 24-Hour Period (KCAMERCE46 RG)

3.1.2 Inflow/Infiltration Observations

In observing and analyzing the flow data, V&A observed several sites had some small reactions to the rainfall. Given the short duration and fairly high intensity of the rainfall event, a reaction consistent with inflow is more likely, as opposed to a response associated with infiltration. This type of reaction might be observed after several rainfall events in succession and the ground becomes saturated.

Figure 3-3 shows the reaction of LowDen-6 to the rainfall event.

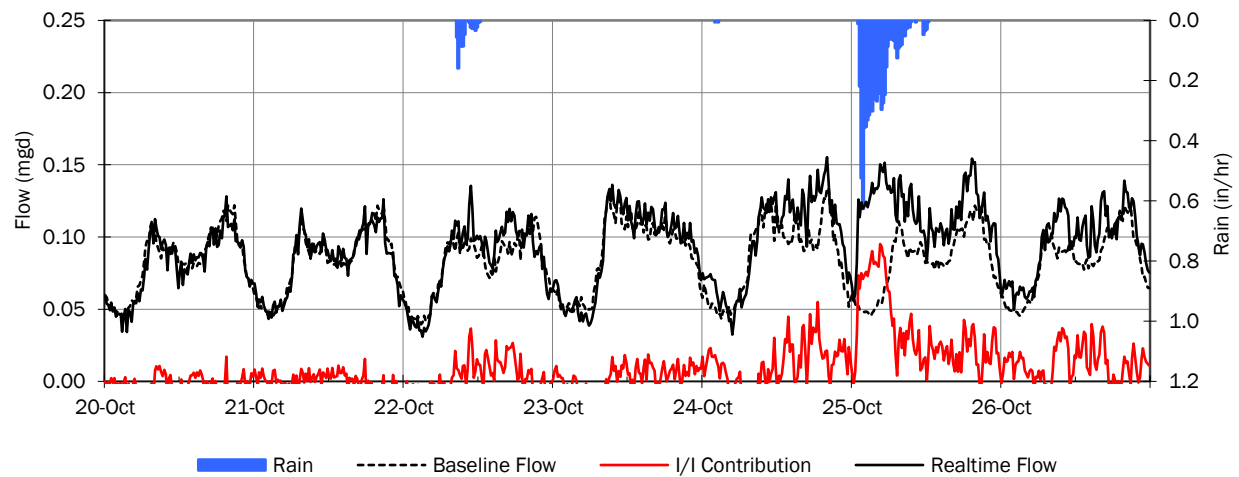


Figure 3-3. LowDen-6 – Reaction to October 25, 2021 rainfall event.

3.2 Average Flow Analysis

Average dry weather flow (ADWF) curves were established during dry days when I/I had the least impact on the baseline flow. Table 3-2 summarizes the dry weather flow data measured for this study. ADWF curves for each site can be found in *Appendix A*.

Table 3-2. Dry Weather Flow

Monitored Site	Sediment (in.)	Mon-Thu ADWF (MGD)	Friday ADWF (MGD)	Saturday ADWF (MGD)	Sunday ADWF (MGD)	Overall ADWF (MGD)
PlanDev-1	-	0.345	0.332	0.368	0.400	0.354
PlanDev-2	-	0.280	0.272	0.291	0.308	0.284
UC Merced	-	0.123	0.122	0.087	0.101	0.115
Industrial-1	1.0	0.152	0.127	0.187	0.184	0.158
Industrial-2	-	0.039	0.035	0.016	0.007	0.030
Industrial-3	-	0.382	0.328	0.310	0.252	0.345
OfficeComm-2	-	0.382	0.328	0.310	0.252	0.0058
Mobile-1	-	0.028	0.026	0.028	0.029	0.028
Mobile-2	-	0.019	0.021	0.021	0.022	0.020
LowDen-1	-	0.430	0.406	0.427	0.457	0.430
LowDen-2	-	0.051	0.050	0.054	0.058	0.052
LowDen-3	-	0.043	0.040	0.043	0.045	0.043
LowDen-4	-	0.179	0.173	0.176	0.188	0.179
LowDen-5	-	0.085	0.076	0.087	0.095	0.085
LowDen-6	0.5	0.083	0.081	0.089	0.087	0.084
LowDen-7	-	0.050	0.046	0.049	0.054	0.050
LowDen-8	-	0.112	0.107	0.130	0.132	0.117
LowDen-9	-	0.020	0.019	0.019	0.022	0.020
HiMedDen-1	-	0.058	0.054	0.056	0.056	0.057
HiDen-1	-	0.050	0.055	0.050	0.057	0.052
WWTP Influent	-	6.843	6.799	6.987	7.004	6.881

The following ADWF analysis results are noted:

- The Industrial-1 and LowDen-6 sites had 0.5 to 1-inches of sediment measured during visits.

3.3 Flow Monitoring: Peak Measured Flows / Pipeline Capacity

Peak measured flows and the hydraulic grade line data (flow depths) are important to understanding the capacity limitations. The capacity analysis terms used in the text below are defined as follows:

- Peaking Factor:** Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors, including size and topography of the tributary area, flow attenuation, flow restrictions, and characteristics of I/I entering the collection system. Municipal standards for peaking factor vary agency by agency; the District should refer to jurisdictional standards when evaluating peaking factors⁴. For this study, peaking factors over 5.0 are highlighted **YELLOW** and over 10 are highlighted in **RED**.
- d/D Ratio:** The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). The d/D ratio for each site was computed based on the maximum depth of flow for the study. Standards for d/D ratio vary from agency to agency, but typically range between $d/D \leq 0.5$ and $d/D \leq 0.75$. The District should refer to jurisdictional standards when evaluating d/D ratios. For this study, d/D ratios over 0.75 are highlighted **YELLOW**. Surcharged sites are highlighted **RED**.

Table 3-3 summarizes the peak flows, levels, d/D ratios, and peaking factors during the flow monitoring period. Capacity analysis data are presented on a site-by-site basis and represents the hydraulic conditions only at the site nodes; hydraulic conditions in other areas of the collection system will differ.

Table 3-3. Capacity Analysis Summary

Monitored Site	ADWF (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Pipe Diameter, D (in)	Max Depth, d (in)	Max d/D Ratio
PlanDev-1	0.354	0.688	1.9	27	6.5	0.24
PlanDev-2	0.284	0.541	1.9	n/a	n/a	n/a
UC Merced	0.115	0.561	4.9	21	4.47	0.21
Industrial-1	0.158	1.388	8.8	33	4.95	0.15
Industrial-2	0.030	0.163	5.3	n/a	n/a	n/a
Industrial-3	0.345	0.886	2.6	12	7.74	0.65
OfficeComm-2	0.0058	0.024	4.1	10	3.13	0.31
Mobile-1	0.028	0.058	2.1	8	2.19	0.27
Mobile-2	0.020	0.075	3.8	8	6.33	0.79
LowDen-1	0.430	0.836	1.9	18	7.18	0.40
LowDen-2	0.052	0.167	3.2	10	4.14	0.41
LowDen-3	0.043	0.119	2.8	10	2.78	0.28
LowDen-4	0.179	0.334	1.9	16	5.61	0.35

⁴ WEF Manual of Practice FD-6 and ASCE Manual No. 62 suggests typical peaking factor ratios range between 3 and 4, with higher values possibly indicative of pronounced I/I flows.

LowDen-5	0.085	0.211	2.5	11.5	2.99	0.26
LowDen-6	0.084	0.188	2.2	12	5.74	0.48
LowDen-7	0.050	0.154	3.1	10	4.26	0.43
LowDen-8	0.117	0.306	2.6	n/a	n/a	n/a
LowDen-9	0.020	0.072	3.6	7.75	2.31	0.30
HiMedDen-1	0.057	0.156	2.8	10	3.22	0.32
HiDen-1	0.052	0.249	4.8	10.25	3.64	0.36
WWTP Influent	6.881	9.778	1.4	60	13.64	0.23

n/a = not applicable.

The following capacity analysis results are noted:

- **Peaking Factors:** Two sites had peaking factors over 5.0. Industrial-1 and Industrial-2 were the only sites with a peaking factor over 5.0.
- **d/D Ratio:** No sites surcharged during the study; only the Mobile-2 site had a d/D higher than 0.75

Figure 3-4 and Figure 3-5 show bar graph summaries of the peaking factors and d/D ratios, respectively.

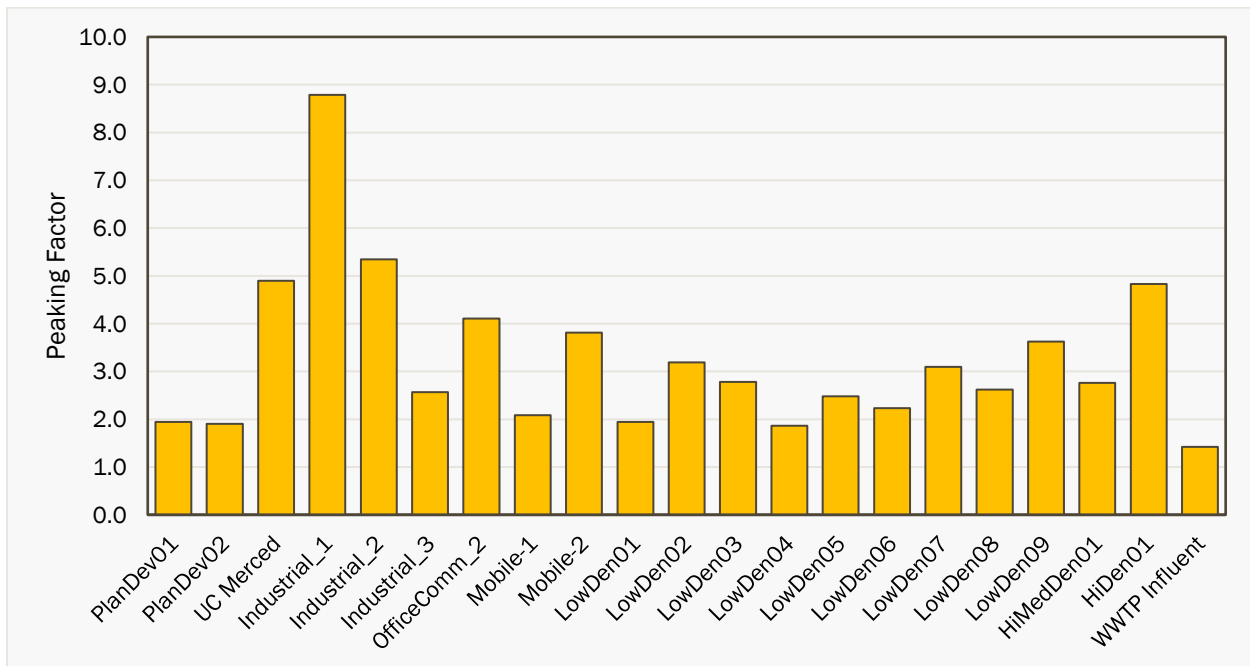


Figure 3-4. Peaking Factors

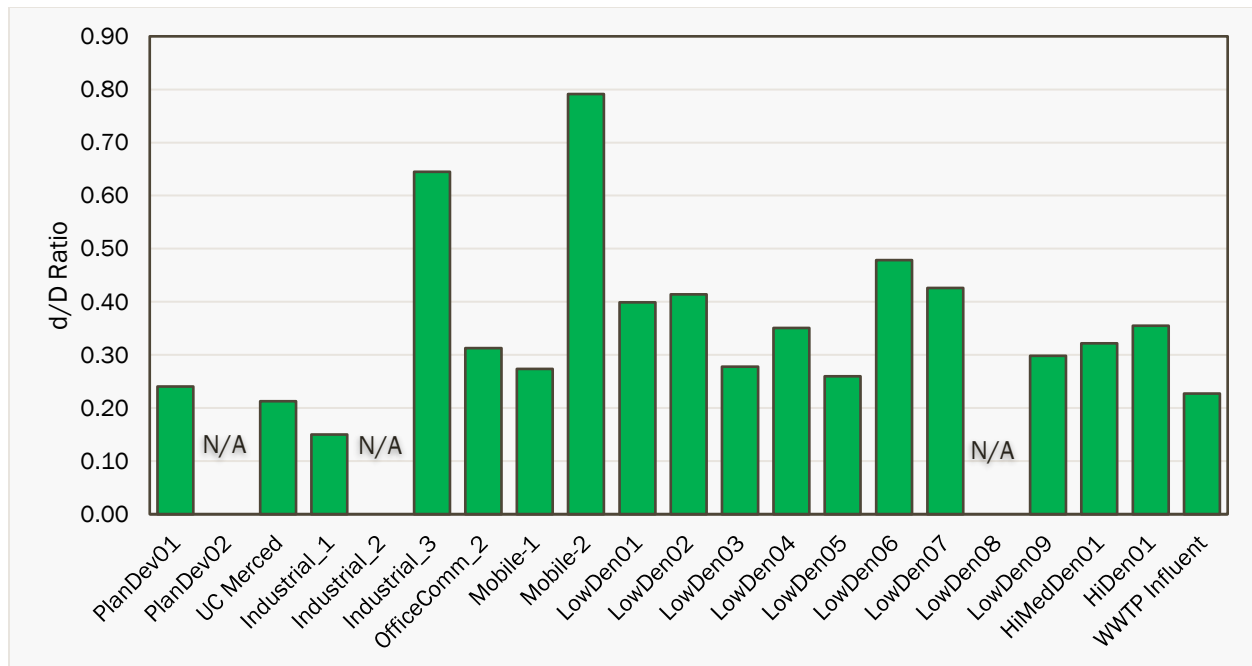


Figure 3-5. Capacity Summary: Max d/D Ratios

3.4 Flow Monitoring: Flow per Sewer Account

The City provided V&A with basin maps that showed the amount of active sewer accounts per basin. V&A counted these individual accounts and compared these amounts against the average dry weather flows (ADWF). The basin maps provided to V&A are shown in Appendix B and the results of this comparison are shown in Table 3-4.

Table 3-4. Flow per Sewer Account Summary

Monitored Site	ADWF (mgd)	# of Sewer Accounts	Flow per Account (gpd)
PlanDev-1	0.354	1084	327
PlanDev-2	0.284	1694	168
Industrial-1	0.158	5	31,600
Industrial-2	0.030	41	732
Industrial-3	0.345	12	28750
OfficeComm-2	0.0058	4	1450
Mobile-1	0.028	215	129
Mobile-2	0.020	155	127
LowDen-1	0.430	2641	163
LowDen-2	0.052	170	306
LowDen-3	0.043	267	161
LowDen-4	0.179	749	239
LowDen-5	0.085	342	249
LowDen-6	0.084	400	210
LowDen-7	0.050	254	197
LowDen-8	0.117	328	356
LowDen-9	0.020	149	134
HiMedDen-1	0.057	5	11,400
HiDen-1	0.052	87	598

The following sewer flow per account results are noted:

- **LowDen-2:** This basin has 2 multi-family developments that are not counted individually, skewing the flow/account number.
- **HiMedDen-1:** This basin has a large number of apartments and condominiums that are represented by only 5 accounts. If the actual number of dwellings were determined, a more accurate flow per account number could be calculated.

Appendix A

Flow Monitoring Sites: Data, Graphs, and Information

PLANNED DEVELOPMENT-1

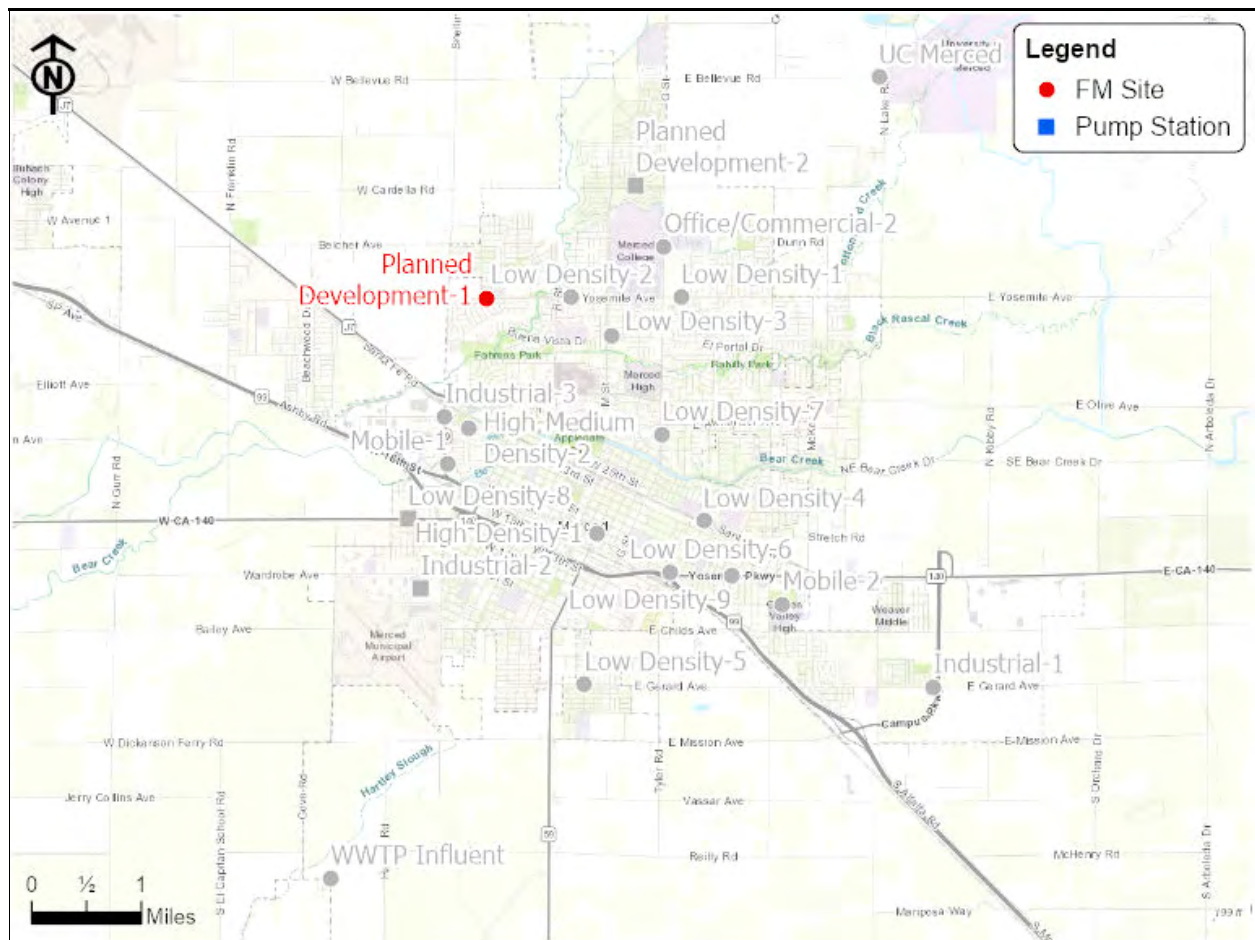
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: W Yosemite Avenue east of San Augustine Avenue

Data Summary Report



Vicinity Map: Planned Development-1

PLANNED DEVELOPMENT-1

Site Information

Location: W Yosemite Avenue east of San Augustine Avenue

Coordinates: 120.4983° W, 37.3320° N

Rim Elevation (Earth): 166 feet

Measured Pipe Diameter: 27 inches

ADWF: 0.354 mgd

Peak Measured Flow: 0.688 mgd

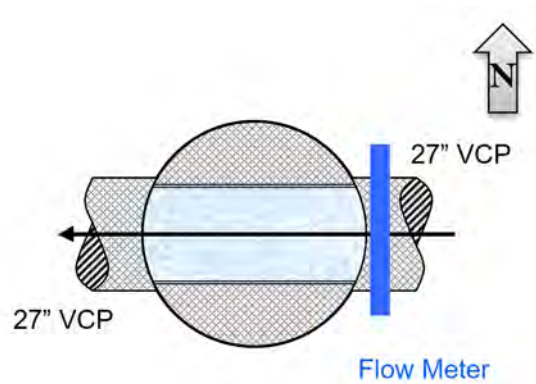
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



Street View



Plan View

PLANNED DEVELOPMENT-1

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

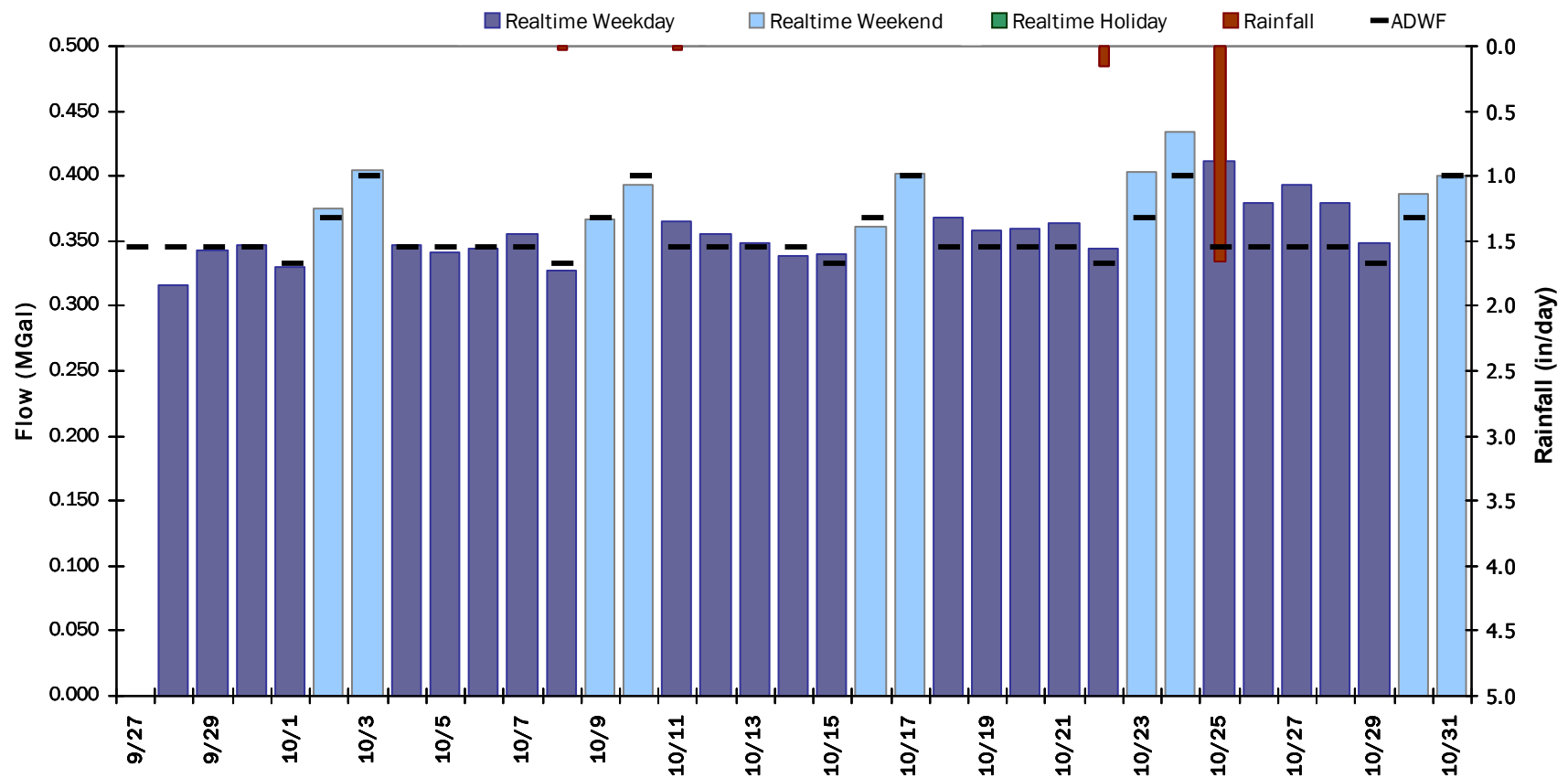


PLANNED DEVELOPMENT-1

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.365 MGal Peak Daily Flow: 0.434 MGal Min Daily Flow: 0.316 MGal

Total Rainfall: 1.87 inches



PLANNED DEVELOPMENT-1

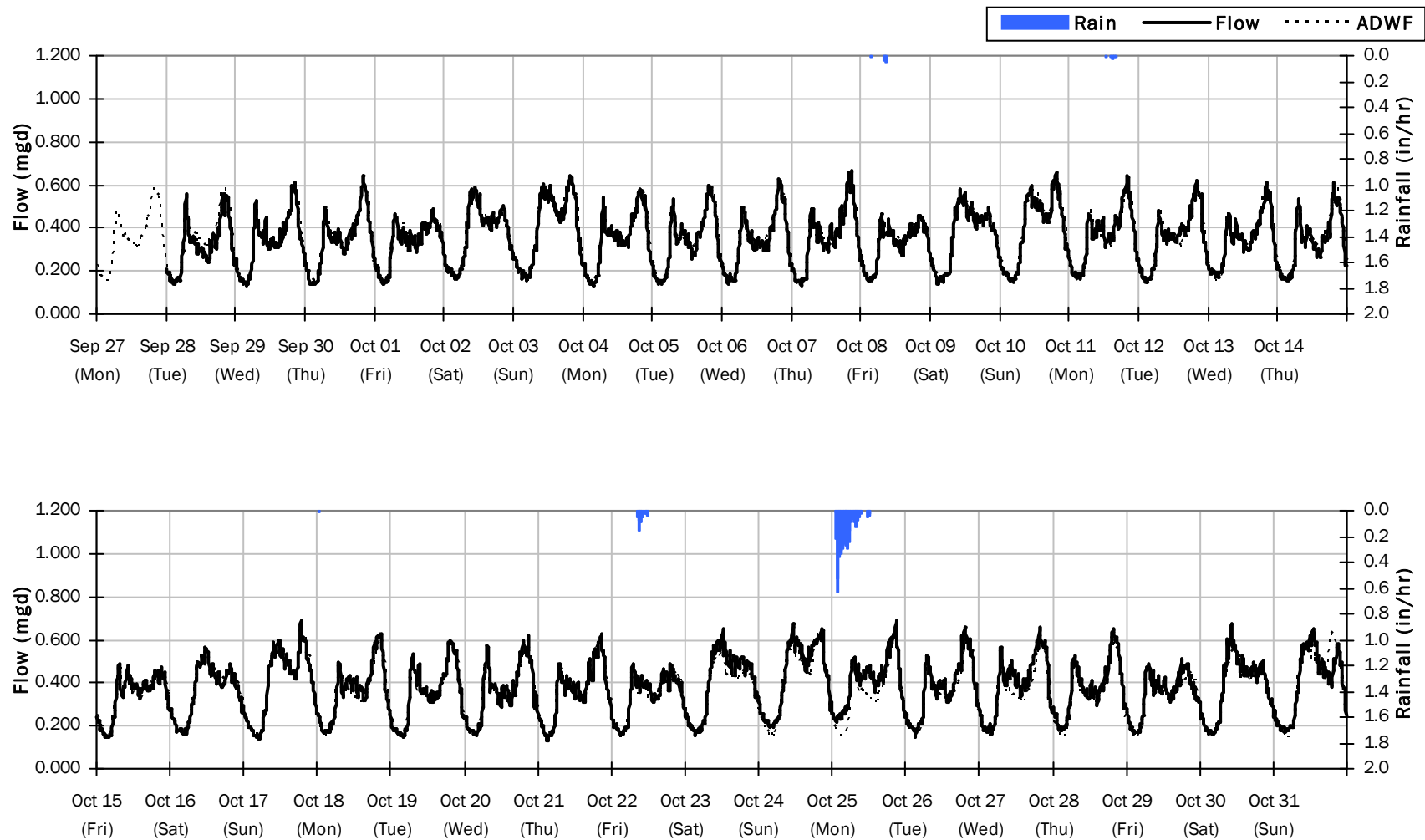
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.365 mgd

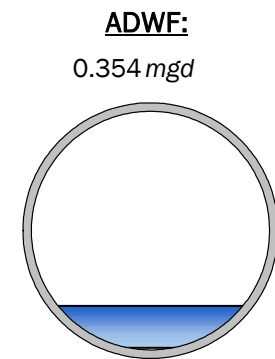
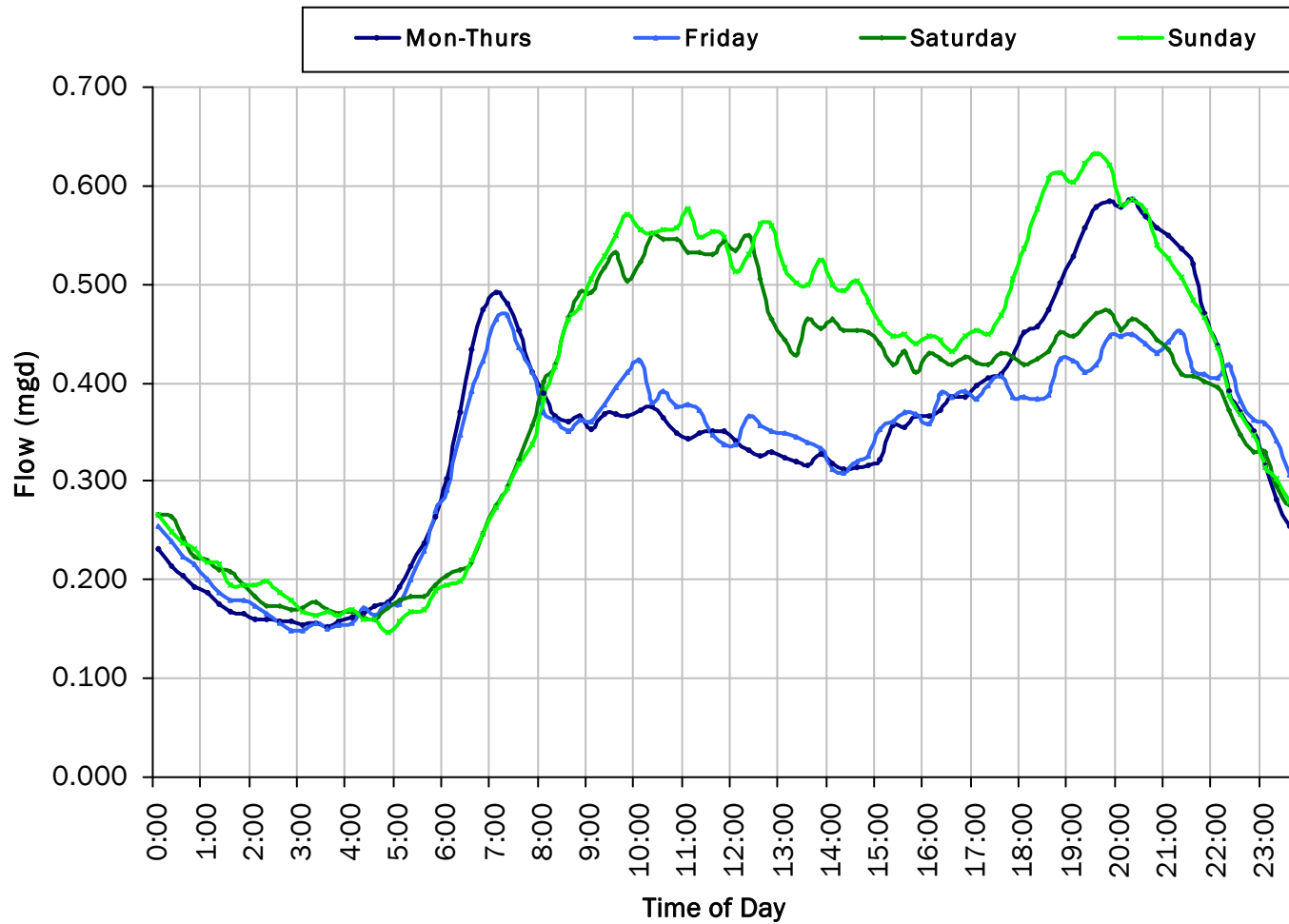
Period Peak Flow: 0.688 mgd

Period Min Flow: 0.131 mgd



PLANNED DEVELOPMENT-1

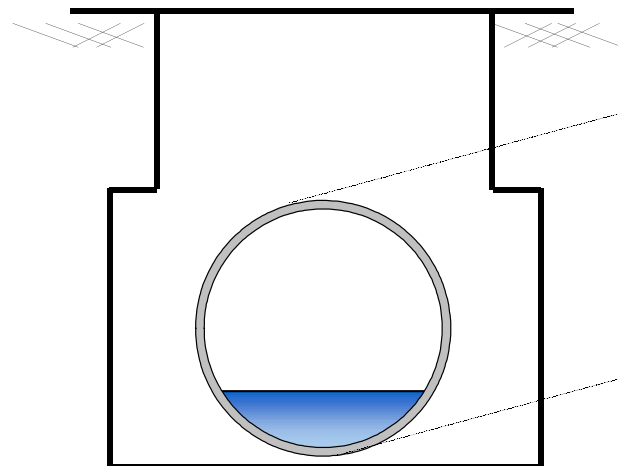
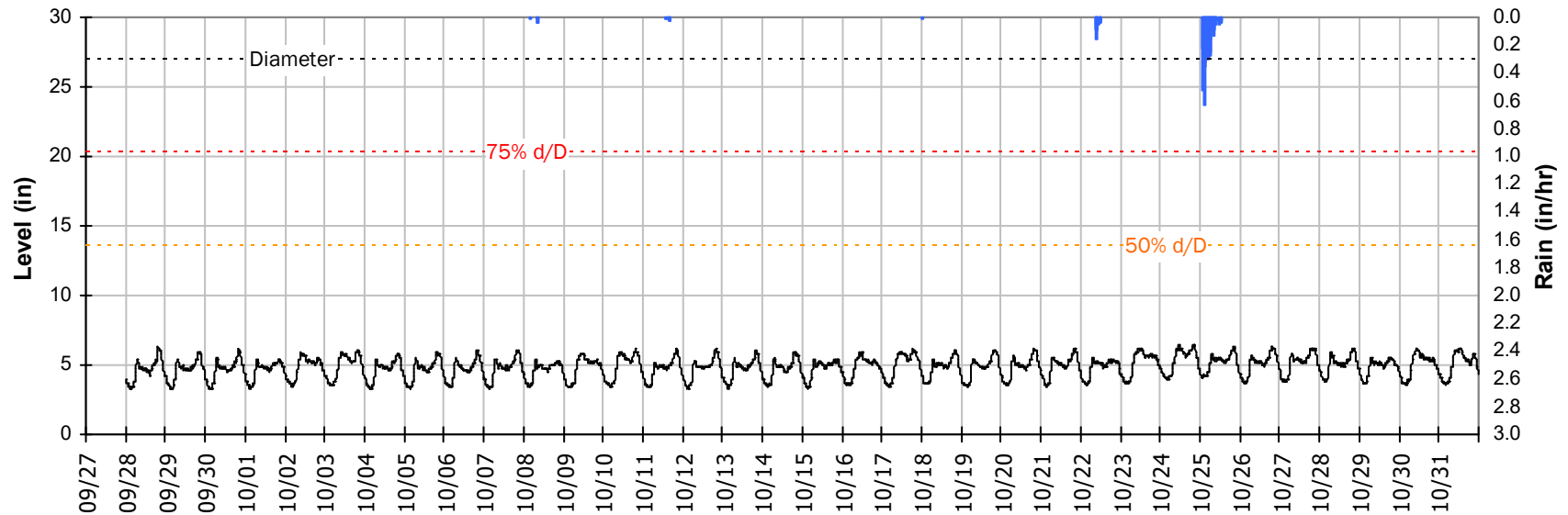
Average Dry Weather Flow Hydrographs



PLANNED DEVELOPMENT-1

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

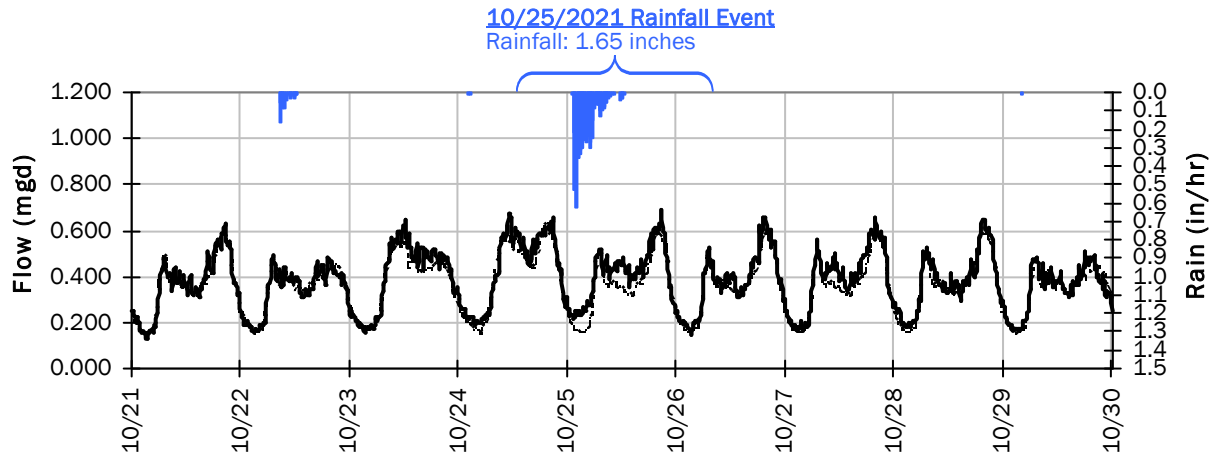


Pipe Diameter: 27 inches
Peak Measured Level: 6.5 inches
Peak d/D Ratio: 0.24

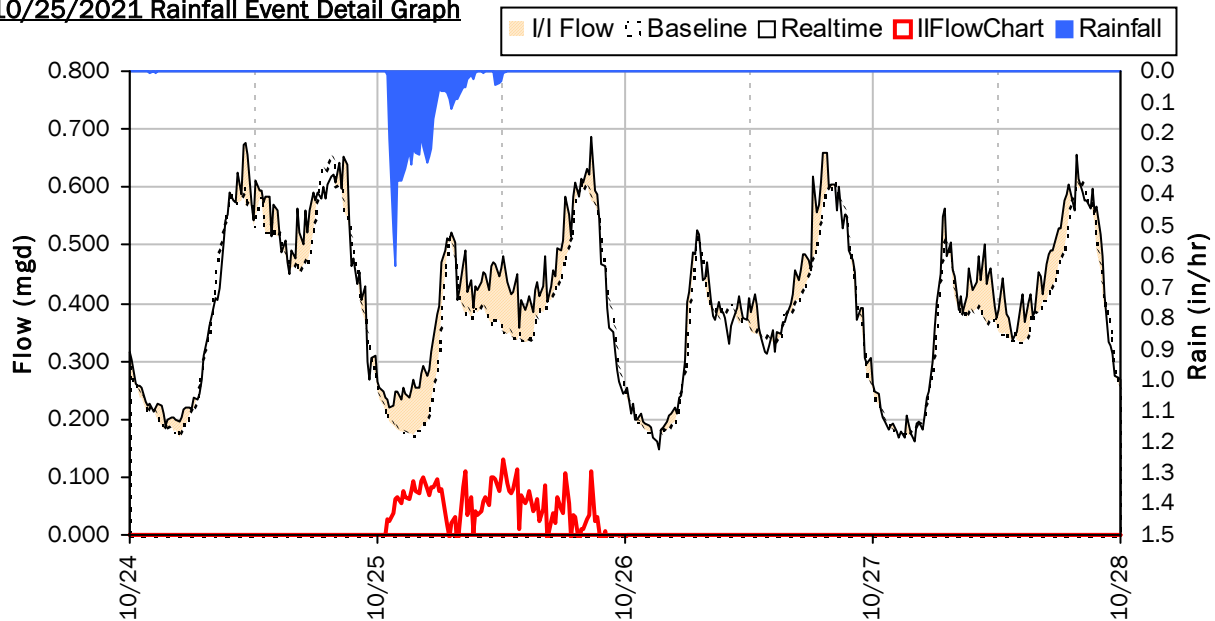
PLANNED DEVELOPMENT-1

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.687 mgd
PF: 1.94
Peak Level: 6.31 in
d/D Ratio: 0.23

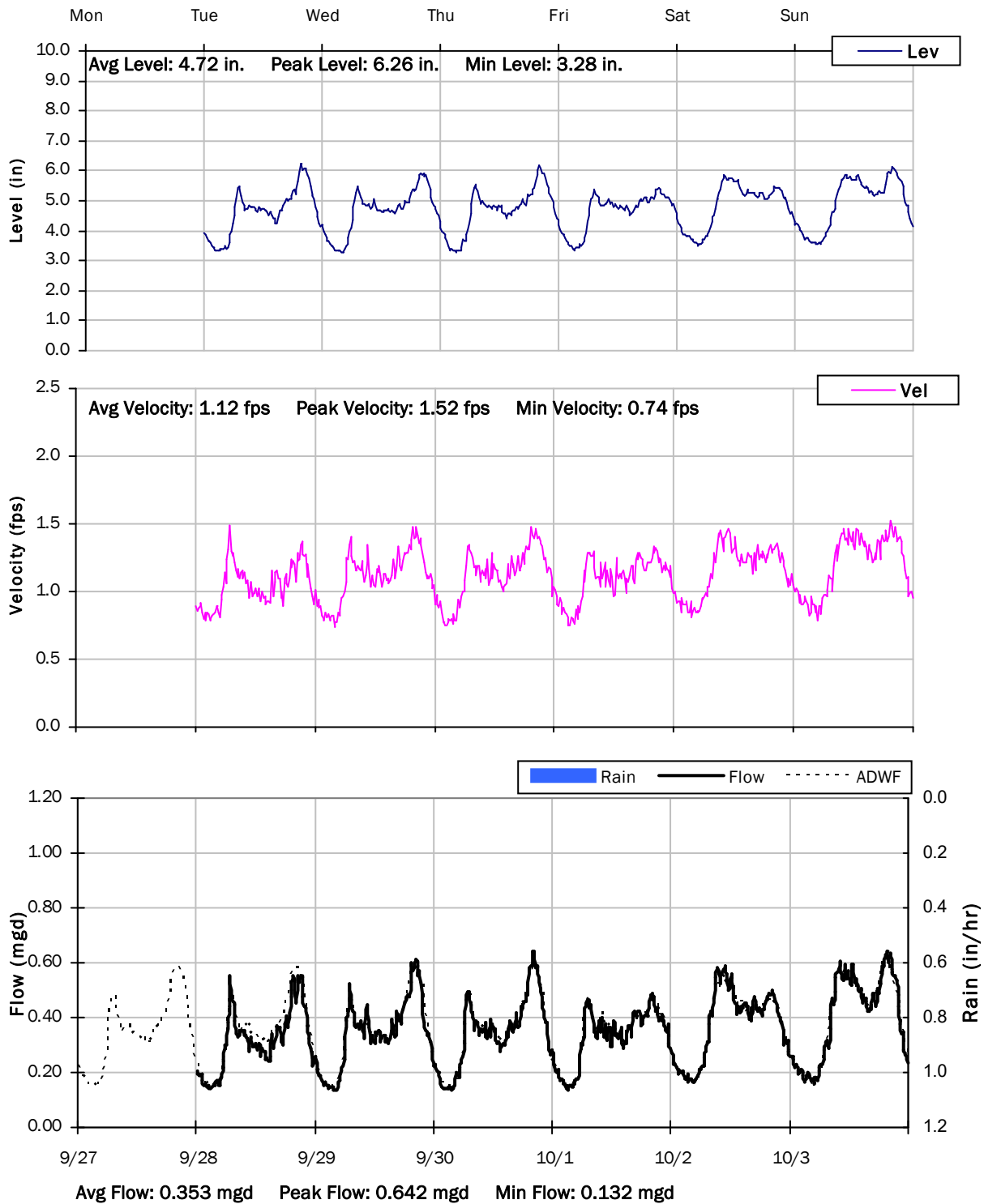
Inflow / Infiltration

Peak I/I Rate: 0.129 mgd
Total I/I: 45,000 gallons

PLANNED DEVELOPMENT-1

Weekly Level, Velocity and Flow Hydrographs

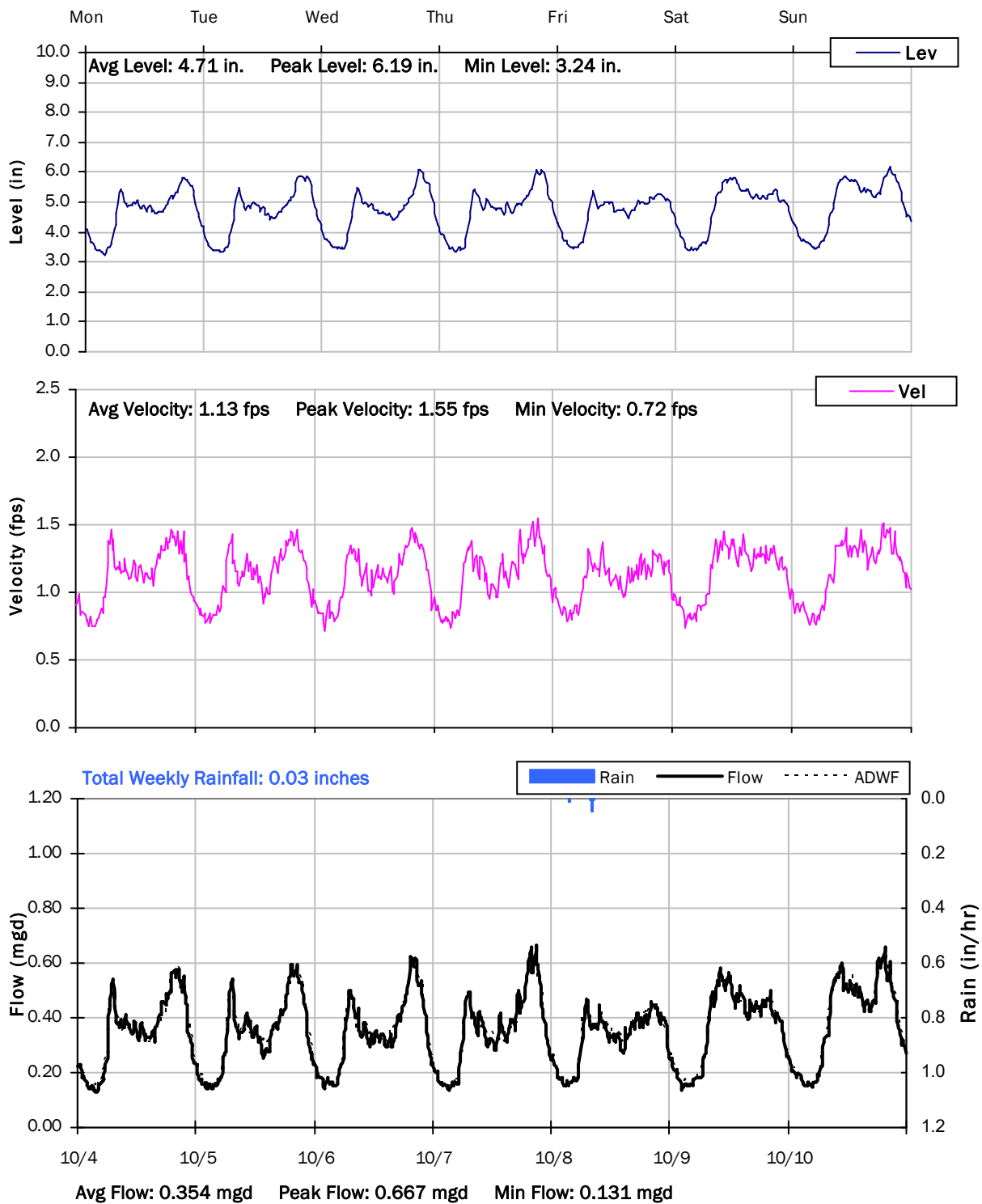
9/27/2021 to 10/4/2021



PLANNED DEVELOPMENT-1

Weekly Level, Velocity and Flow Hydrographs

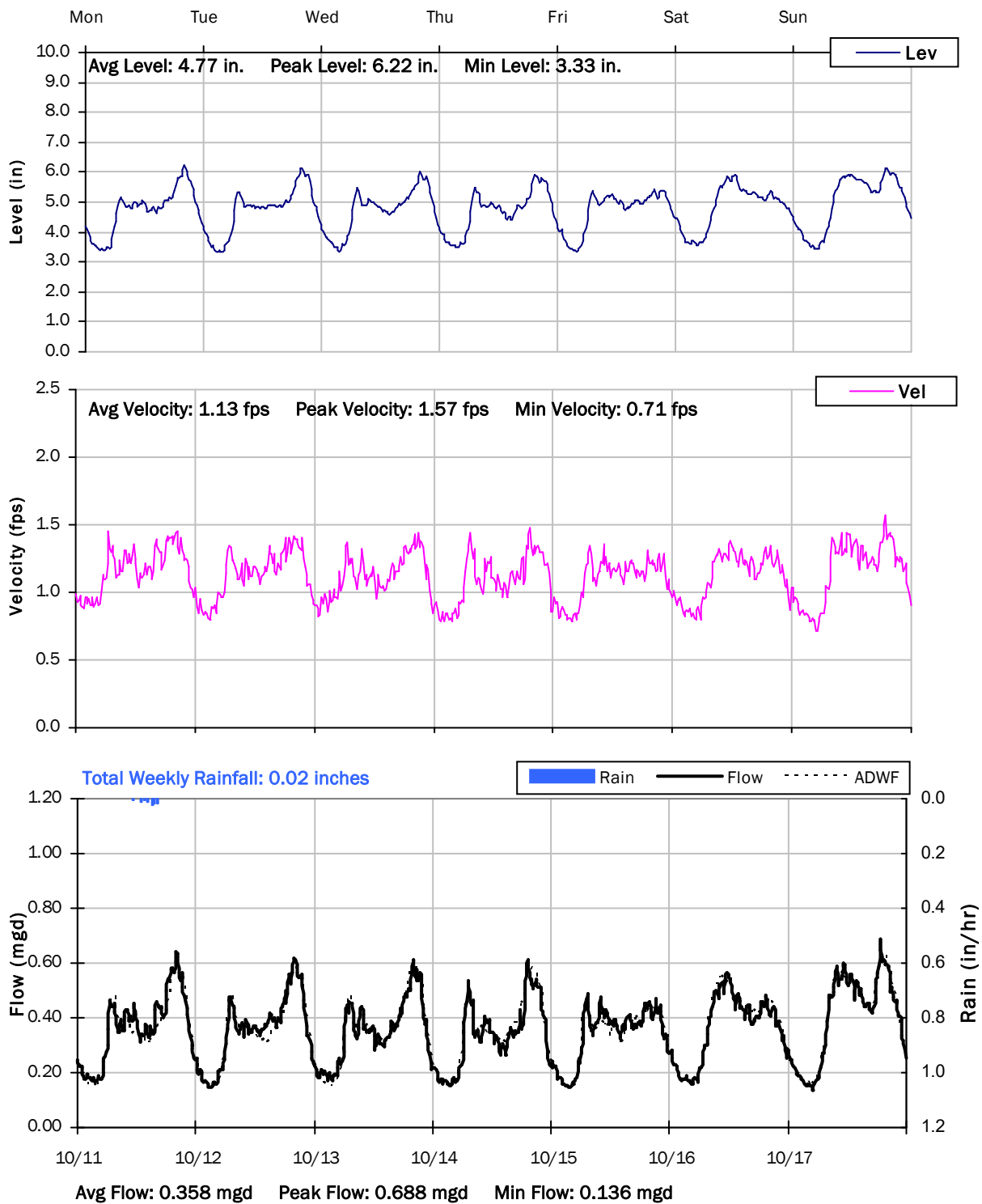
10/4/2021 to 10/11/2021



PLANNED DEVELOPMENT-1

Weekly Level, Velocity and Flow Hydrographs

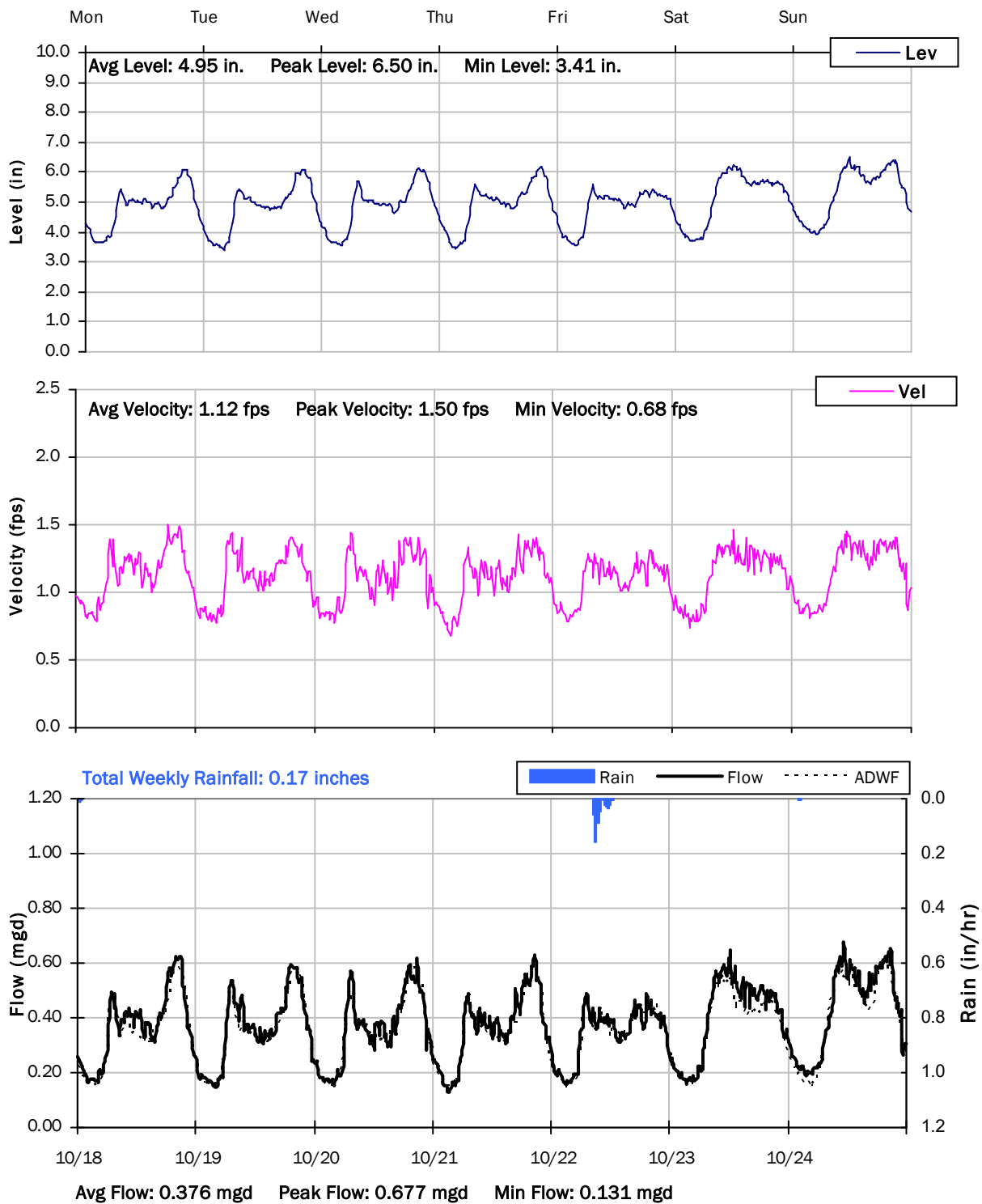
10/11/2021 to 10/18/2021



PLANNED DEVELOPMENT-1

Weekly Level, Velocity and Flow Hydrographs

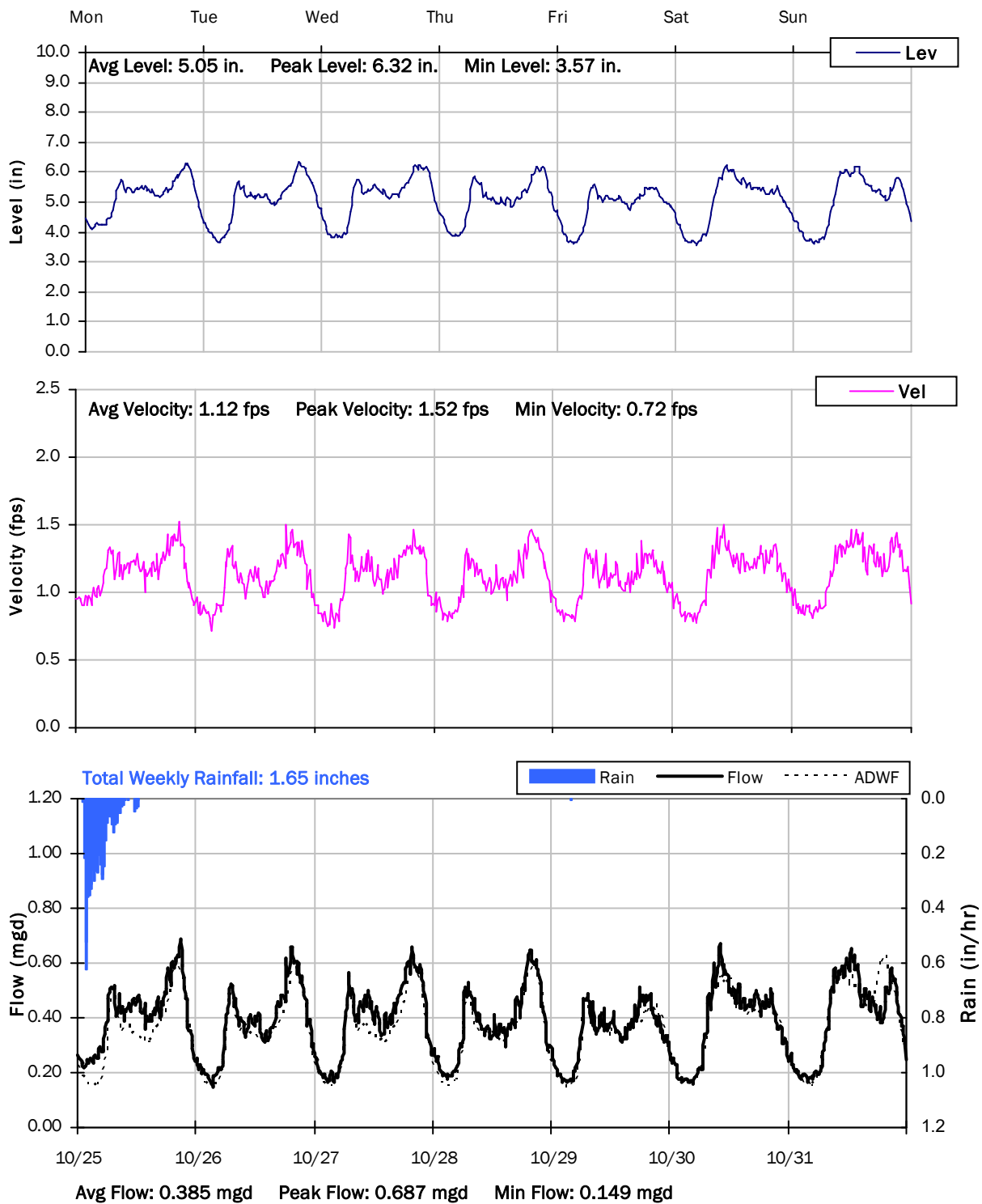
10/18/2021 to 10/25/2021



PLANNED DEVELOPMENT-1

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021

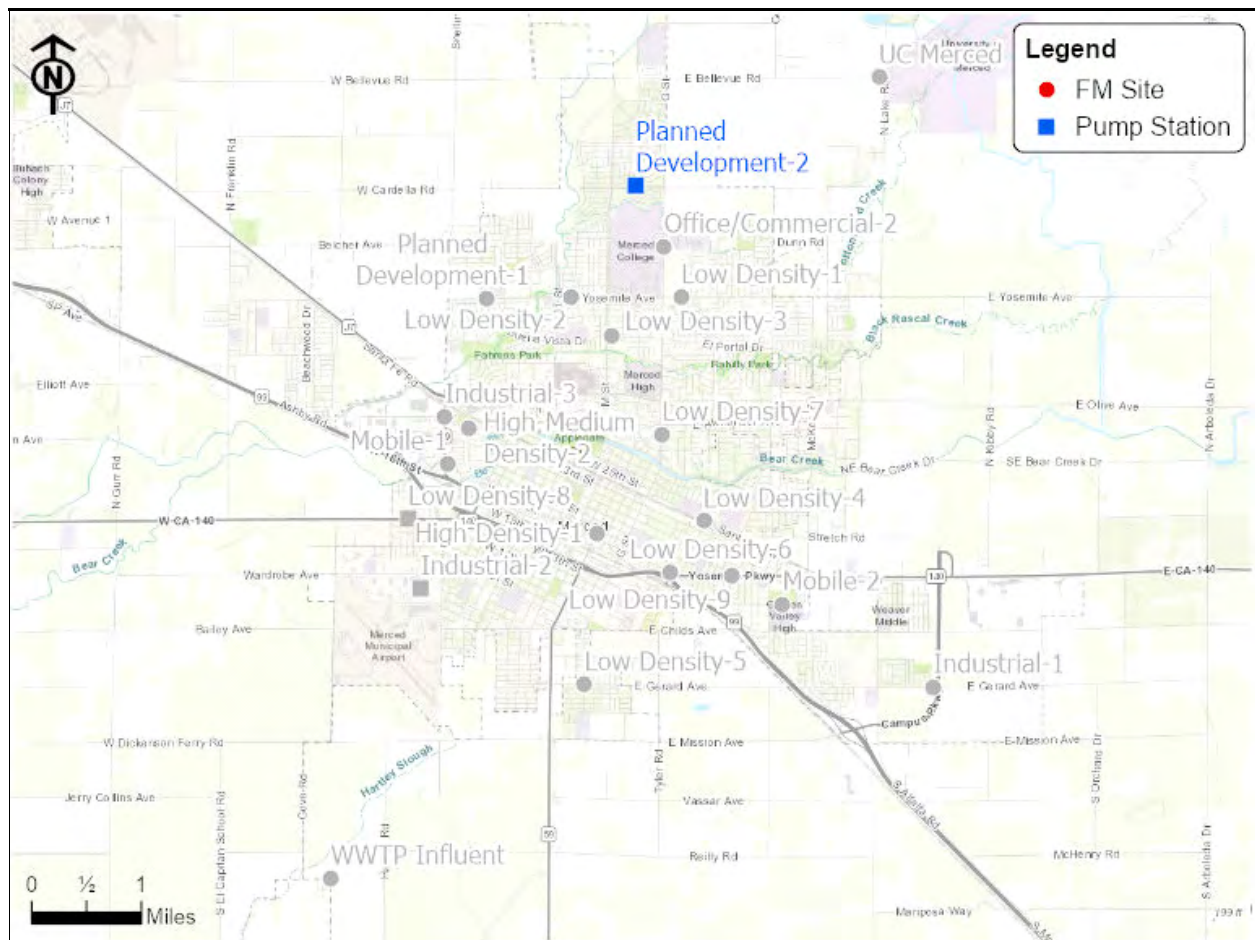


City of Merced, CA

September 27, 2021 - October 31, 2021

Location: Pump Station at northwest corner of Bancroft Drive and Cardella Road

Data Summary Report

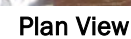
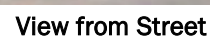
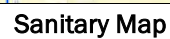


Vicinity Map: Planned Development-2

Site Information

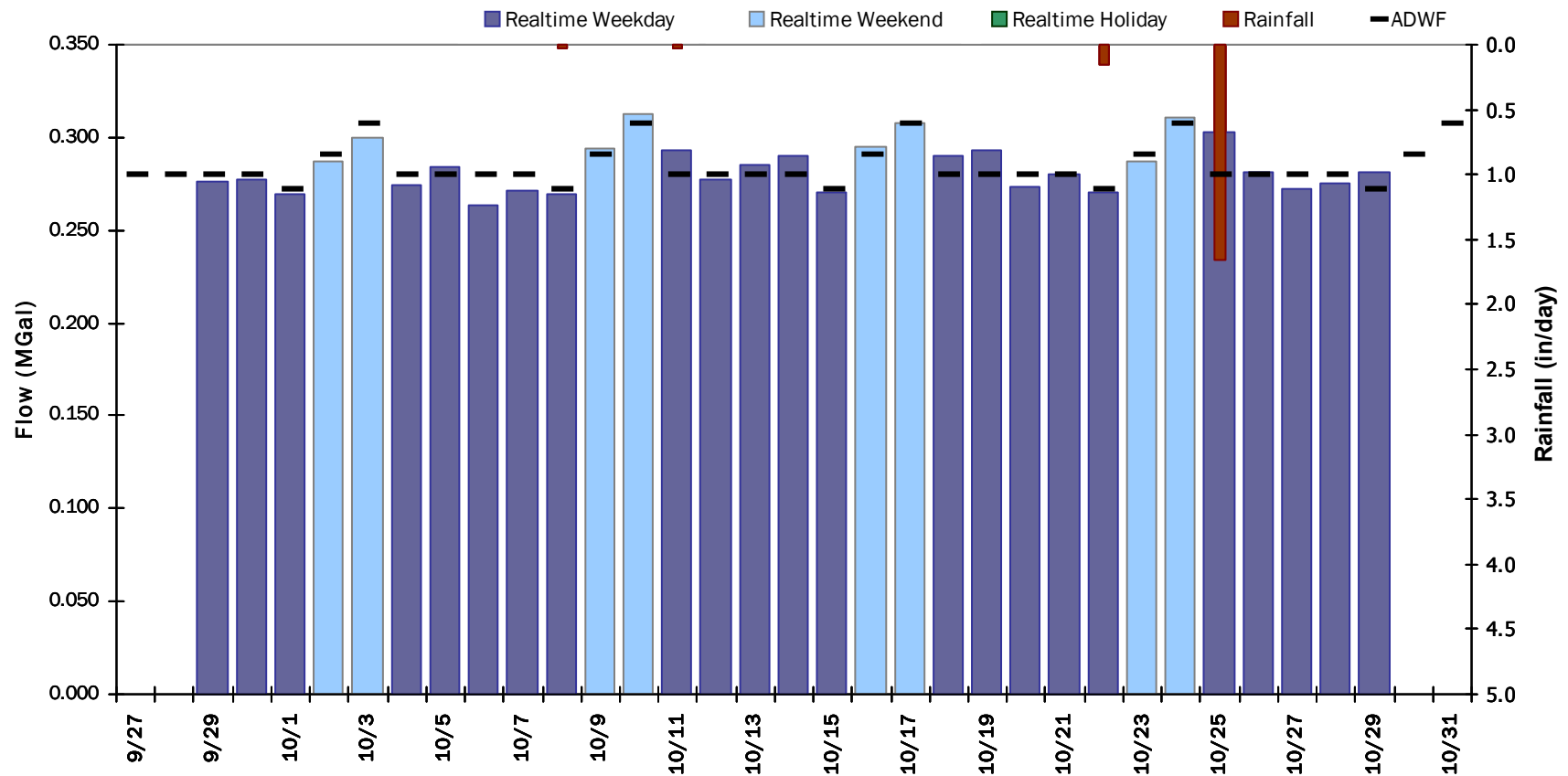
Rim Elevation (Earth): 177 feet

Sediment: None



PLANNED DEVELOPMENT-2

Period Flow Summary: Daily Flow Totals



PLANNED DEVELOPMENT-2

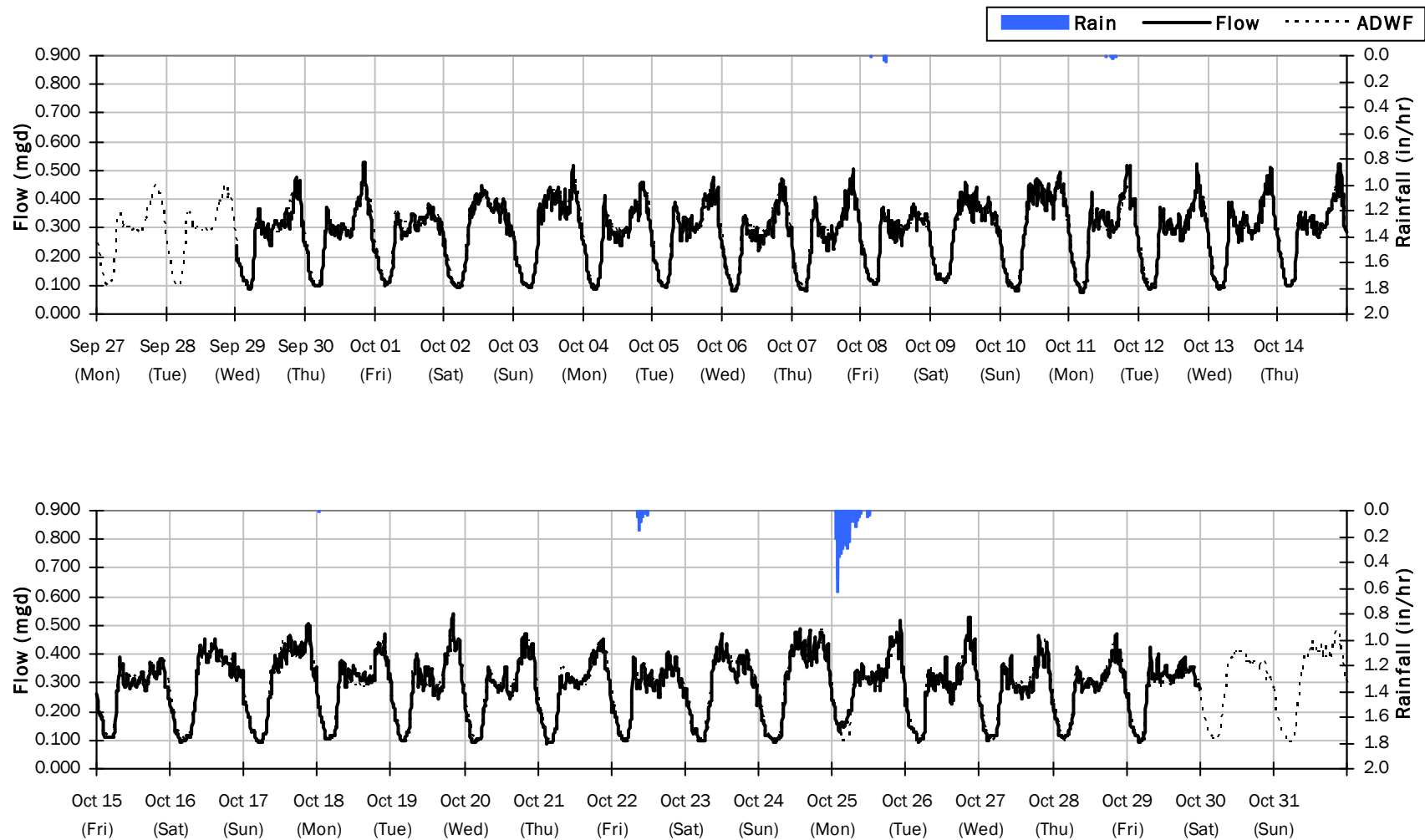
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.284 mgd

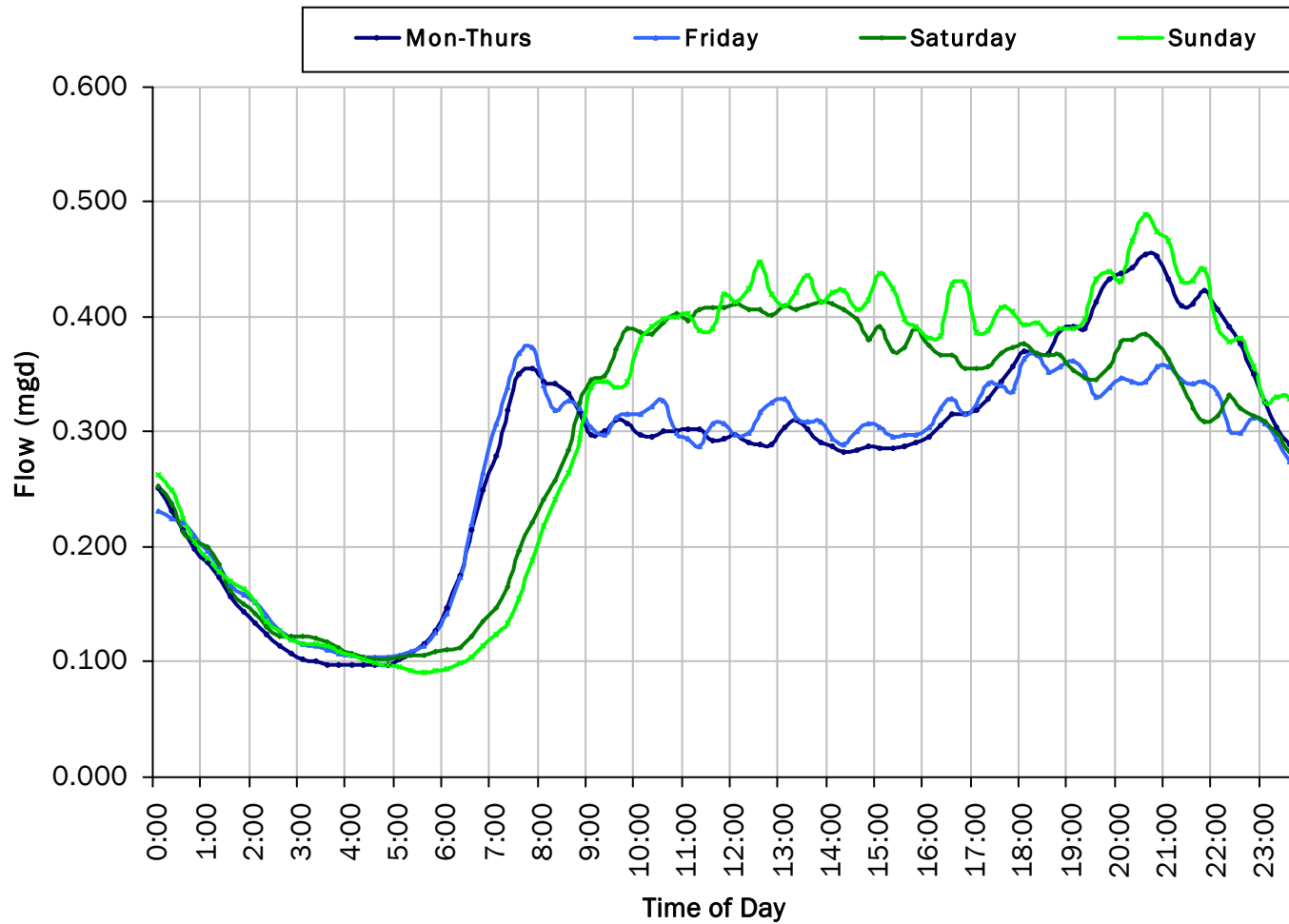
Period Peak Flow: 0.541 mgd

Period Min Flow: 0.073 mgd



PLANNED DEVELOPMENT-2

Average Dry Weather Flow Hydrographs

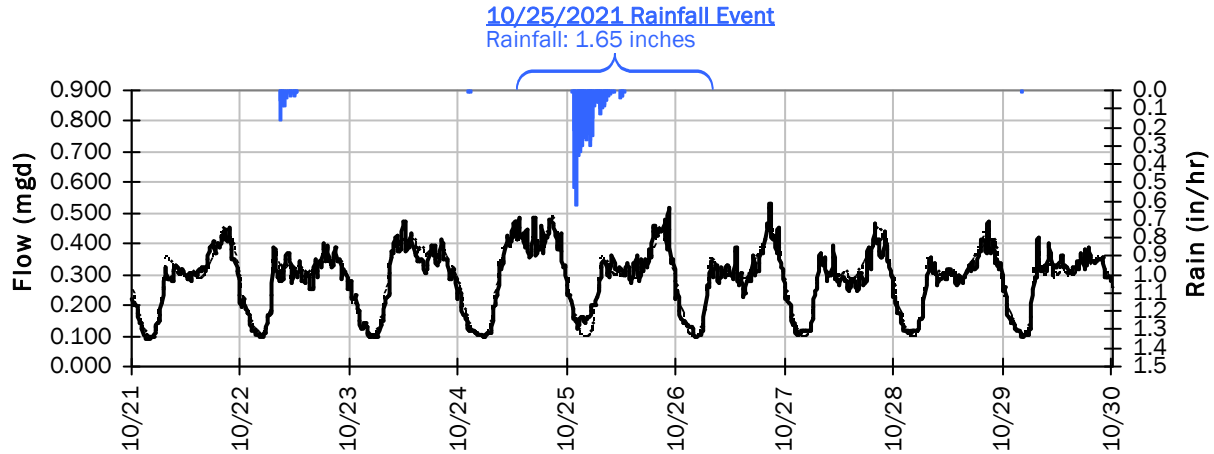


ADWF:
0.284 mgd

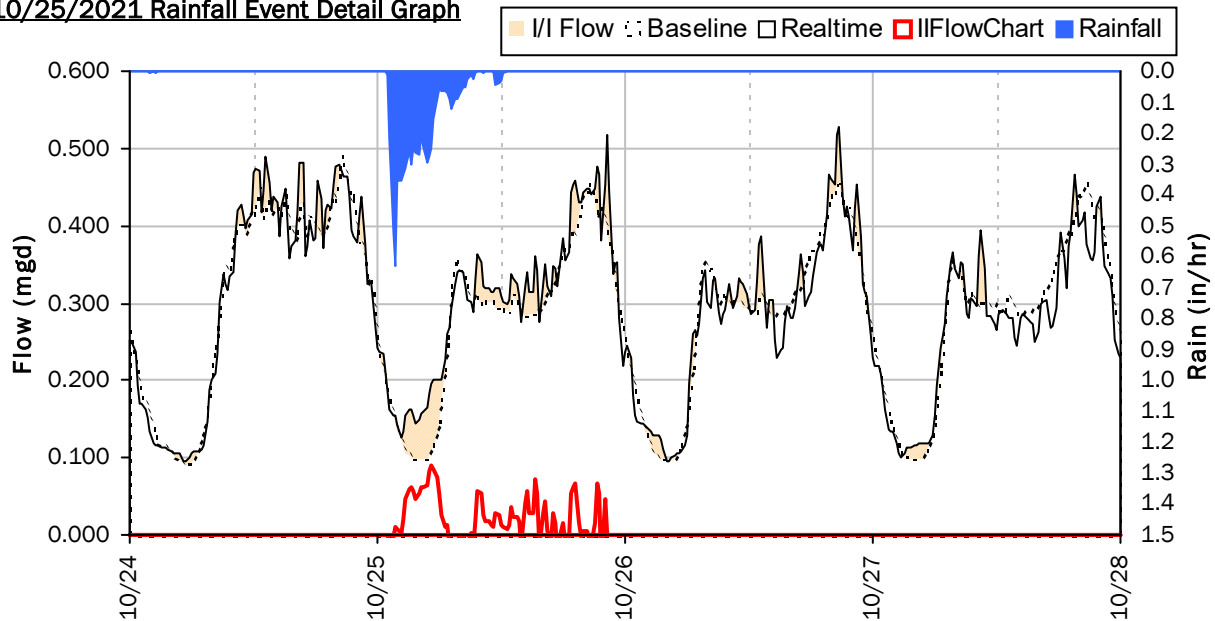
PLANNED DEVELOPMENT-2

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.477 mgd
PF: 1.68

Peak Level: in
d/D Ratio:

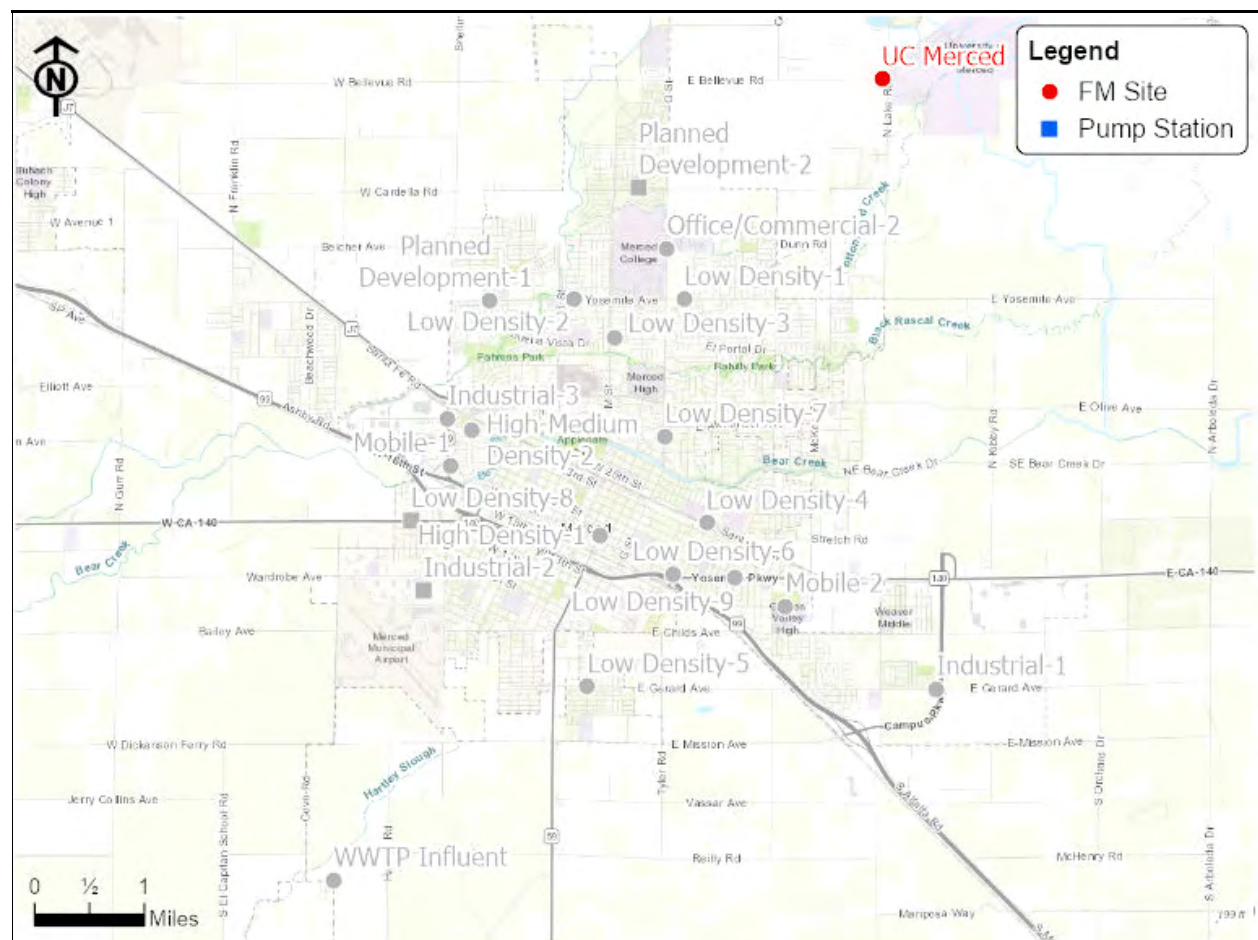
Inflow / Infiltration

Peak I/I Rate: 0.089 mgd
Total I/I: 20,000 gallons

City of Merced, CA

September 27, 2021 - October 31, 2021

Data Summary Report



Vicinity Map: UC Merced

UC MERCED

Site Information

Location: Bellevue Road west of Lake Road

Coordinates: 120.4333° W, 37.3613° N

Rim Elevation (Earth): 238 feet

Measured Pipe Diameter: 20 inches

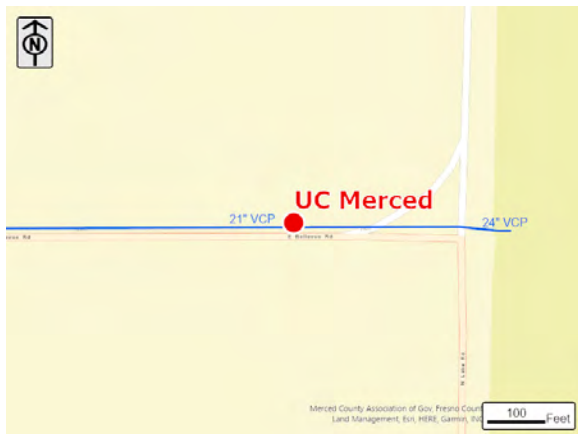
ADWF: 0.115 mgd

Peak Measured Flow: 0.561 mgd

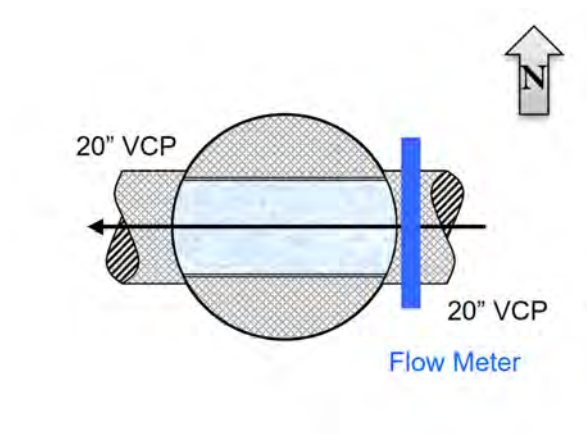
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

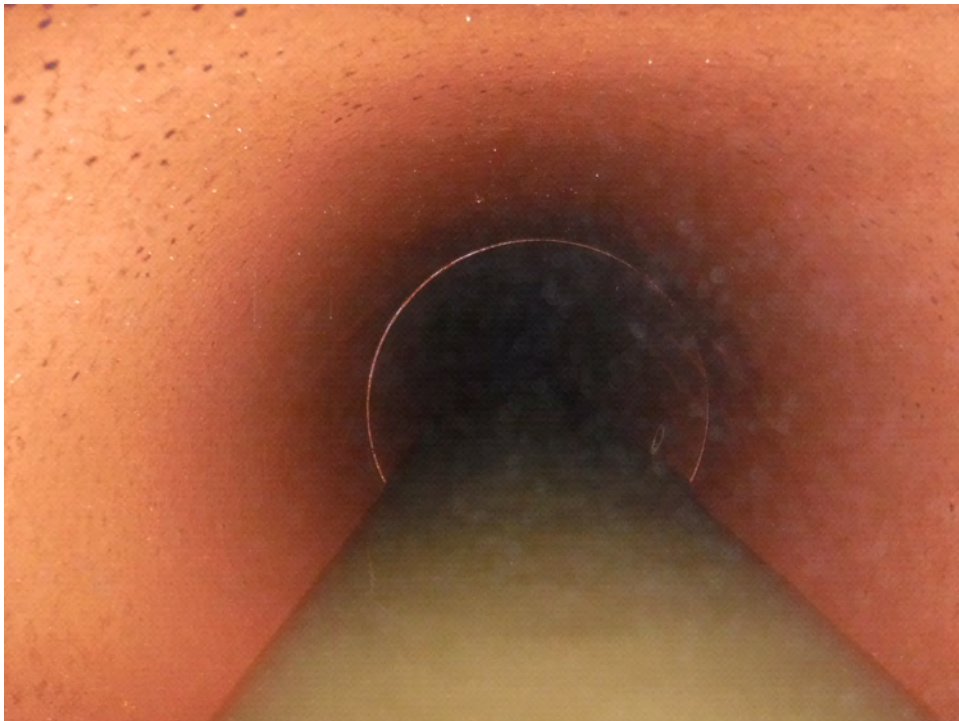
UC MERCED

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

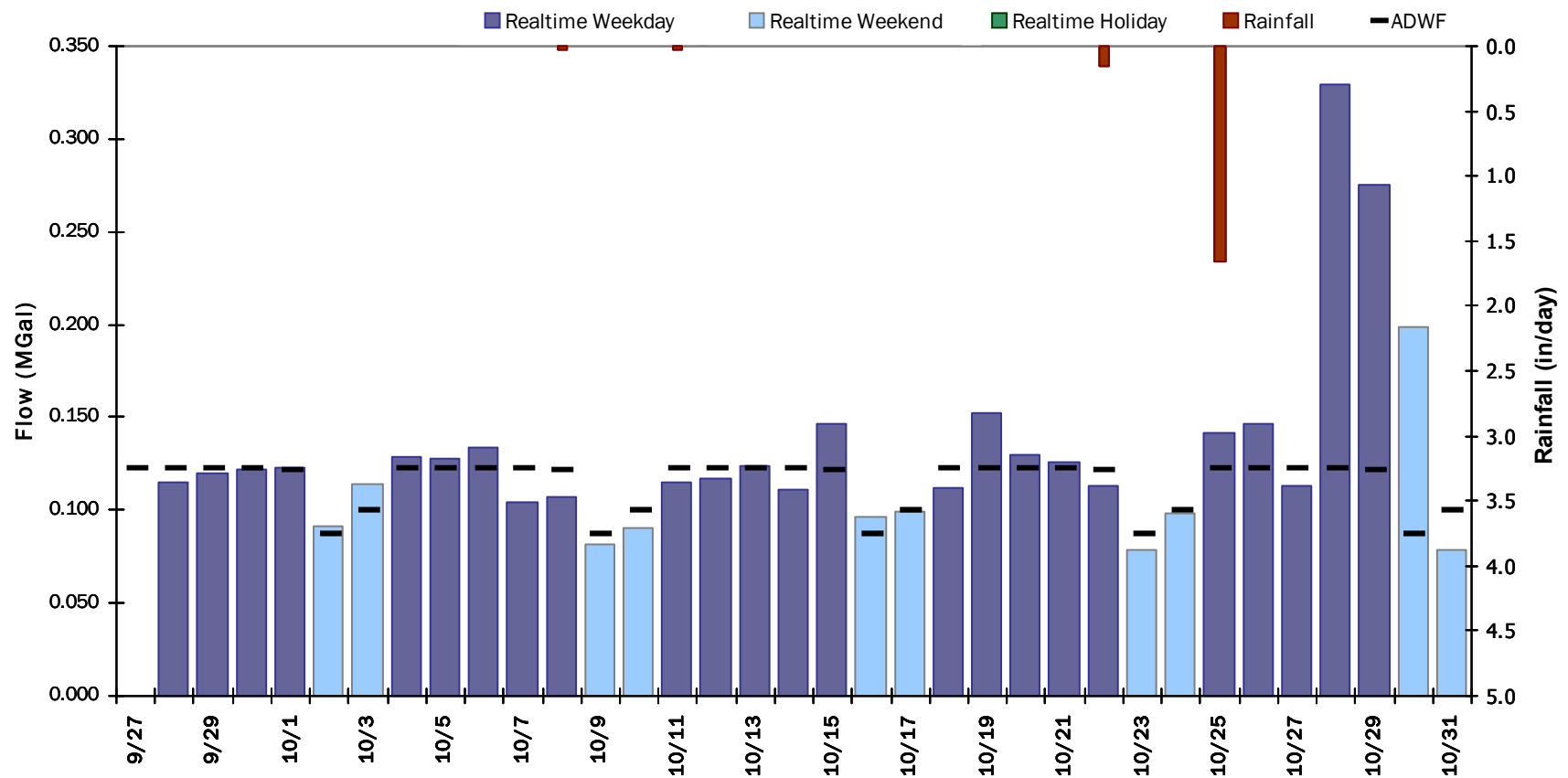


UC MERCED

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.128 MGal Peak Daily Flow: 0.330 MGal Min Daily Flow: 0.078 MGal

Total Rainfall: 1.87 inches



UC MERCED

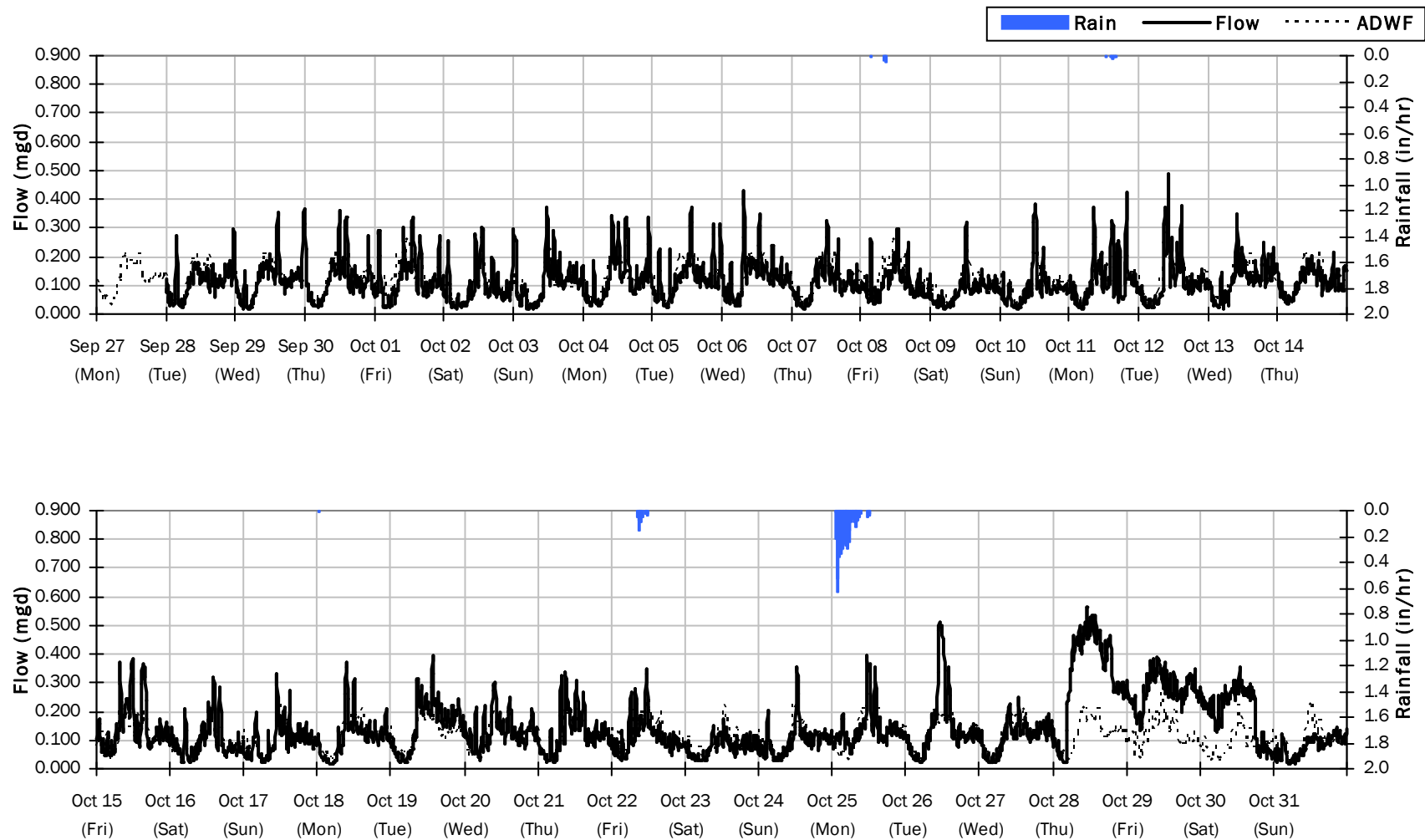
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.128 mgd

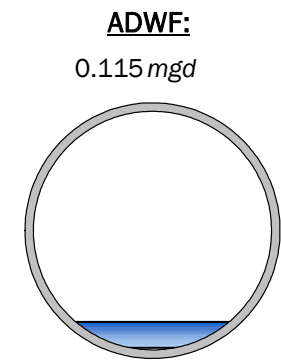
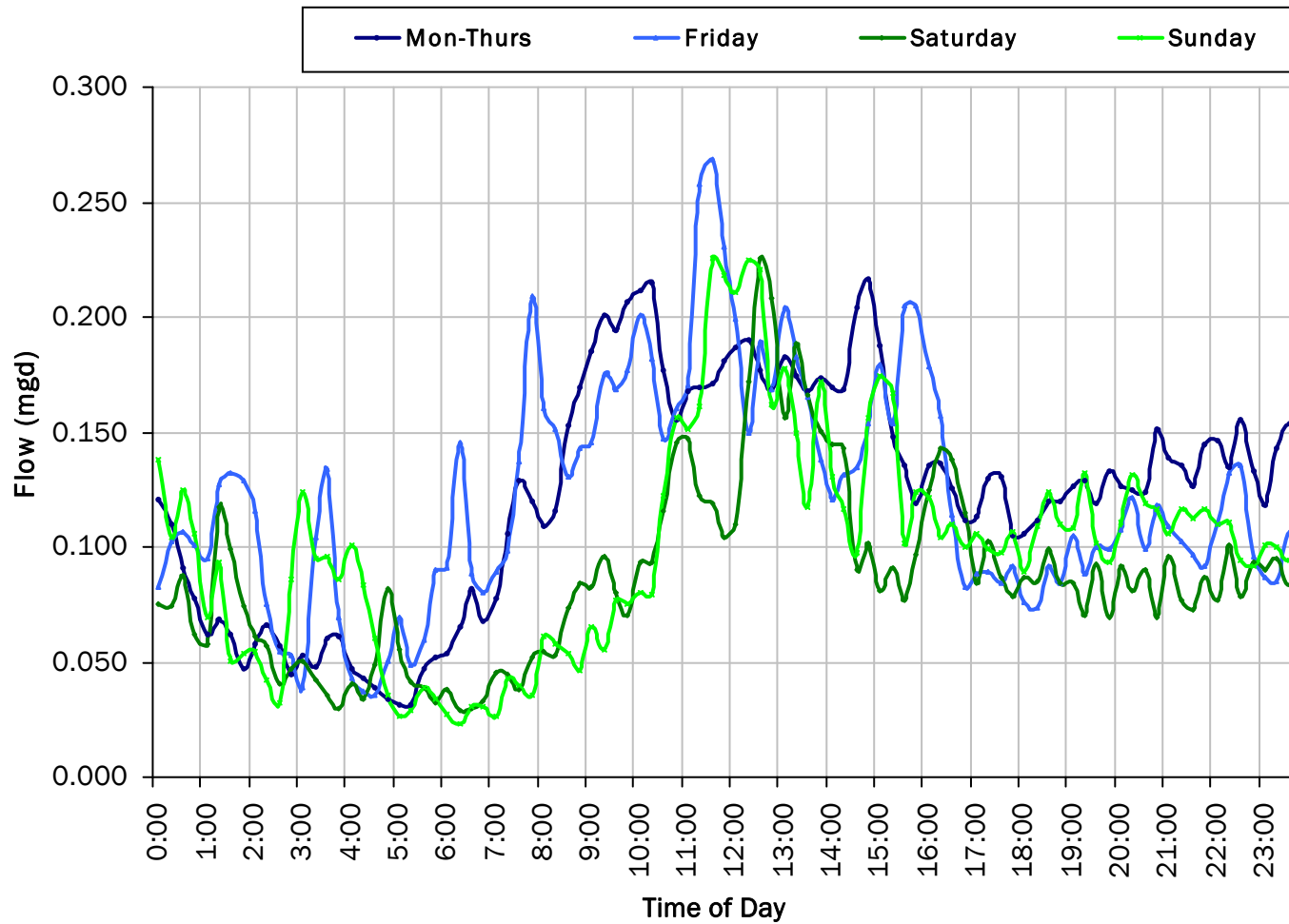
Period Peak Flow: 0.561 mgd

Period Min Flow: 0.015 mgd



UC MERCED

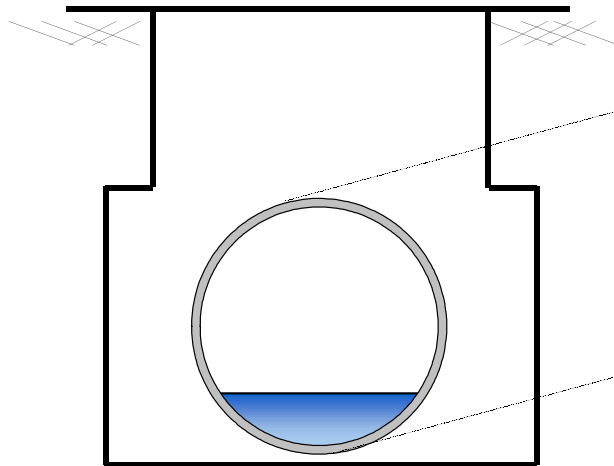
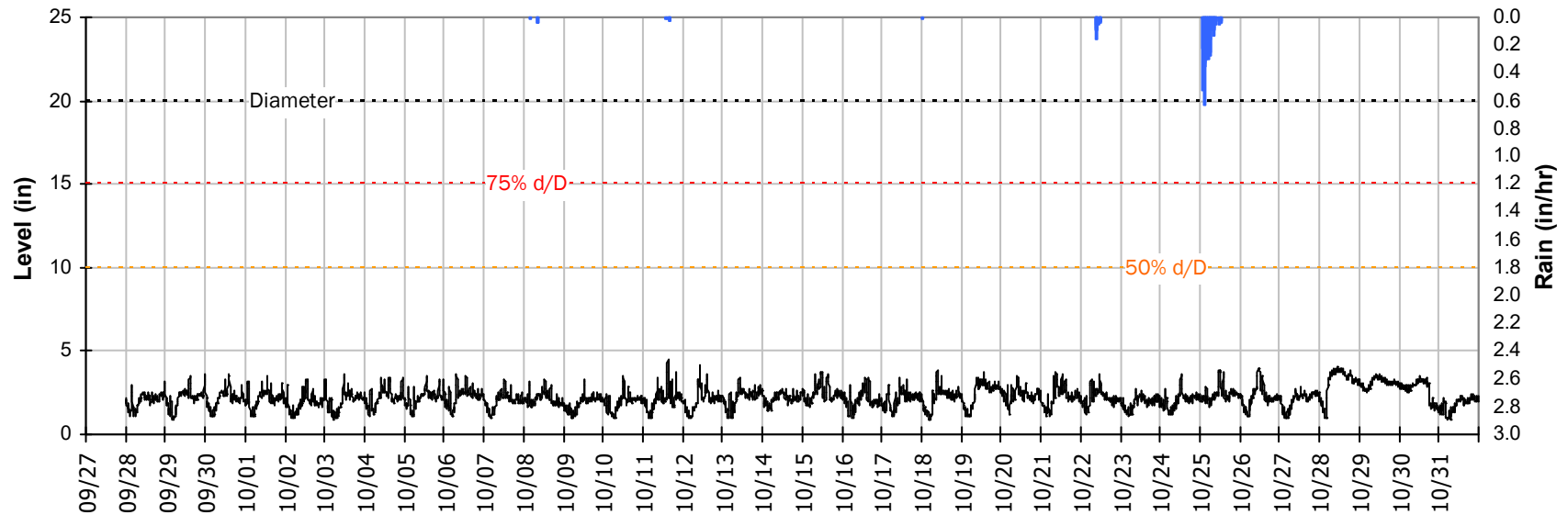
Average Dry Weather Flow Hydrographs



UC MERCED

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

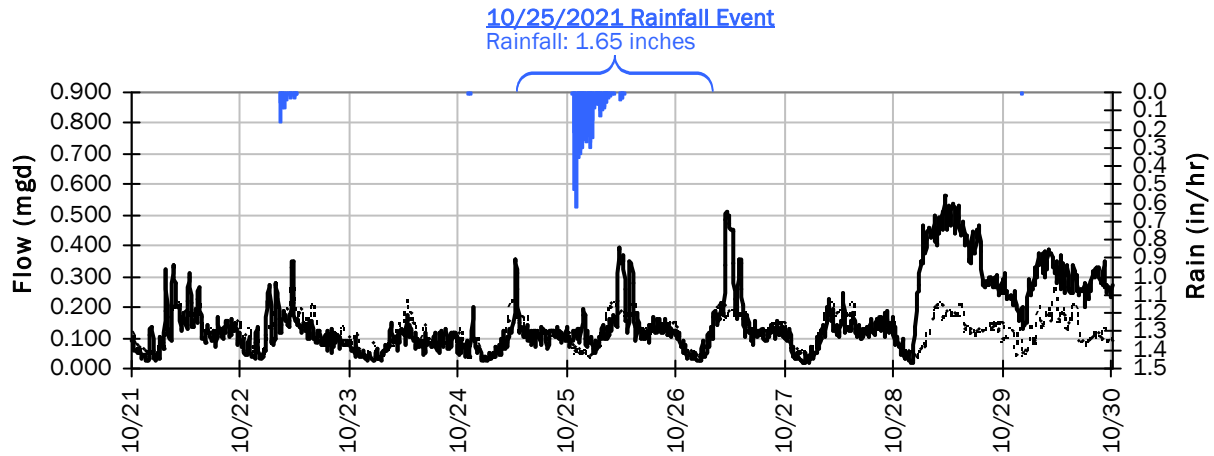


Pipe Diameter: 20 inches
Peak Measured Level: 4.47 inches
Peak d/D Ratio: 0.22

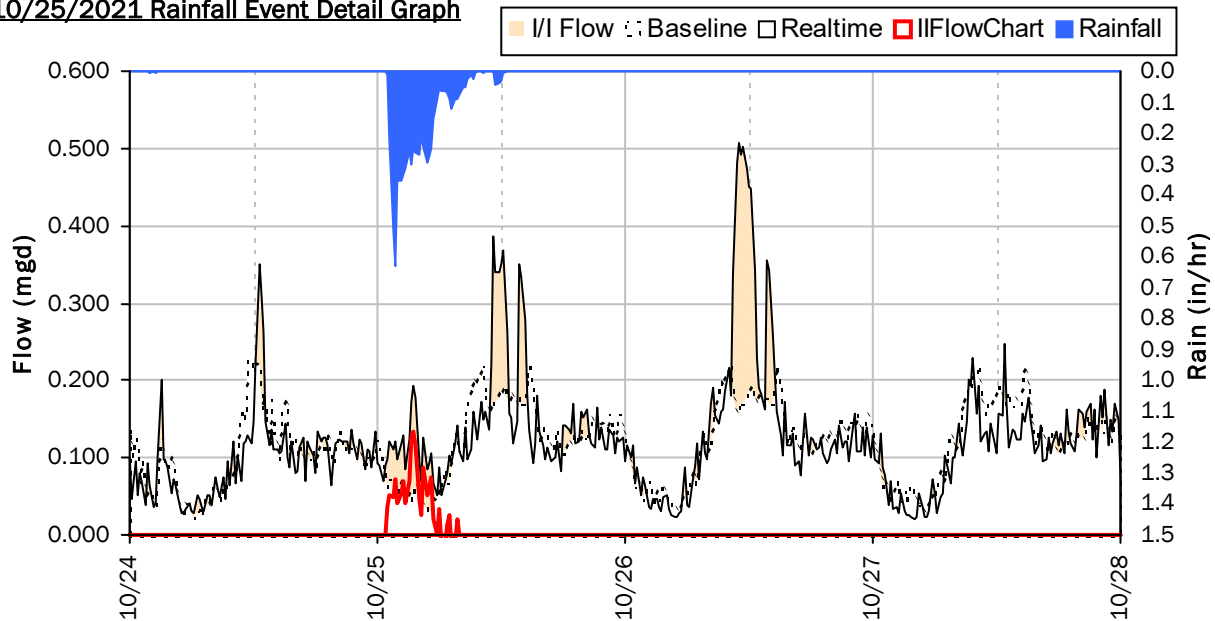
UC MERCED

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



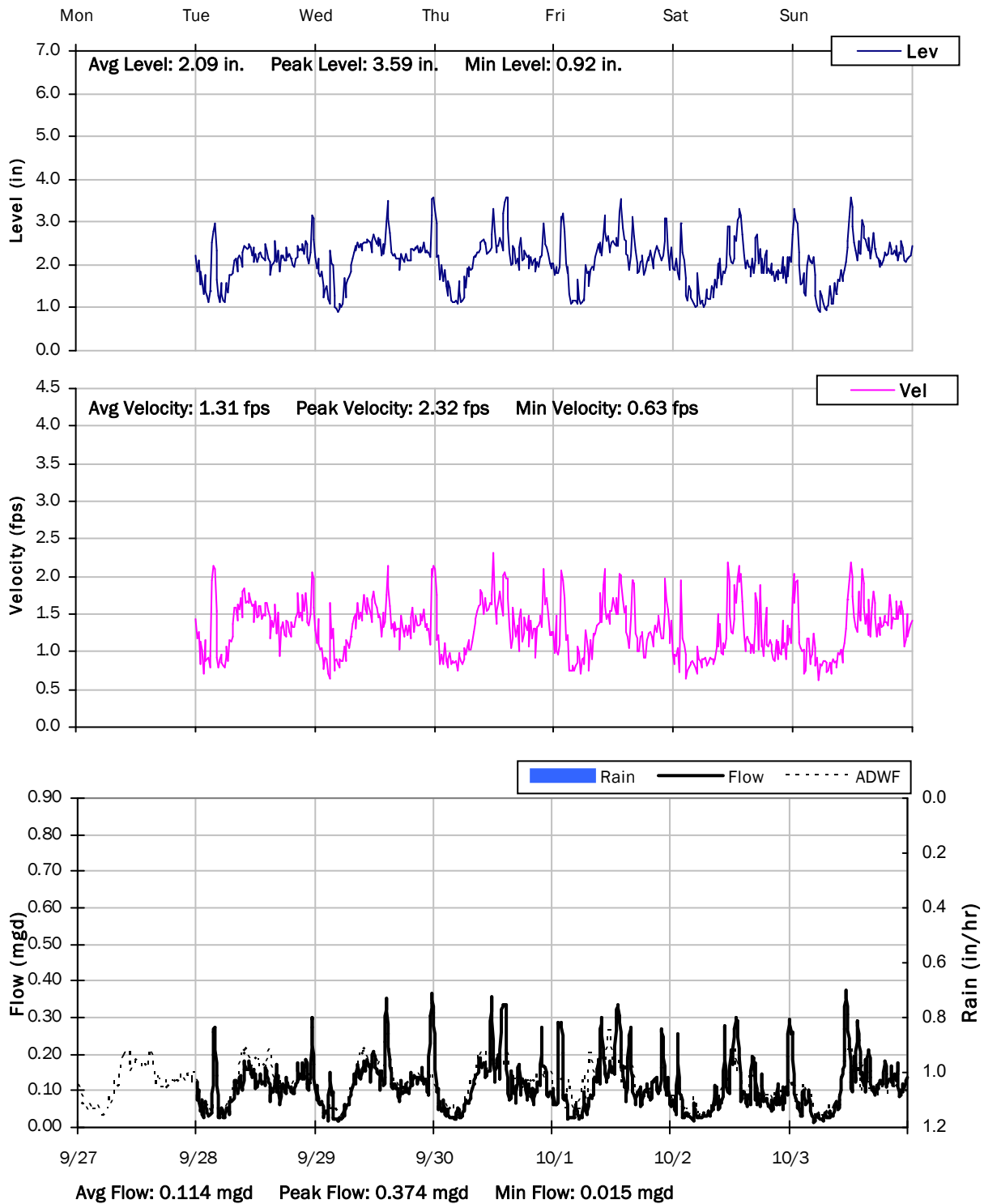
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.193 <i>mgd</i>	Peak I/I Rate:	0.133 <i>mgd</i>
PF:	1.69	Total I/I:	13,000 <i>gallons</i>
Peak Level:	2.86 <i>in</i>		
d/D Ratio:	0.14		

UC MERCED

Weekly Level, Velocity and Flow Hydrographs

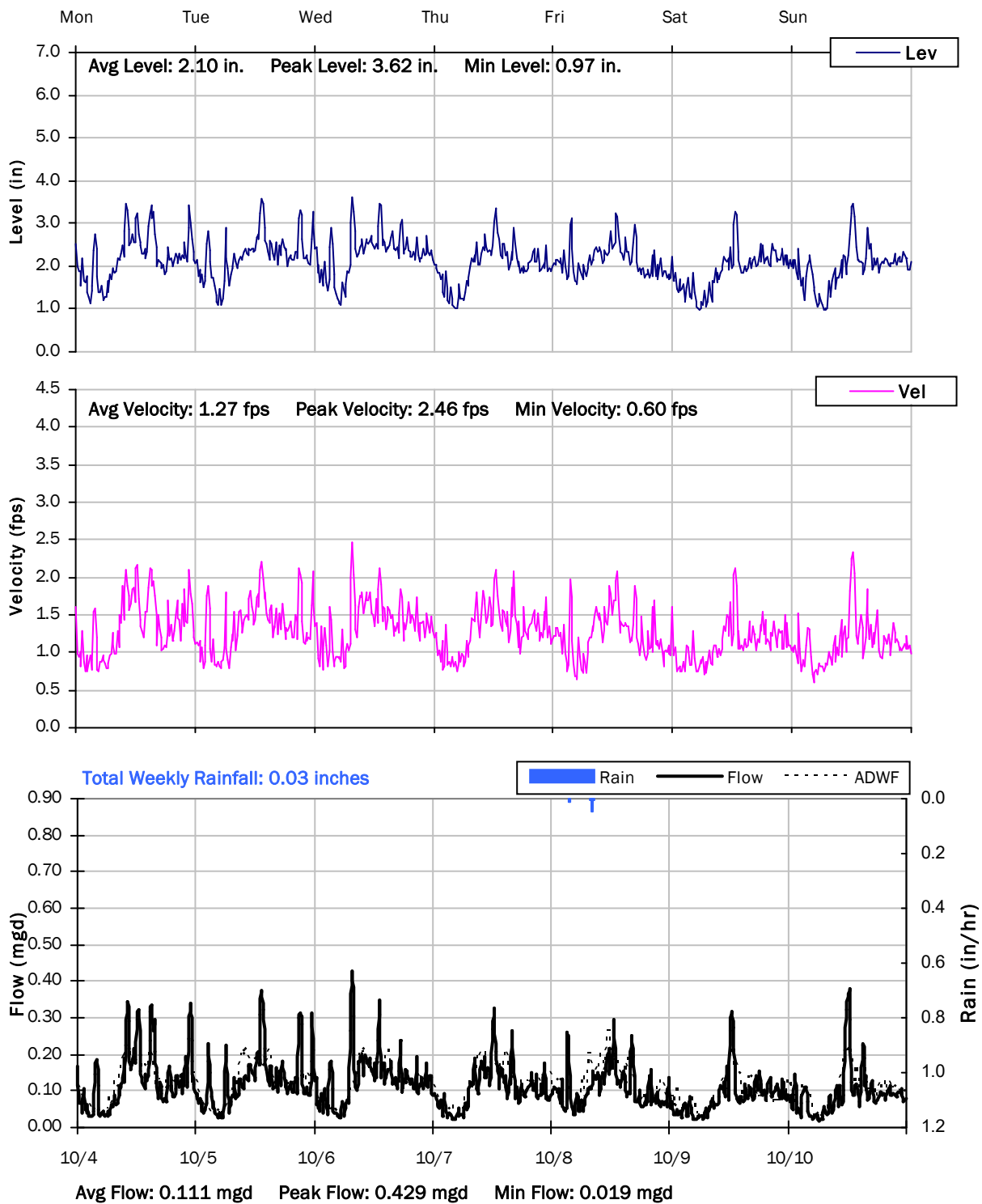
9/27/2021 to 10/4/2021



UC MERCED

Weekly Level, Velocity and Flow Hydrographs

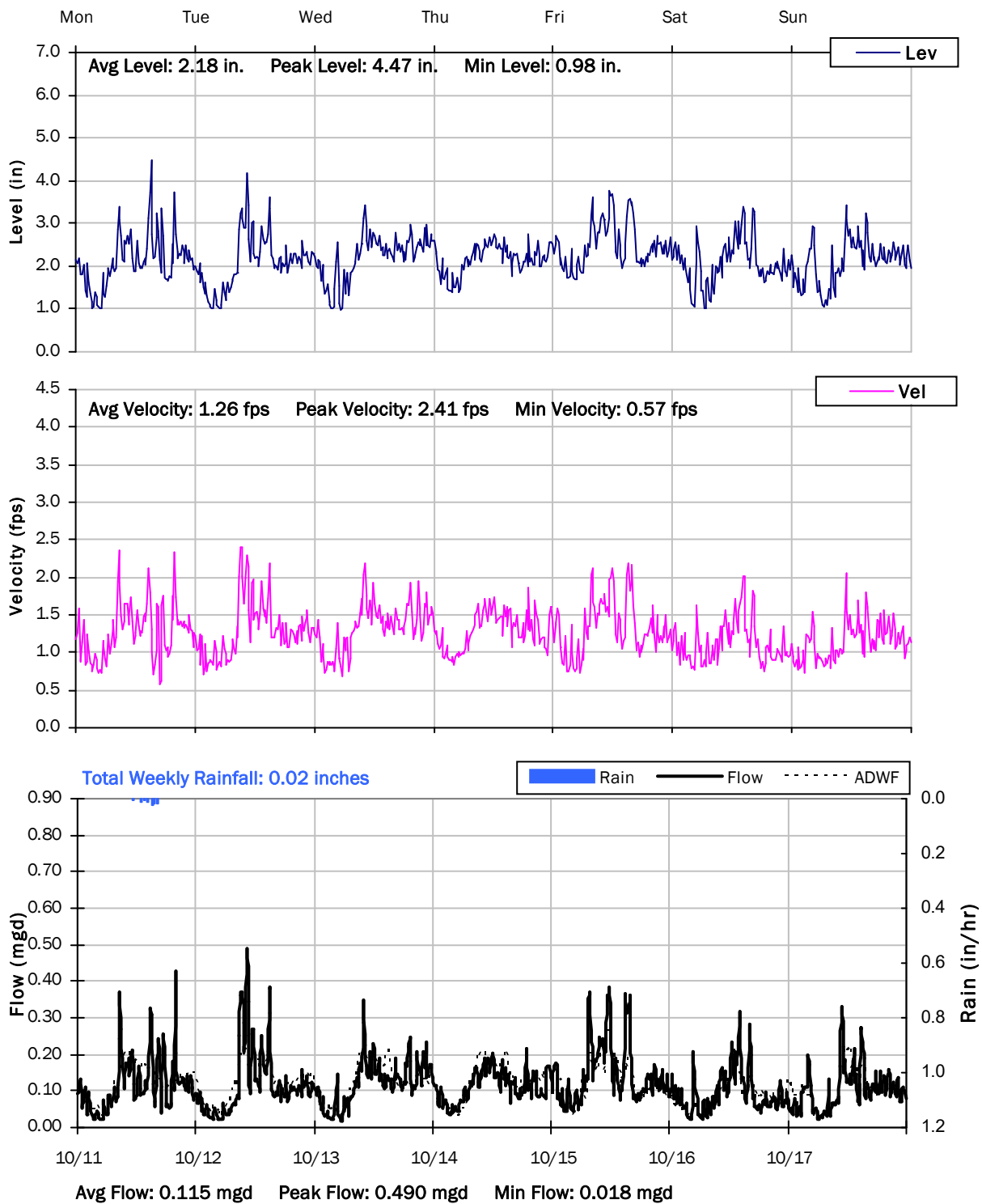
10/4/2021 to 10/11/2021



UC MERCED

Weekly Level, Velocity and Flow Hydrographs

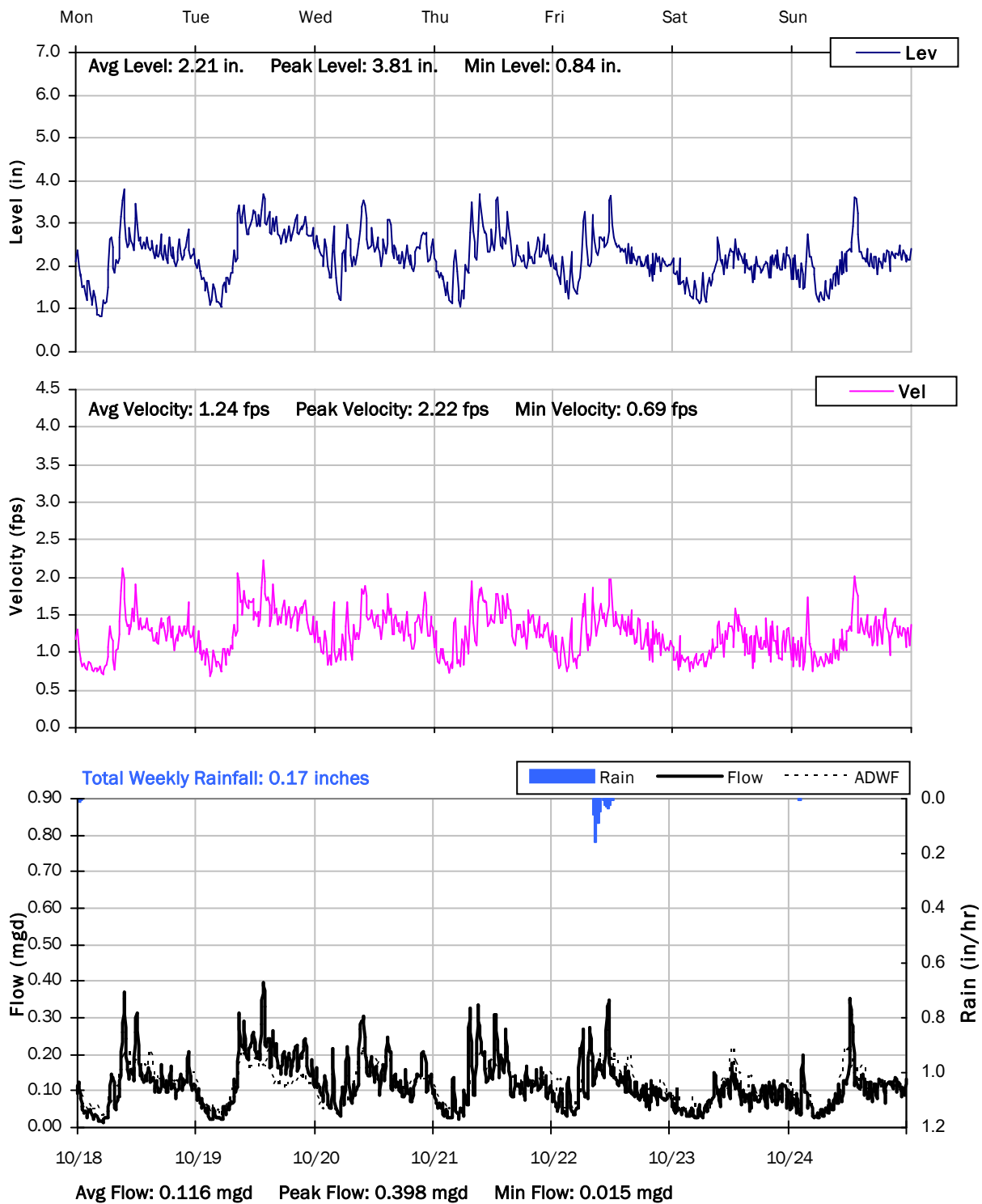
10/11/2021 to 10/18/2021



UC MERCED

Weekly Level, Velocity and Flow Hydrographs

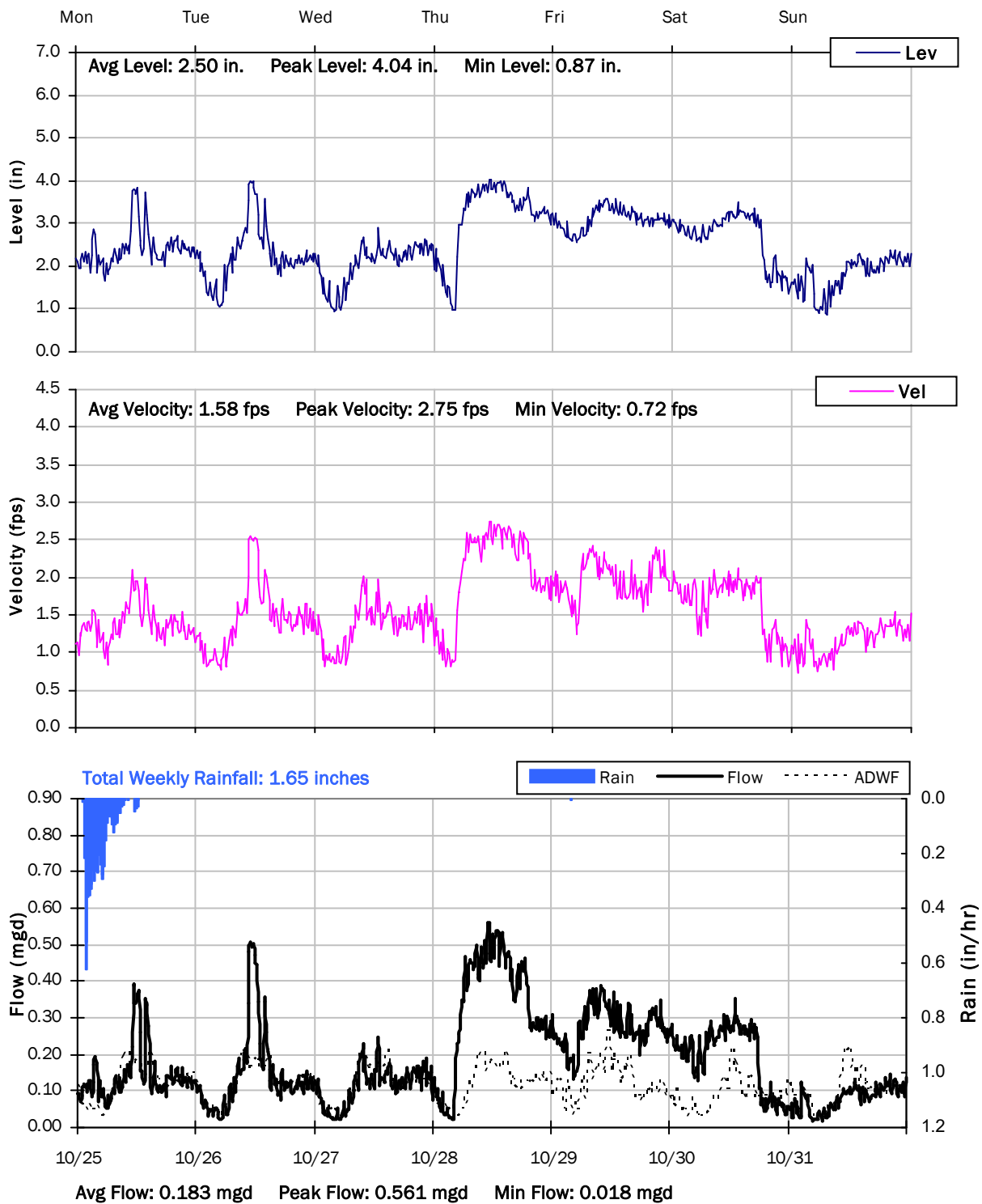
10/18/2021 to 10/25/2021



UC MERCED

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



INDUSTRIAL-1

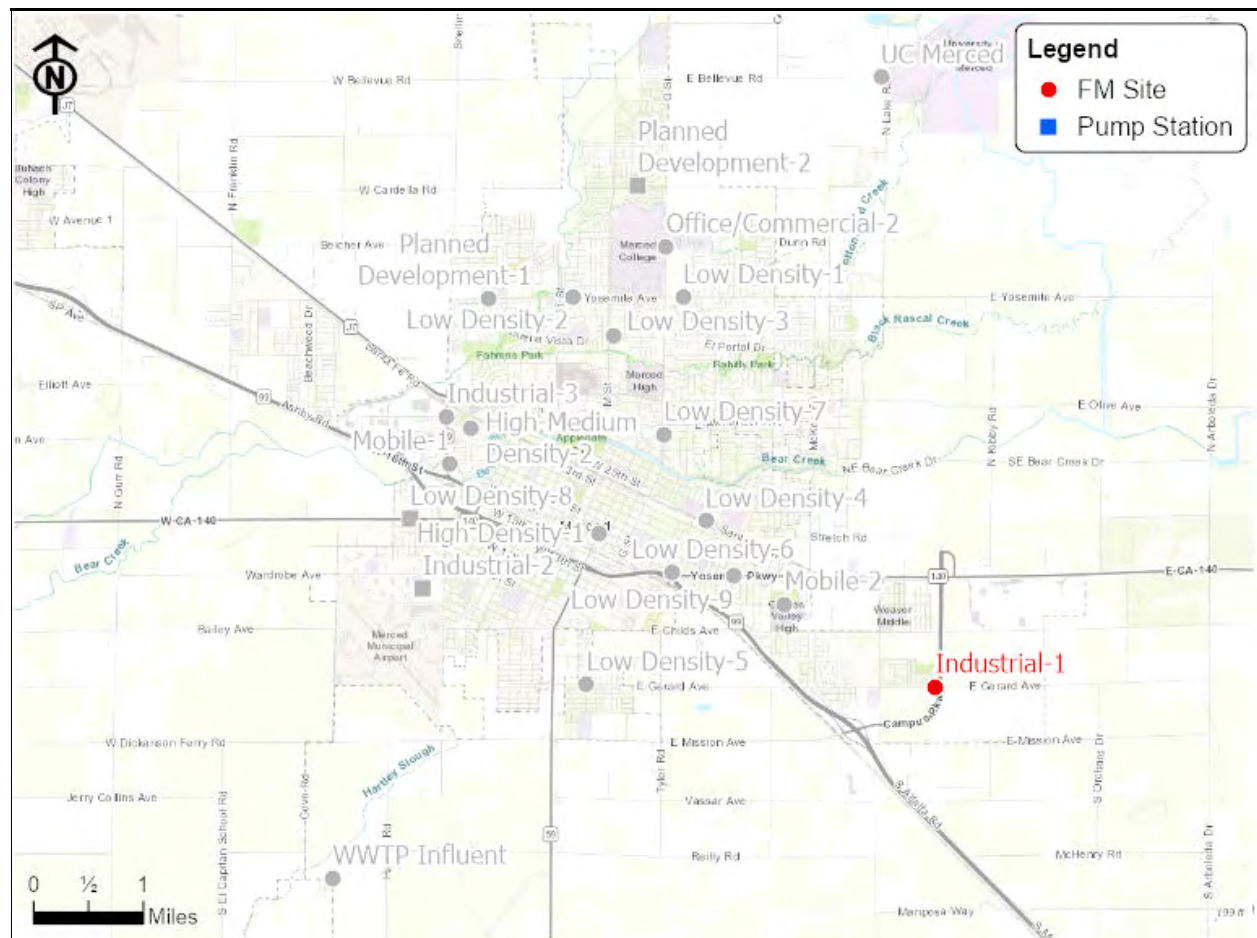
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: E Gerard Avenue west of Campus Parkway

Data Summary Report



Vicinity Map: Industrial-1

INDUSTRIAL-1

Site Information

Location: E Gerard Avenue west of
Campus Parkway

Coordinates: 120.4244° W, 37.2806° N

Rim Elevation (Earth): 188 feet

Measured Pipe Diameter: 33 inches

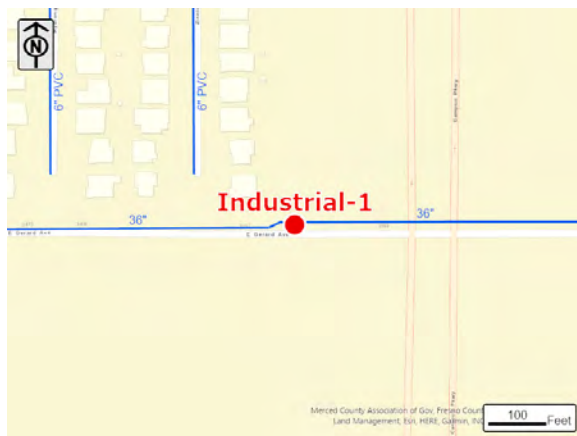
ADWF: 0.156 mgd

Peak Measured Flow: 1.388 mgd

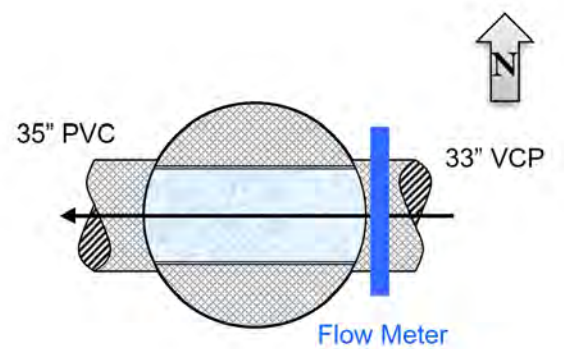
Sediment: 1 inches



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

INDUSTRIAL-1

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

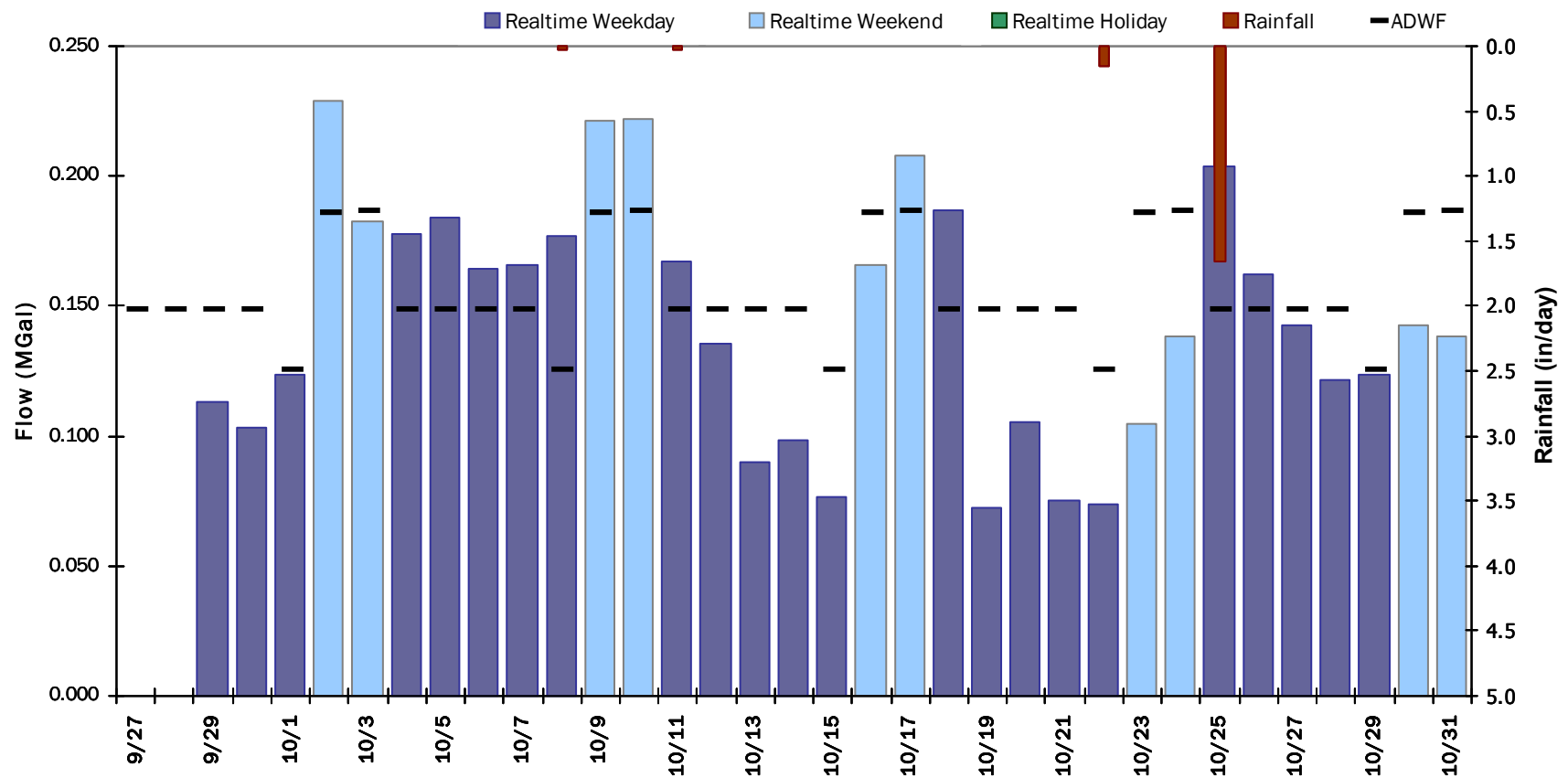


INDUSTRIAL-1

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.145 MGal Peak Daily Flow: 0.229 MGal Min Daily Flow: 0.073 MGal

Total Rainfall: 1.87 inches



INDUSTRIAL-1

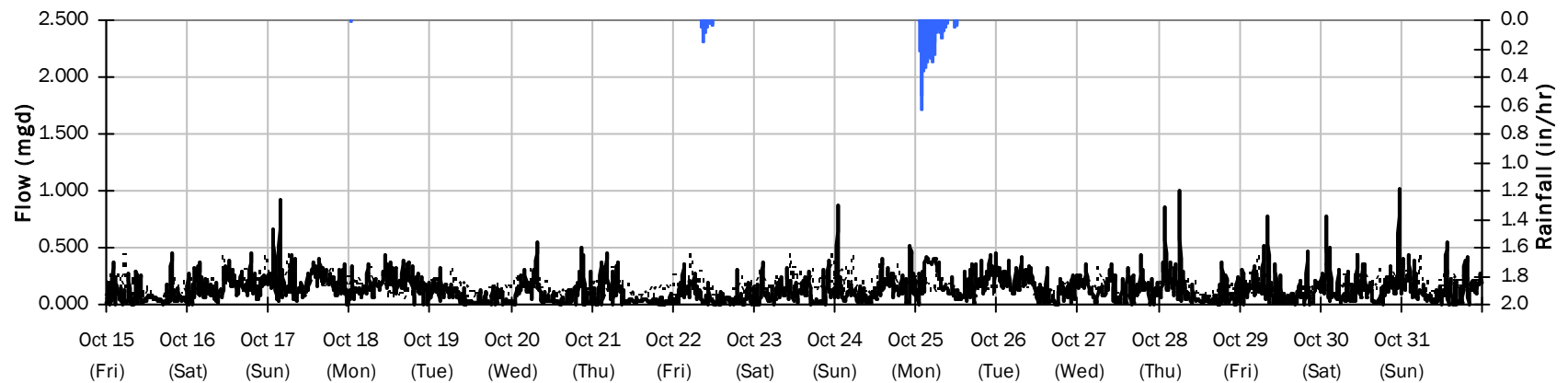
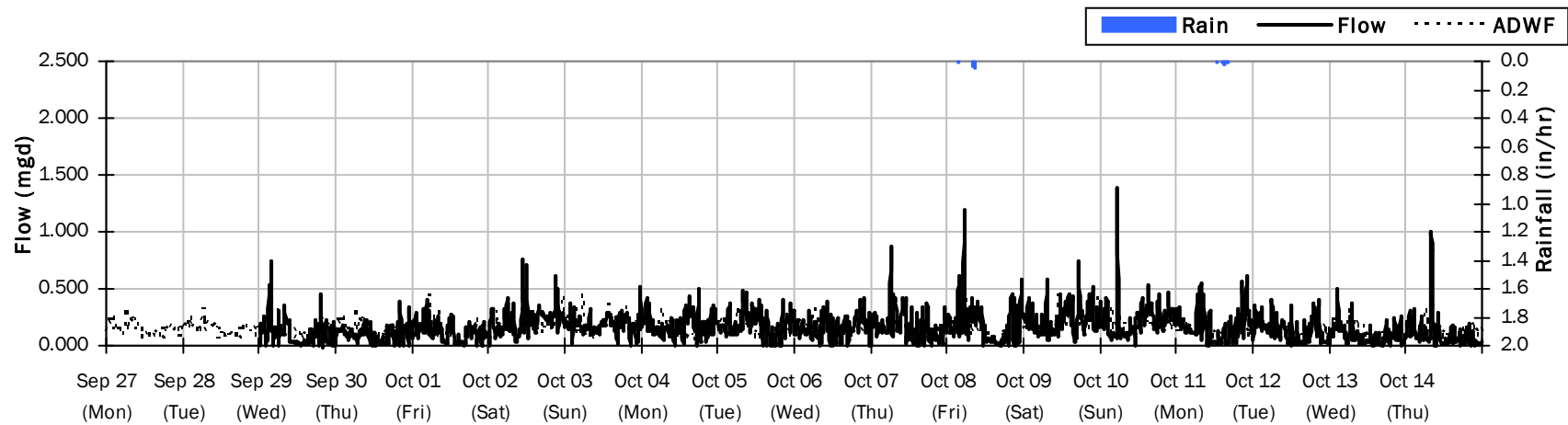
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.145 mgd

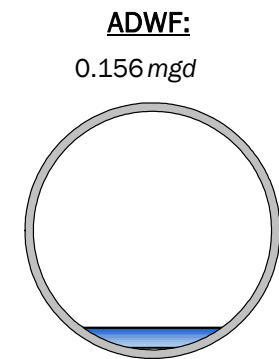
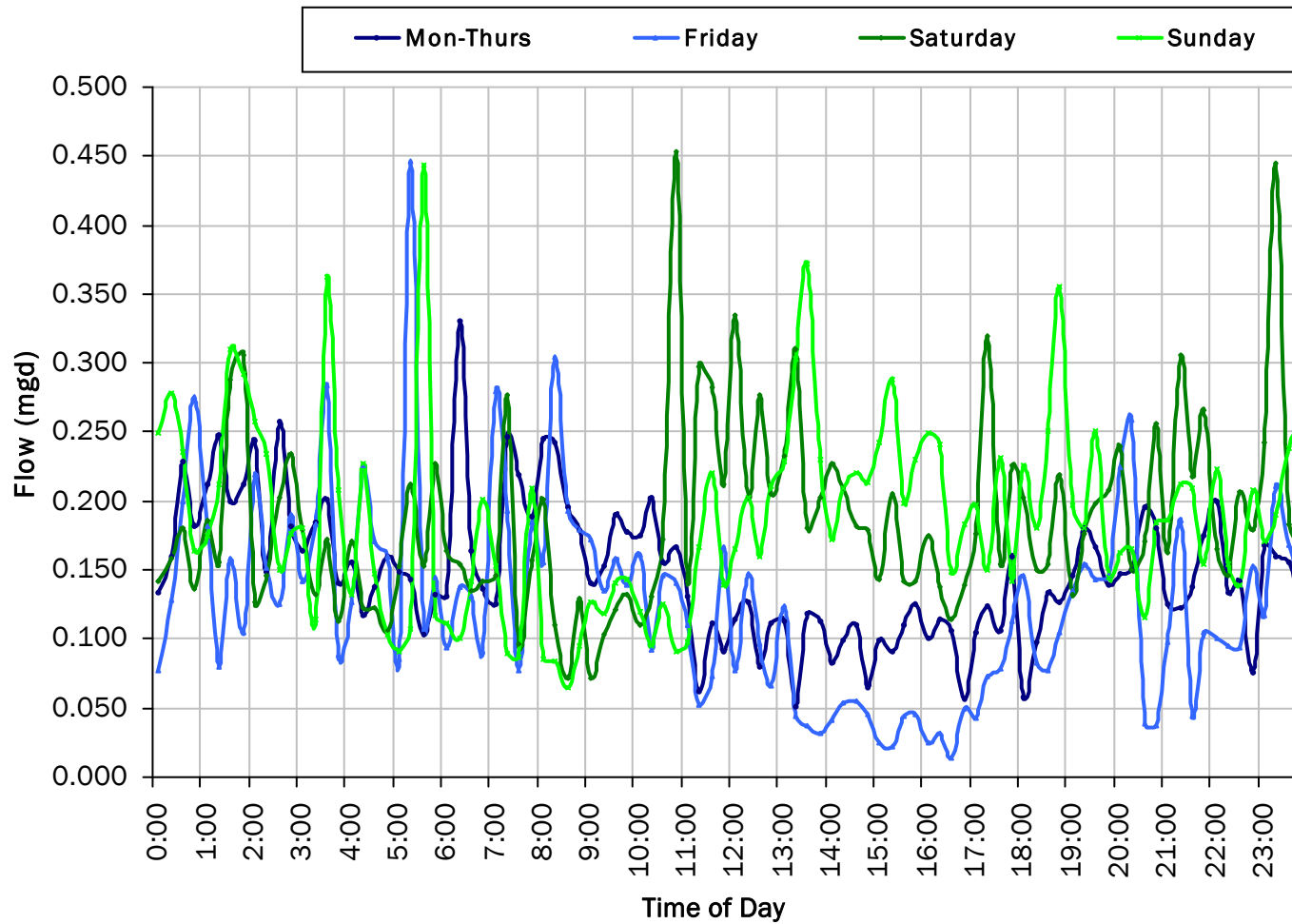
Period Peak Flow: 1.388 mgd

Period Min Flow: -0.003 mgd



INDUSTRIAL-1

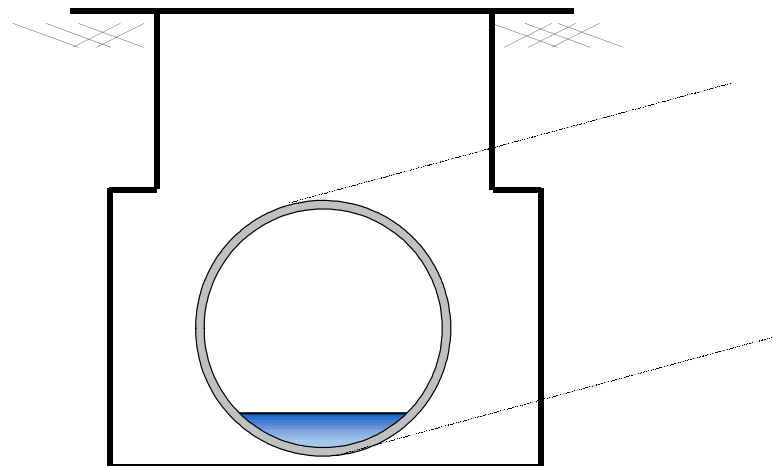
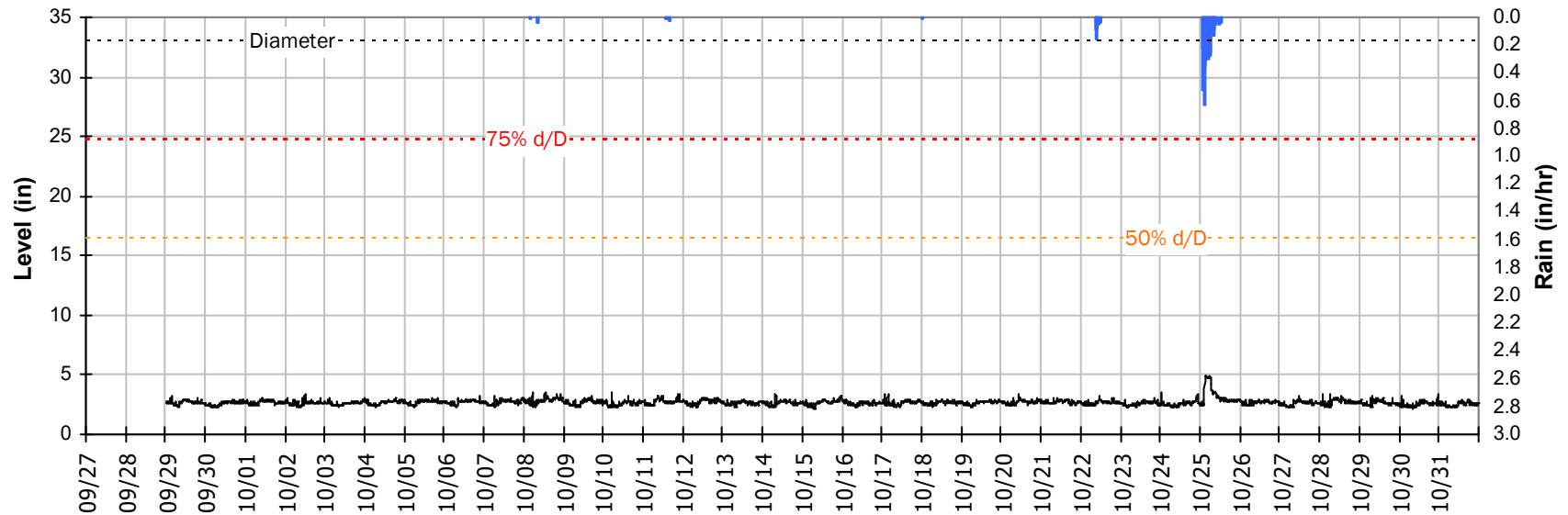
Average Dry Weather Flow Hydrographs



INDUSTRIAL-1

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

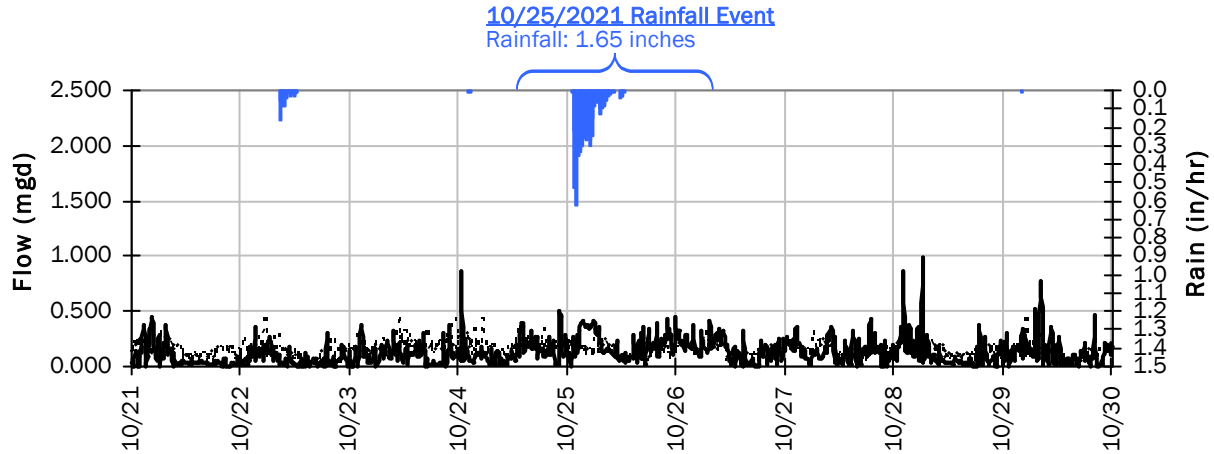


Pipe Diameter: 33 inches
Peak Measured Level: 4.95 inches
Peak d/D Ratio: 0.15

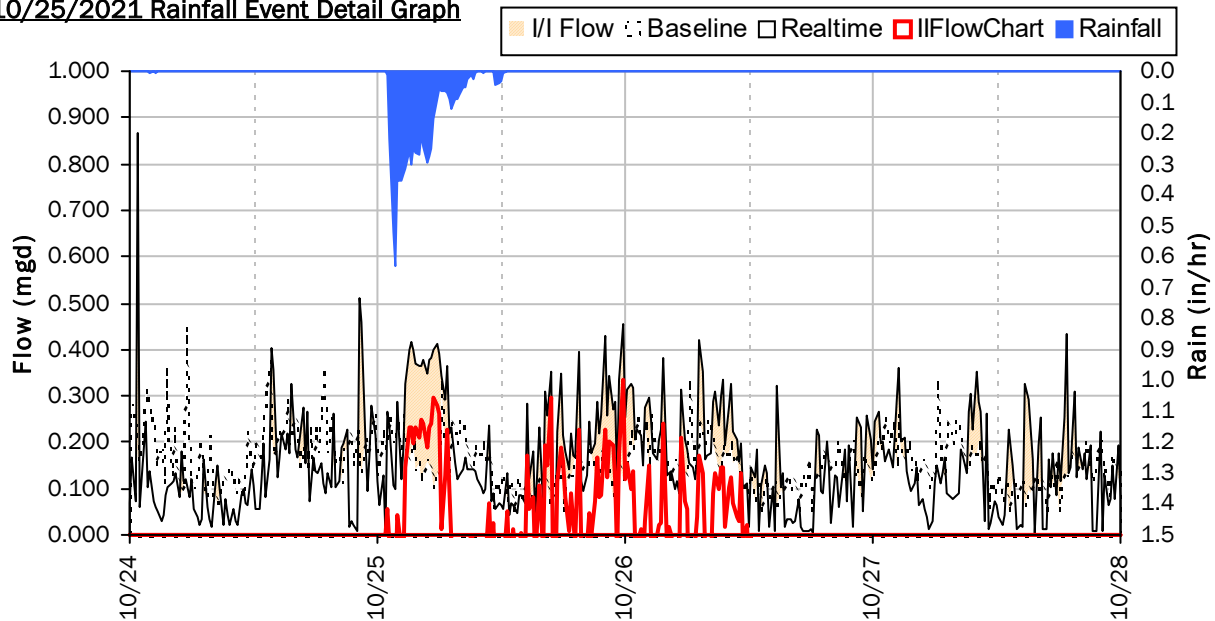
INDUSTRIAL-1

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



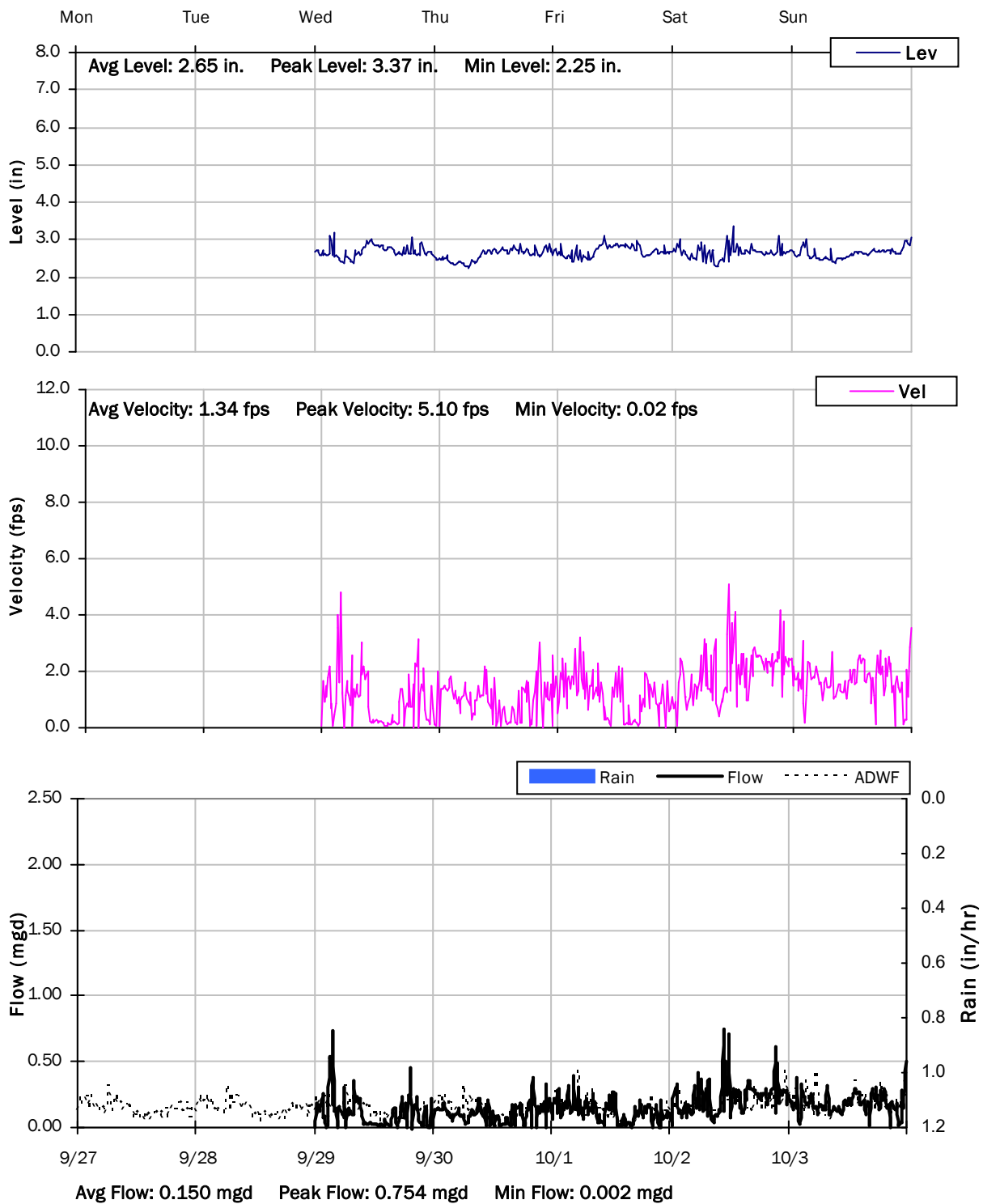
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.455 mgd	Peak I/I Rate:	0.334 mgd
PF:	2.91	Total I/I:	81,000 gallons
Peak Level:	4.95 in		
d/D Ratio:	0.15		

INDUSTRIAL-1

Weekly Level, Velocity and Flow Hydrographs

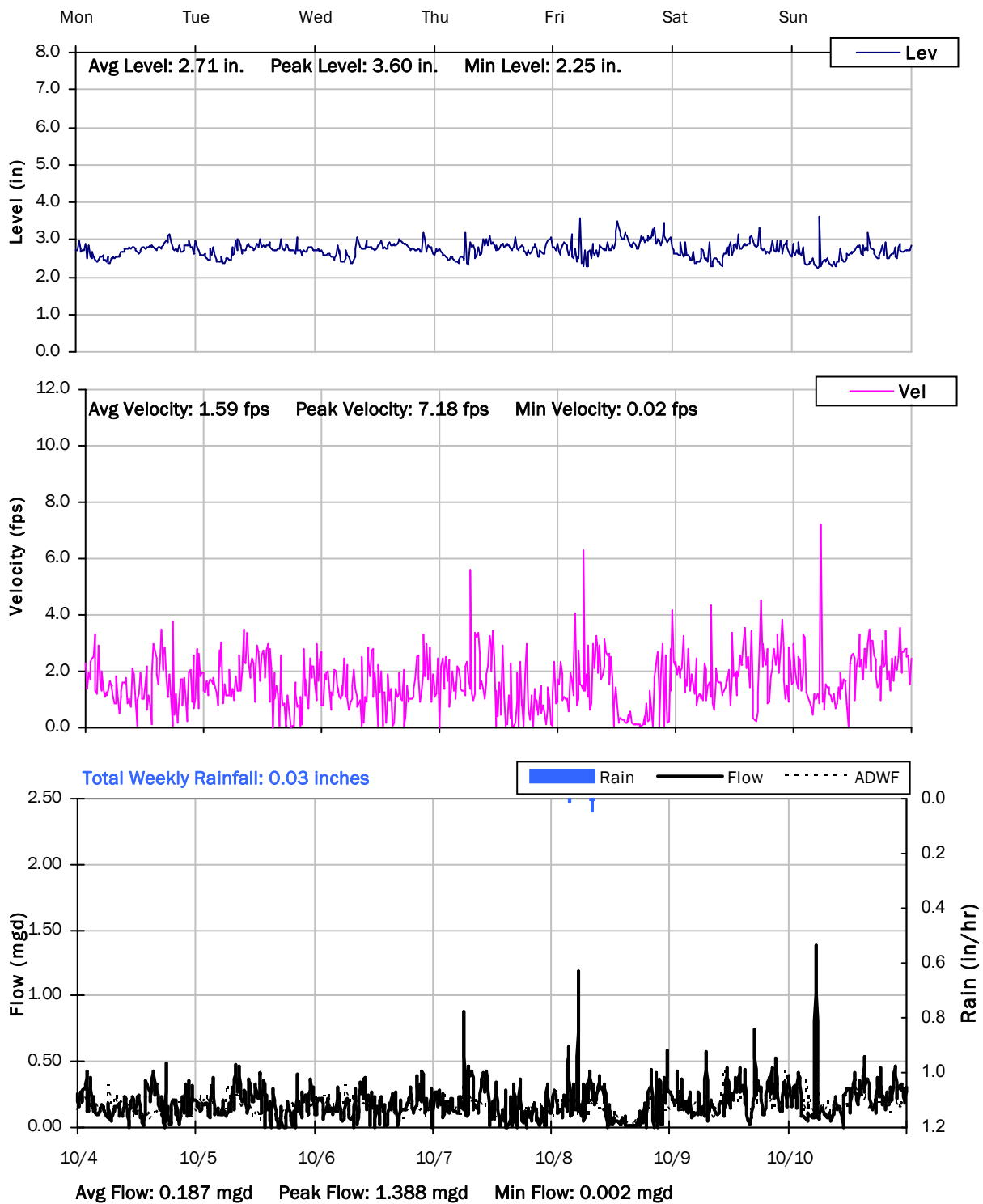
9/27/2021 to 10/4/2021



INDUSTRIAL-1

Weekly Level, Velocity and Flow Hydrographs

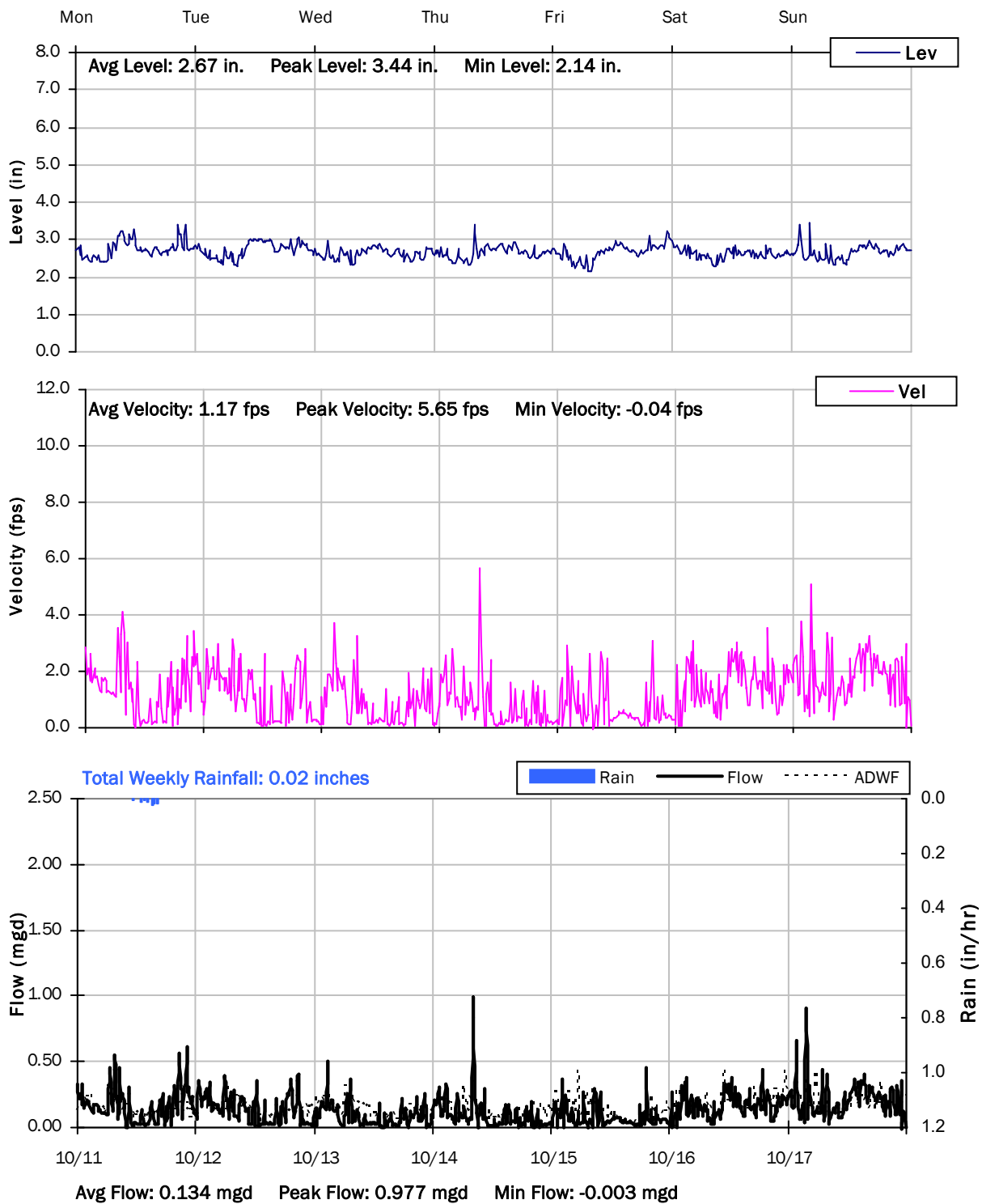
10/4/2021 to 10/11/2021



INDUSTRIAL-1

Weekly Level, Velocity and Flow Hydrographs

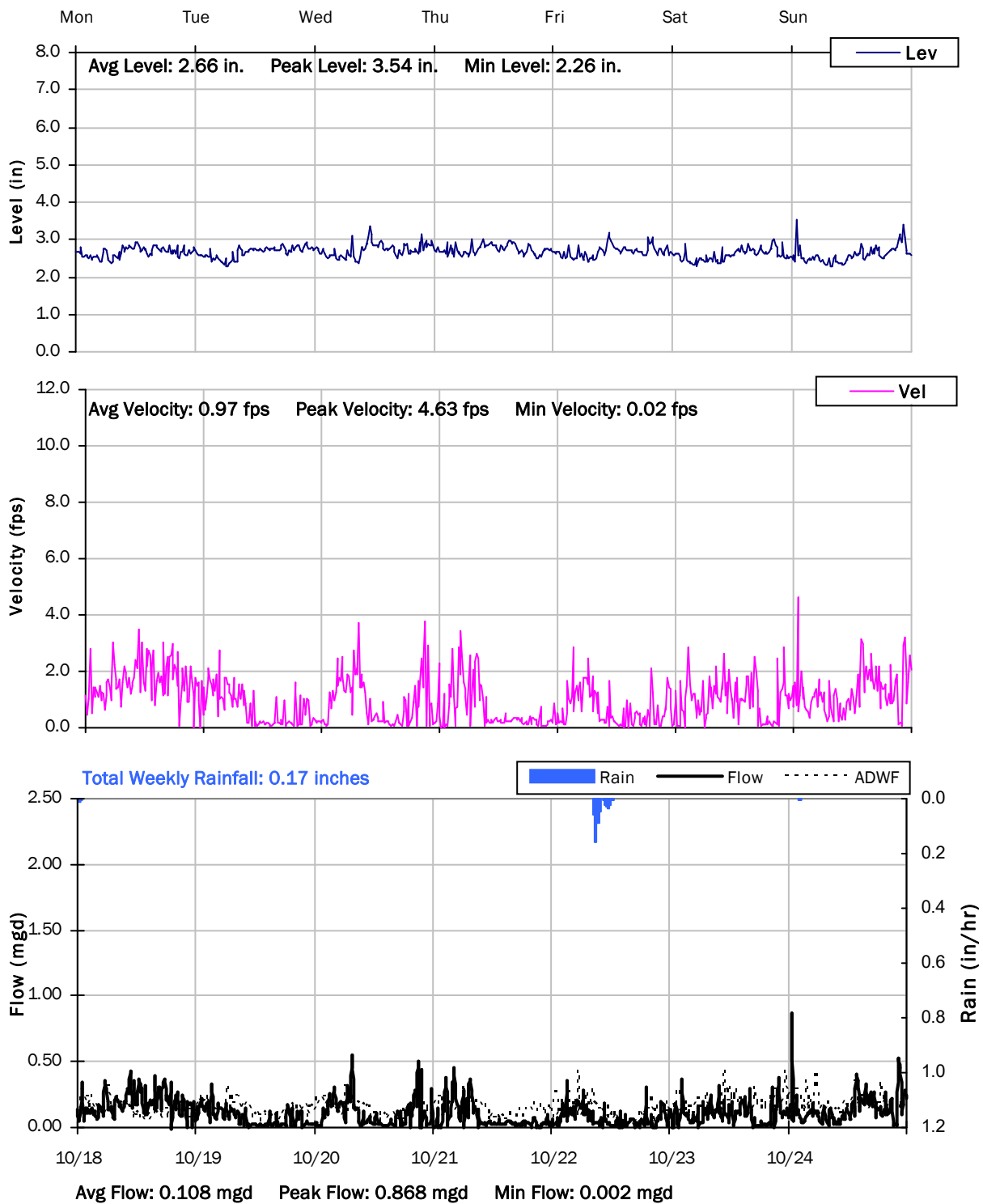
10/11/2021 to 10/18/2021



INDUSTRIAL-1

Weekly Level, Velocity and Flow Hydrographs

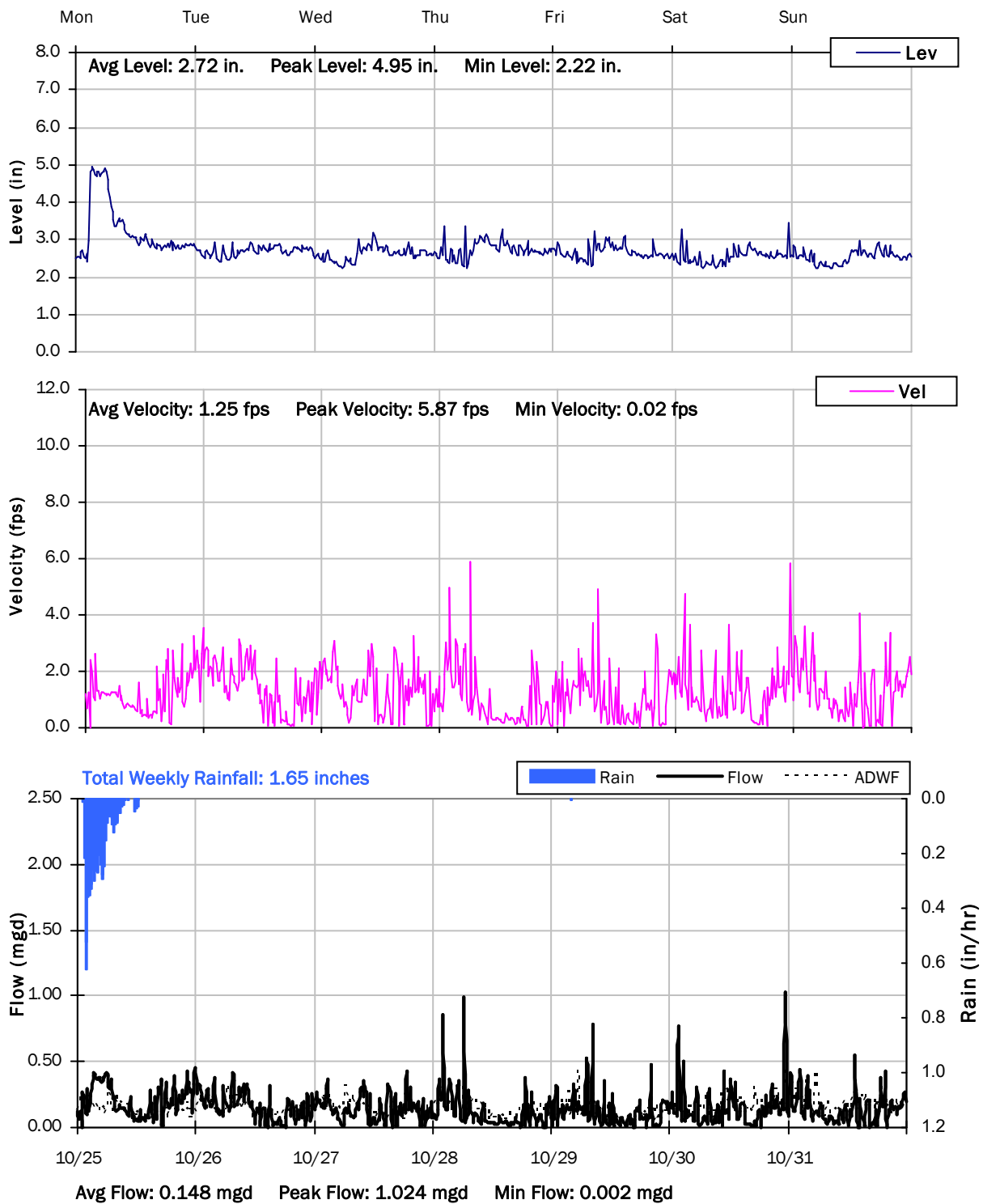
10/18/2021 to 10/25/2021



INDUSTRIAL-1

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



INDUSTRIAL-2

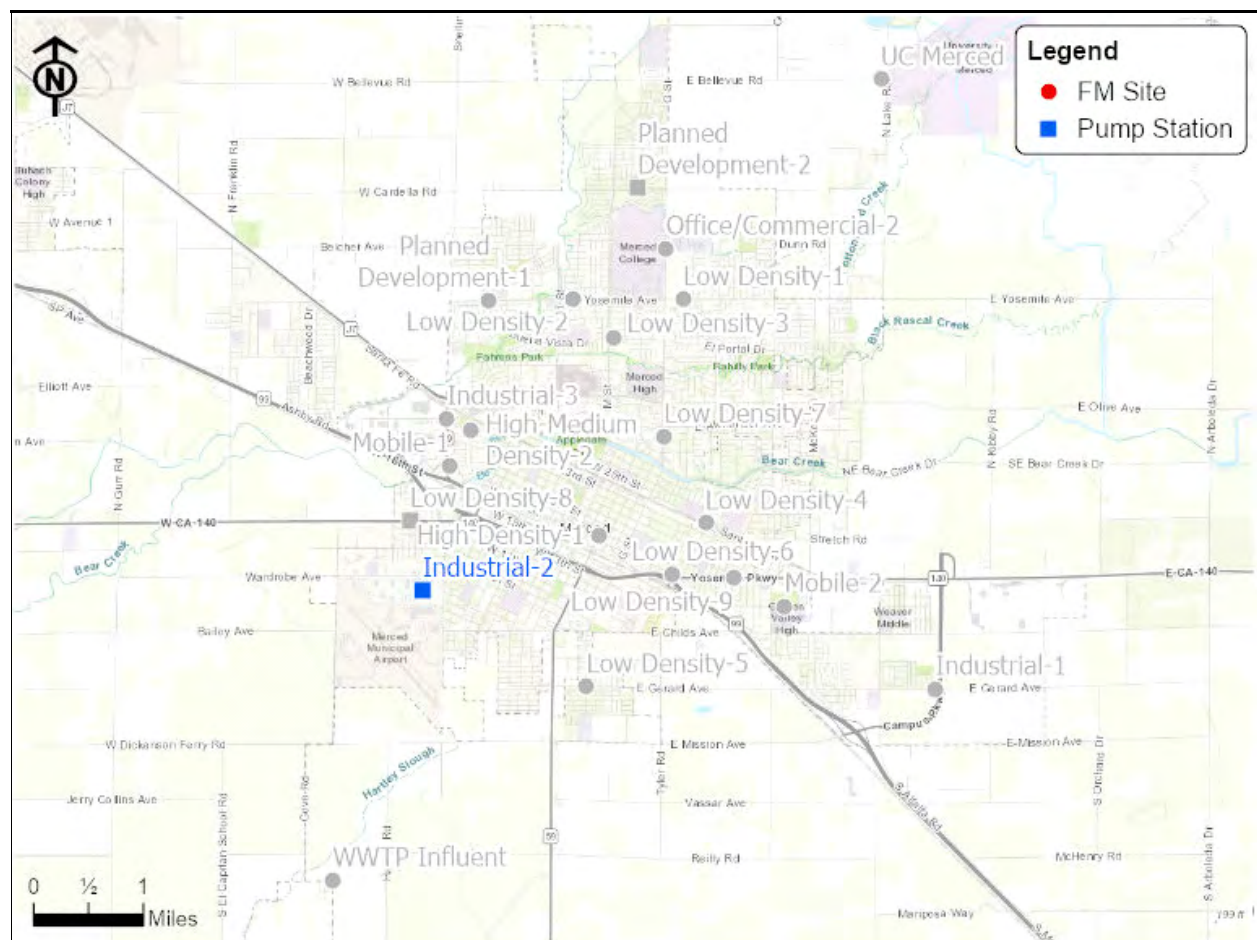
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Pump Station in field at Grogan Avenue and West Avenue

Data Summary Report



Vicinity Map: Industrial-2

INDUSTRIAL-2

Site Information

Location: Pump Station in field at Grogan Avenue and West Avenue

Coordinates: 120.5092° W, 37.2936° N

Rim Elevation (Earth): 159 feet

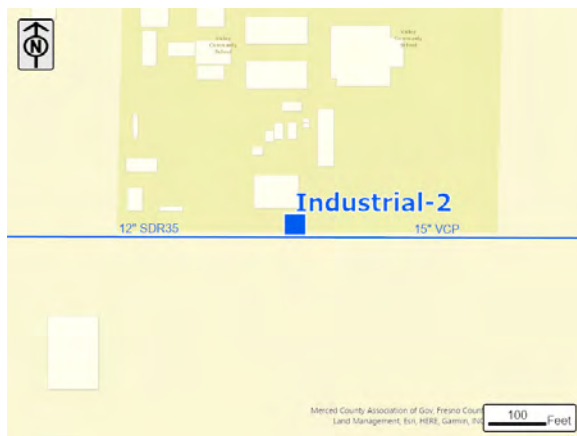
ADWF: 0.030 mgd

Peak Measured Flow: 0.163 mgd

Sediment: None



Satellite Map



Sanitary Map



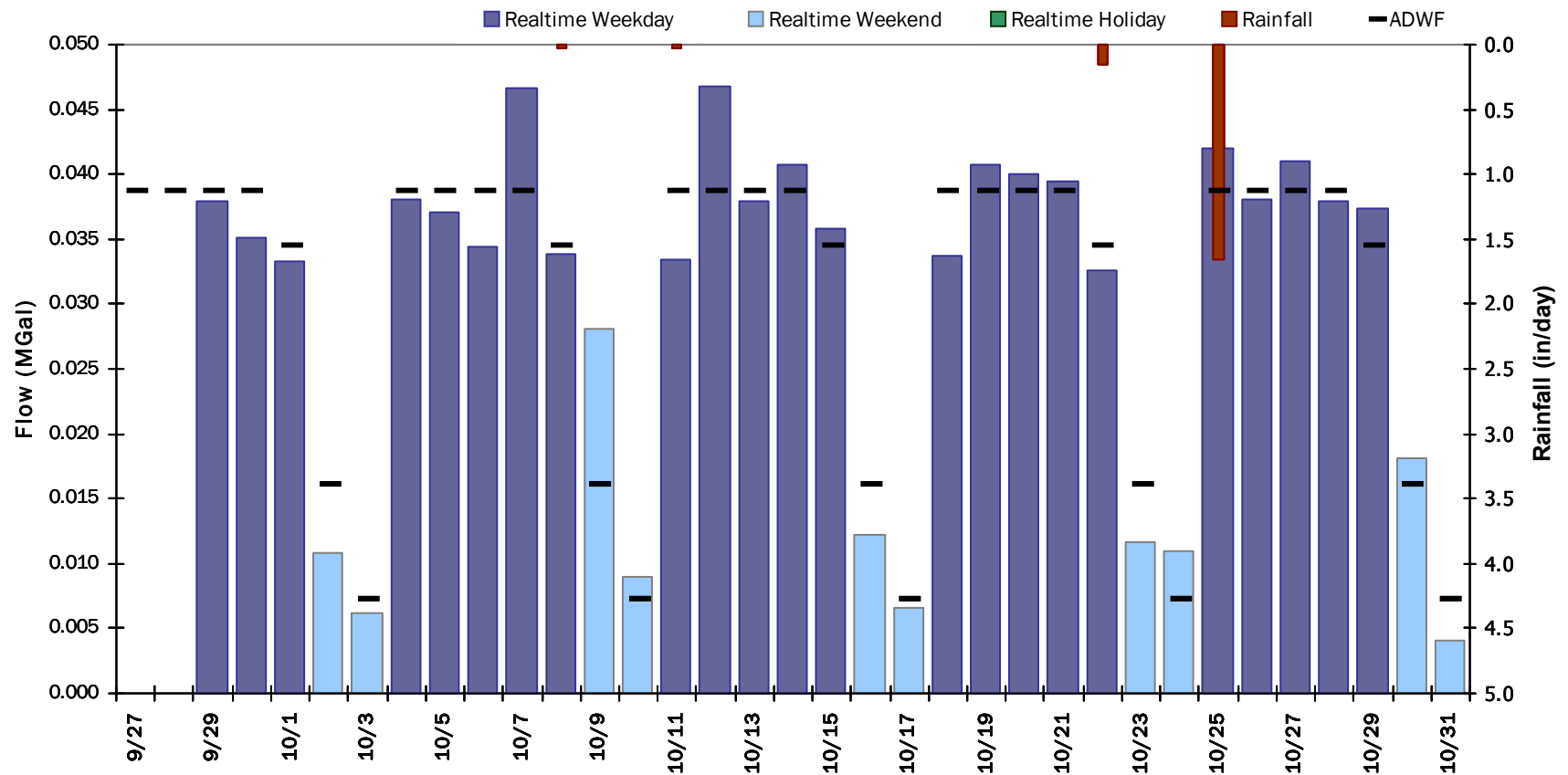
View from Street



Plan View

INDUSTRIAL-2

Period Flow Summary: Daily Flow Totals



INDUSTRIAL-2

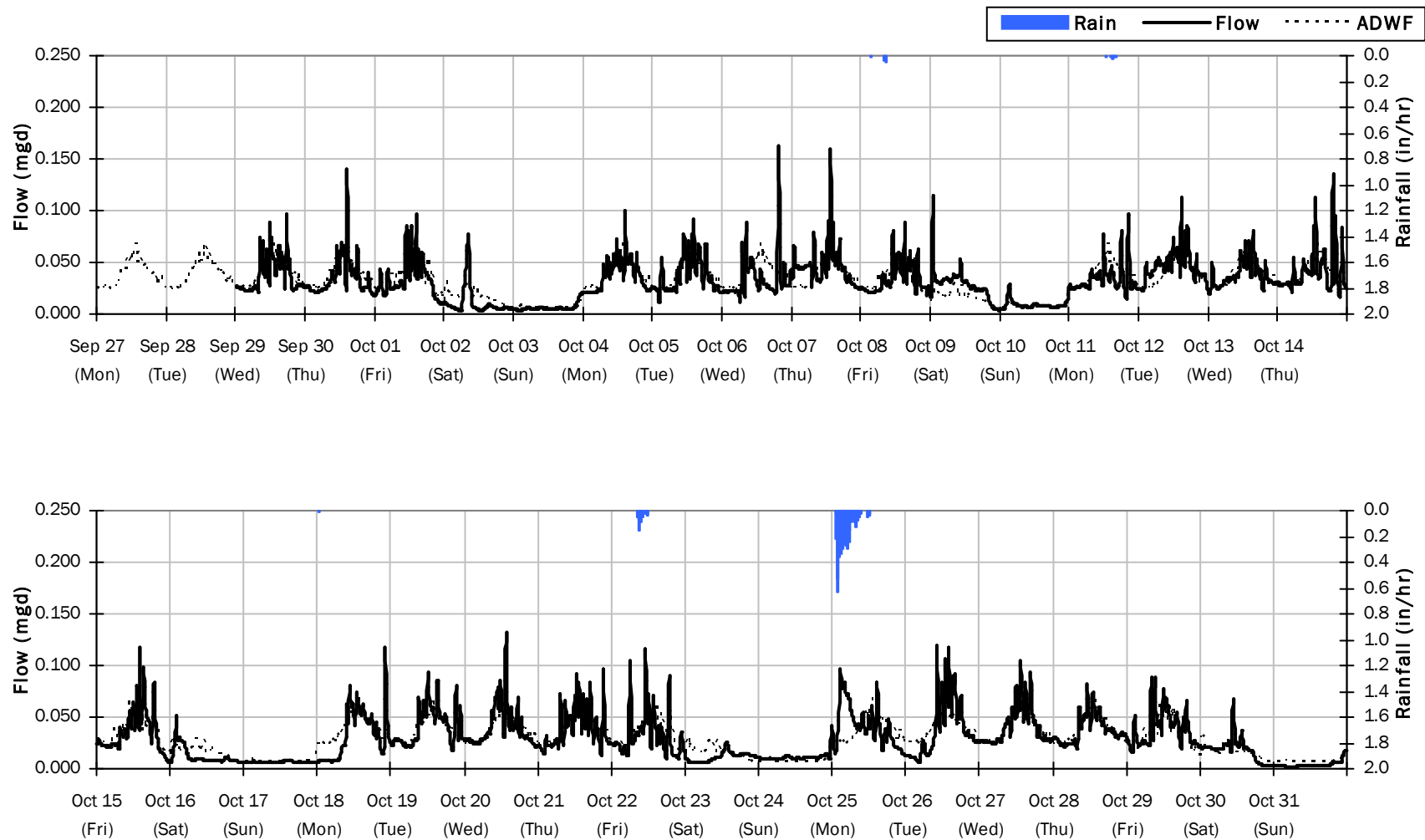
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.030 mgd

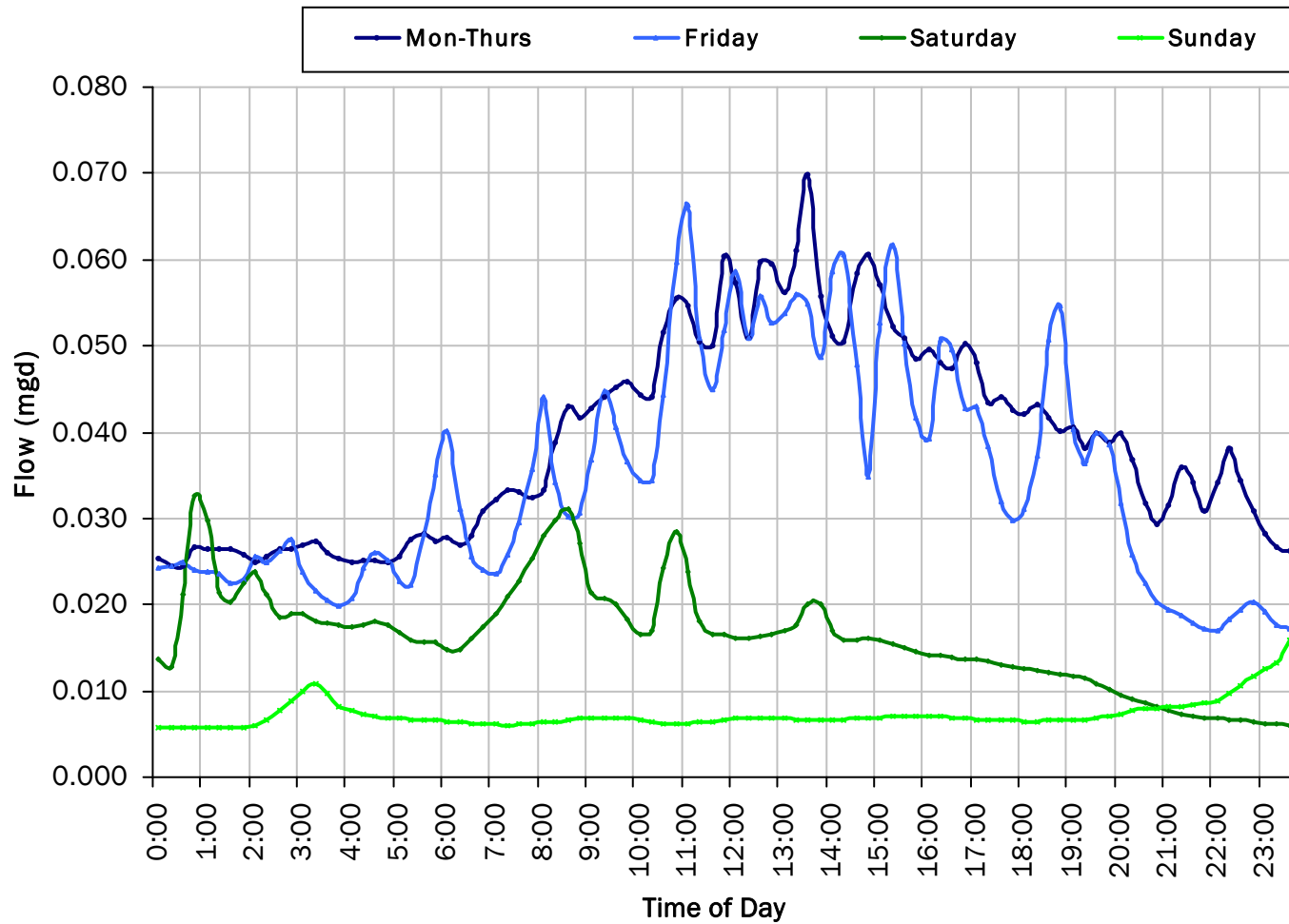
Period Peak Flow: 0.163 mgd

Period Min Flow: 0.002 mgd



INDUSTRIAL-2

Average Dry Weather Flow Hydrographs

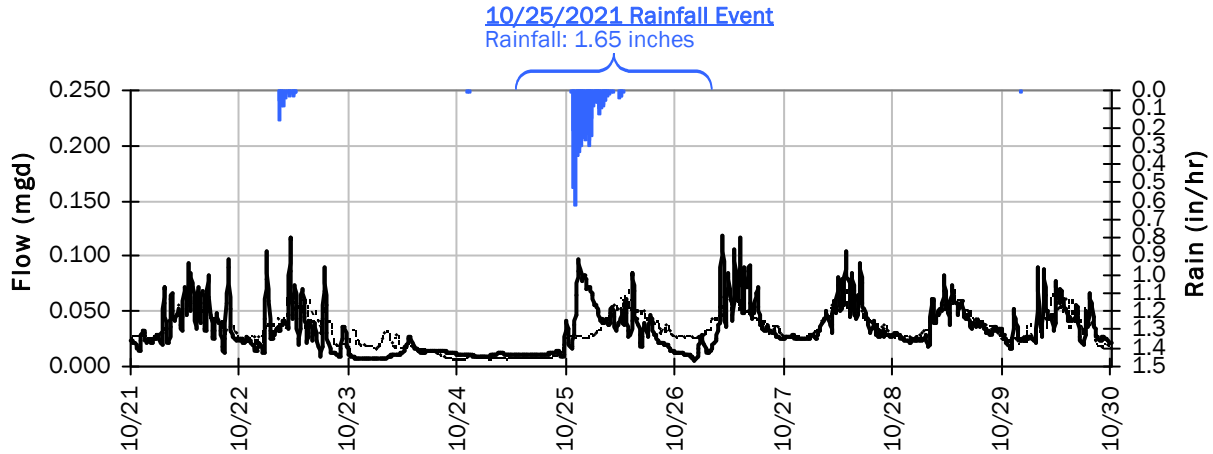


ADWF:
0.030 mgd

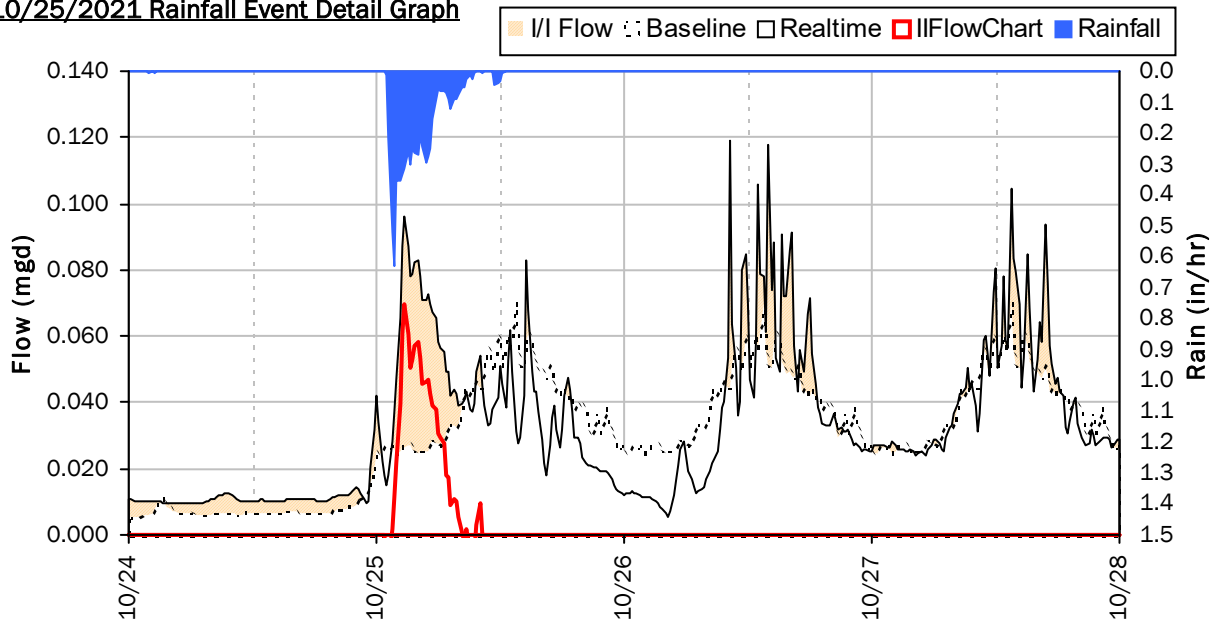
INDUSTRIAL-2

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.096 mgd
PF: 3.16

Peak Level: in
d/D Ratio:

Inflow / Infiltration

Peak I/I Rate: 0.070 mgd
Total I/I: 10,000 gallons

INDUSTRIAL-3

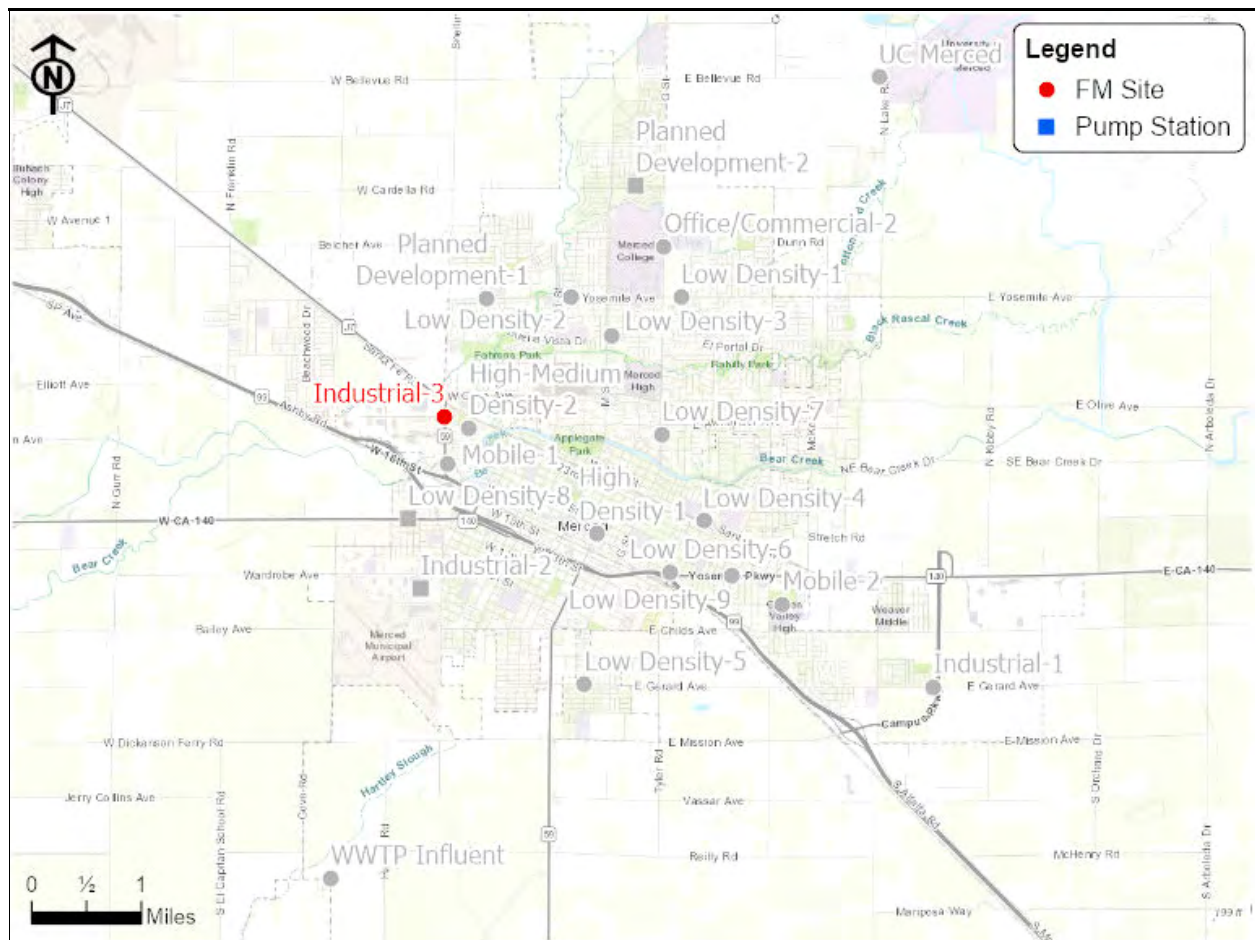
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Intersection of Cooper Avenue and Snelling Highway

Data Summary Report



Vicinity Map: Industrial-3

INDUSTRIAL-3

Site Information

Location: Intersection of Cooper Avenue and Snelling Highway

Coordinates: 120.5052° W, 37.3164° N

Rim Elevation (Earth): 164 feet

Measured Pipe Diameter: 12 inches

ADWF: 0.345 mgd

Peak Measured Flow: 0.880 mgd

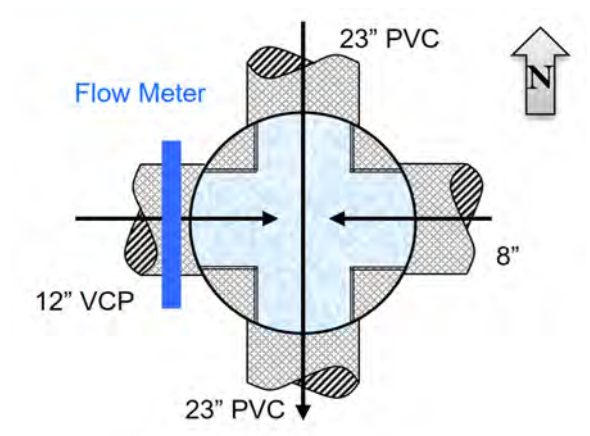
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

INDUSTRIAL-3

Additional Site Photos

Effluent Pipe



Monitored West Influent Pipe



INDUSTRIAL-3

Additional Site Photos

North Influent Pipe



East Influent Pipe

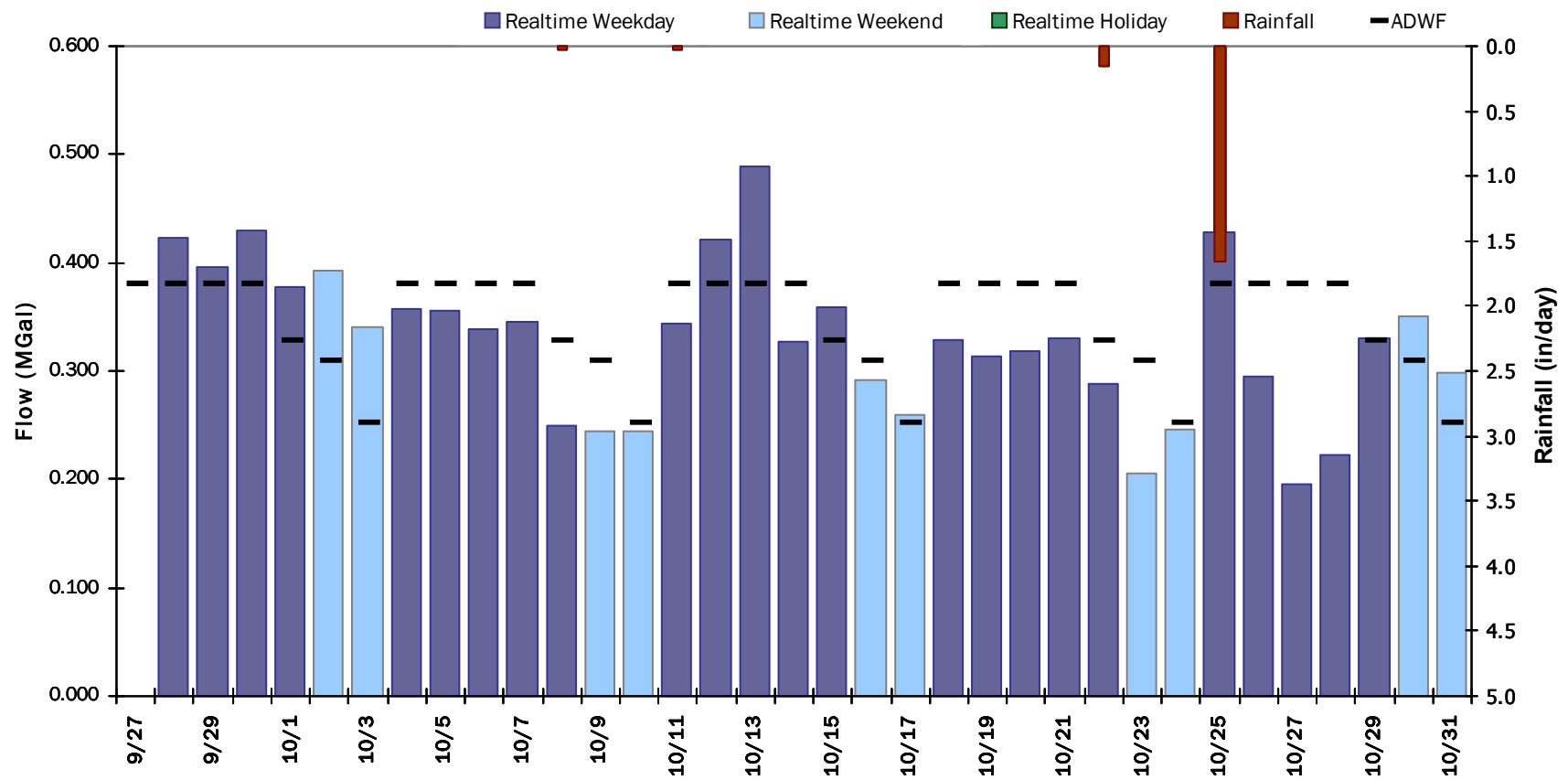


INDUSTRIAL-3

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.327 MGal Peak Daily Flow: 0.488 MGal Min Daily Flow: 0.196 MGal

Total Rainfall: 1.87 inches



INDUSTRIAL-3

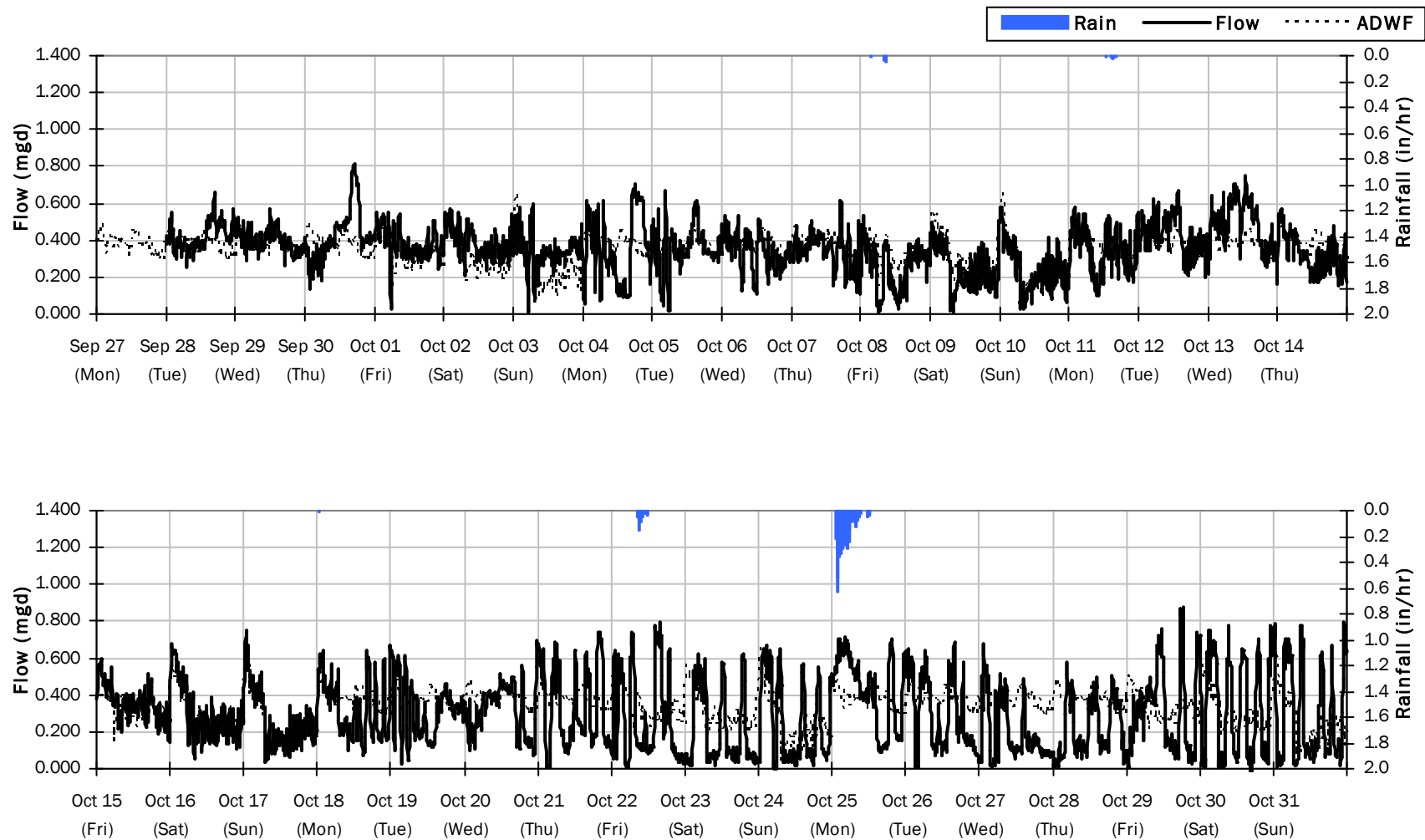
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.327 mgd

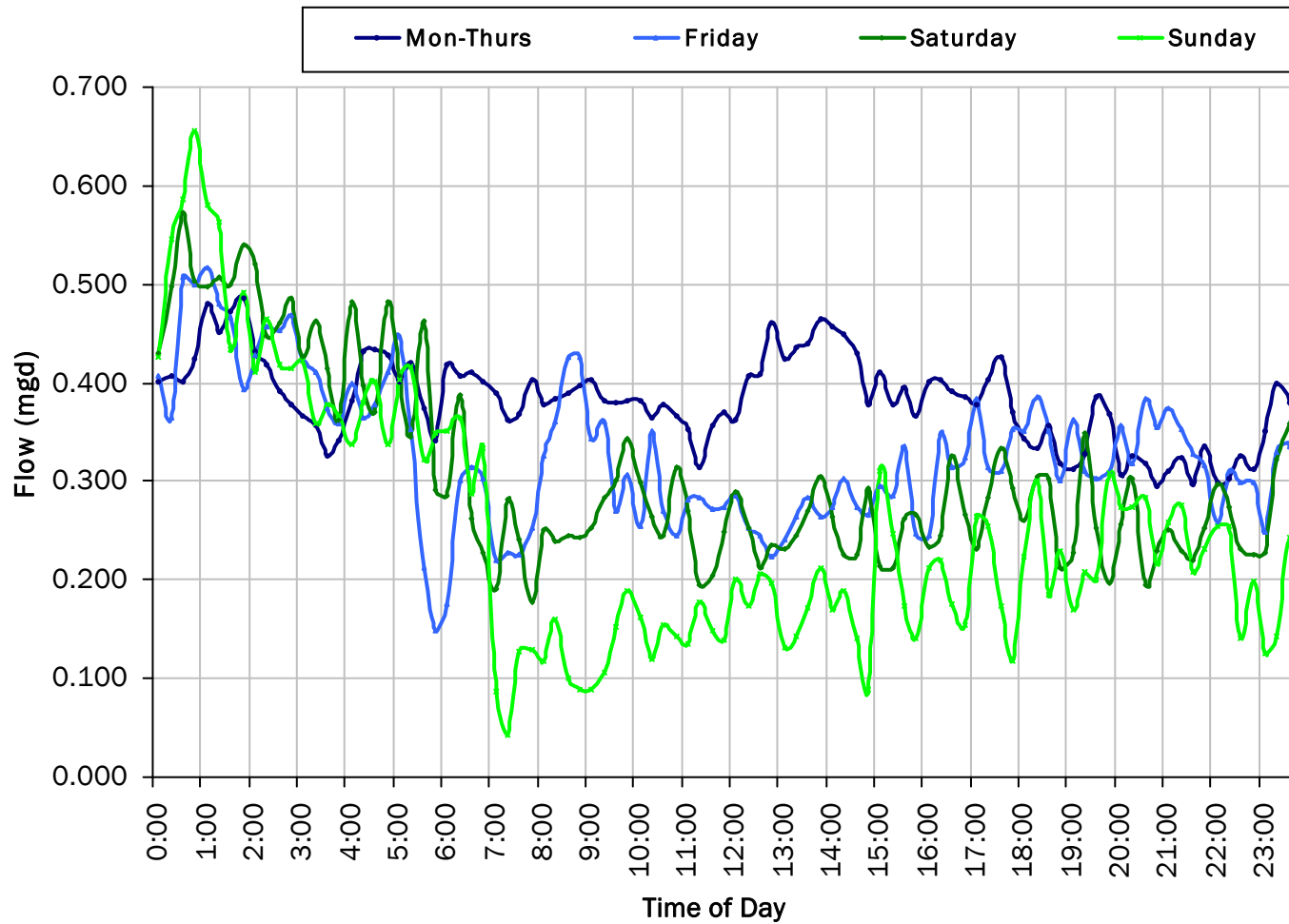
Period Peak Flow: 0.880 mgd

Period Min Flow: -0.093 mgd

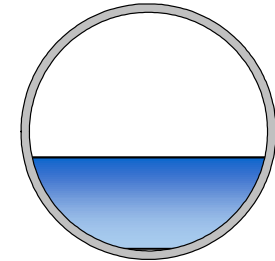


INDUSTRIAL-3

Average Dry Weather Flow Hydrographs



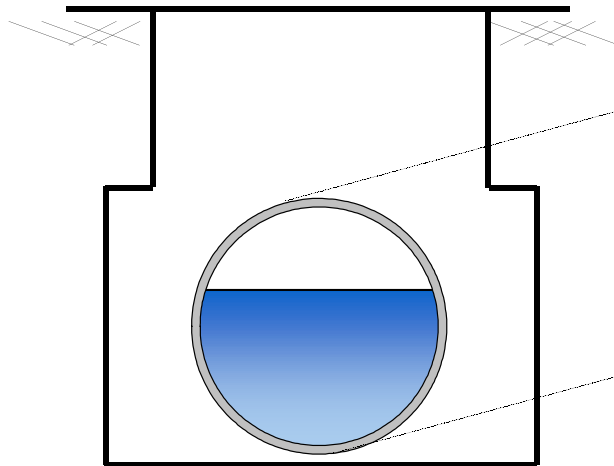
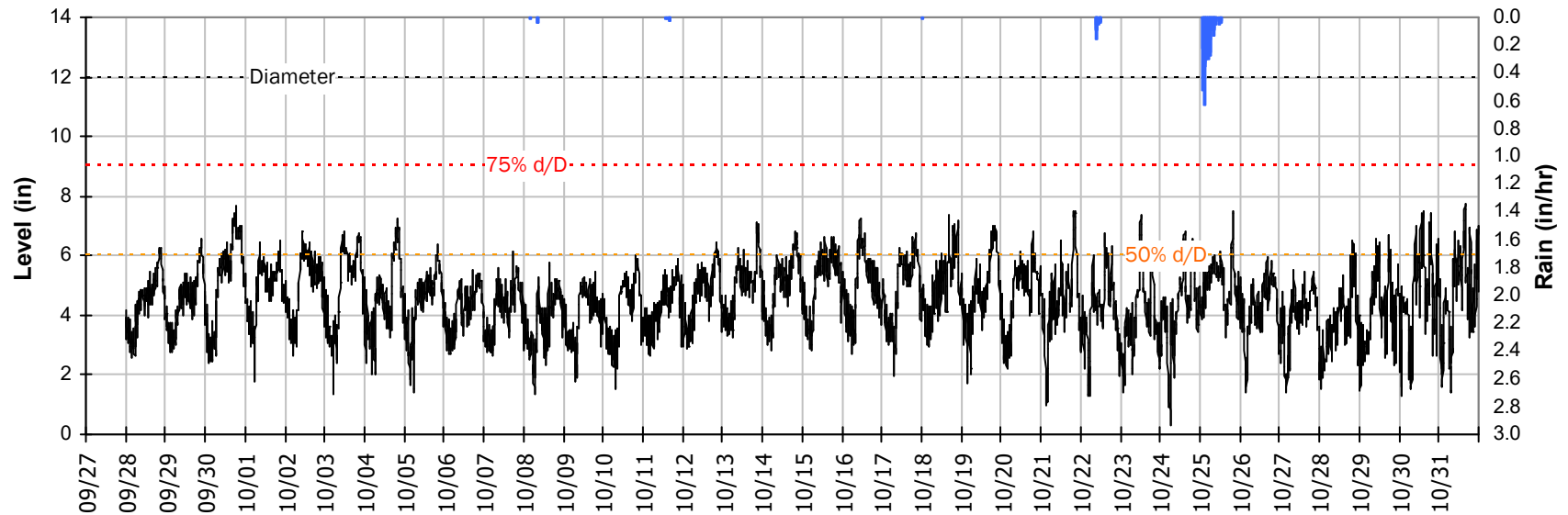
ADWF:
0.345 mgd



INDUSTRIAL-3

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

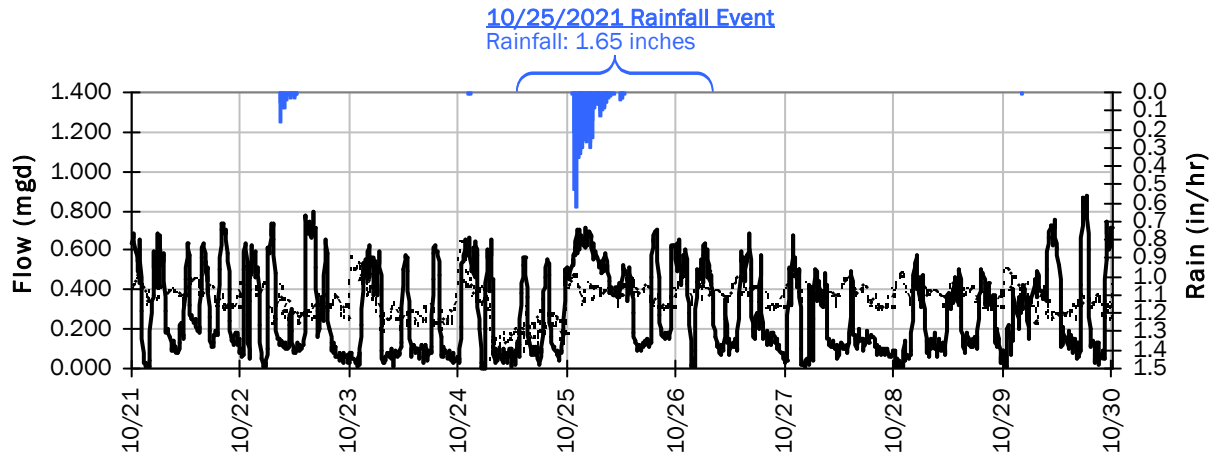


Pipe Diameter: 12 inches
Peak Measured Level: 7.74 inches
Peak d/D Ratio: 0.65

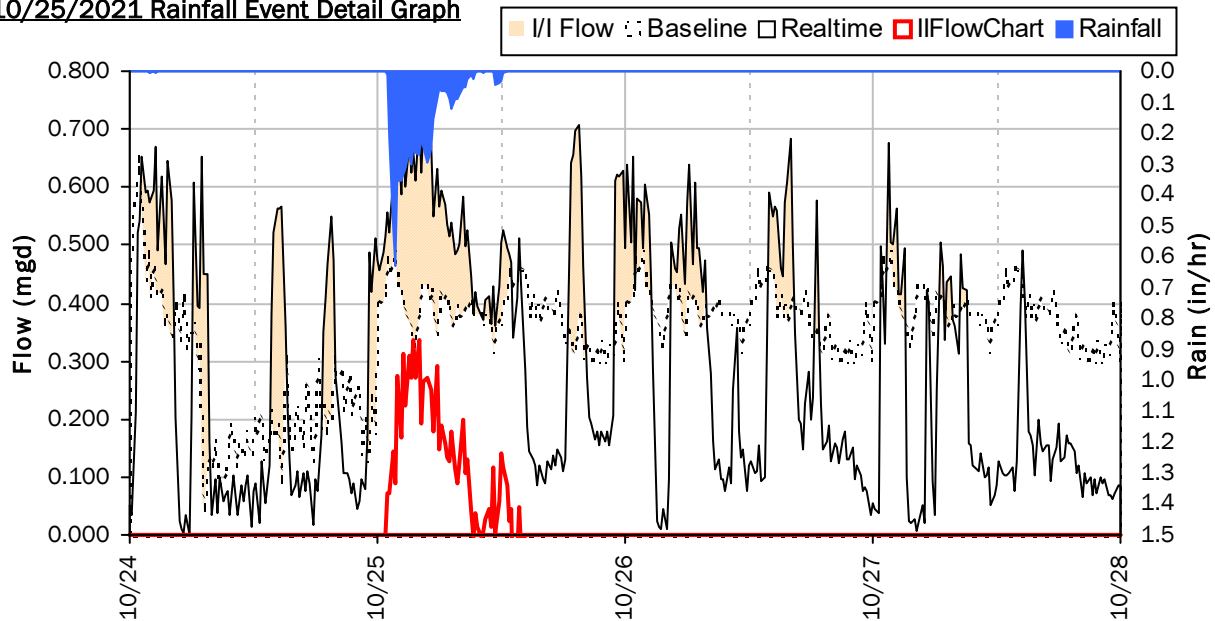
INDUSTRIAL-3

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.717 mgd
PF: 2.08

Peak Level: 6.17 in
d/D Ratio: 0.51

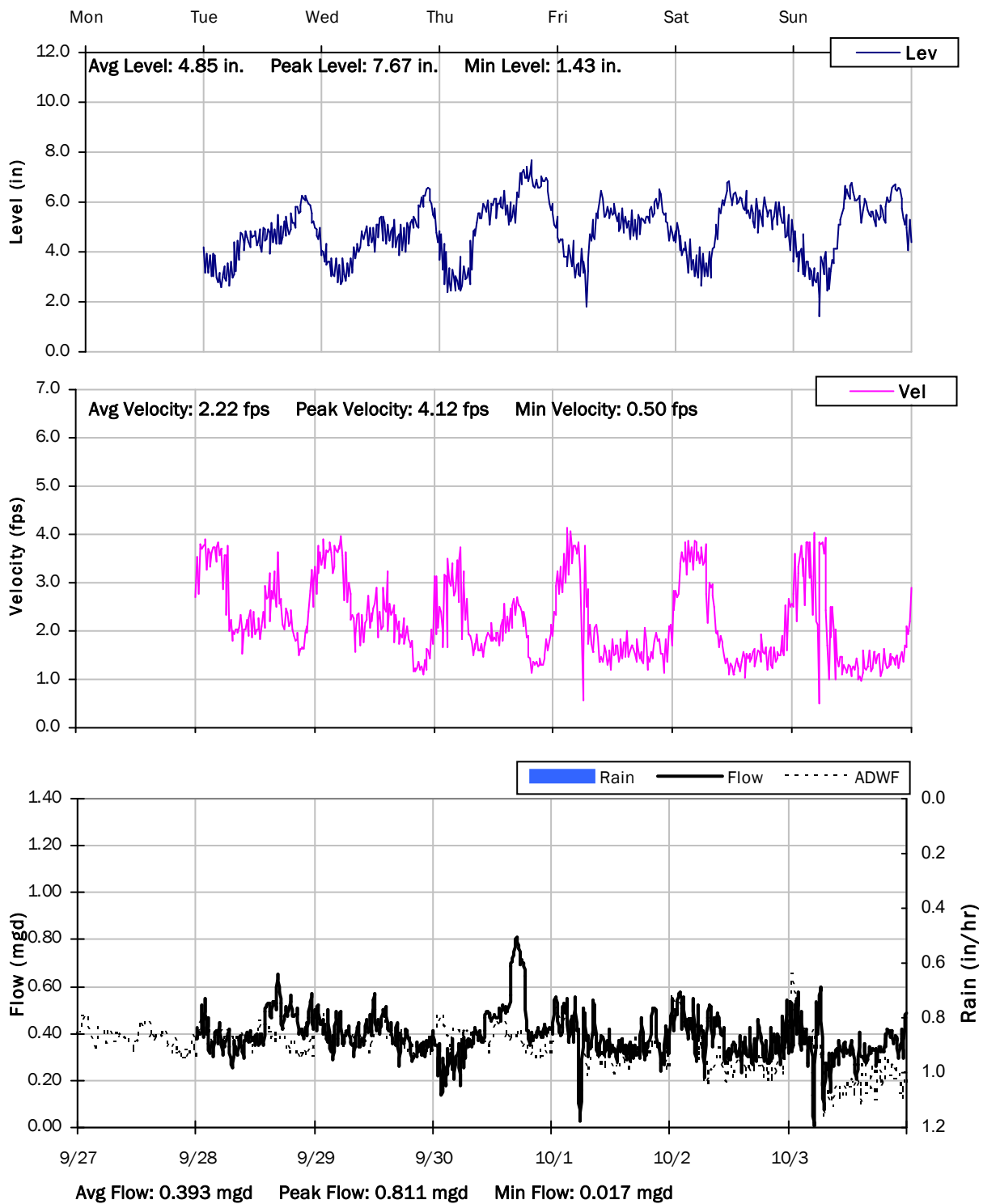
Inflow / Infiltration

Peak I/I Rate: 0.337 mgd
Total I/I: 72,000 gallons

INDUSTRIAL-3

Weekly Level, Velocity and Flow Hydrographs

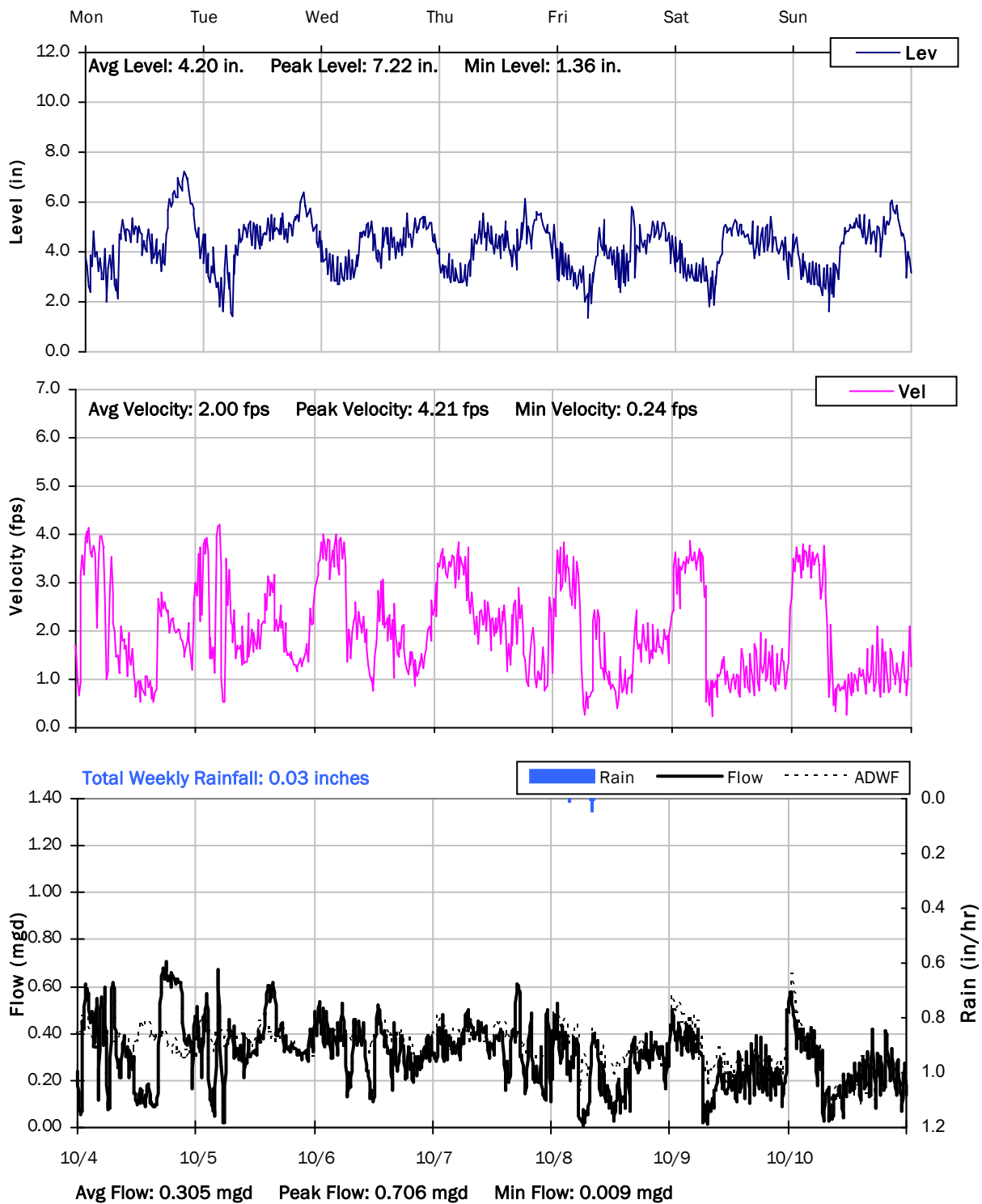
9/27/2021 to 10/4/2021



INDUSTRIAL-3

Weekly Level, Velocity and Flow Hydrographs

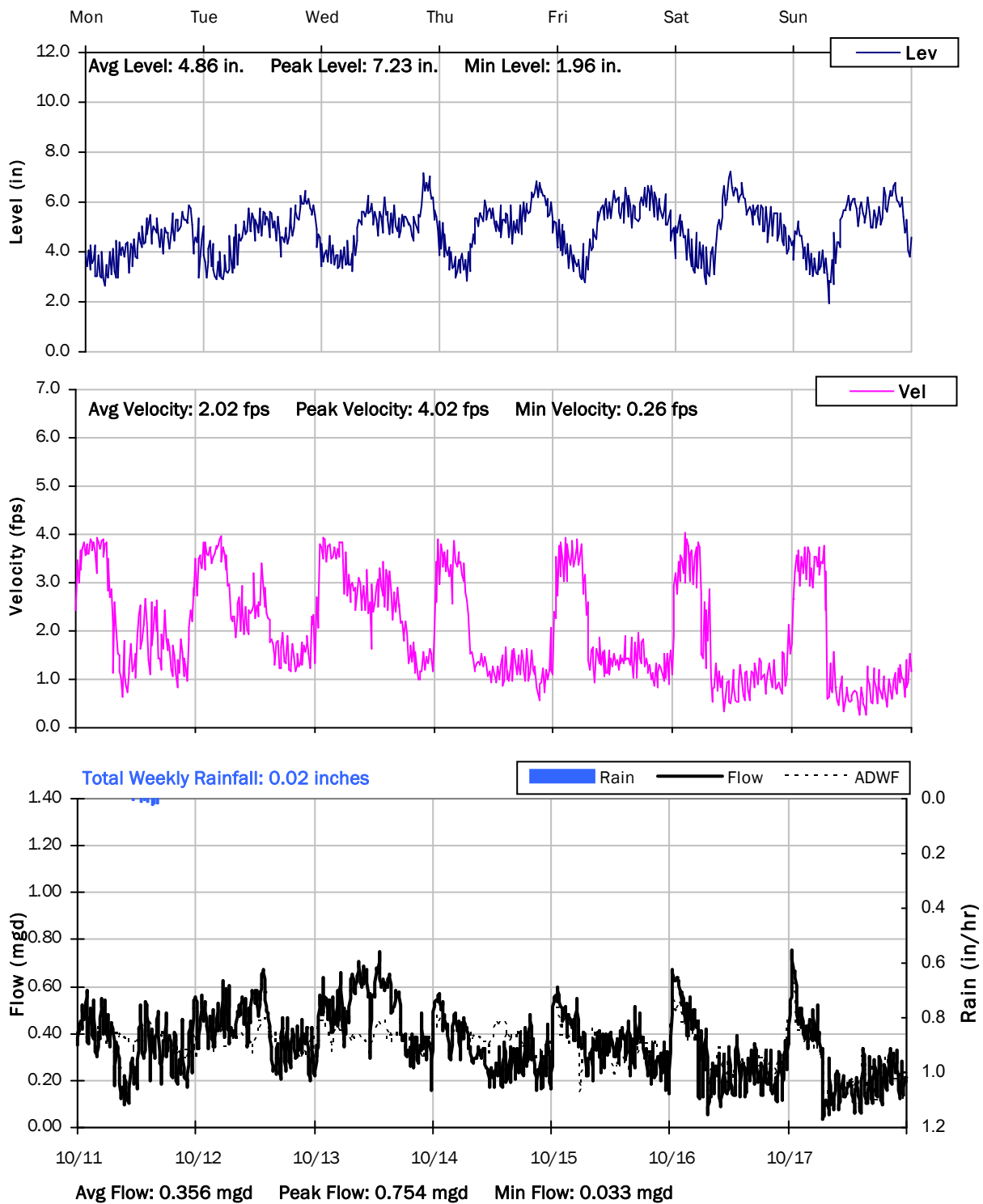
10/4/2021 to 10/11/2021



INDUSTRIAL-3

Weekly Level, Velocity and Flow Hydrographs

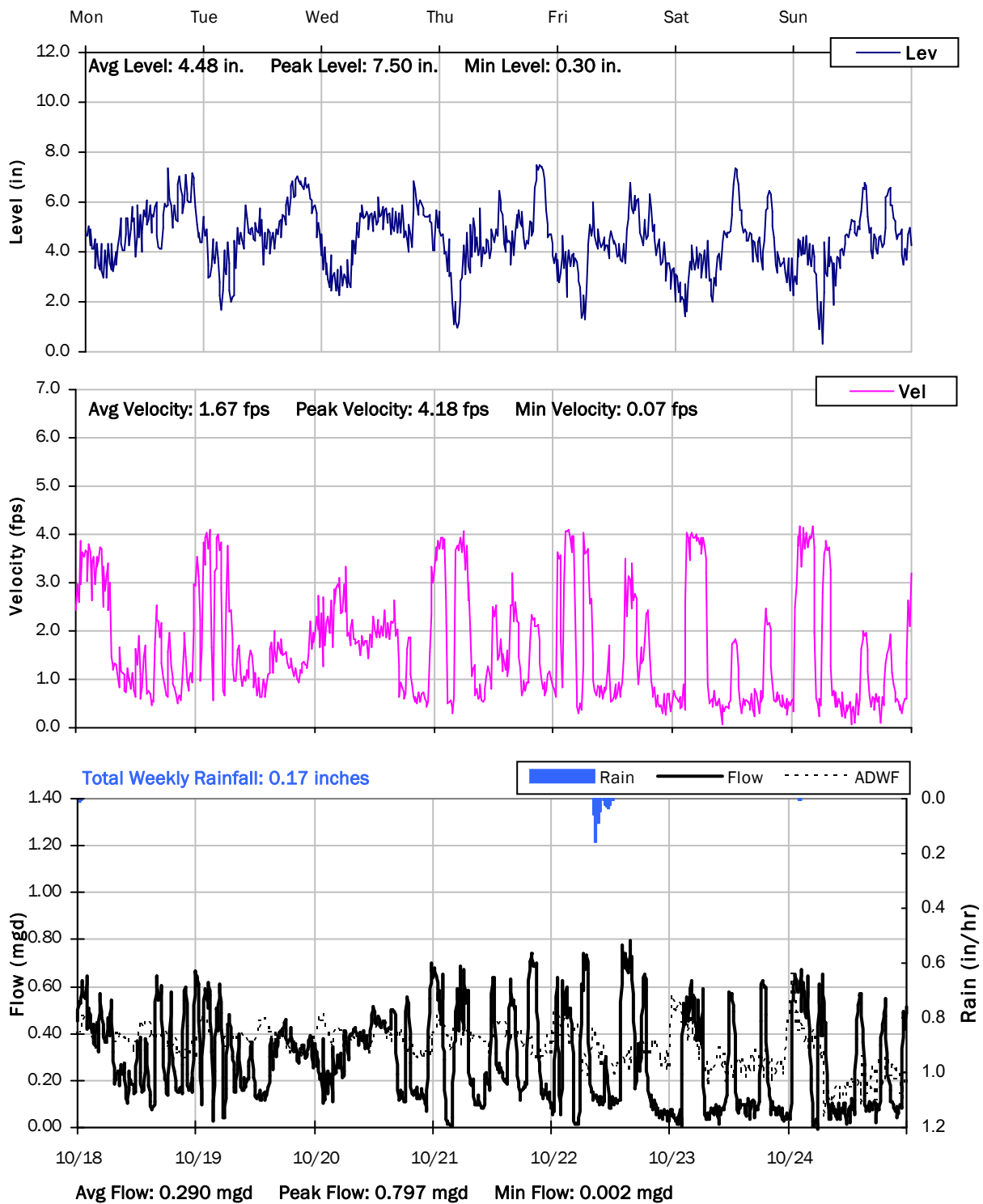
10/11/2021 to 10/18/2021



INDUSTRIAL-3

Weekly Level, Velocity and Flow Hydrographs

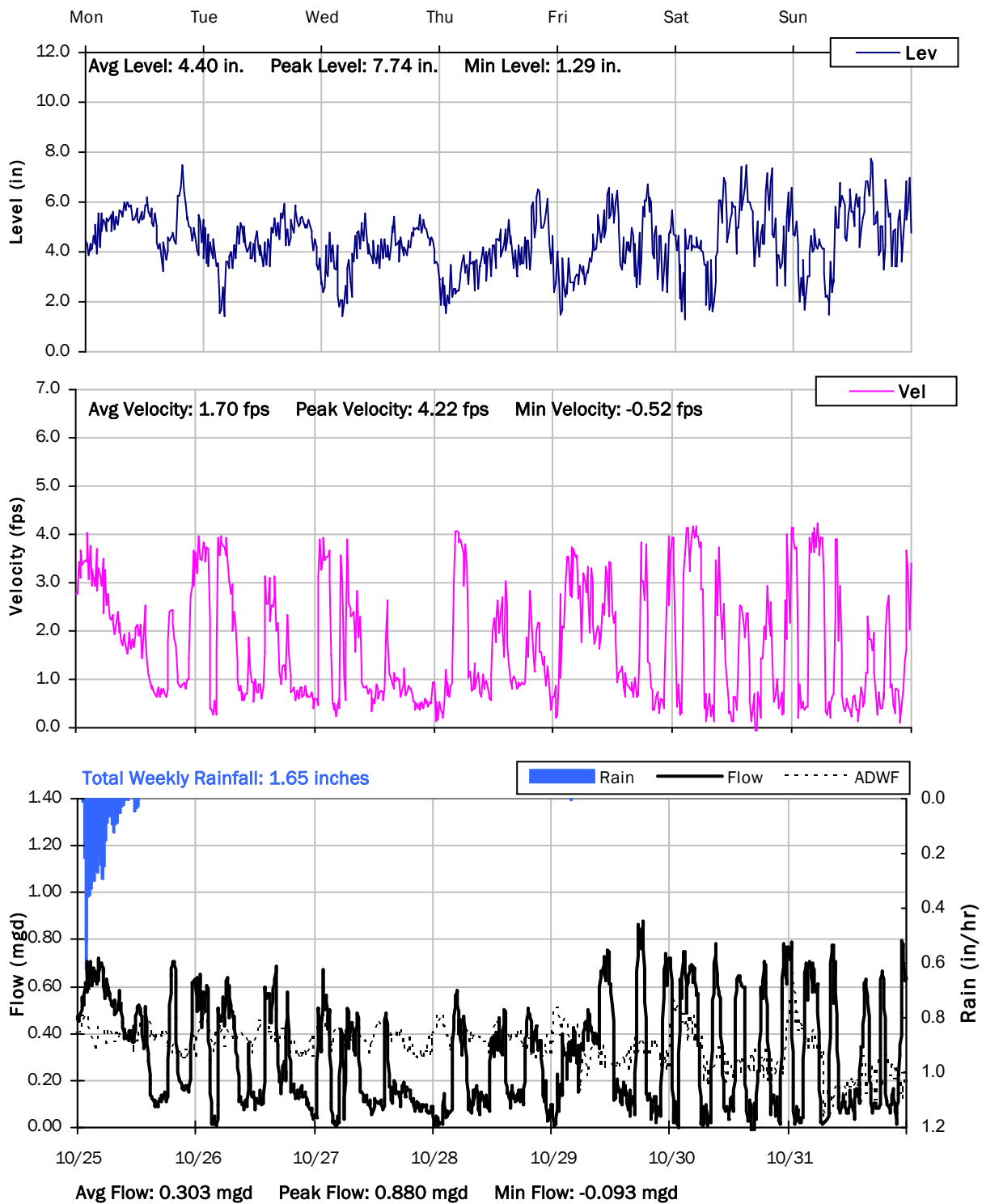
10/18/2021 to 10/25/2021



INDUSTRIAL-3

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



OFFICE/COMMERCIAL-2

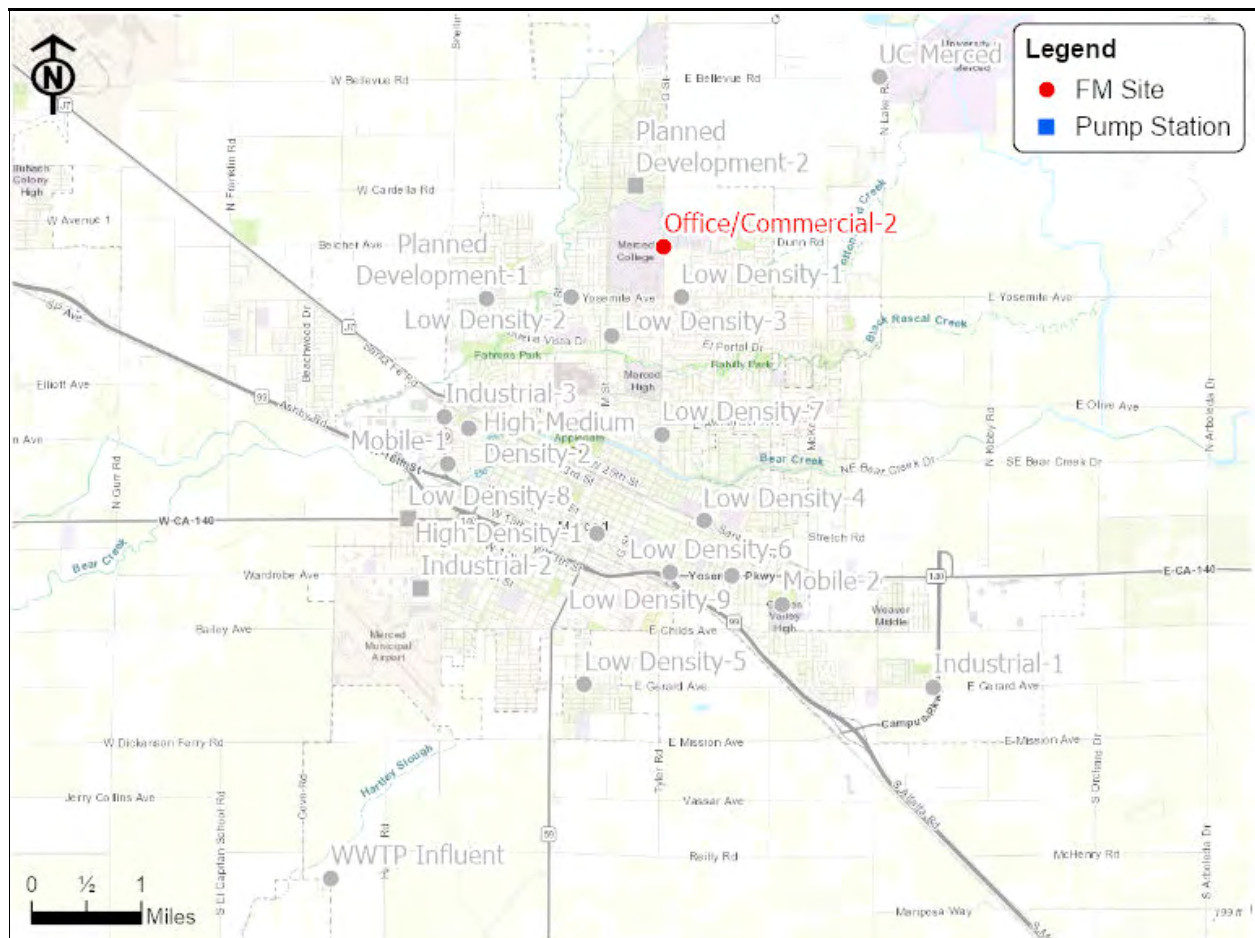
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Intersection of G Street and Mercy Avenue

Data Summary Report



Vicinity Map: Office/Commercial-2

OFFICE/COMMERCIAL-2

Site Information

Location: Intersection of G Street and Mercy Avenue

Coordinates: 120.4689° W, 37.3389° N

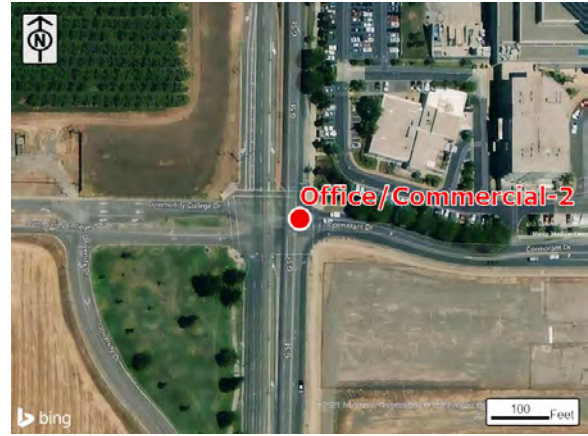
Rim Elevation (Earth): 182 feet

Measured Pipe Diameter: 10 inches

ADWF: 0.006 mgd

Peak Measured Flow: 0.027 mgd

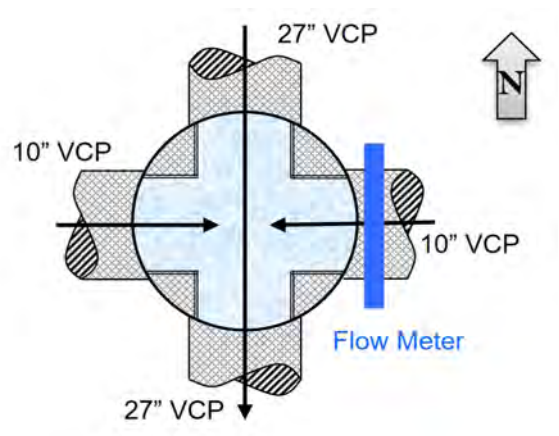
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

OFFICE/COMMERCIAL-2

Additional Site Photos

Effluent Pipe



Monitored East Influent Pipe



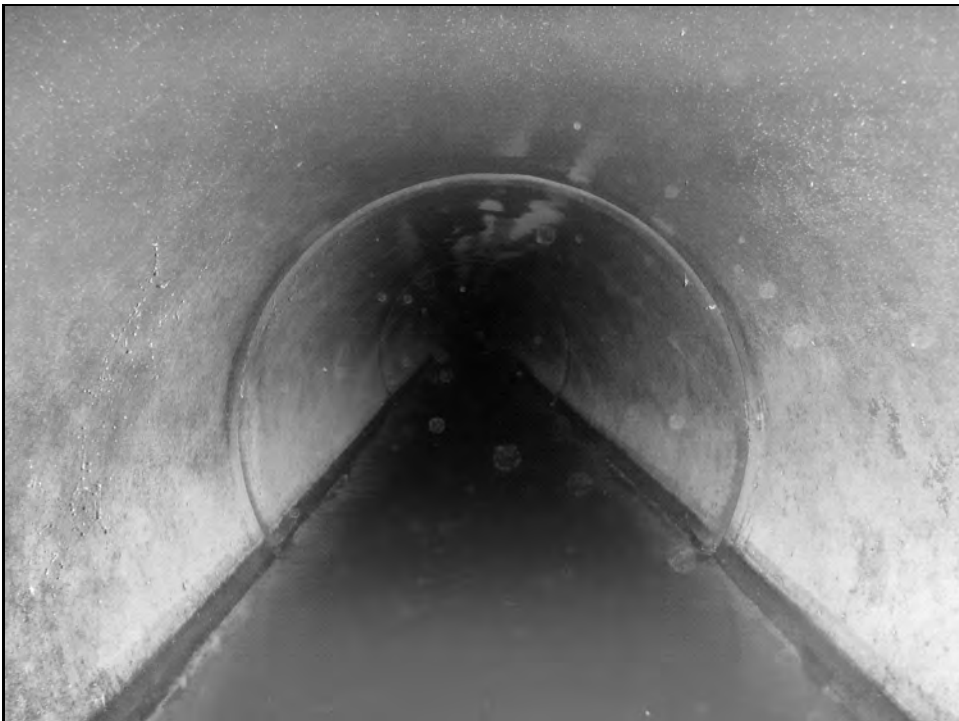
OFFICE/COMMERCIAL-2

Additional Site Photos

West Influent Pipe



North Influent Pipe

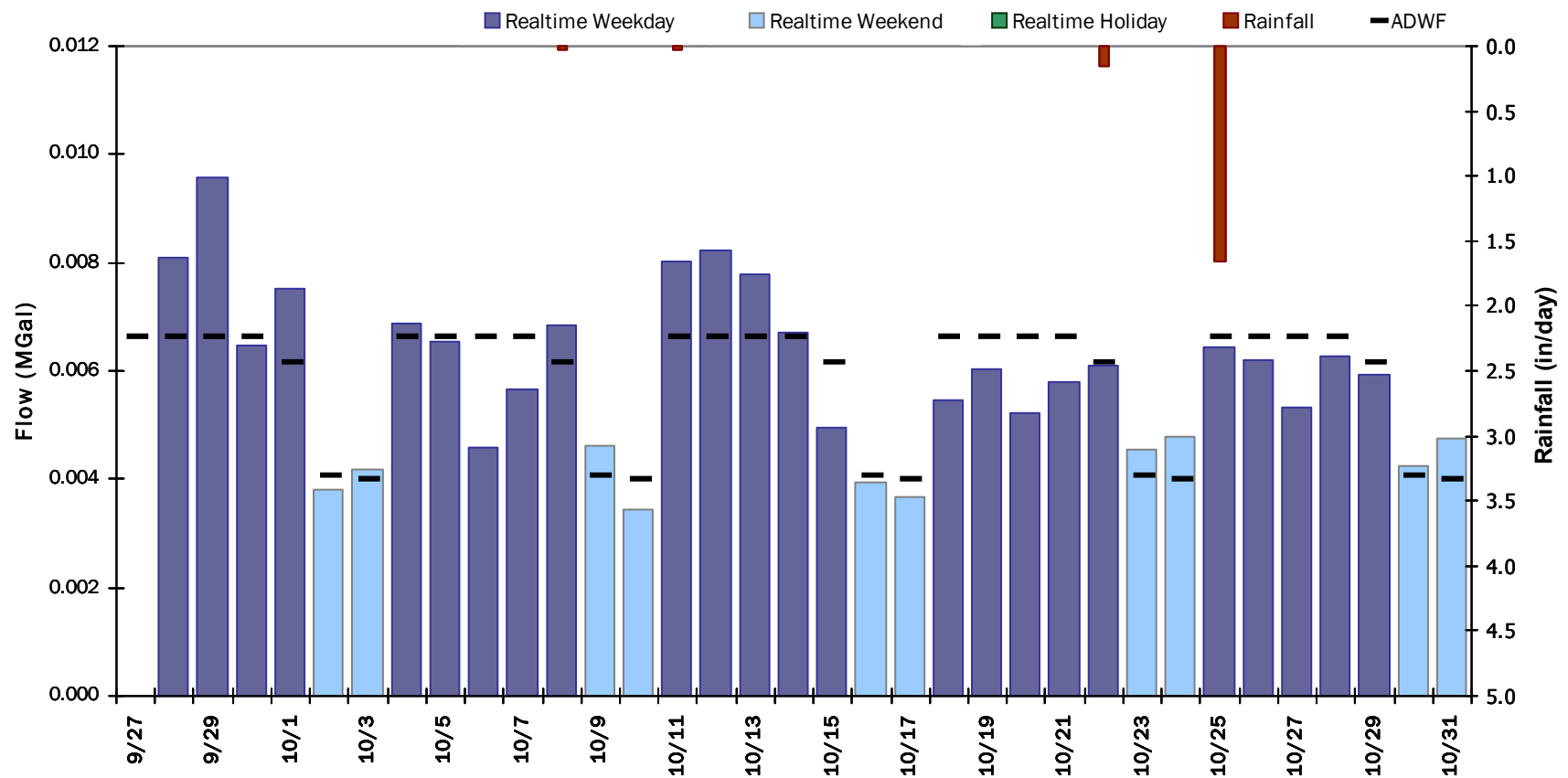


OFFICE/COMMERCIAL-2

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.006 MGal Peak Daily Flow: 0.010 MGal Min Daily Flow: 0.003 MGal

Total Rainfall: 1.87 inches



OFFICE/COMMERCIAL-2

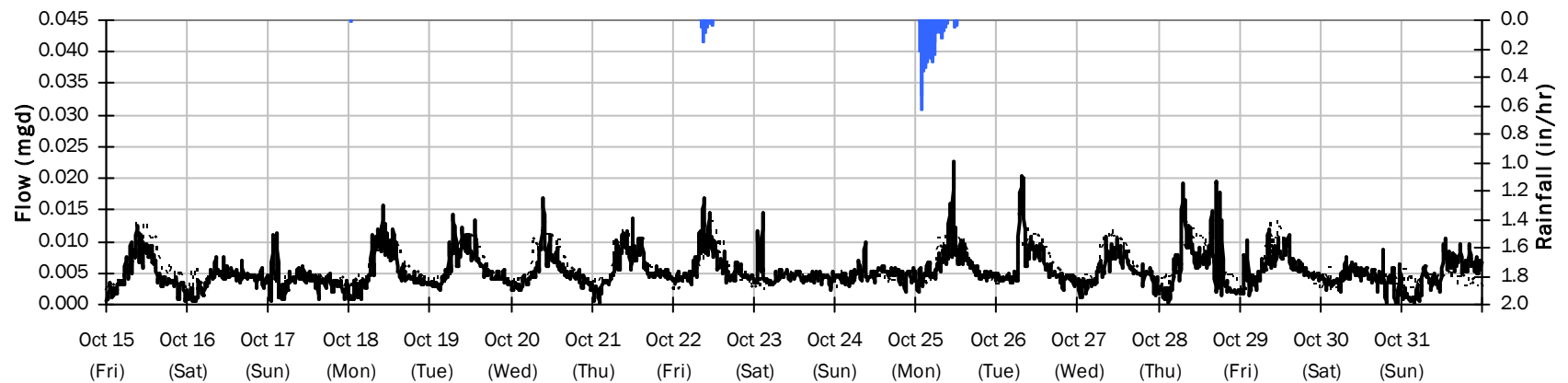
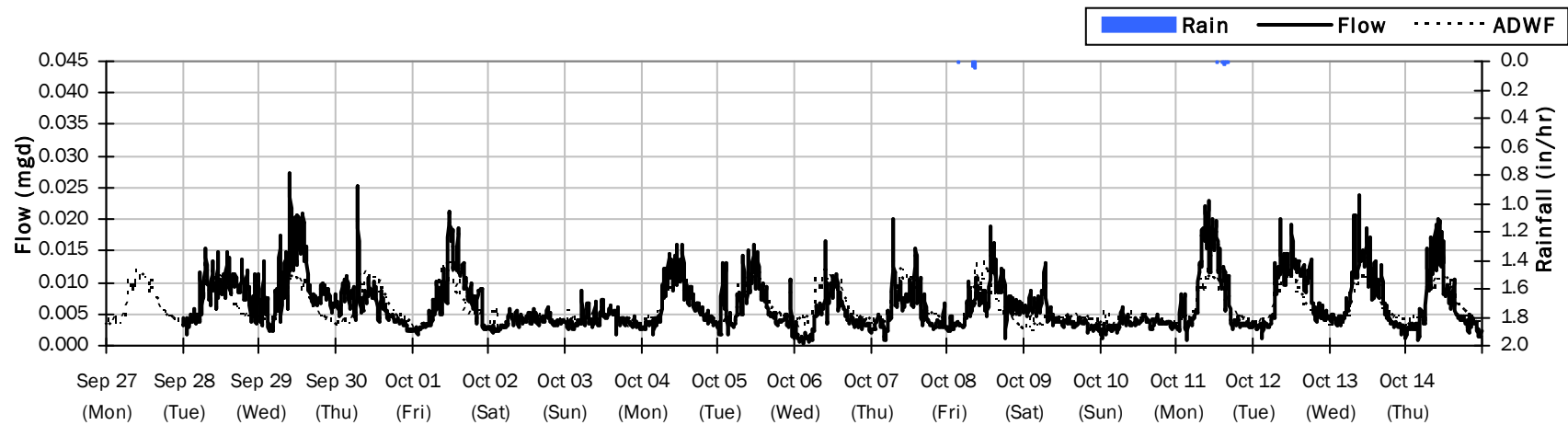
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.006 mgd

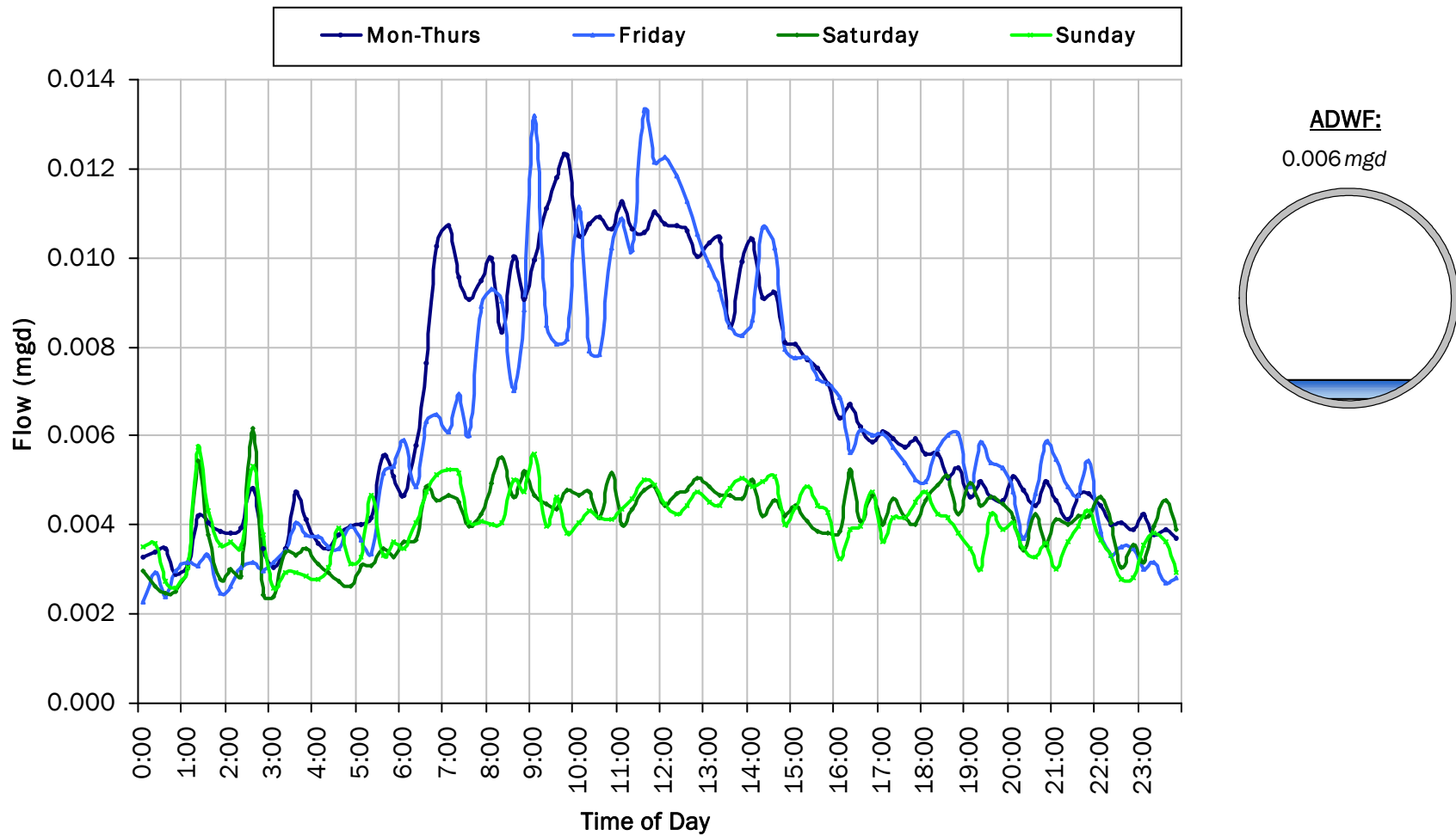
Period Peak Flow: 0.027 mgd

Period Min Flow: 0.000 mgd



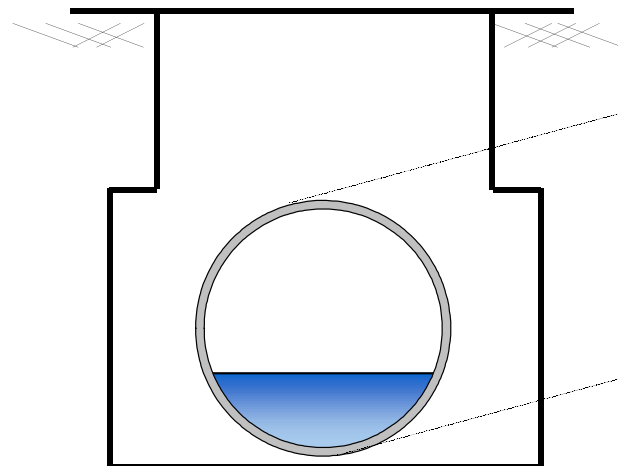
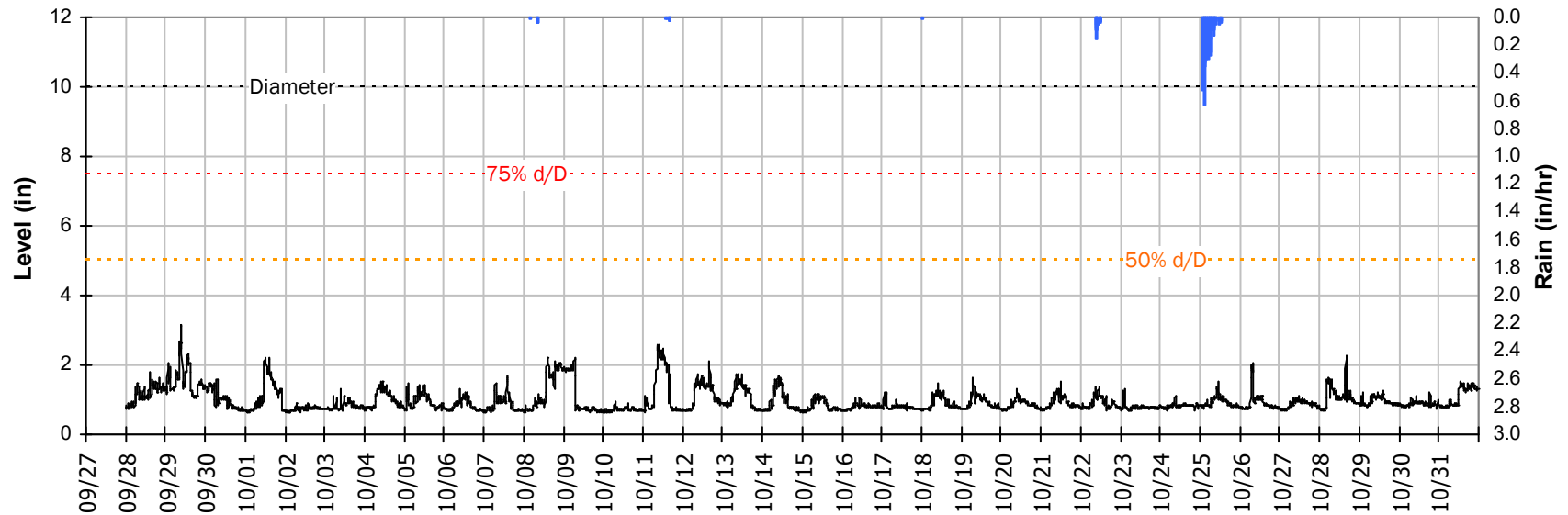
OFFICE/COMMERCIAL-2

Average Dry Weather Flow Hydrographs



OFFICE/COMMERCIAL-2 Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

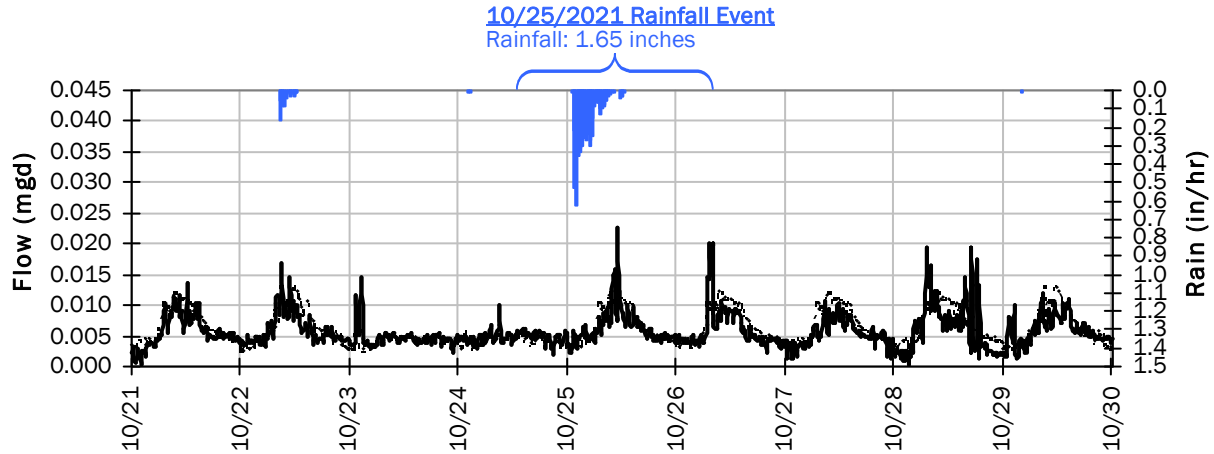


Pipe Diameter: 10 inches
Peak Measured Level: 3.13 inches
Peak d/D Ratio: 0.31

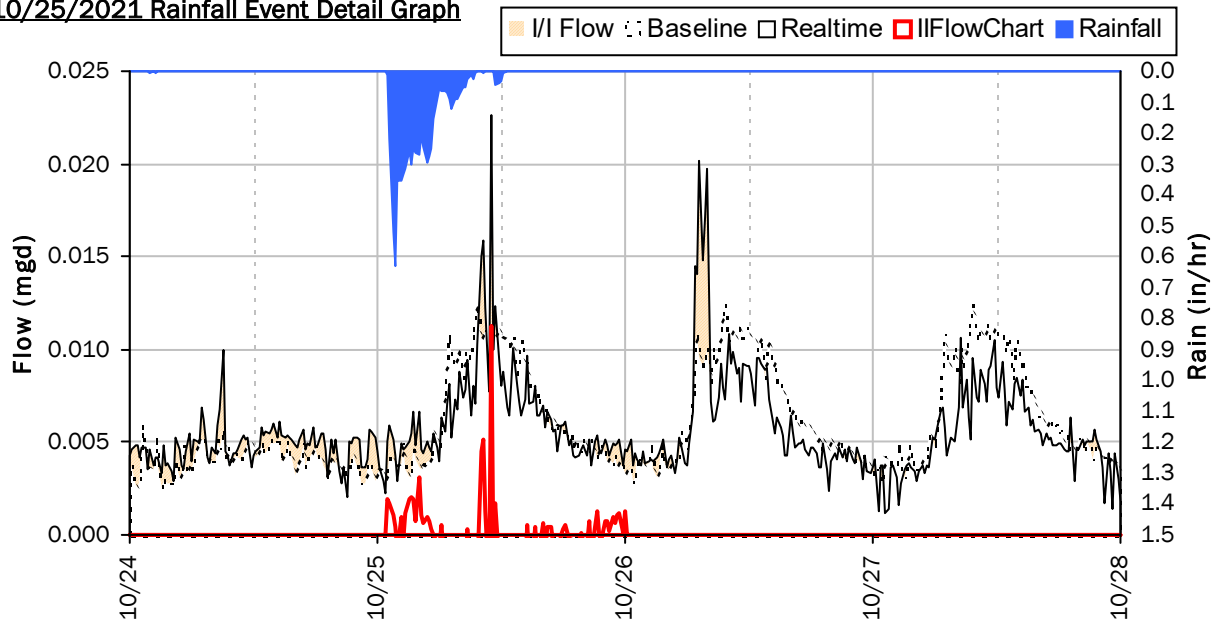
OFFICE/COMMERCIAL-2

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.023 mgd
PF: 3.88
Peak Level: 1.53 in
d/D Ratio: 0.15

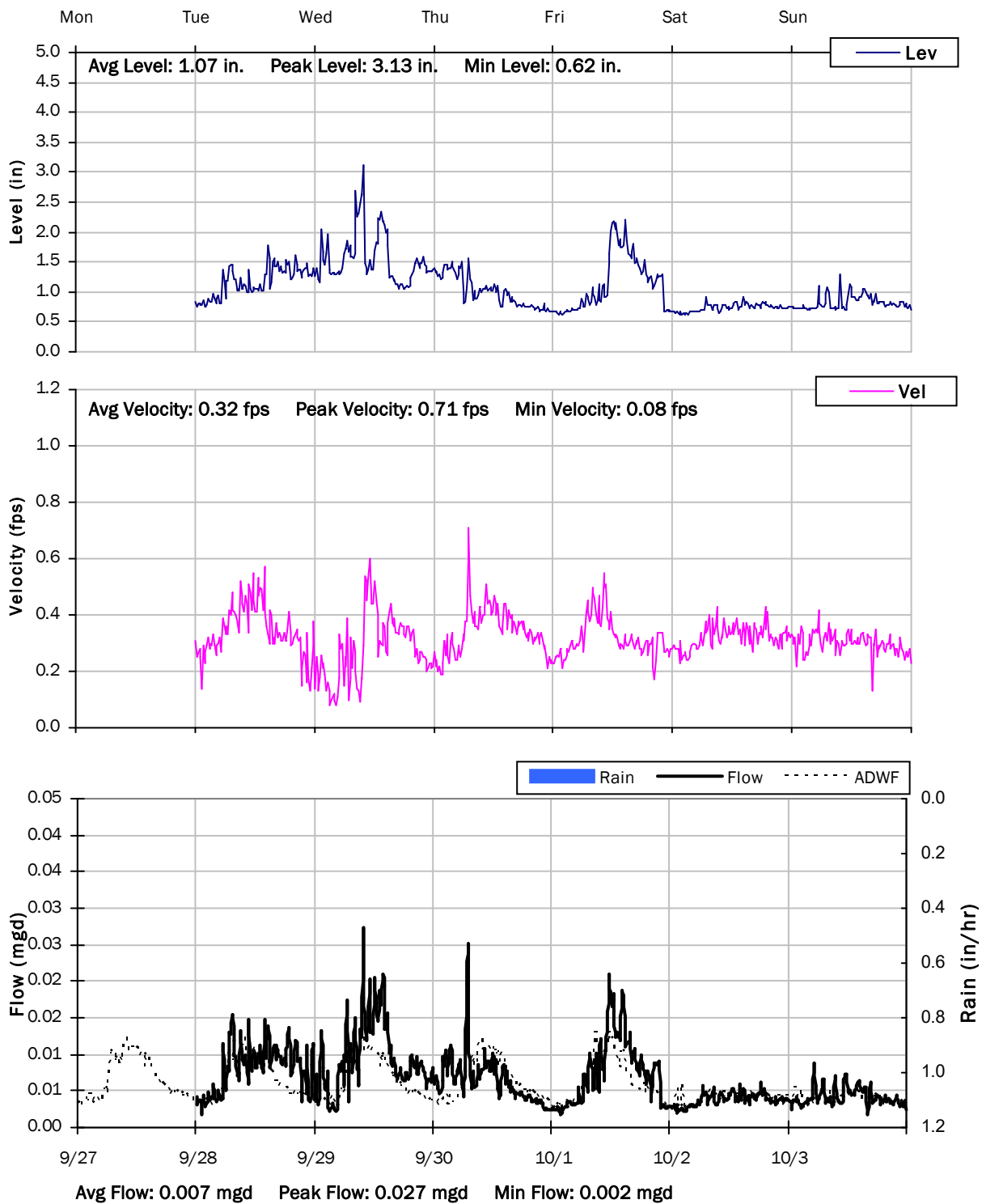
Inflow / Infiltration

Peak I/I Rate: 0.011 mgd
Total I/I: 0 gallons

OFFICE/COMMERCIAL-2

Weekly Level, Velocity and Flow Hydrographs

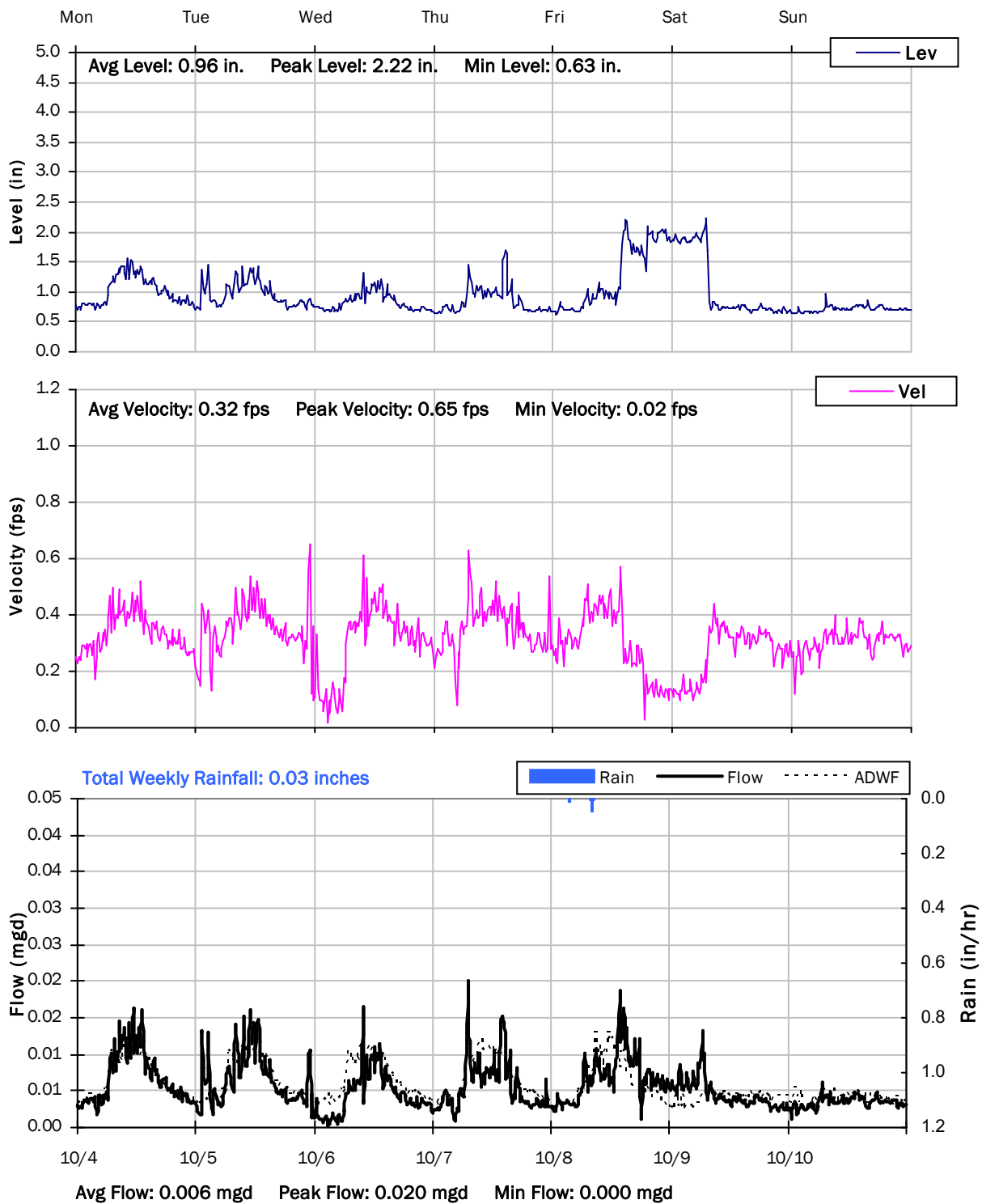
9/27/2021 to 10/4/2021



OFFICE/COMMERCIAL-2

Weekly Level, Velocity and Flow Hydrographs

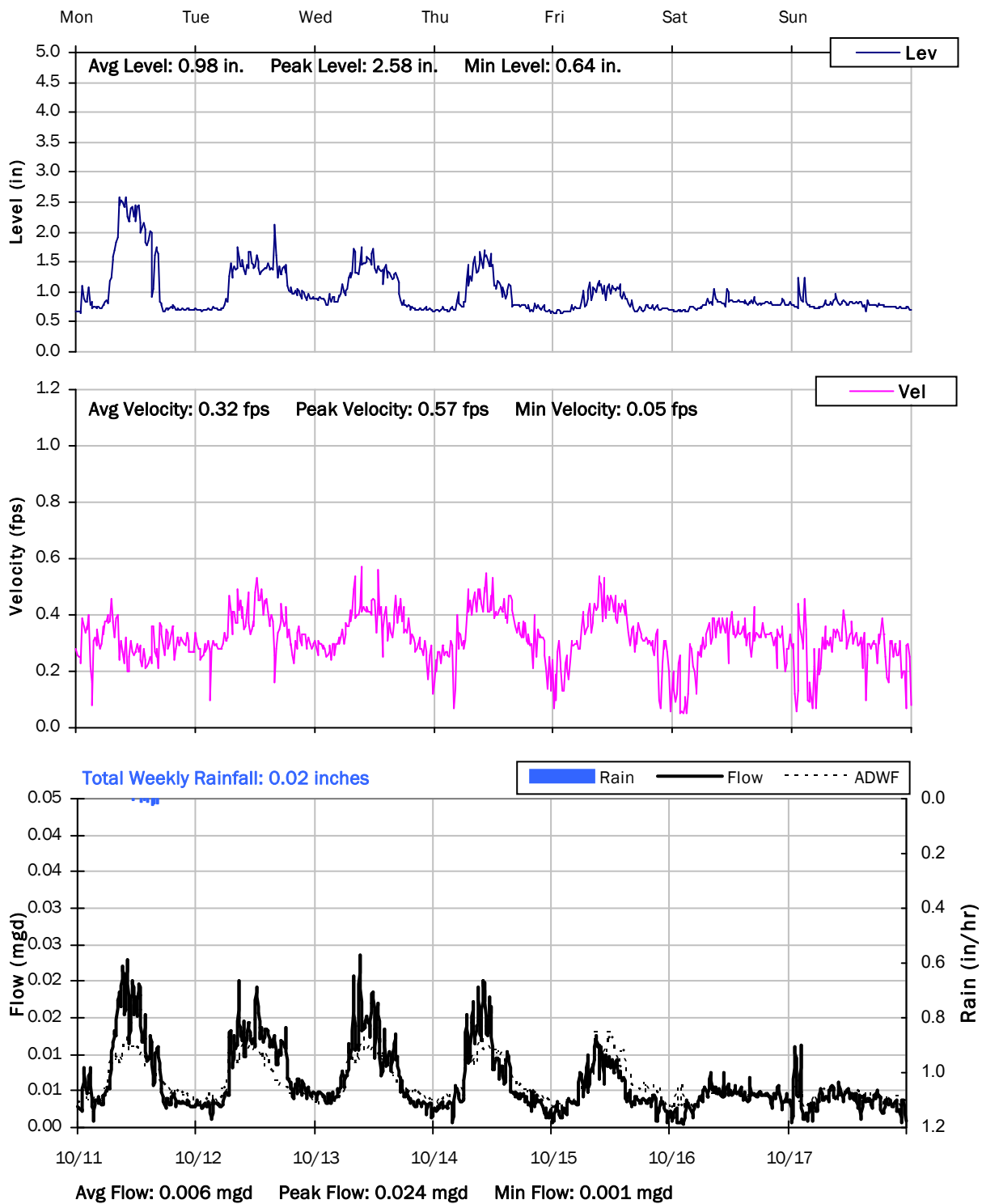
10/4/2021 to 10/11/2021



OFFICE/COMMERCIAL-2

Weekly Level, Velocity and Flow Hydrographs

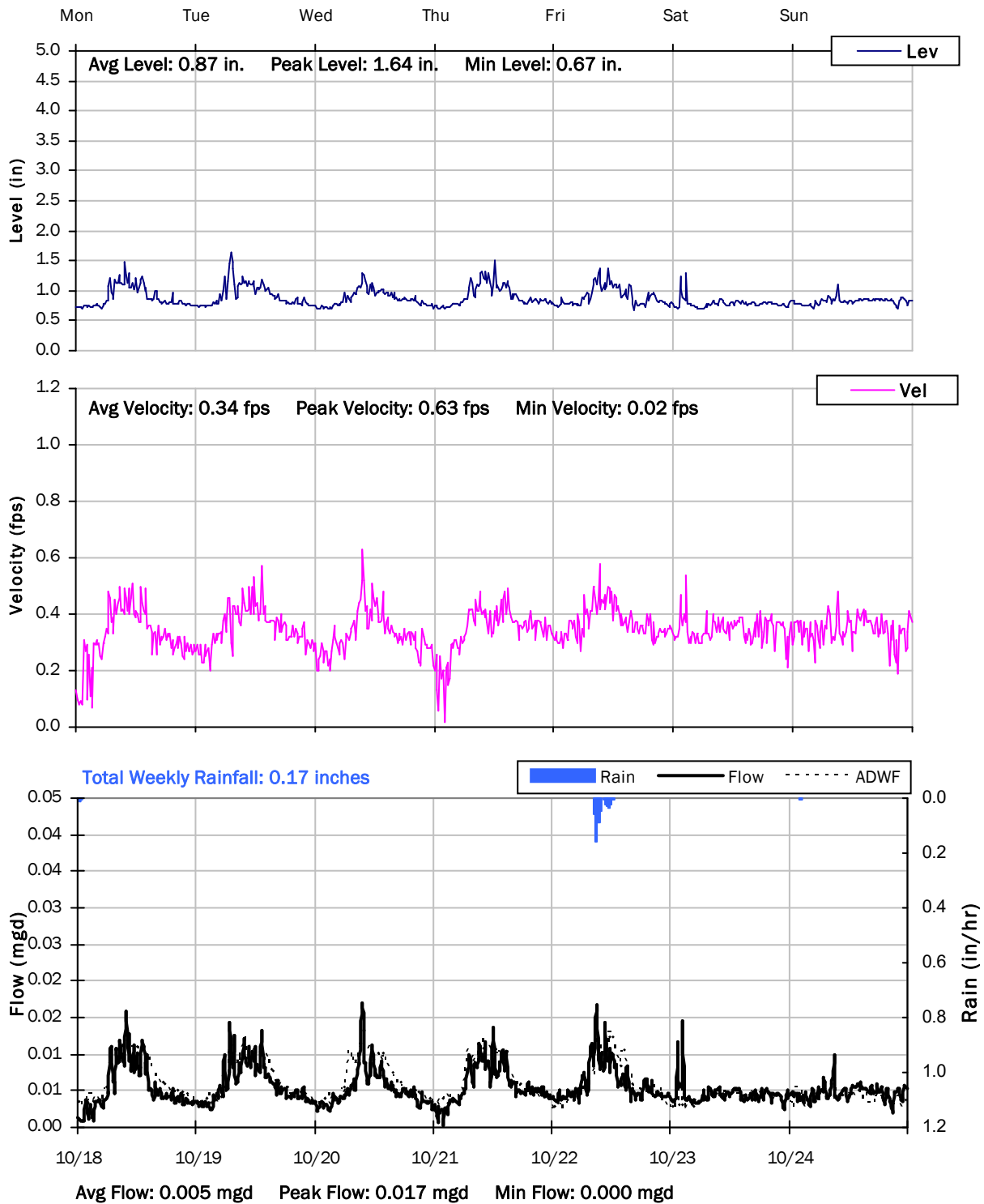
10/11/2021 to 10/18/2021



OFFICE/COMMERCIAL-2

Weekly Level, Velocity and Flow Hydrographs

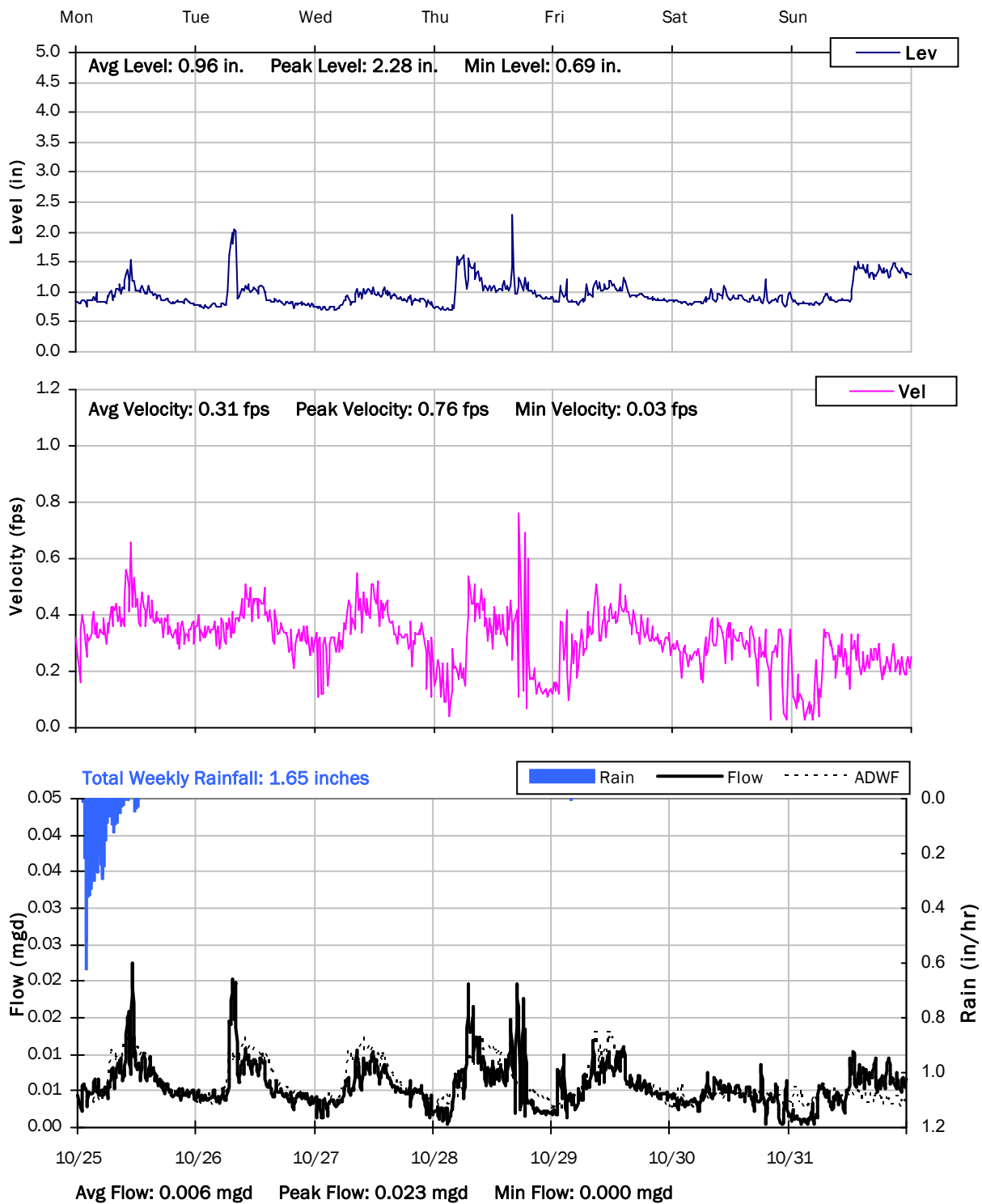
10/18/2021 to 10/25/2021



OFFICE/COMMERCIAL-2

Weekly Level, Velocity and Flow Hydrographs

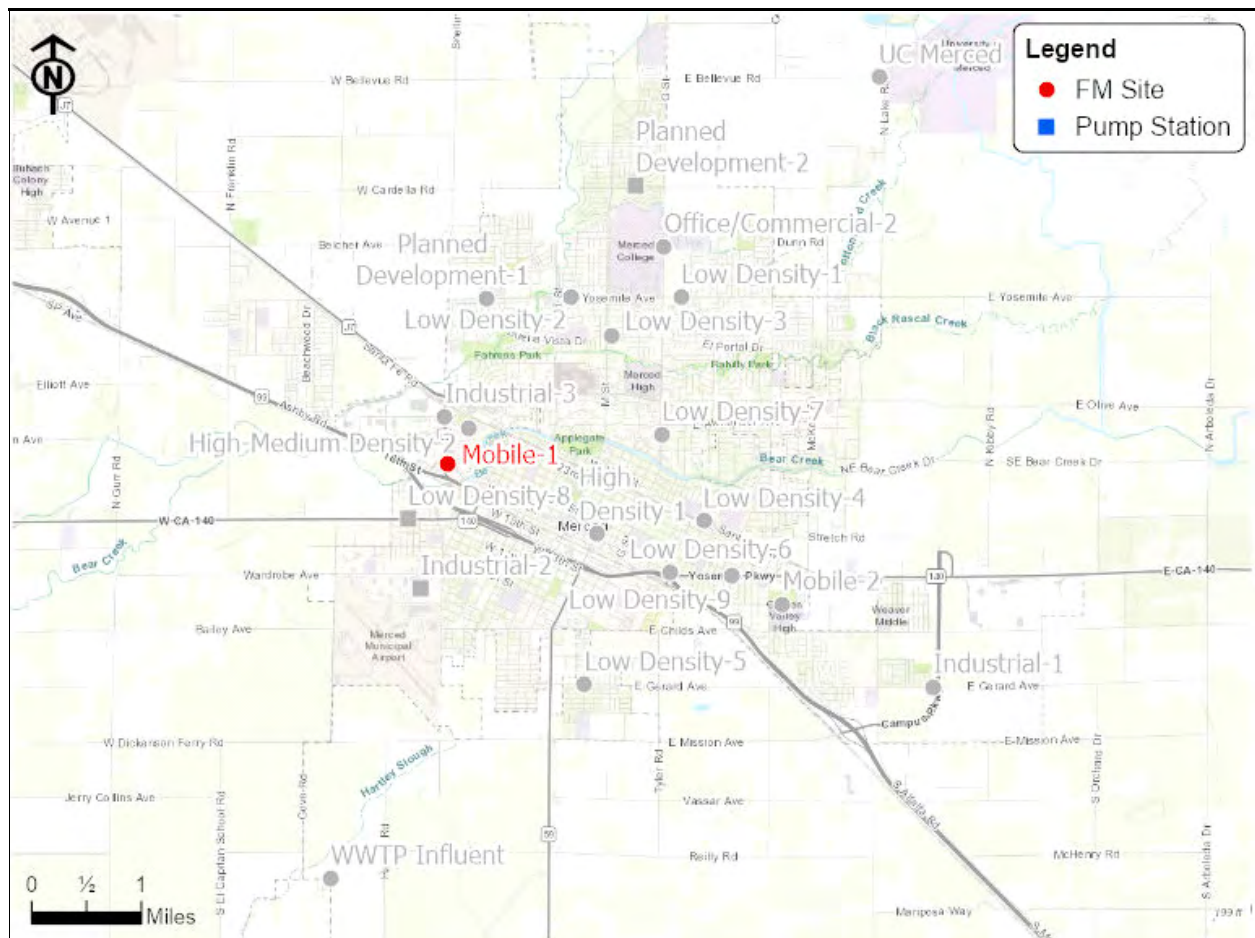
10/25/2021 to 11/1/2021



City of Merced, CA

September 27, 2021 - October 31, 2021

Data Summary Report



Vicinity Map: Mobile-1

MOBILE-1

Site Information

Location: W N Bear Creek Drive east of Snelling Highway

Coordinates: 120.5047° W, 37.3101° N

Rim Elevation (Earth): 167 feet

Measured Pipe Diameter: 8 inches

ADWF: 0.028 mgd

Peak Measured Flow: 0.058 mgd

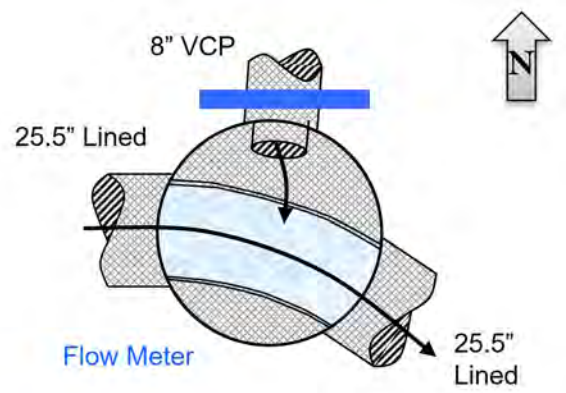
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

MOBILE-1

Additional Site Photos

Effluent Pipe



Monitored West Influent Pipe



MOBILE-1

Additional Site Photos

North Influent Pipe

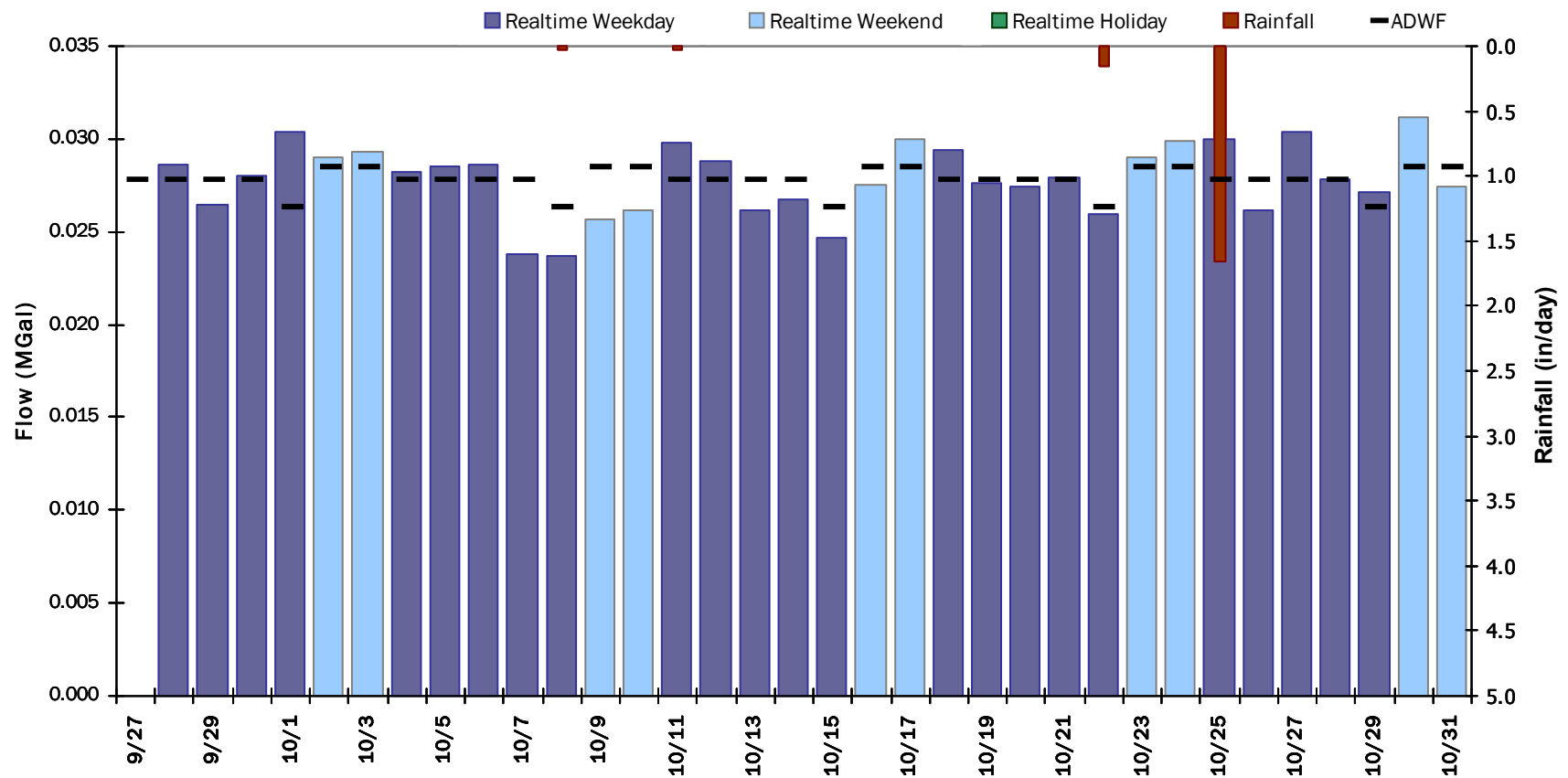


MOBILE-1

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.028 MGal Peak Daily Flow: 0.031 MGal Min Daily Flow: 0.024 MGal

Total Rainfall: 1.87 inches



MOBILE-1

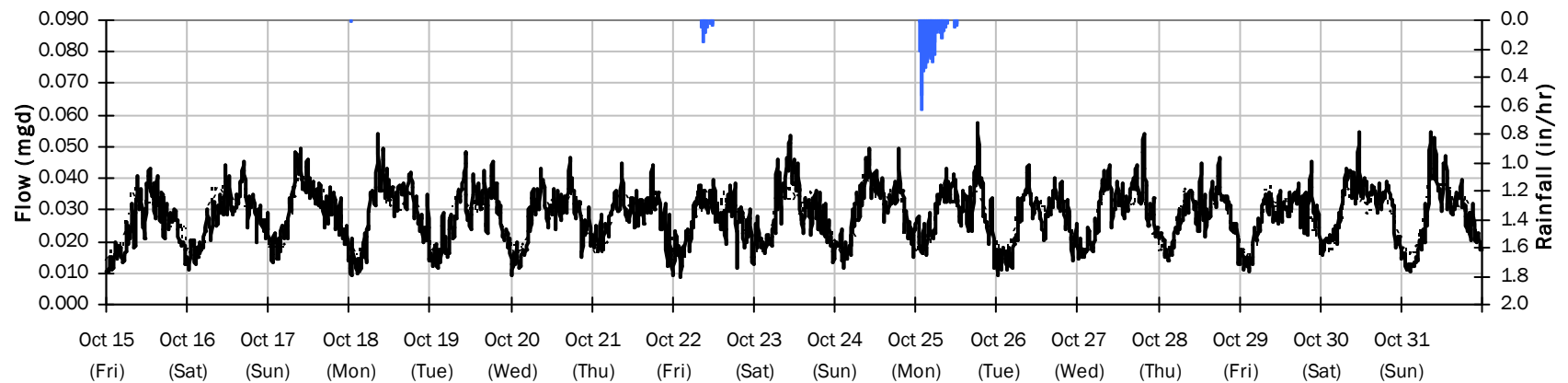
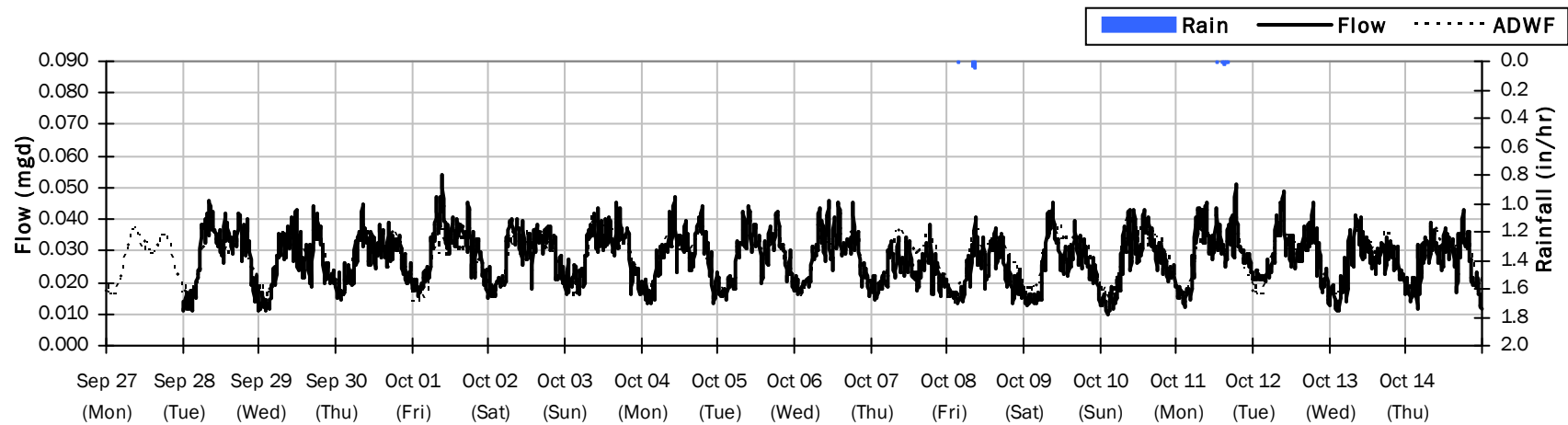
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.028 mgd

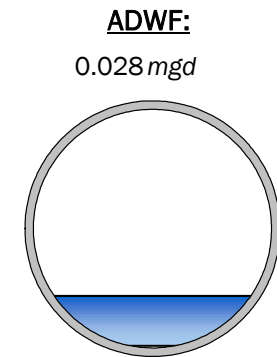
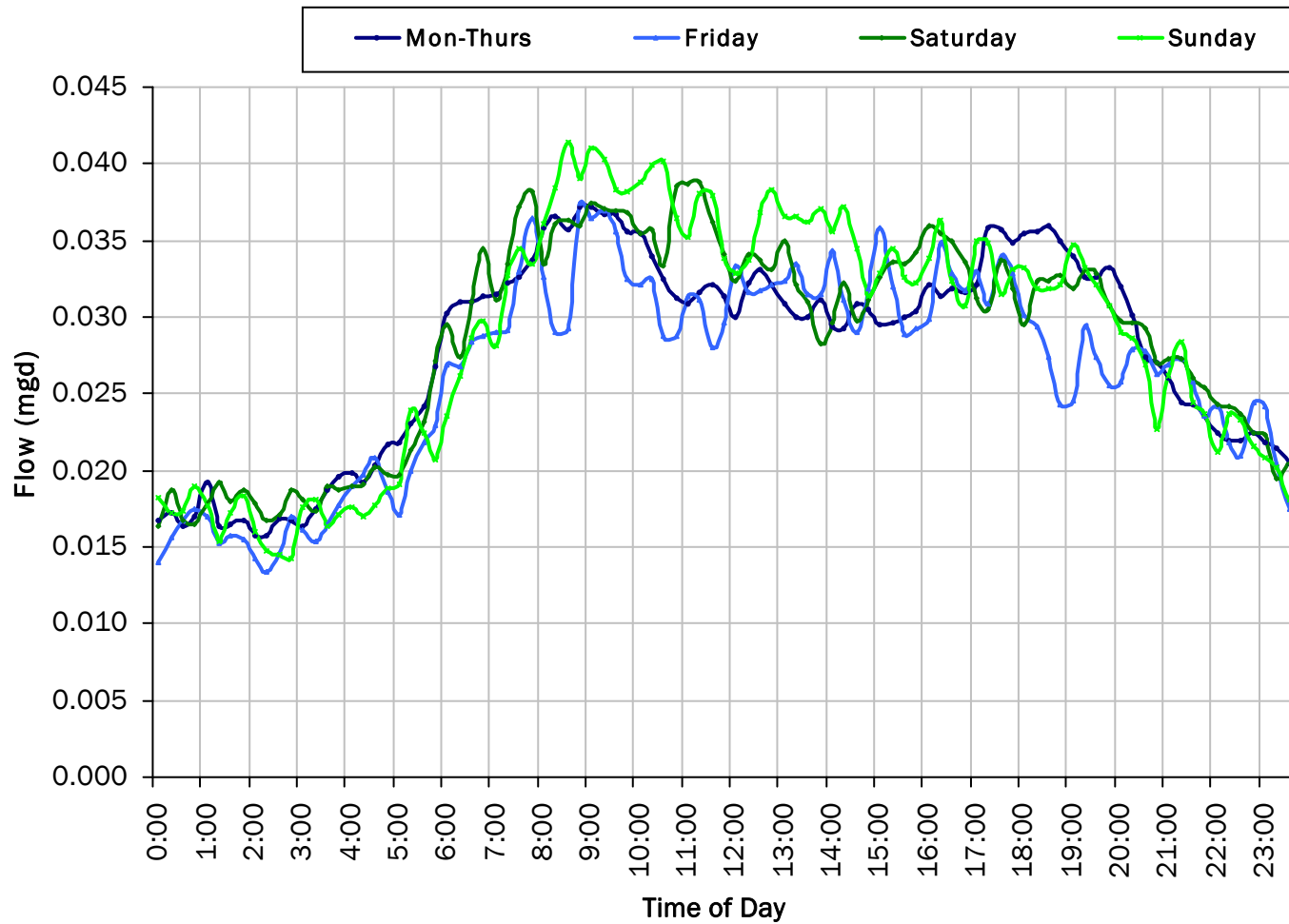
Period Peak Flow: 0.058 mgd

Period Min Flow: 0.009 mgd



MOBILE-1

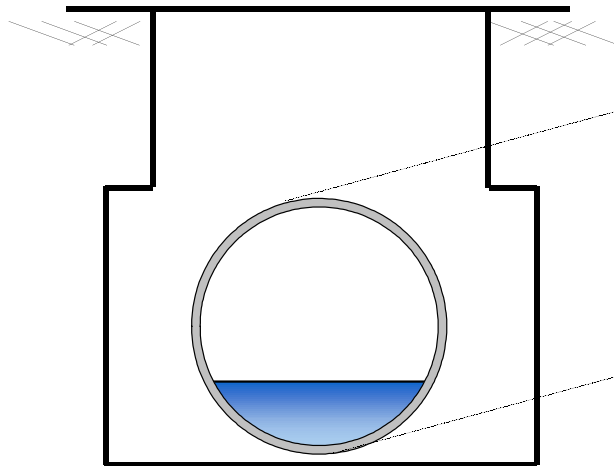
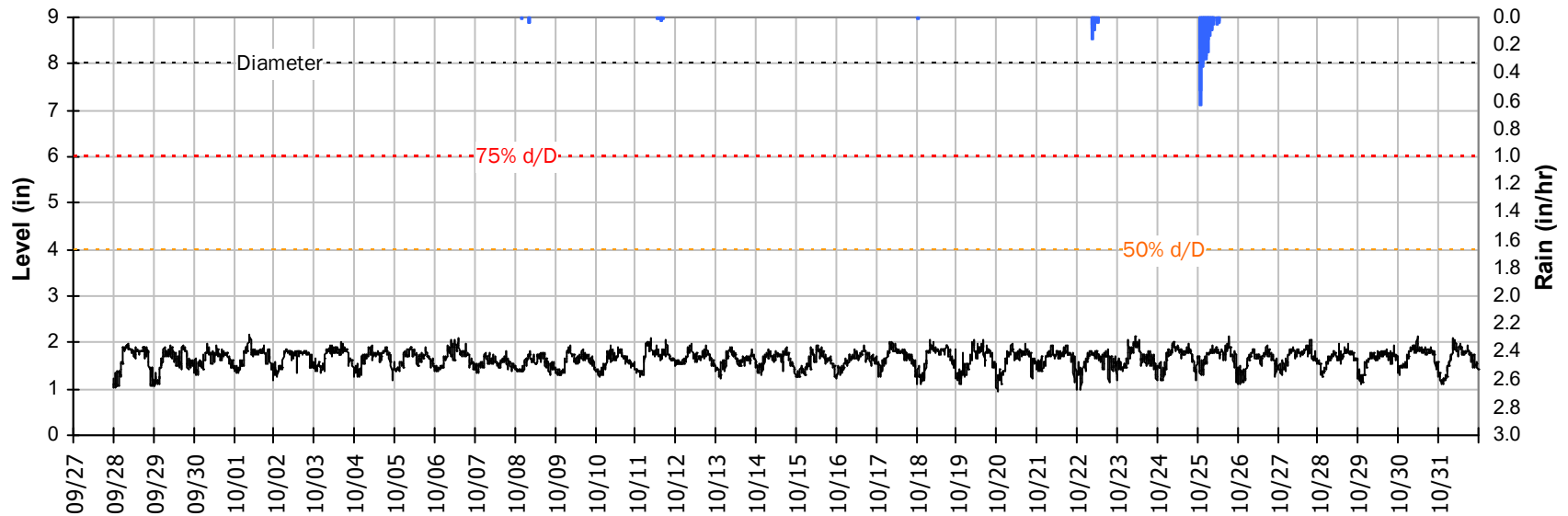
Average Dry Weather Flow Hydrographs



MOBILE-1

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

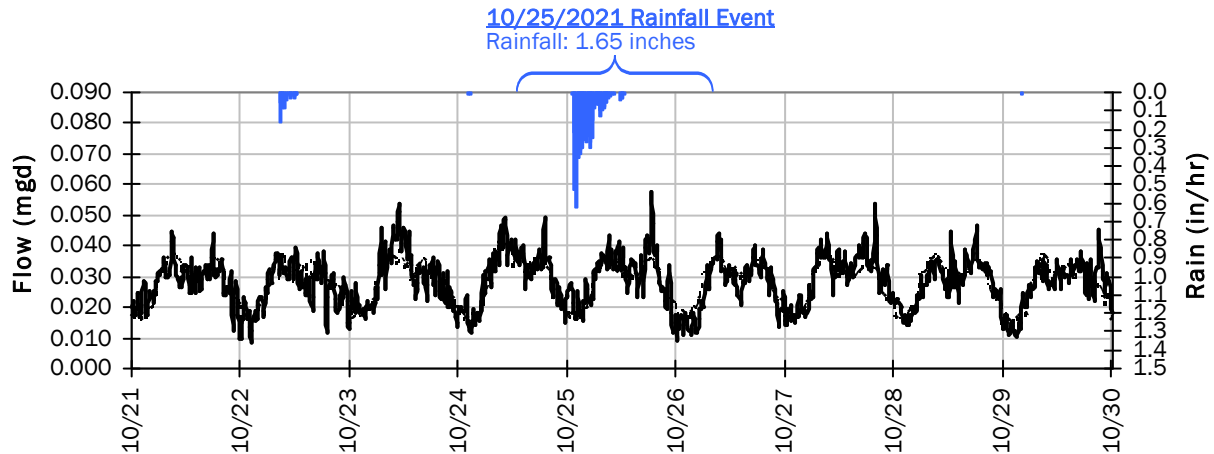


Pipe Diameter: 8 inches
Peak Measured Level: 2.19 inches
Peak d/D Ratio: 0.27

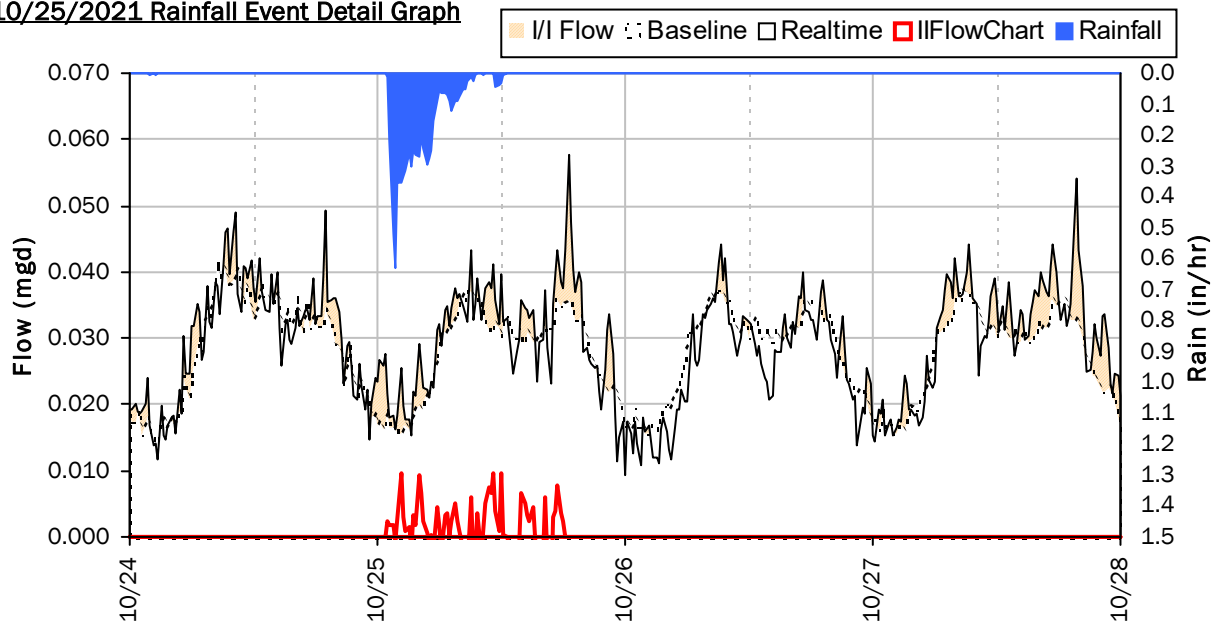
MOBILE-1

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



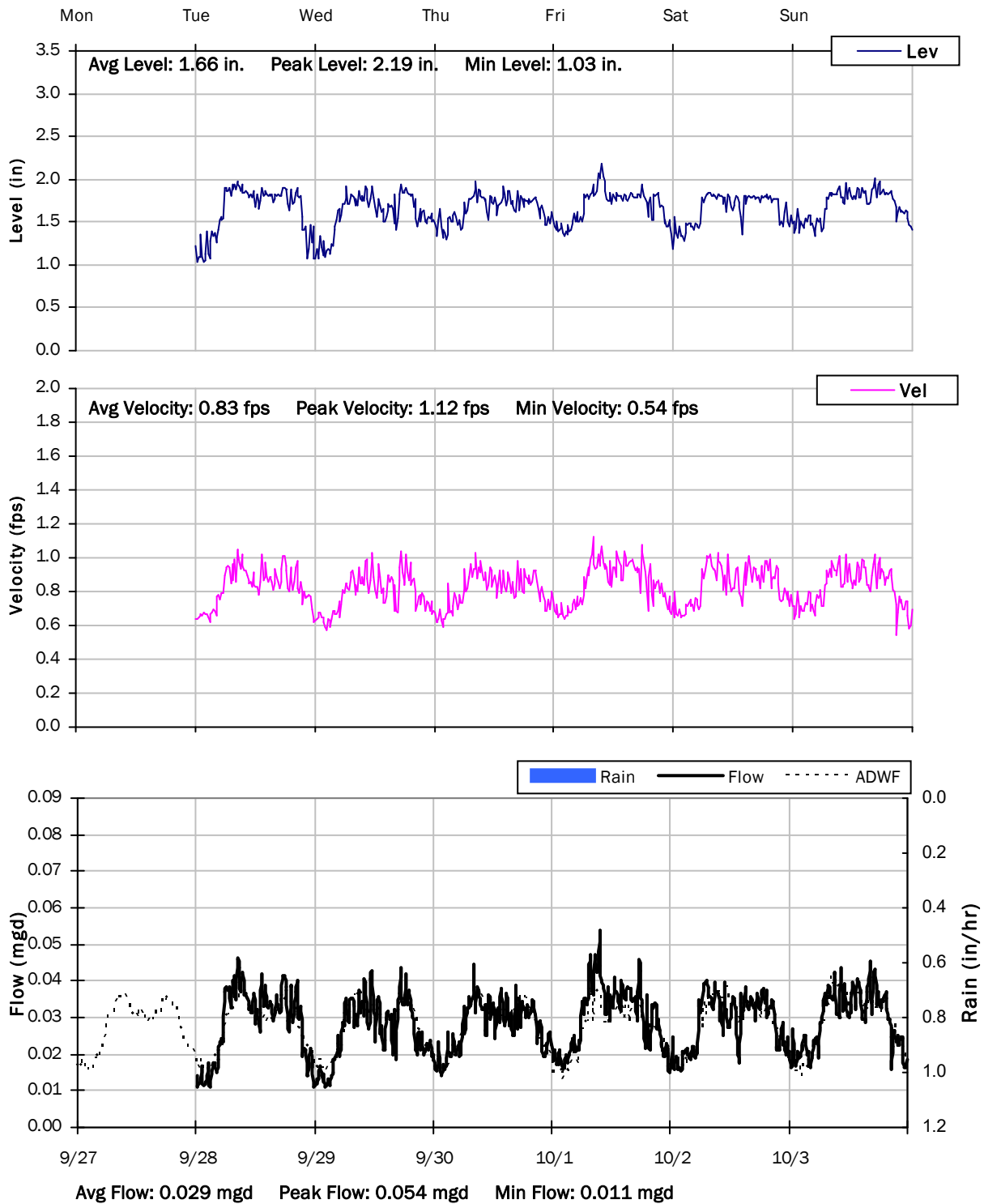
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.043 mgd	Peak I/I Rate:	0.010 mgd
PF:	1.56	Total I/I:	1,000 gallons
Peak Level:	1.96 in		
d/D Ratio:	0.25		

MOBILE-1

Weekly Level, Velocity and Flow Hydrographs

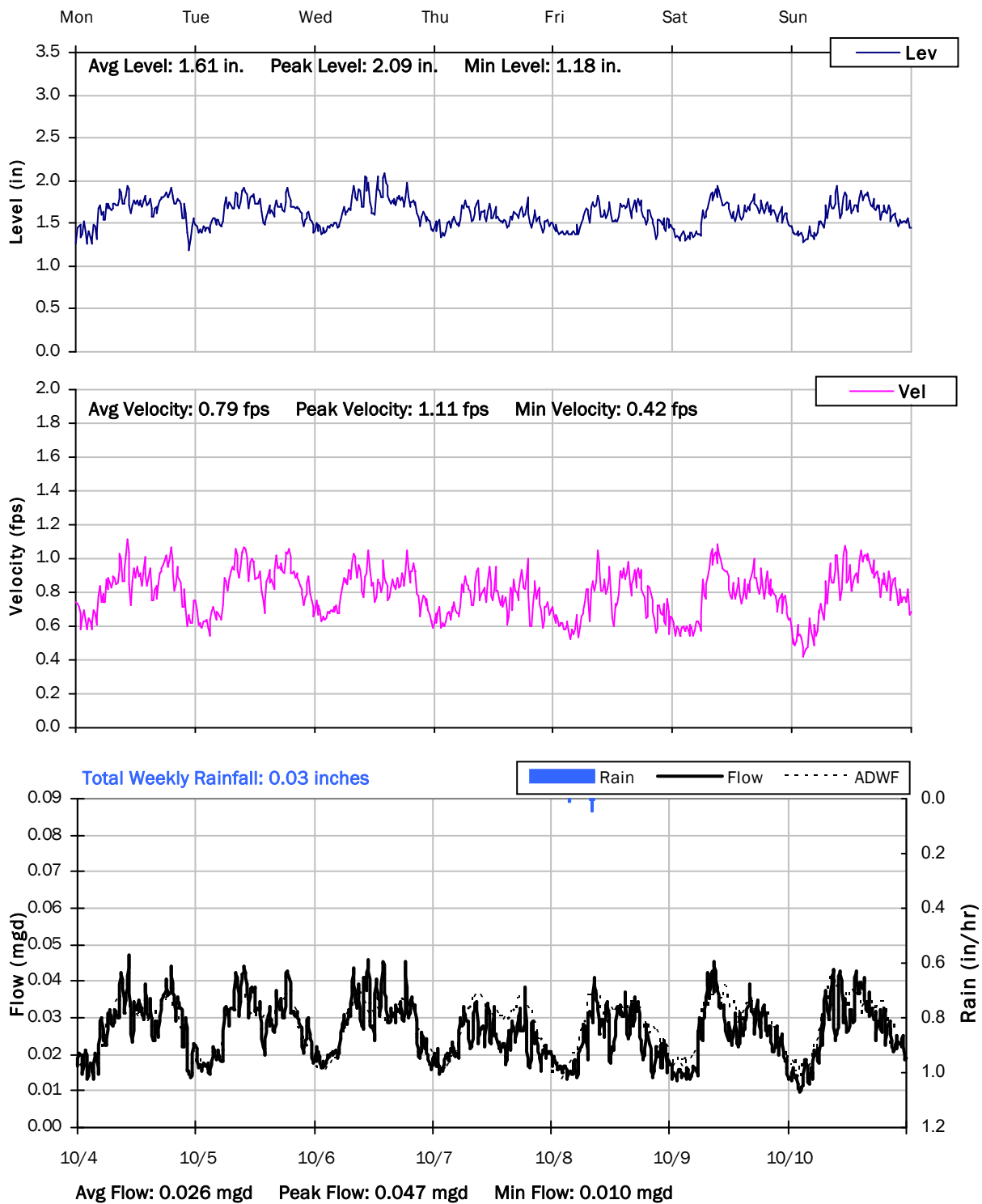
9/27/2021 to 10/4/2021



MOBILE-1

Weekly Level, Velocity and Flow Hydrographs

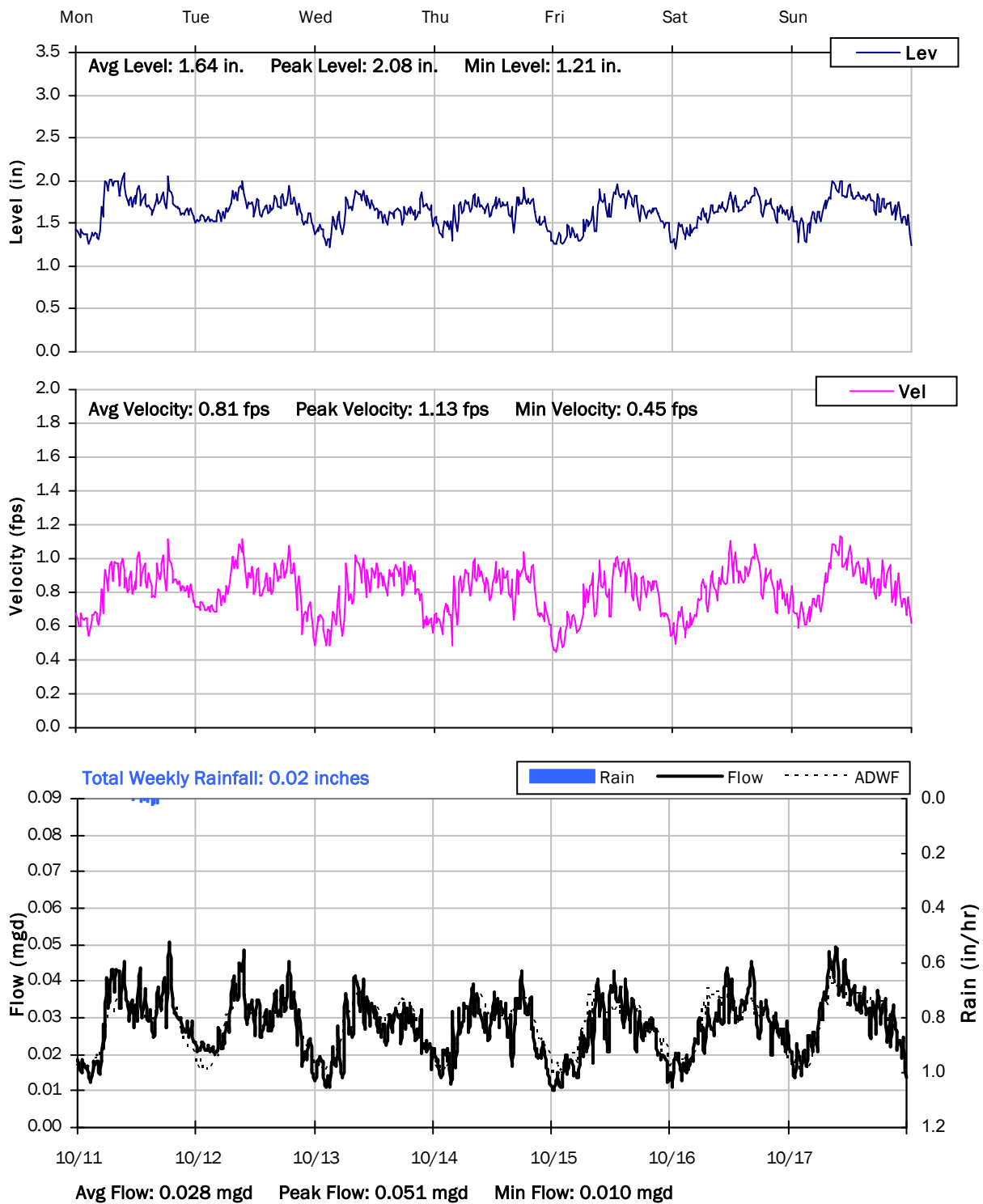
10/4/2021 to 10/11/2021



MOBILE-1

Weekly Level, Velocity and Flow Hydrographs

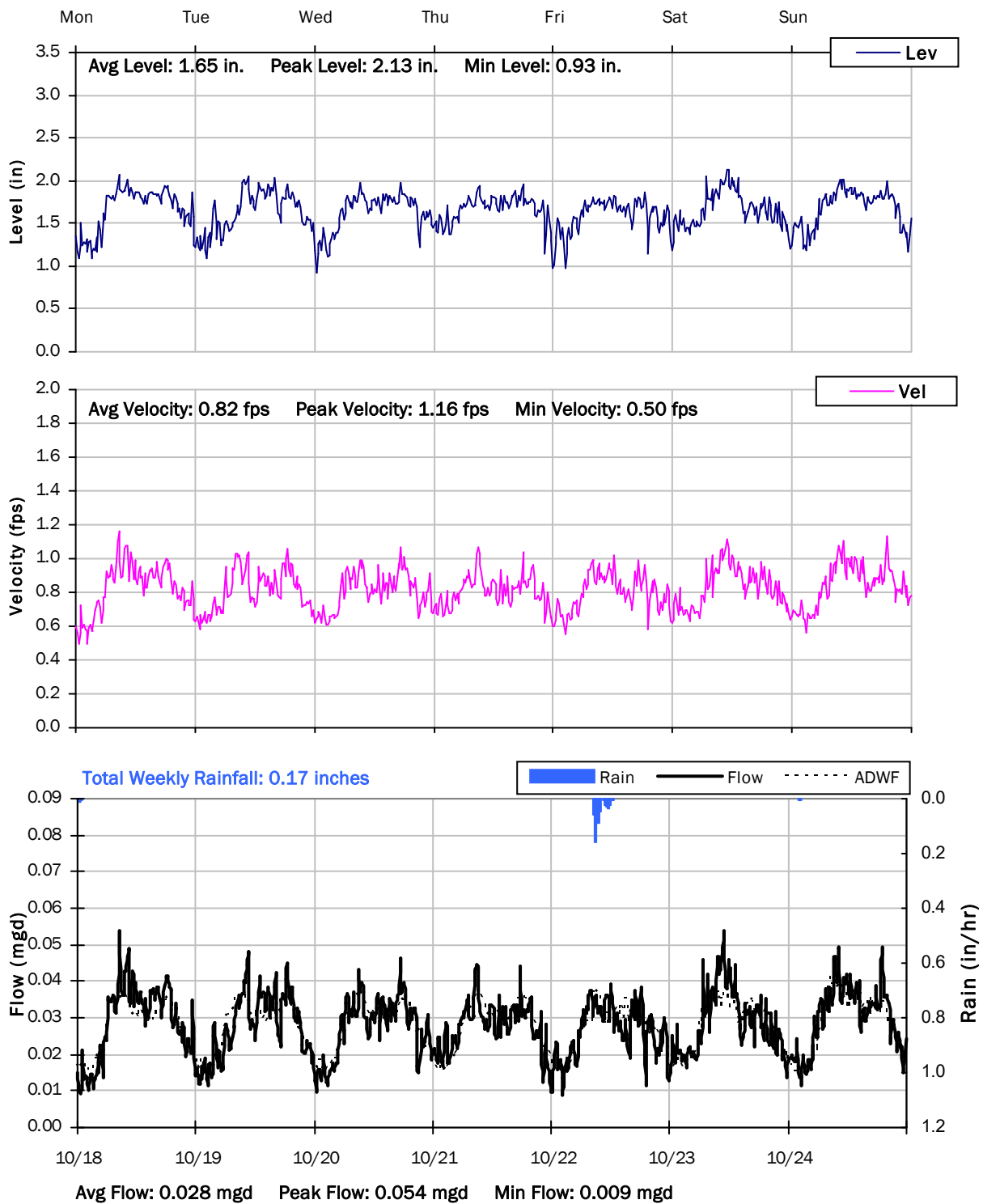
10/11/2021 to 10/18/2021



MOBILE-1

Weekly Level, Velocity and Flow Hydrographs

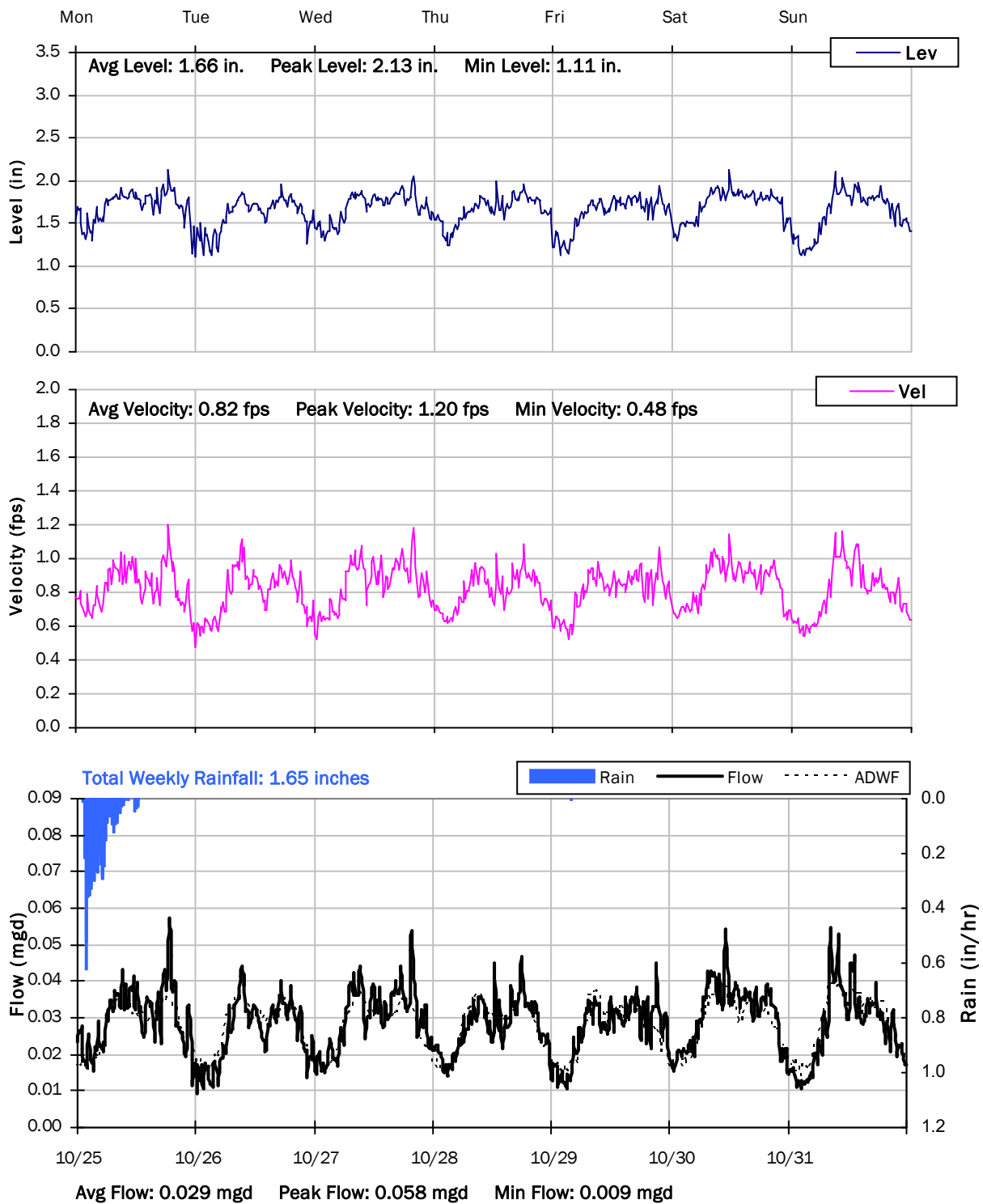
10/18/2021 to 10/25/2021



MOBILE-1

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



MOBILE-2

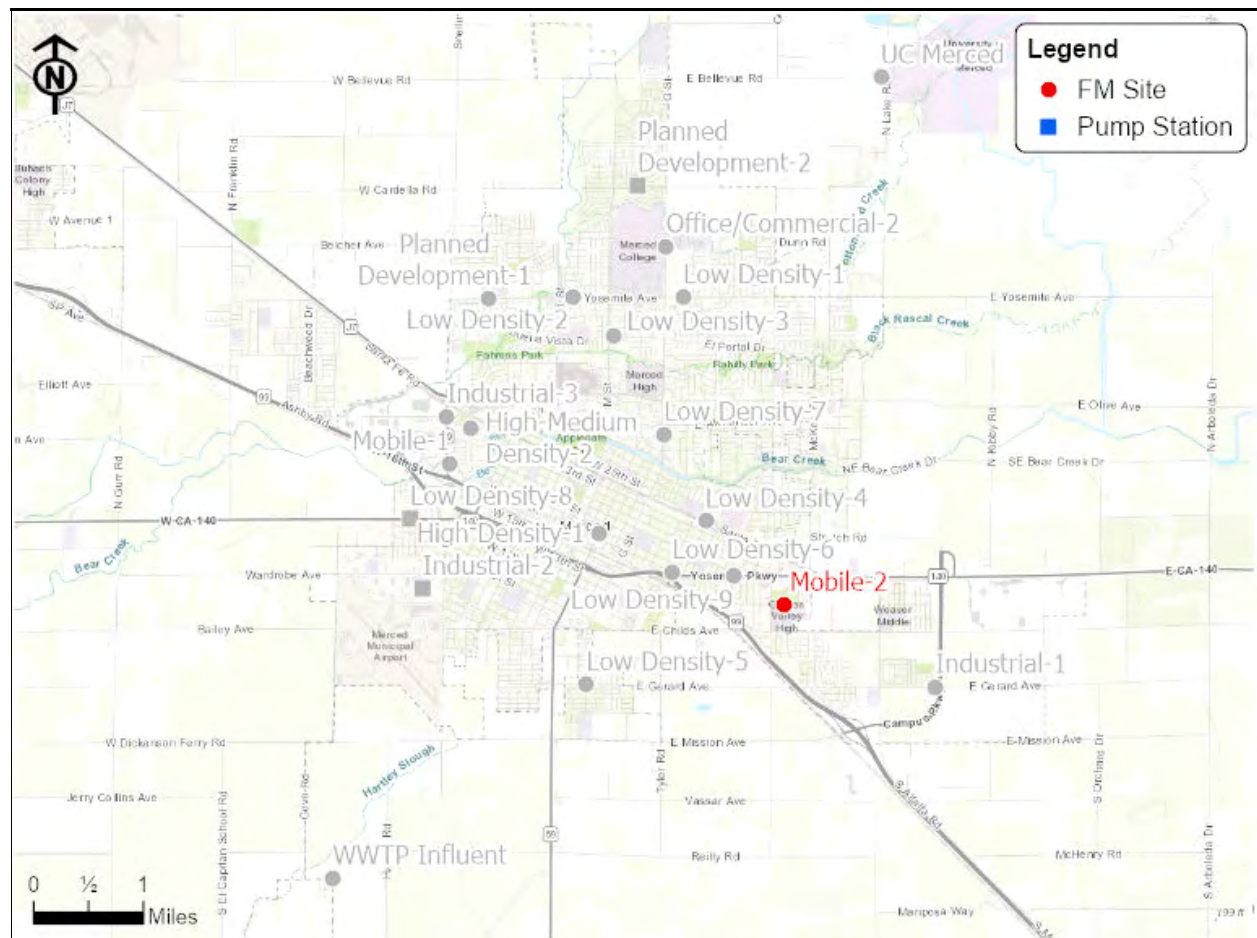
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Field east of Parsons Avenue and Merced Avenue

Data Summary Report



Vicinity Map: Mobile-2

MOBILE-2

Site Information

Location: Field east of Parsons Avenue
and Merced Avenue

Coordinates: 120.4493° W, 37.2915° N

Rim Elevation (Earth): 181 feet

Measured Pipe Diameter: 8 inches

ADWF: 0.020 mgd

Peak Measured Flow: 0.075 mgd

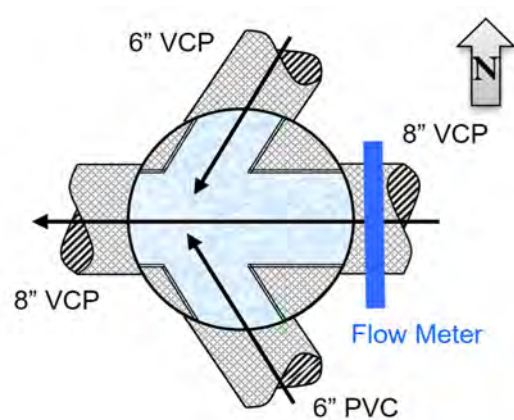
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

MOBILE-2

Additional Site Photos

Effluent Pipe



Monitored East Influent Pipe



MOBILE-2

Additional Site Photos

South Influent Pipe



North Influent Pipe

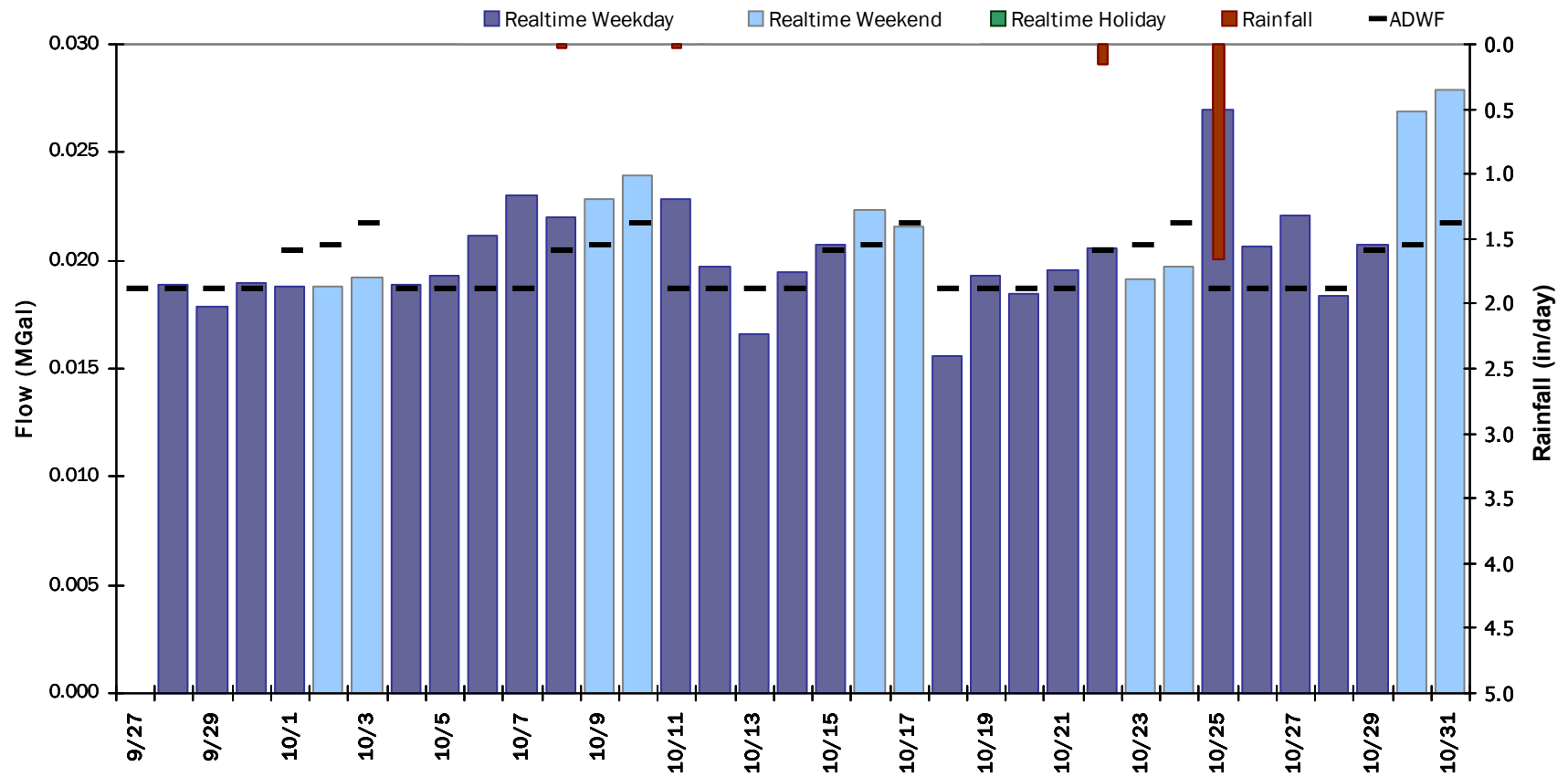


MOBILE-2

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.021 MGal Peak Daily Flow: 0.028 MGal Min Daily Flow: 0.016 MGal

Total Rainfall: 1.87 inches



MOBILE-2

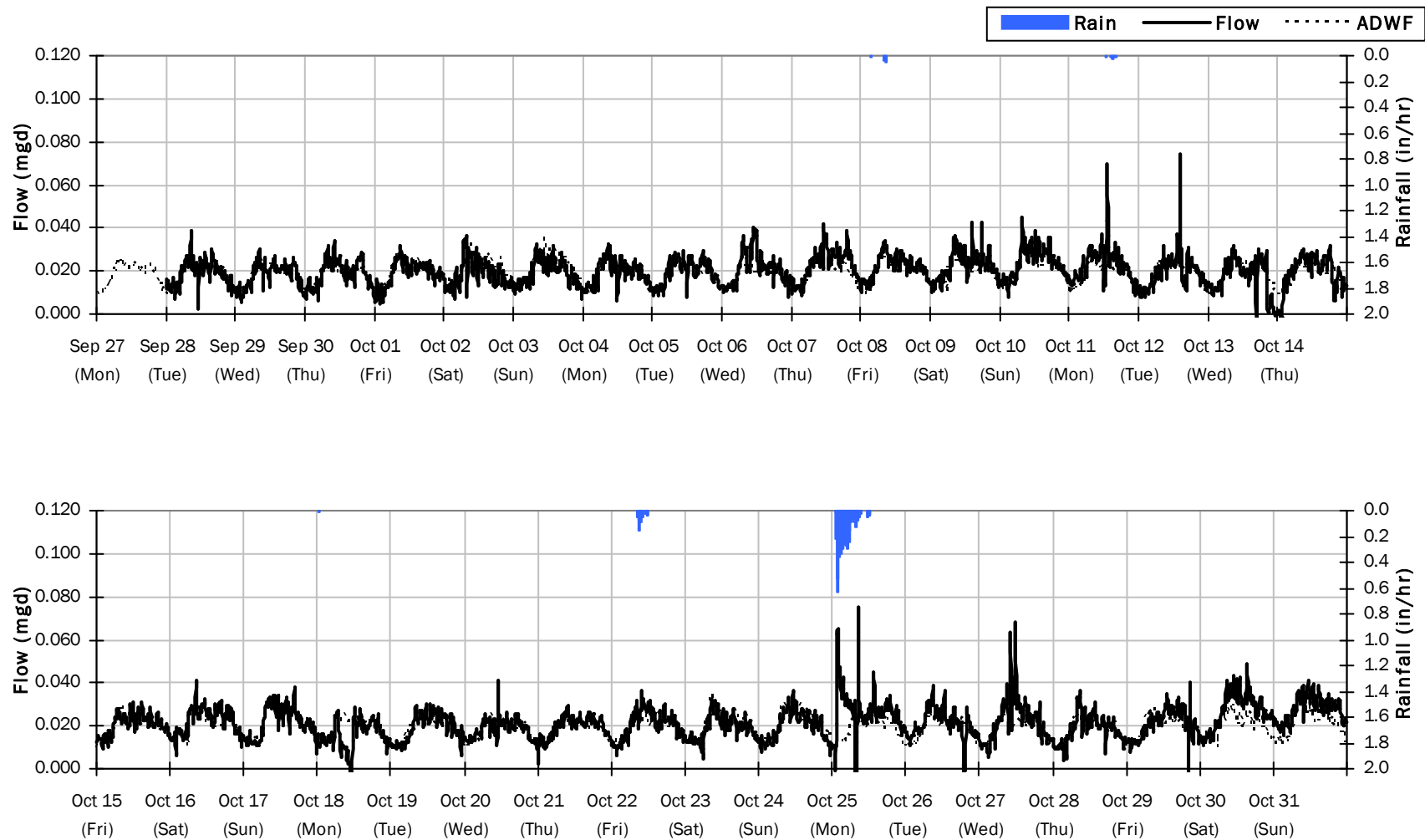
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.021 mgd

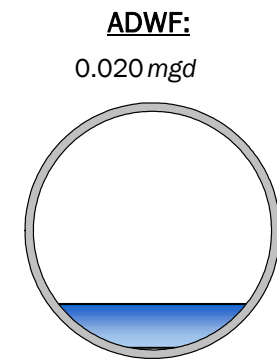
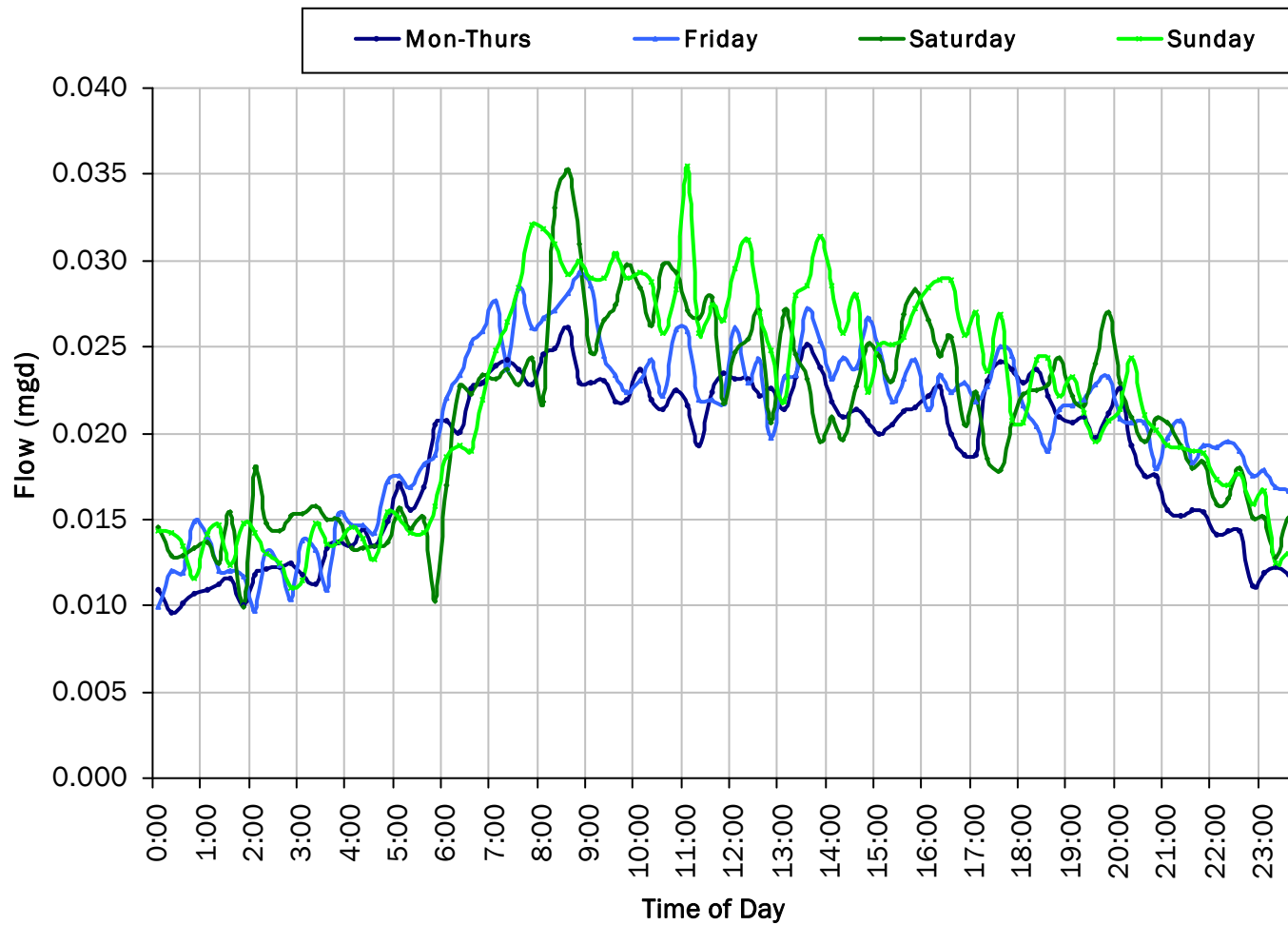
Period Peak Flow: 0.075 mgd

Period Min Flow: -0.033 mgd



MOBILE-2

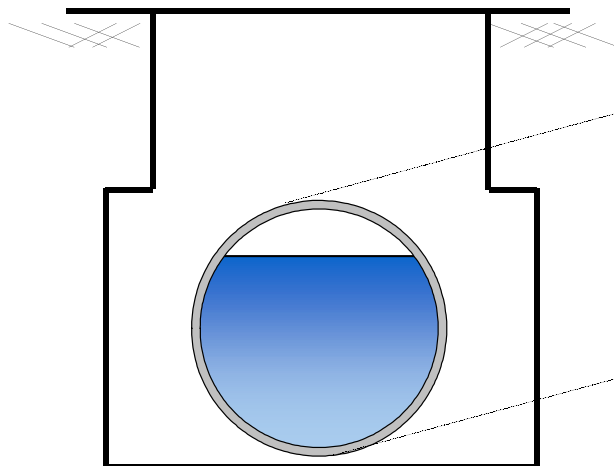
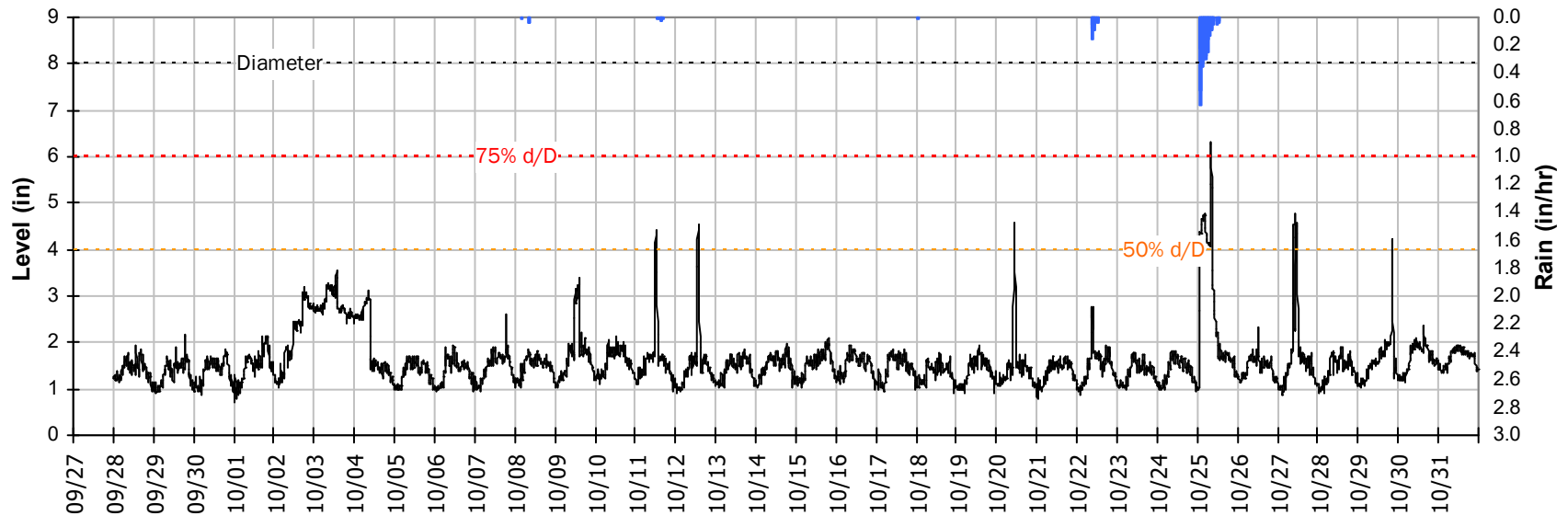
Average Dry Weather Flow Hydrographs



MOBILE-2

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

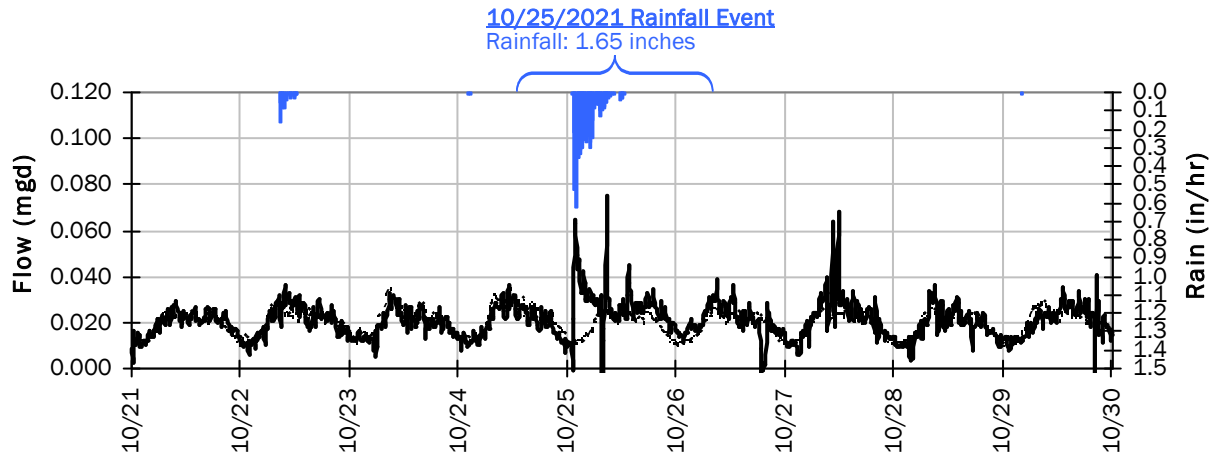


Pipe Diameter: 8 inches
Peak Measured Level: 6.33 inches
Peak d/D Ratio: 0.79

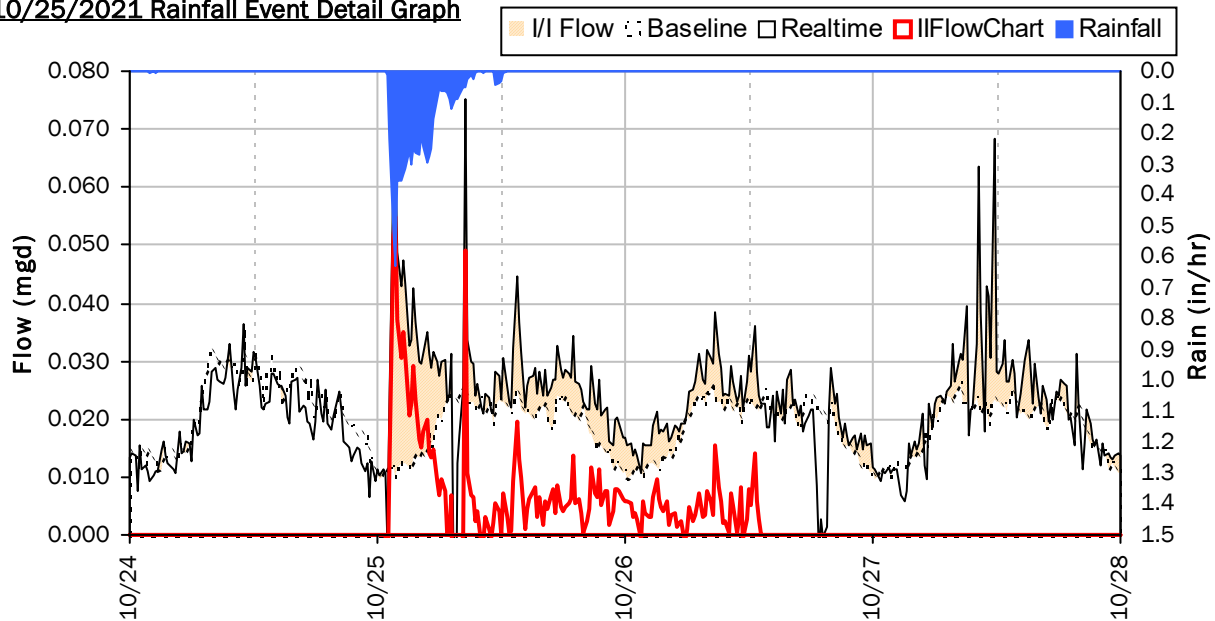
MOBILE-2

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.075 mgd
PF: 3.83

Peak Level: 6.33 in
d/D Ratio: 0.79

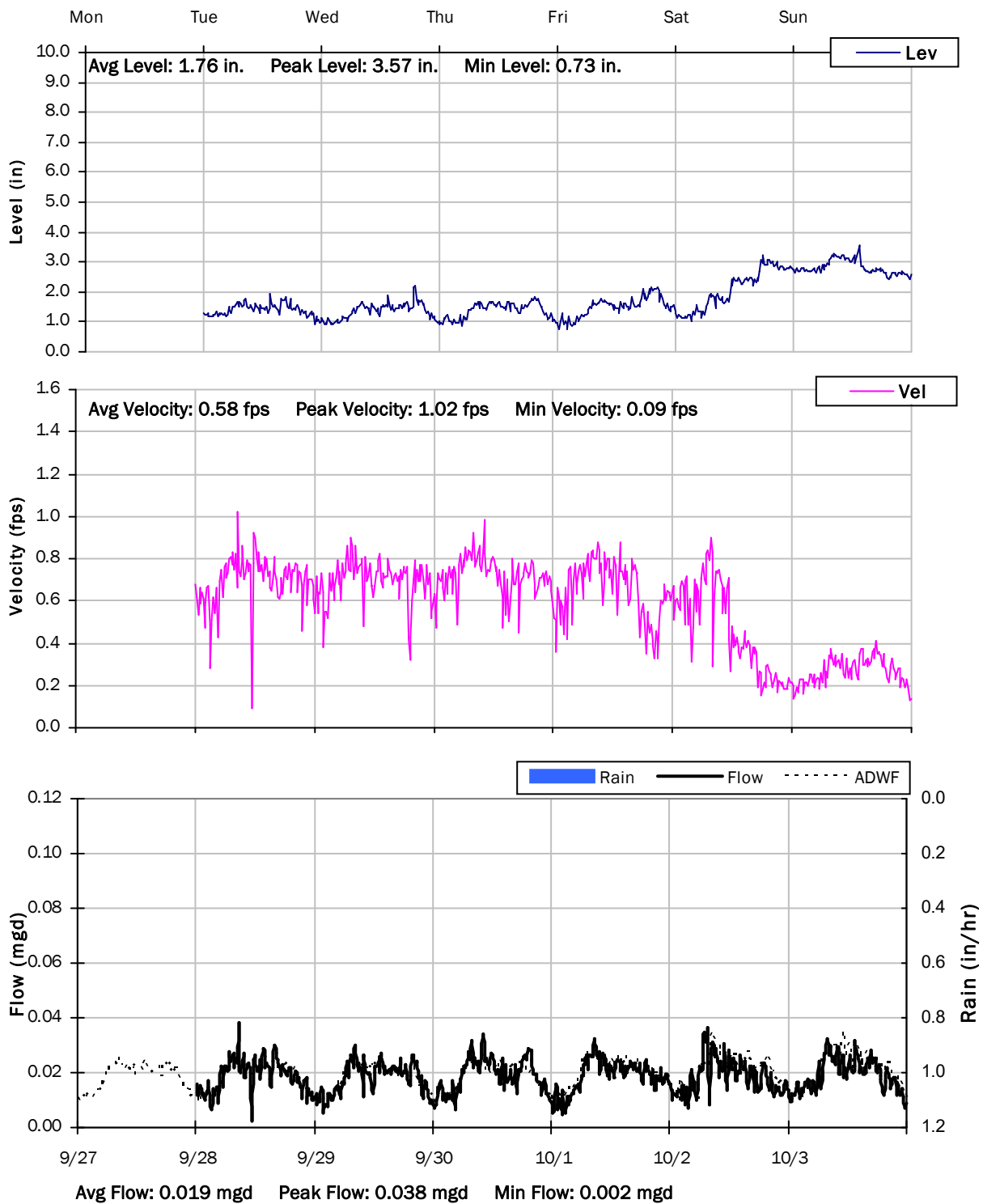
Inflow / Infiltration

Peak I/I Rate: 0.055 mgd
Total I/I: 11,000 gallons

MOBILE-2

Weekly Level, Velocity and Flow Hydrographs

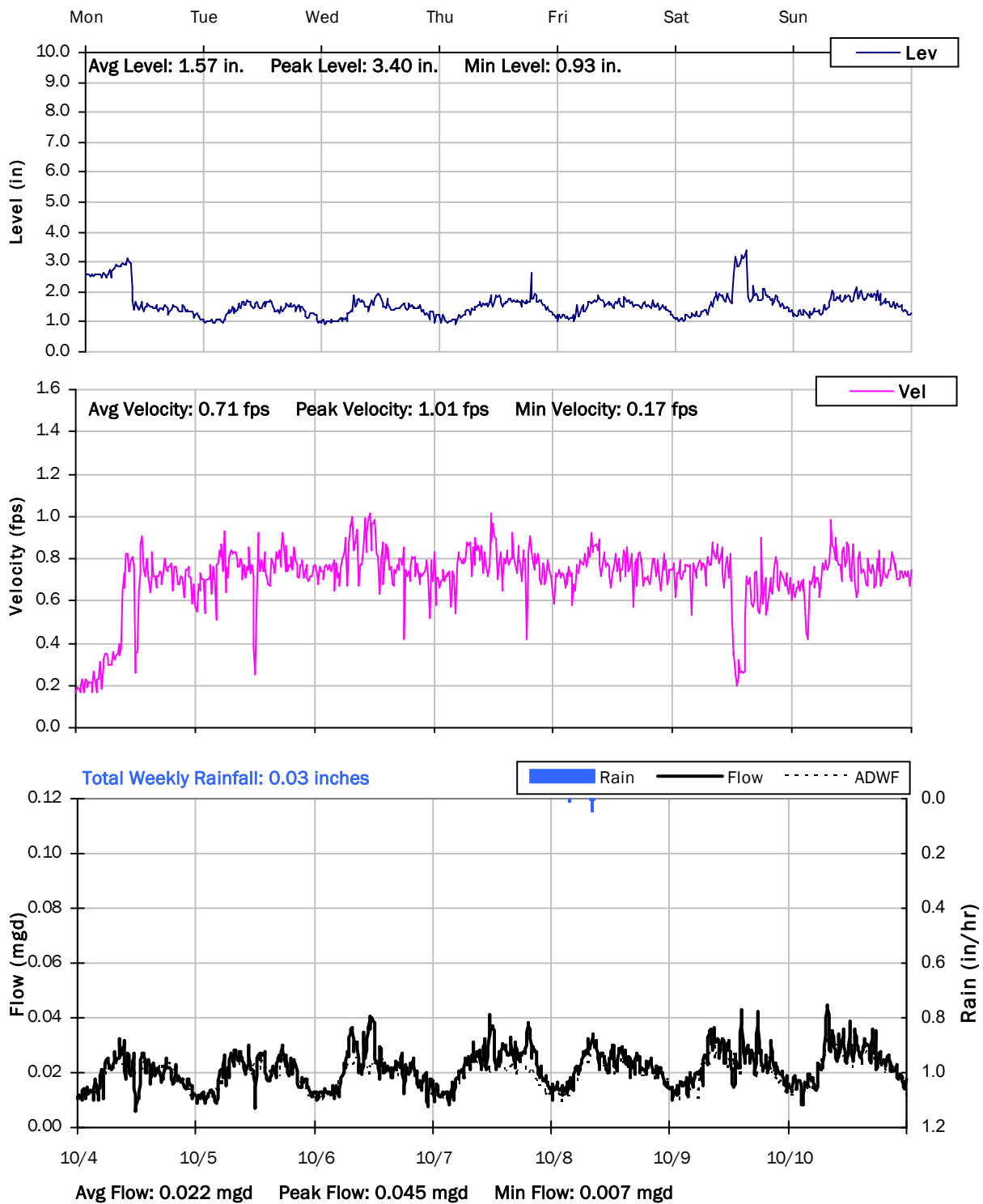
9/27/2021 to 10/4/2021



MOBILE-2

Weekly Level, Velocity and Flow Hydrographs

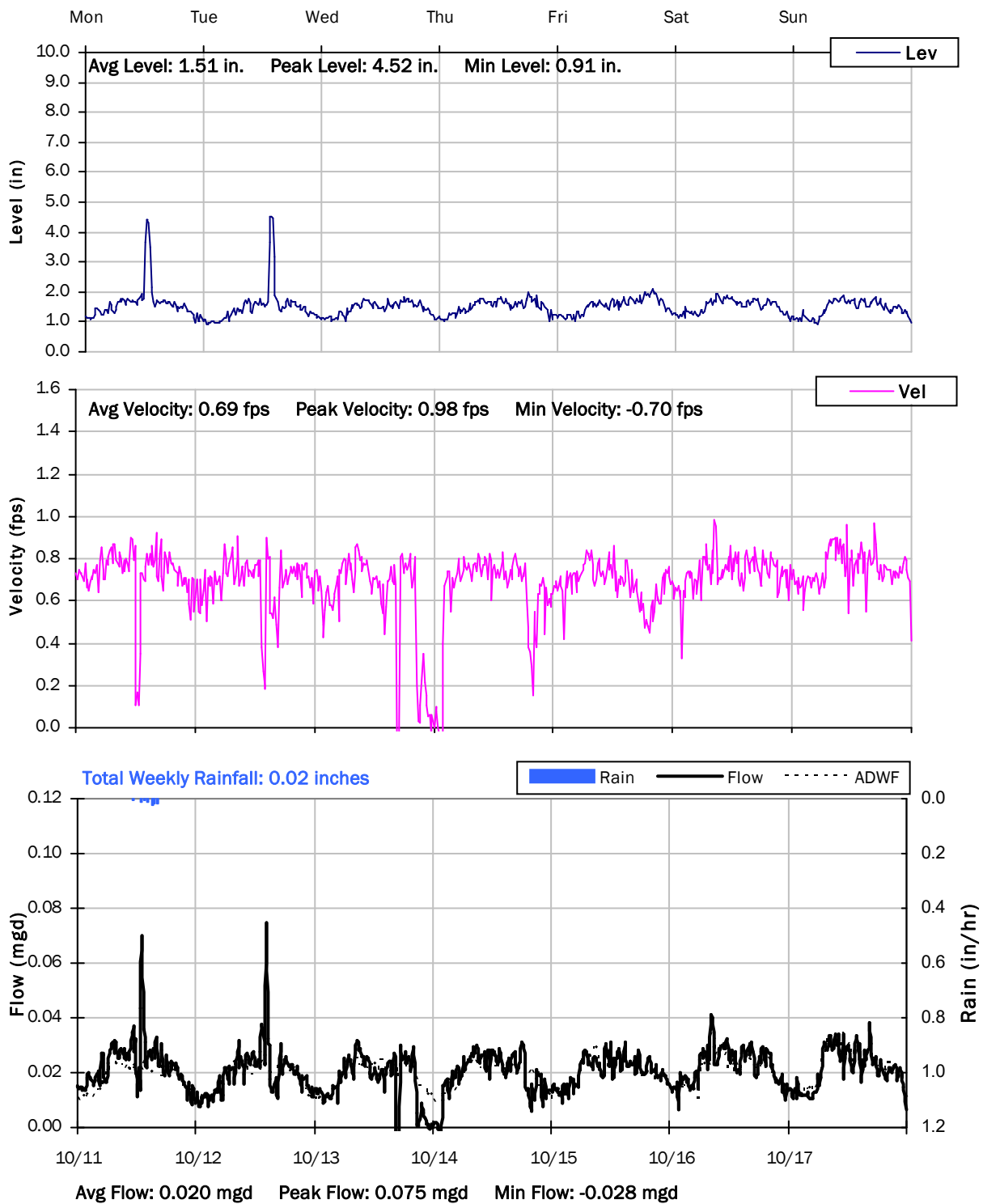
10/4/2021 to 10/11/2021



MOBILE-2

Weekly Level, Velocity and Flow Hydrographs

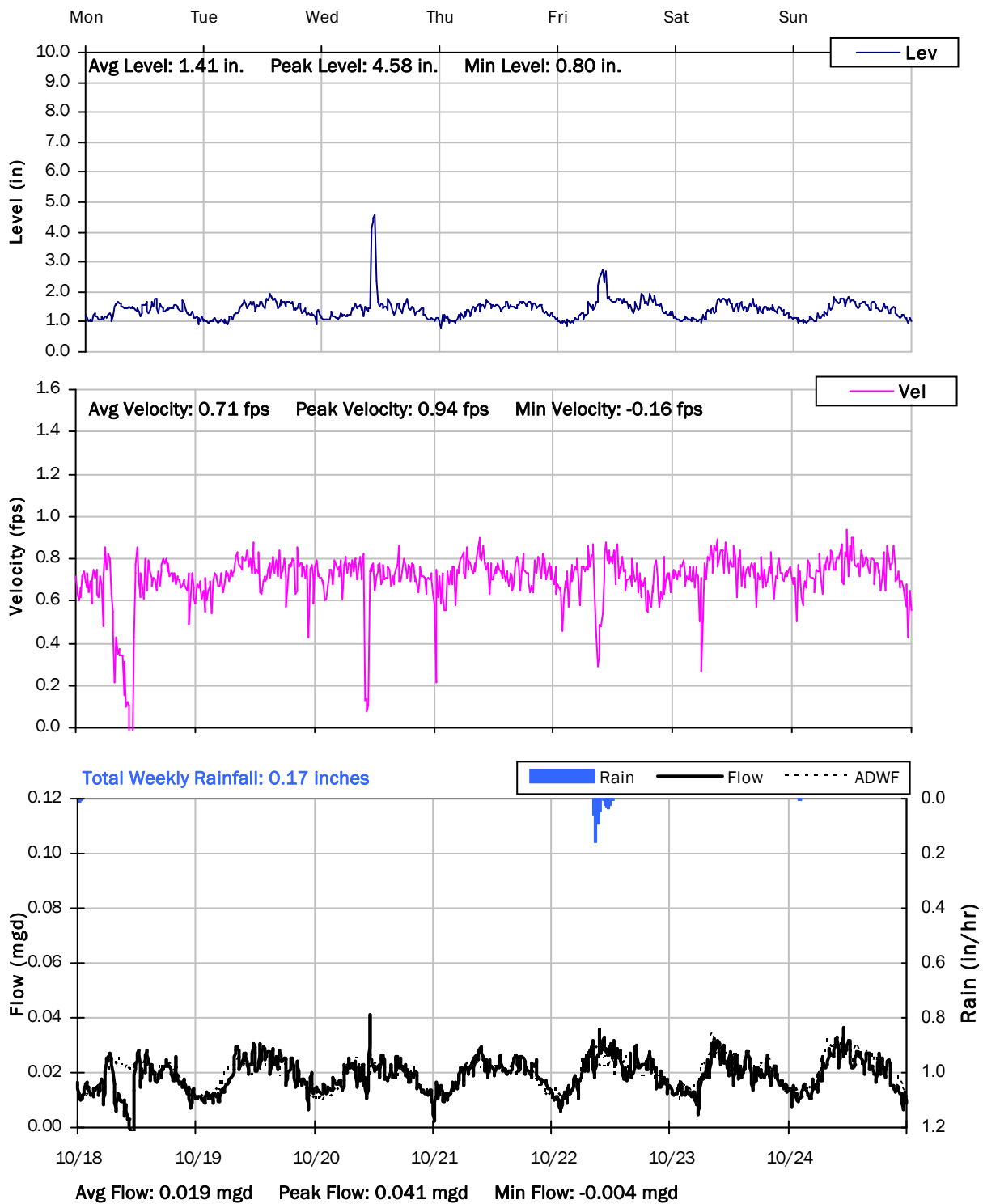
10/11/2021 to 10/18/2021



MOBILE-2

Weekly Level, Velocity and Flow Hydrographs

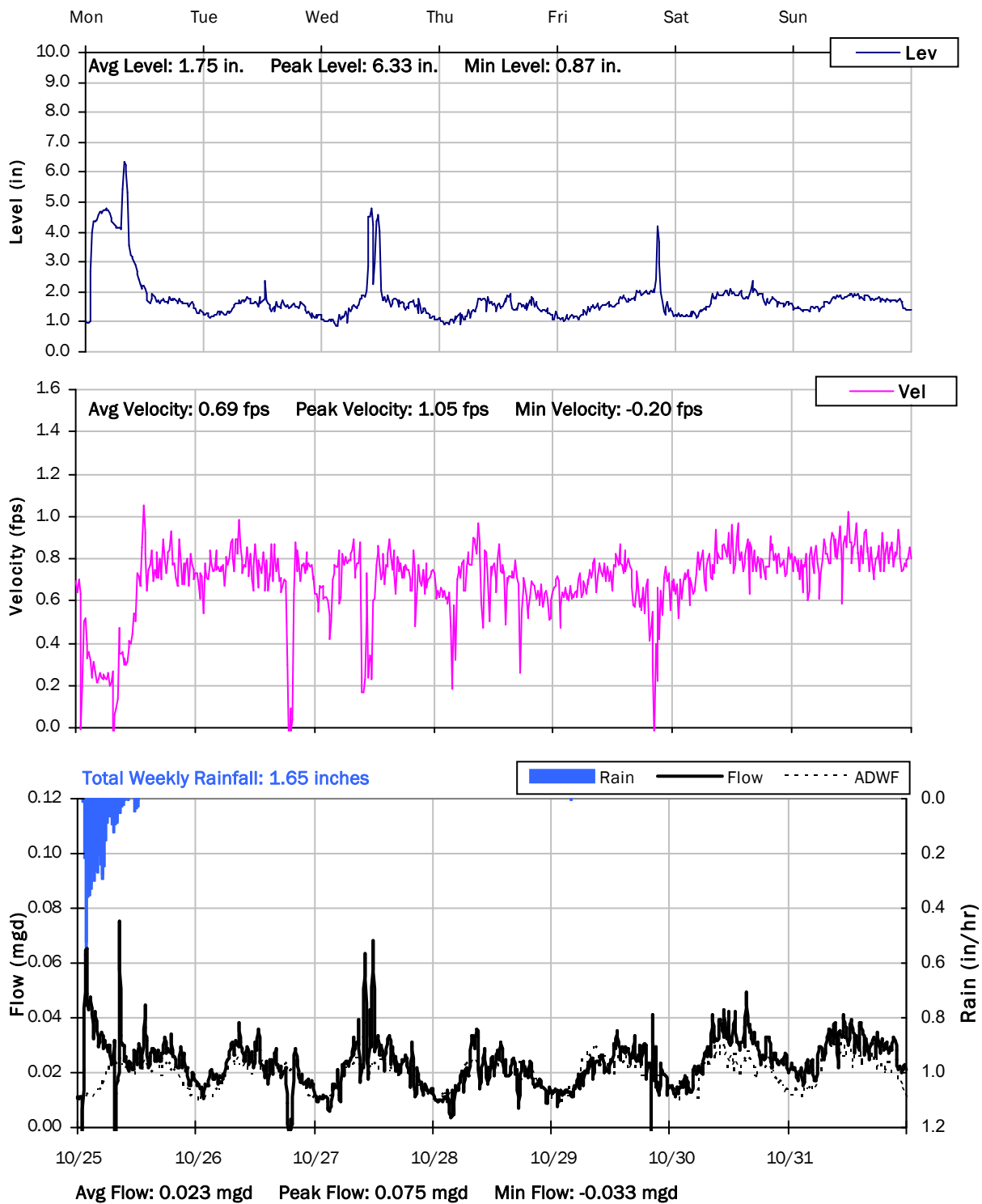
10/18/2021 to 10/25/2021



MOBILE-2

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



LOW DENSITY-1

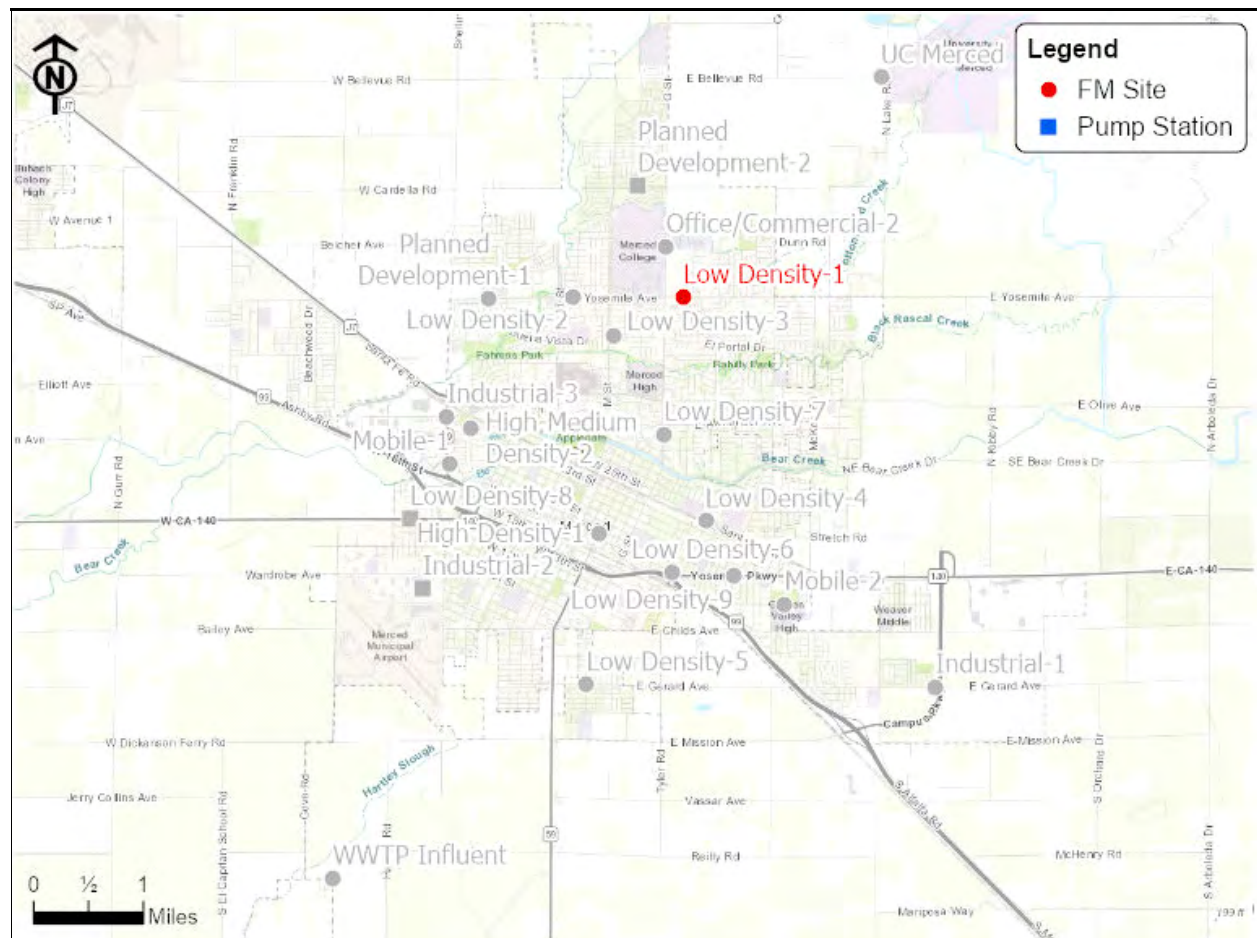
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: E Yosemite Avenue west of Mansionette Drive

Data Summary Report



Vicinity Map: Low Density-1

LOW DENSITY-1

Site Information

Location: E Yosemite Avenue west of Mansionette Drive

Coordinates: 120.4660° W, 37.3322° N

Rim Elevation (Earth): 178 feet

Measured Pipe Diameter: 18 inches

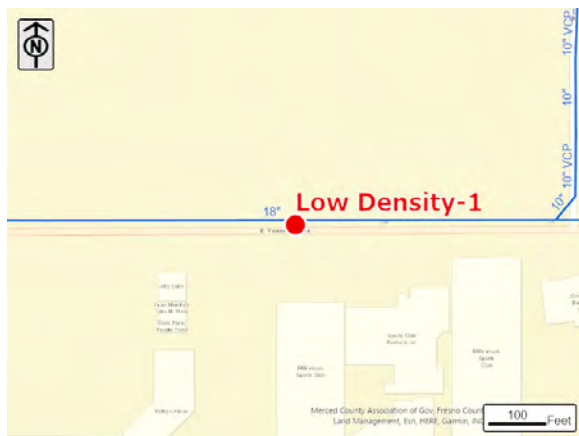
ADWF: 0.430 mgd

Peak Measured Flow: 0.836 mgd

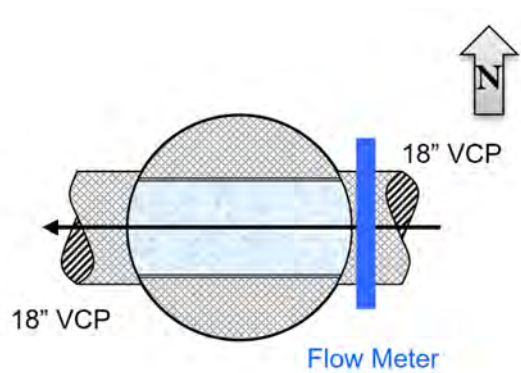
Sediment: None



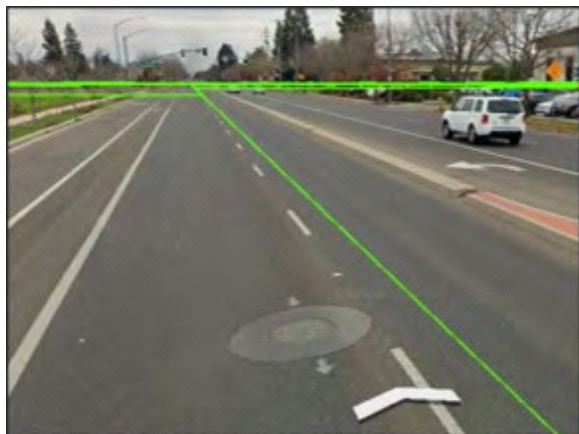
Satellite Map



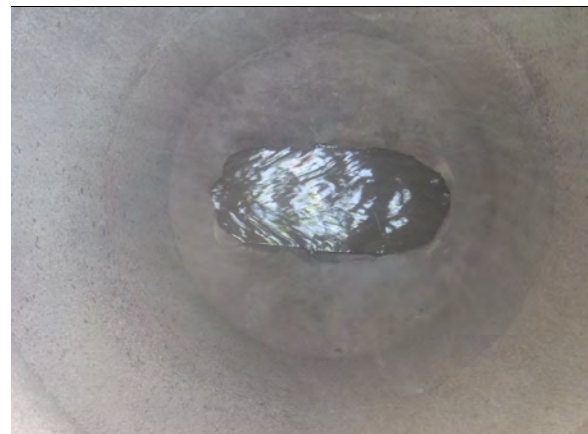
Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-1

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

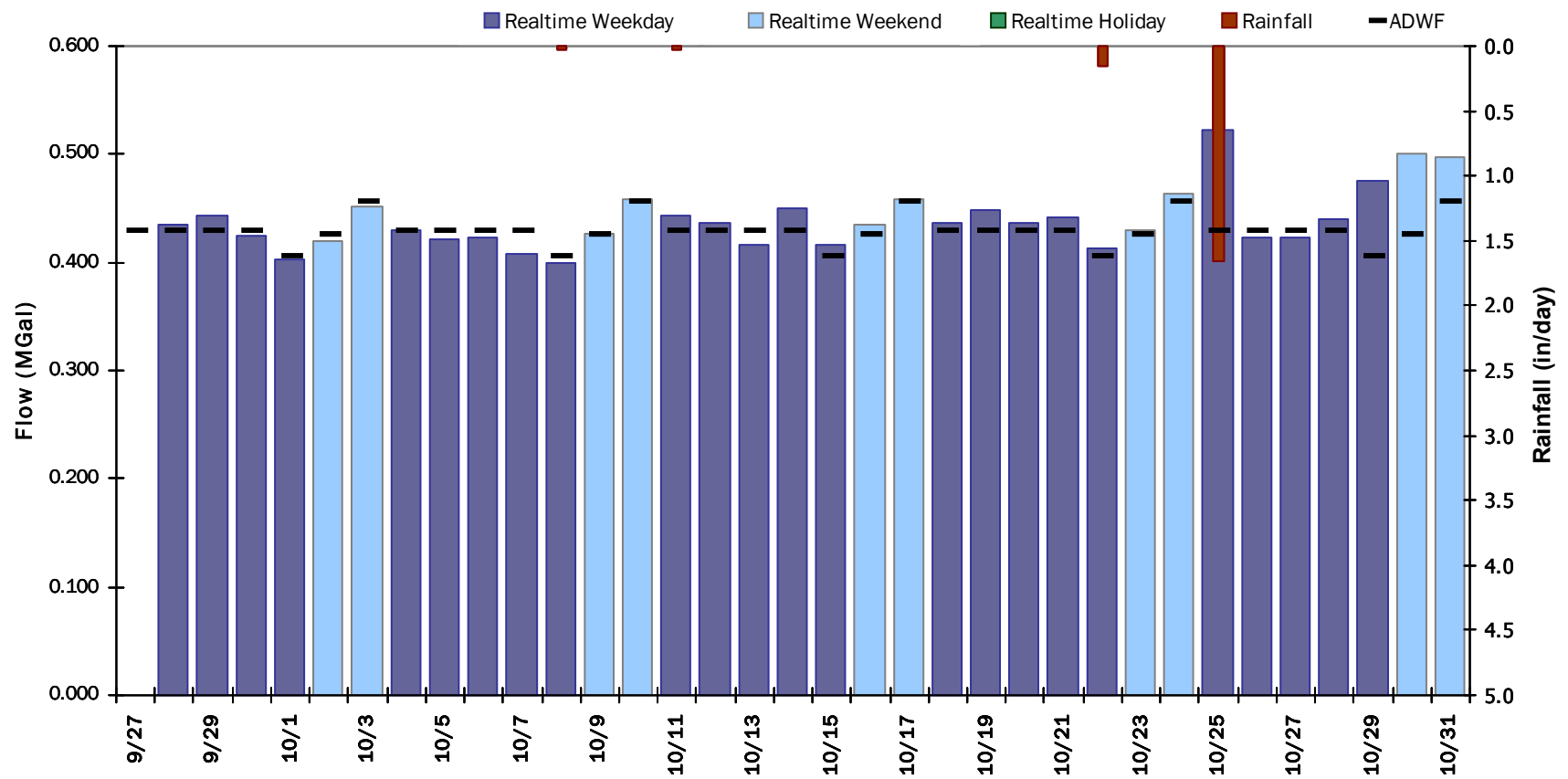


LOW DENSITY-1

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.440 MGal Peak Daily Flow: 0.522 MGal Min Daily Flow: 0.400 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-1

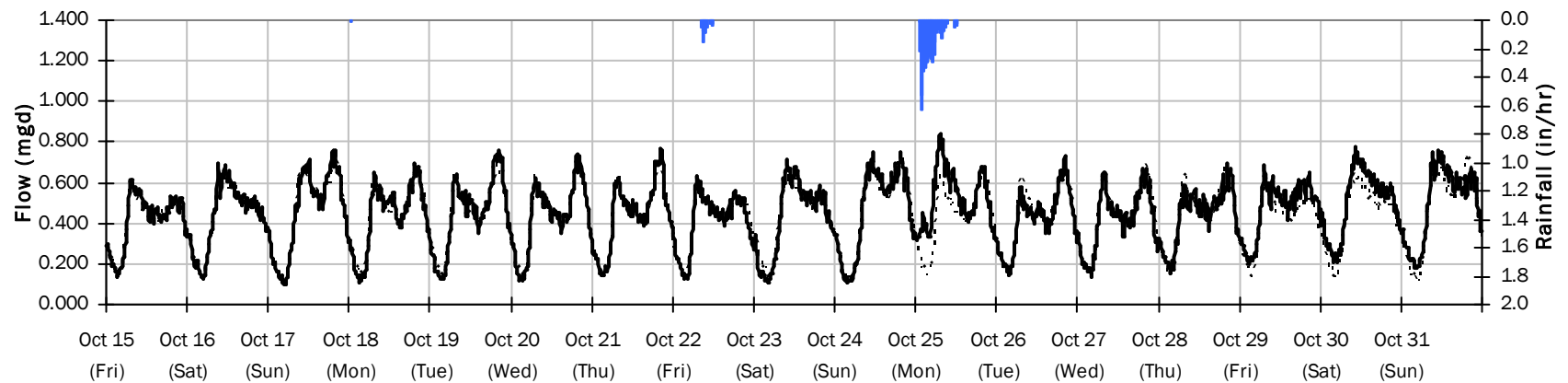
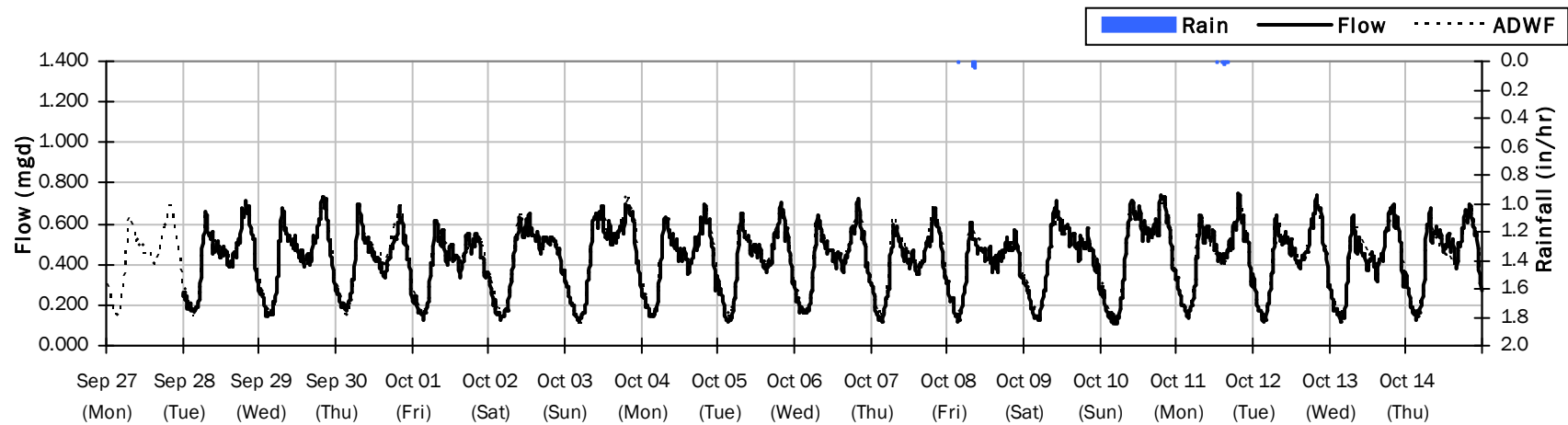
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.440 mgd

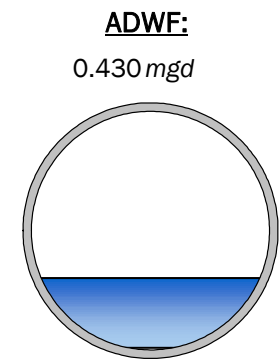
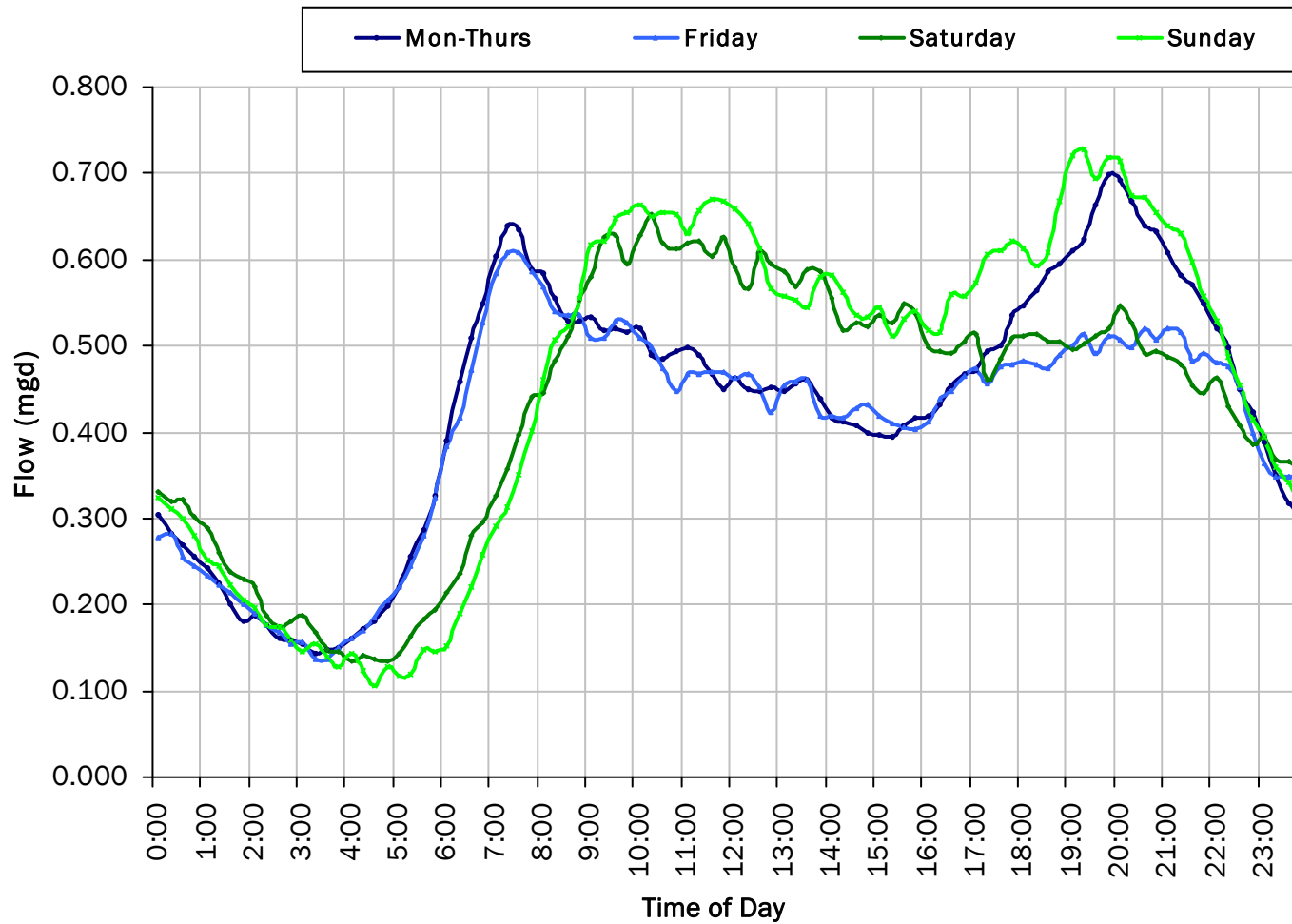
Period Peak Flow: 0.836 mgd

Period Min Flow: 0.098 mgd



LOW DENSITY-1

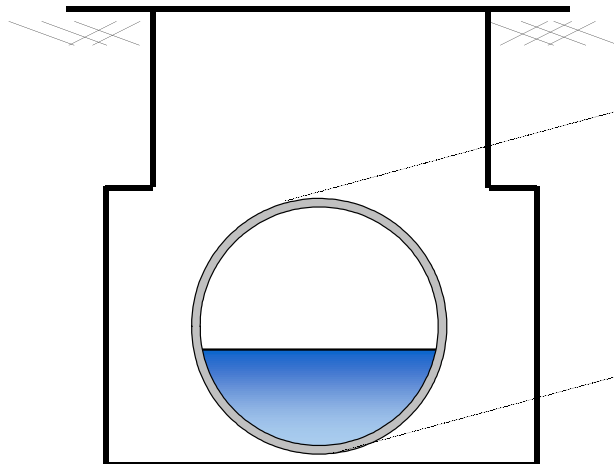
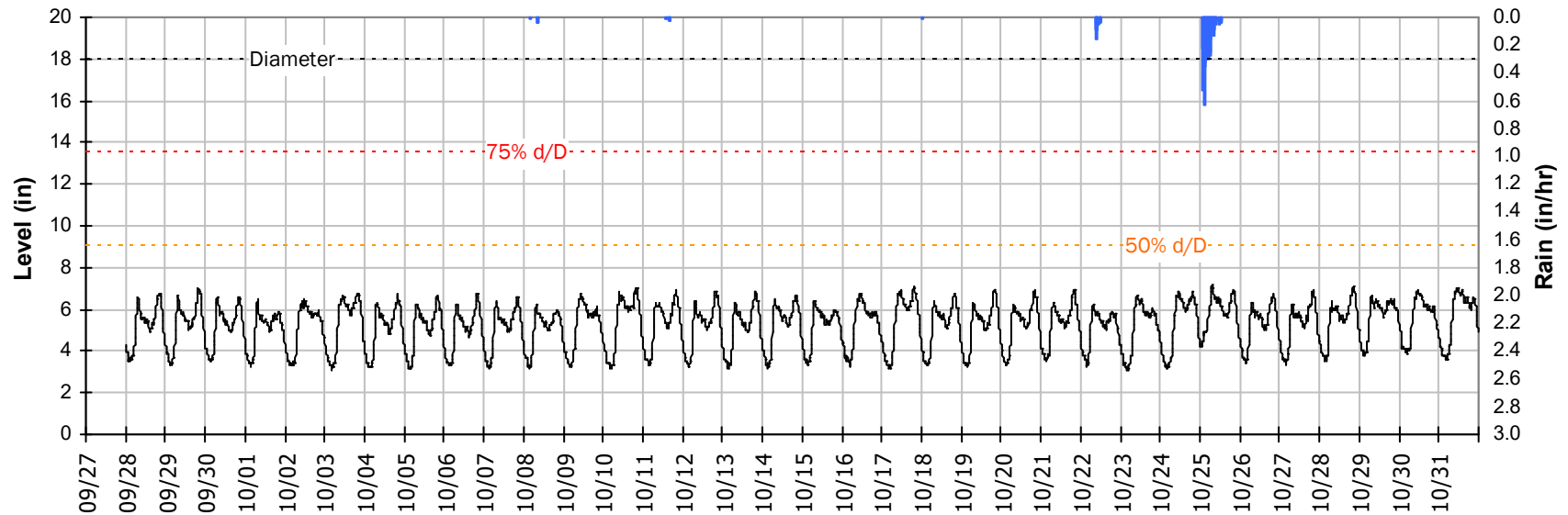
Average Dry Weather Flow Hydrographs



LOW DENSITY-1

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

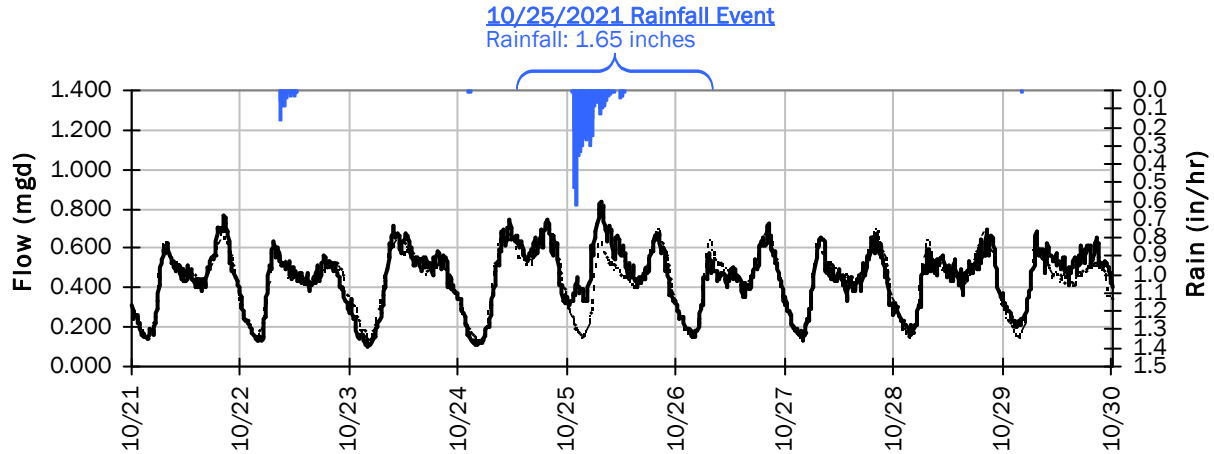


Pipe Diameter: 18 inches
Peak Measured Level: 7.18 inches
Peak d/D Ratio: 0.40

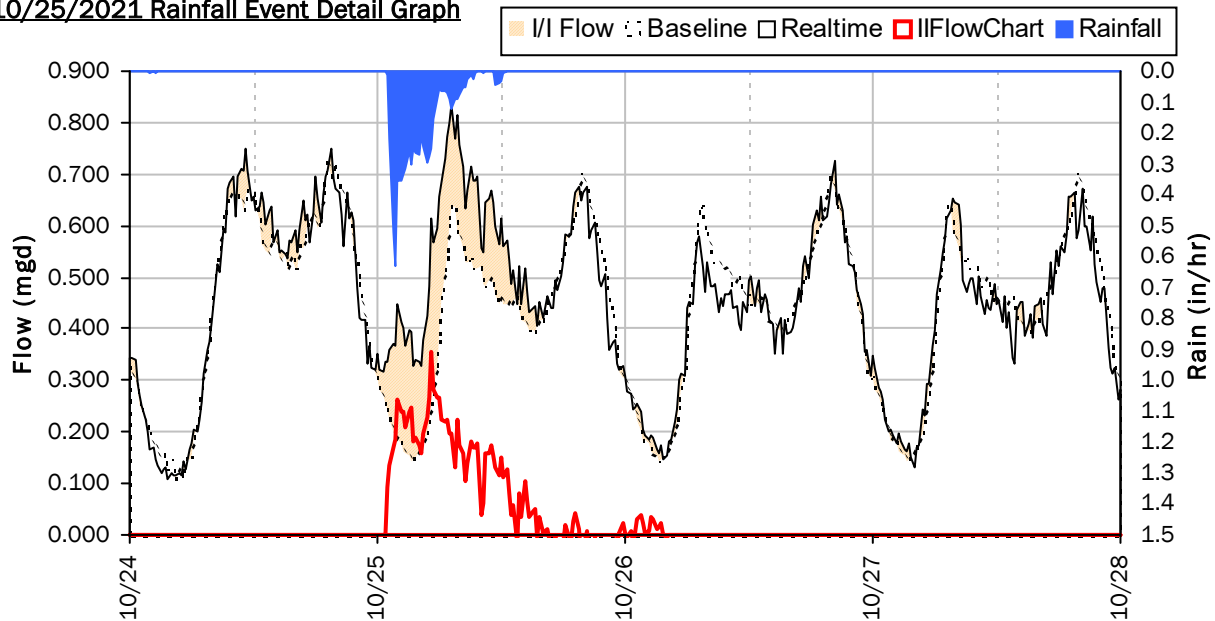
LOW DENSITY-1

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



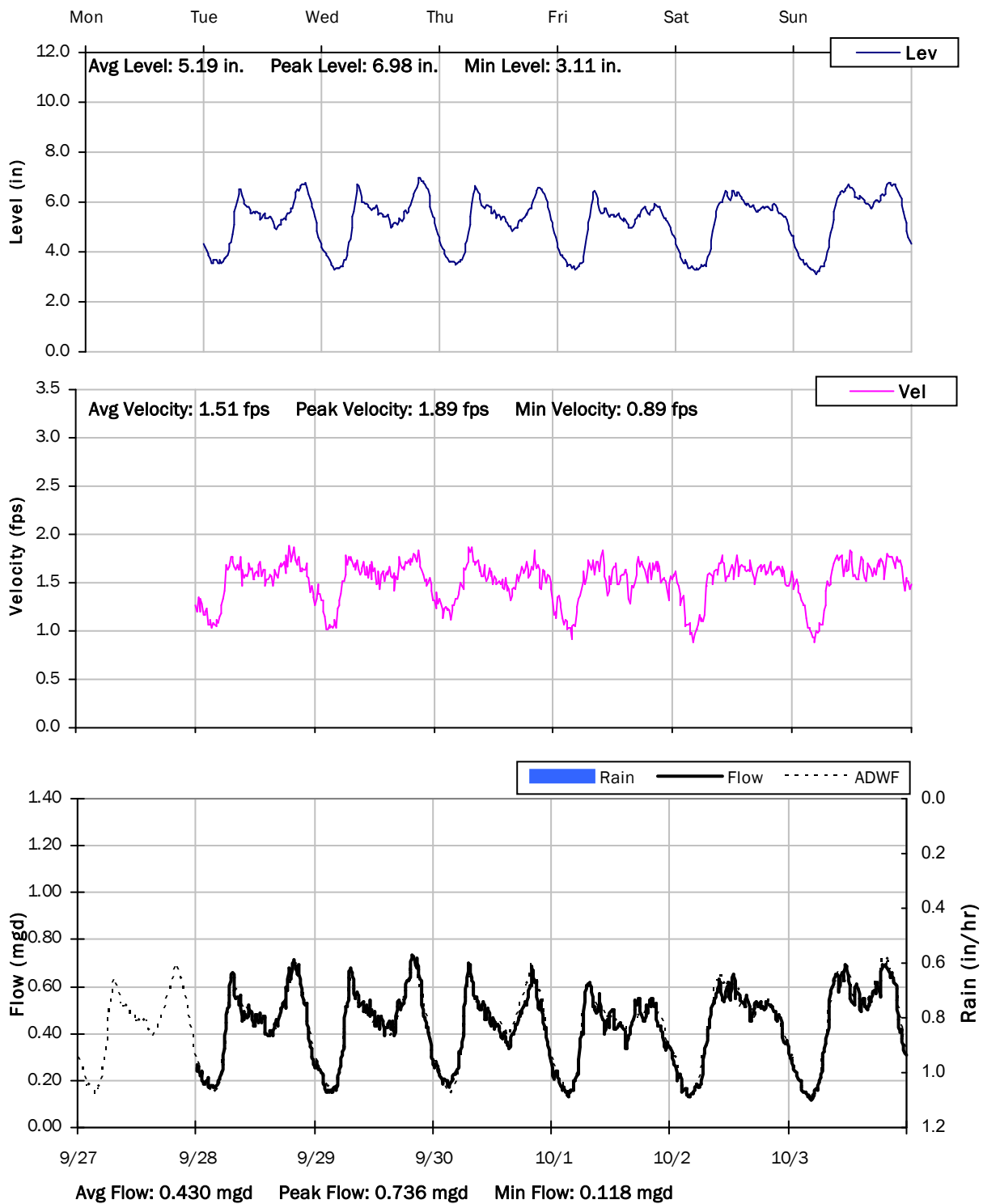
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.836 mgd	Peak I/I Rate:	0.357 mgd
PF:	1.94	Total I/I:	92,000 gallons
Peak Level:	7.18 in		
d/D Ratio:	0.40		

LOW DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

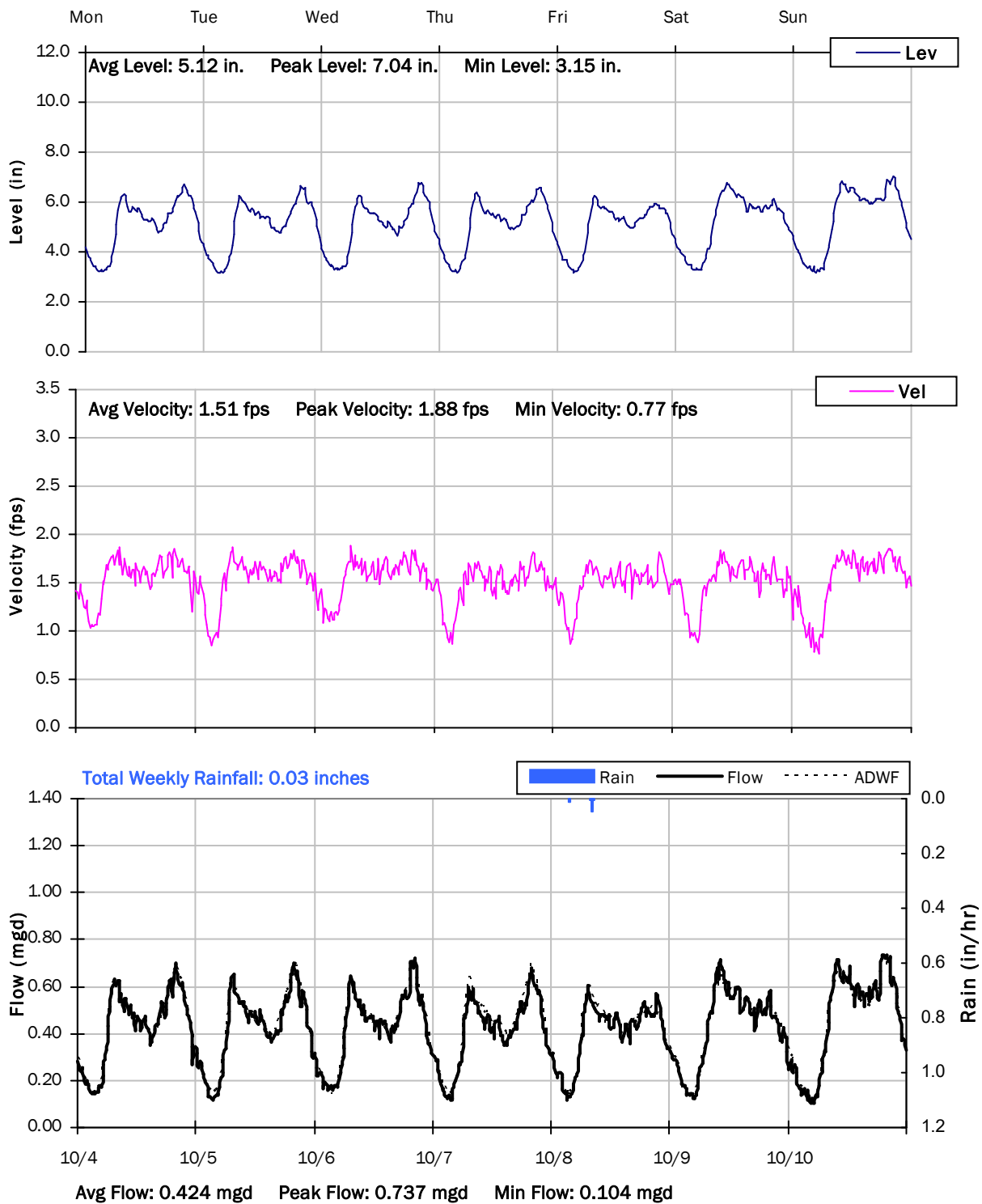
9/27/2021 to 10/4/2021



LOW DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

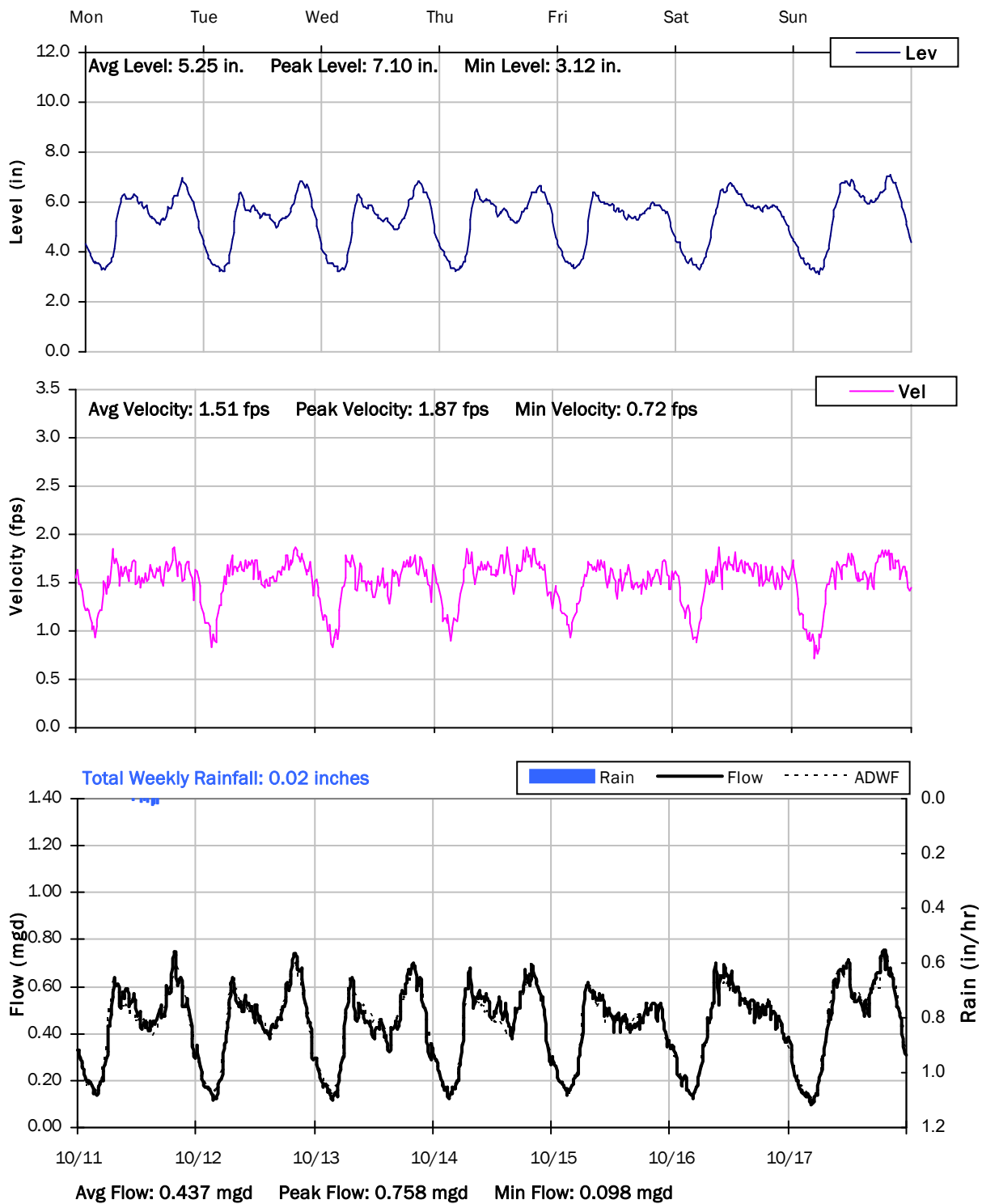
10/4/2021 to 10/11/2021



LOW DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

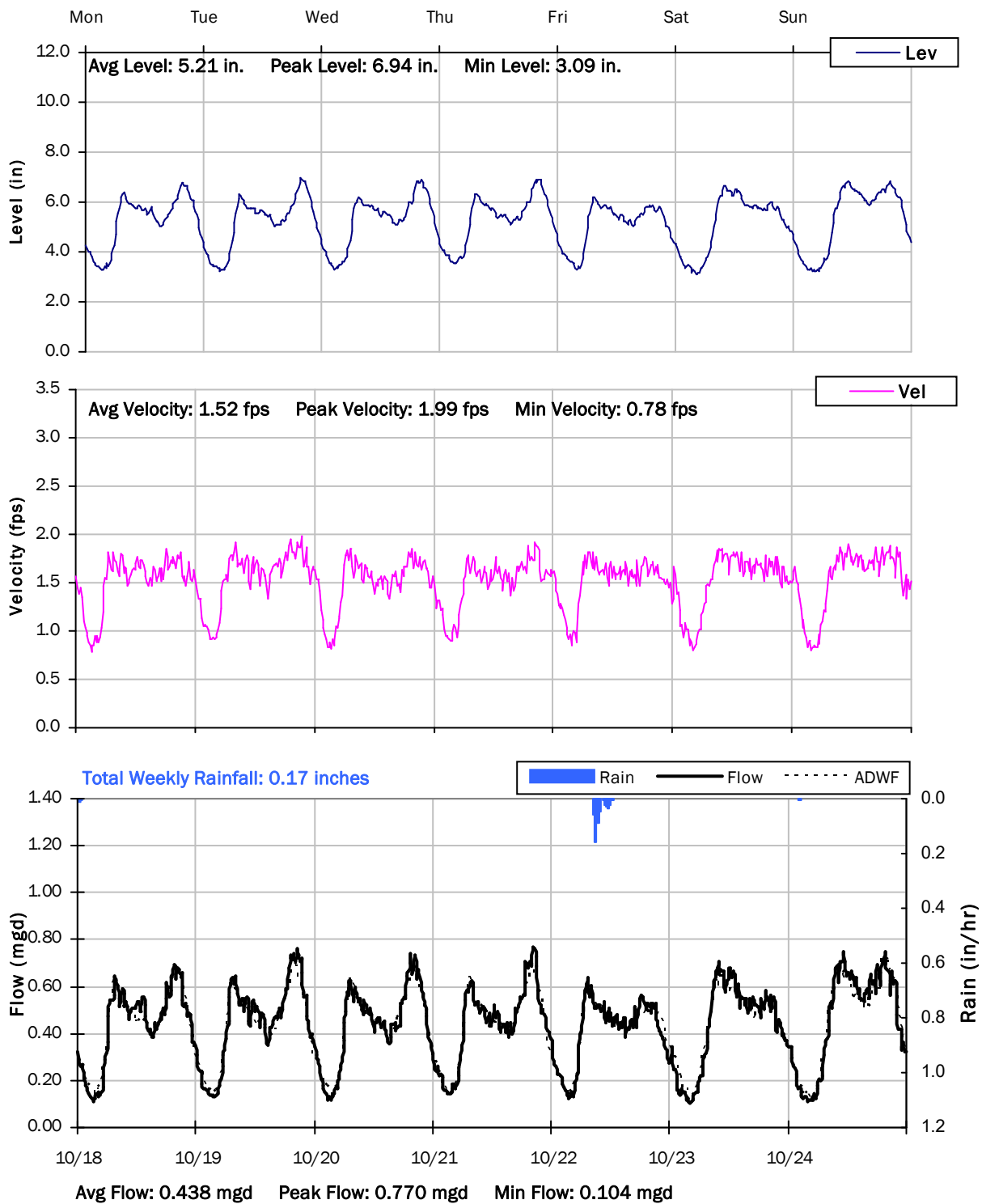
10/11/2021 to 10/18/2021



LOW DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

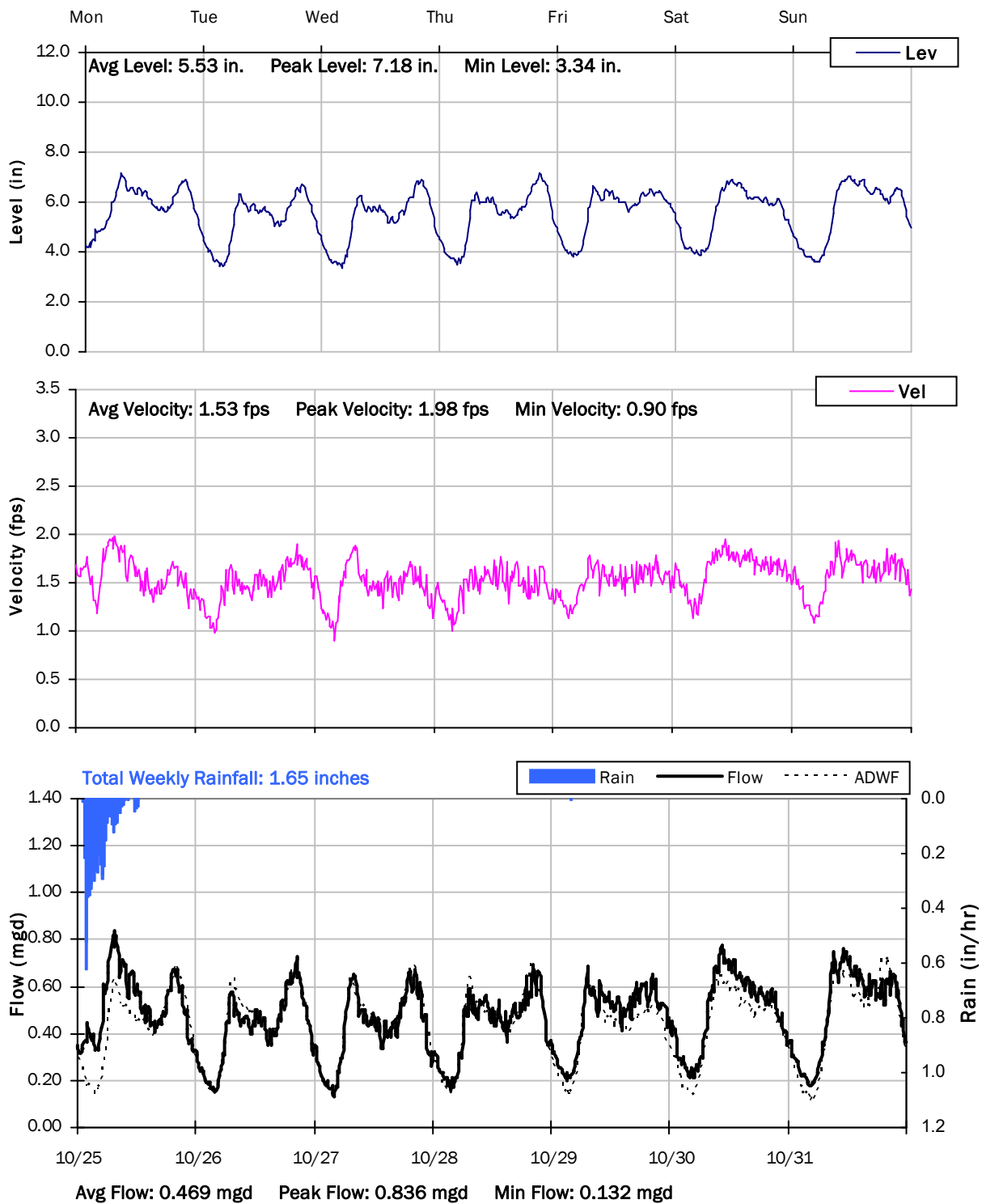
10/18/2021 to 10/25/2021



LOW DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

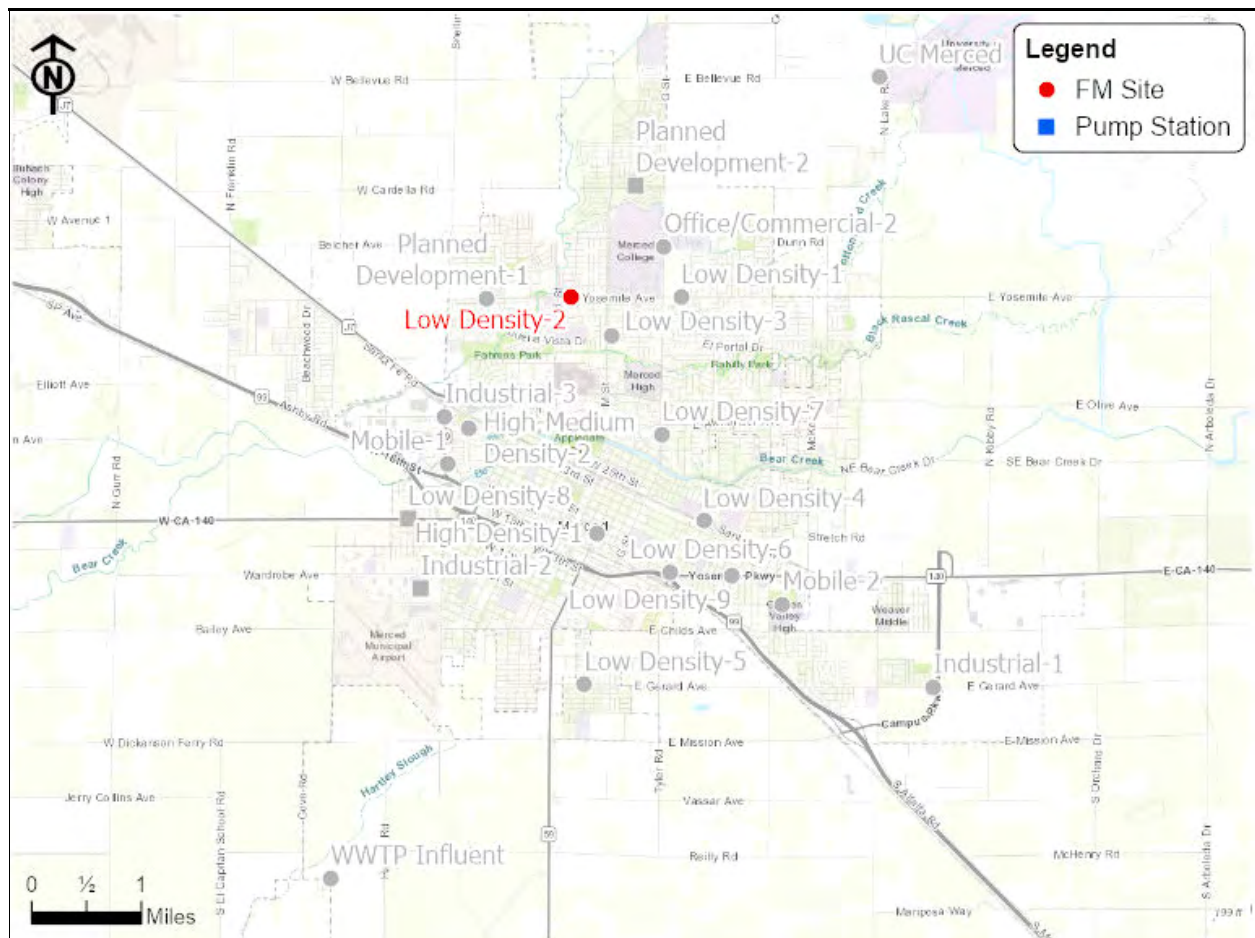
10/25/2021 to 11/1/2021



City of Merced, CA

September 27, 2021 - October 31, 2021

Data Summary Report



Vicinity Map: Low Density-2

LOW DENSITY-2

Site Information

Location: W Yosemite Avenue west of San Jose Avenue

Coordinates: 120.4841° W, 37.3321° N

Rim Elevation (Earth): 170 feet

Measured Pipe Diameter: 9.875 inches

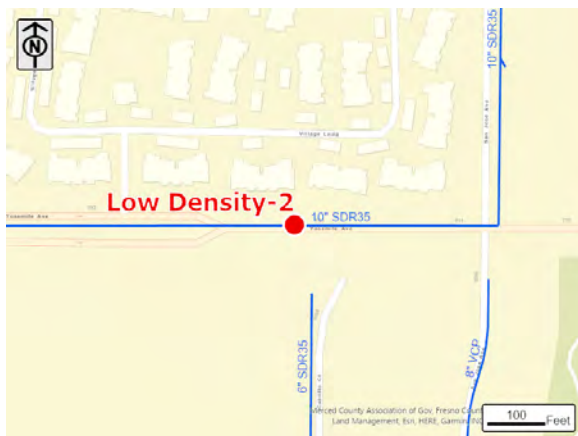
ADWF: 0.052 mgd

Peak Measured Flow: 0.167 mgd

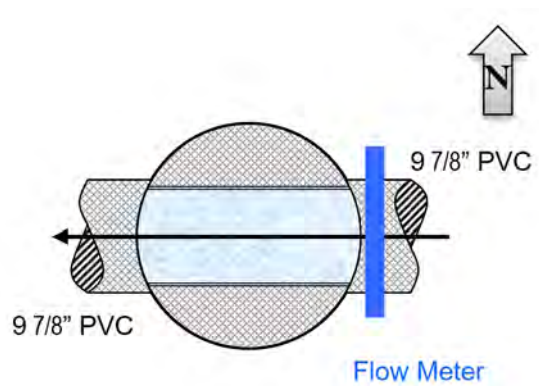
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-2

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

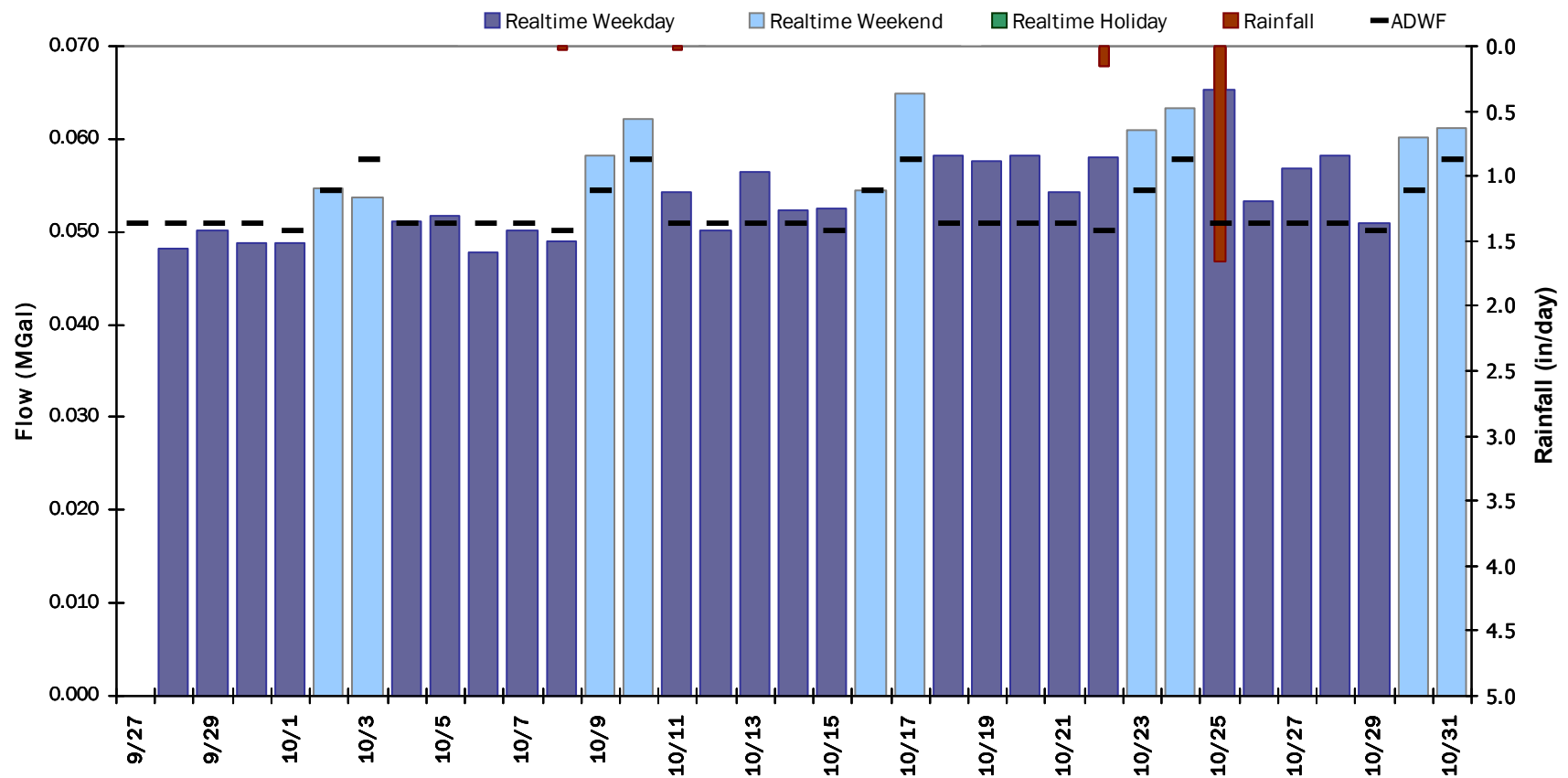


LOW DENSITY-2

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.055 MGal Peak Daily Flow: 0.065 MGal Min Daily Flow: 0.048 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-2

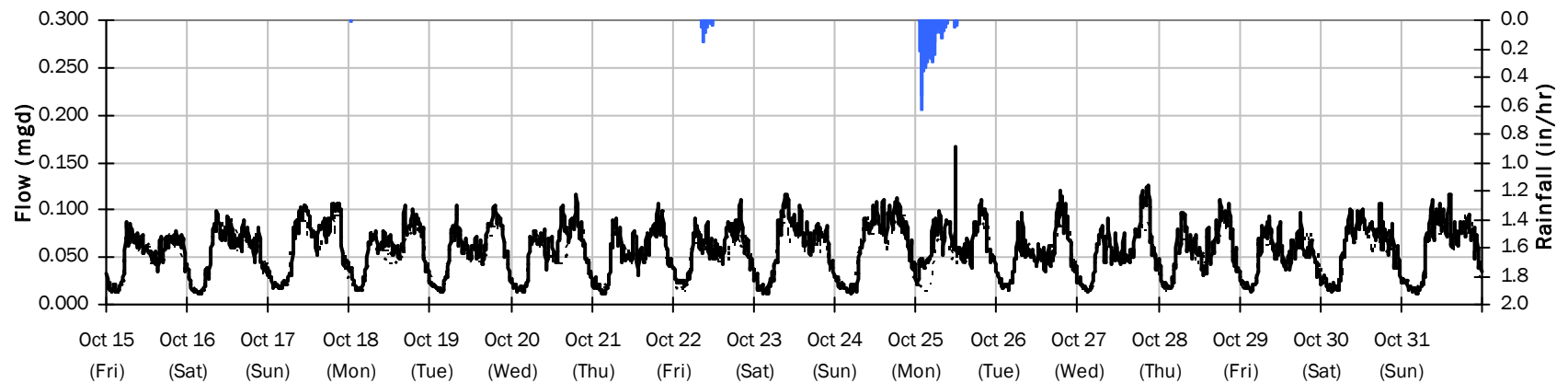
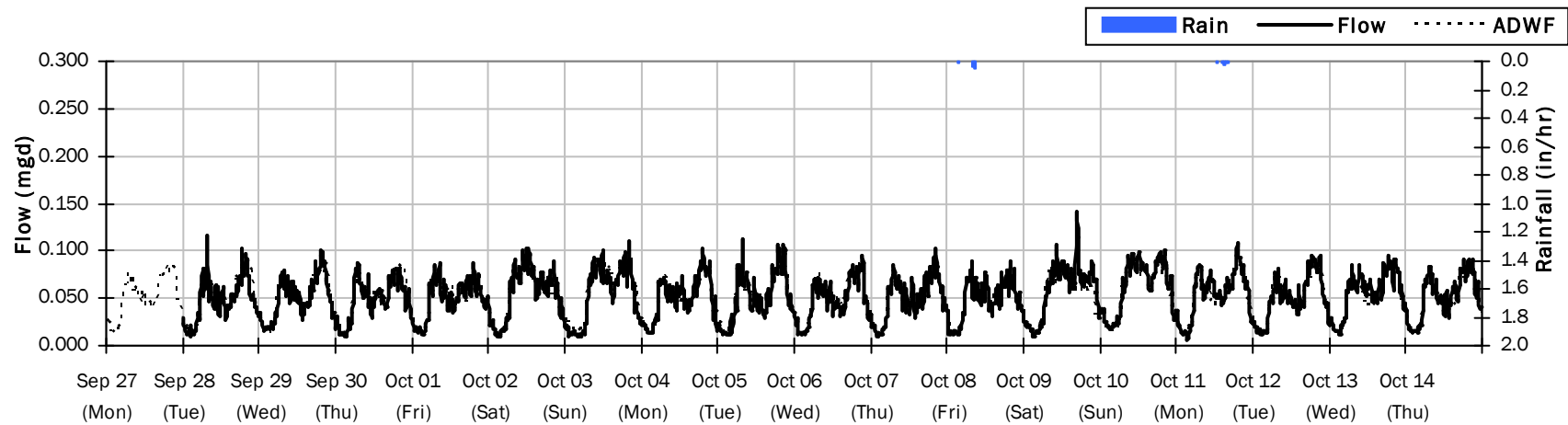
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.055 mgd

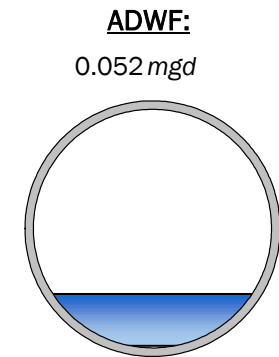
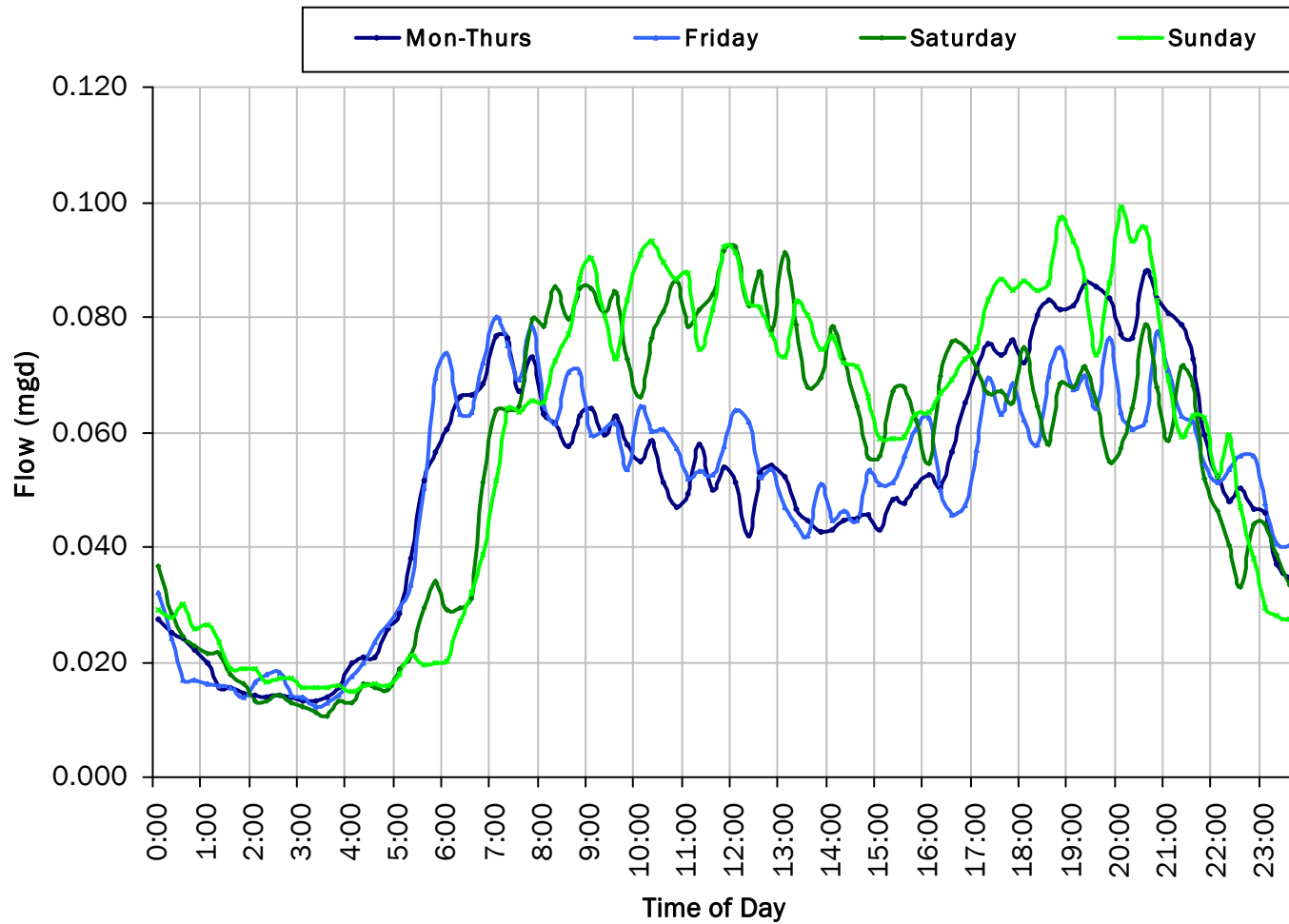
Period Peak Flow: 0.167 mgd

Period Min Flow: 0.007 mgd



LOW DENSITY-2

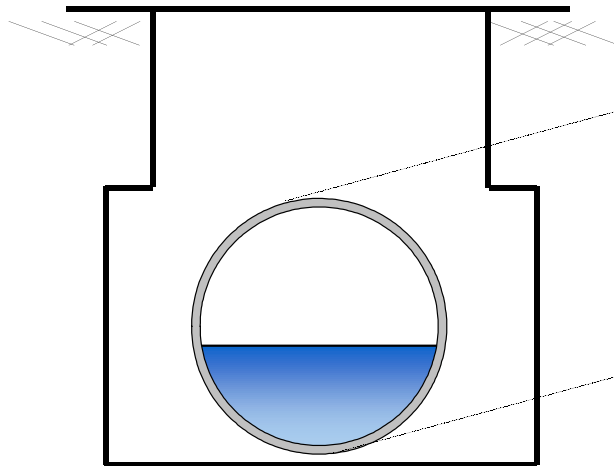
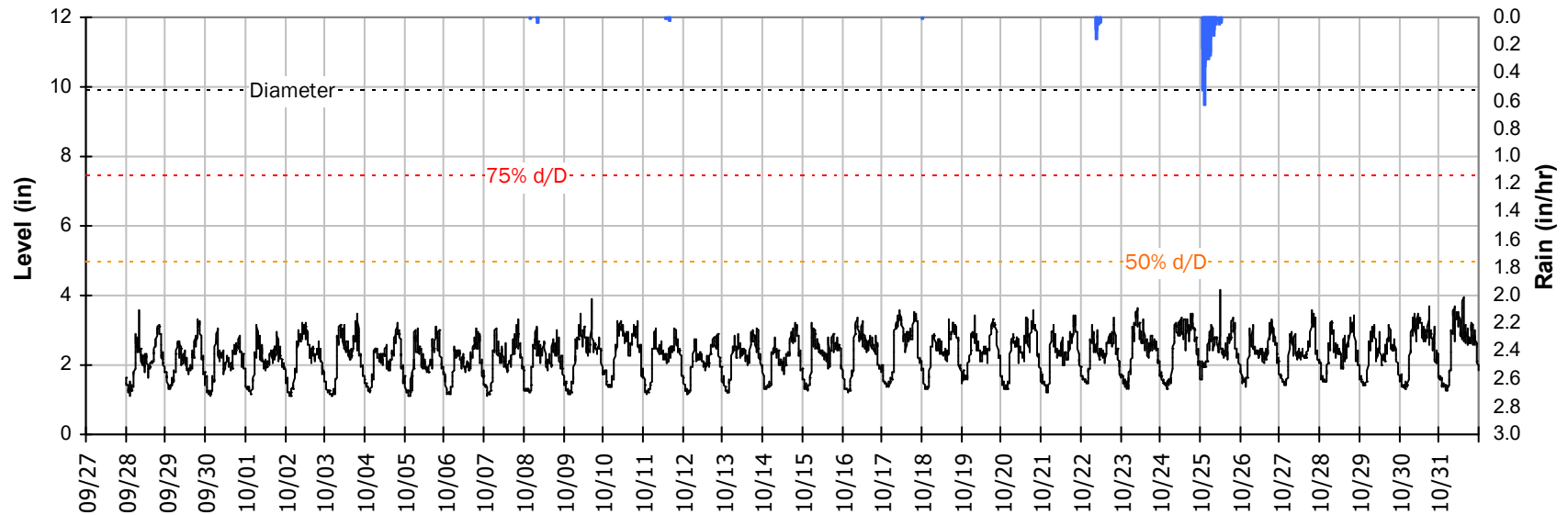
Average Dry Weather Flow Hydrographs



LOW DENSITY-2

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

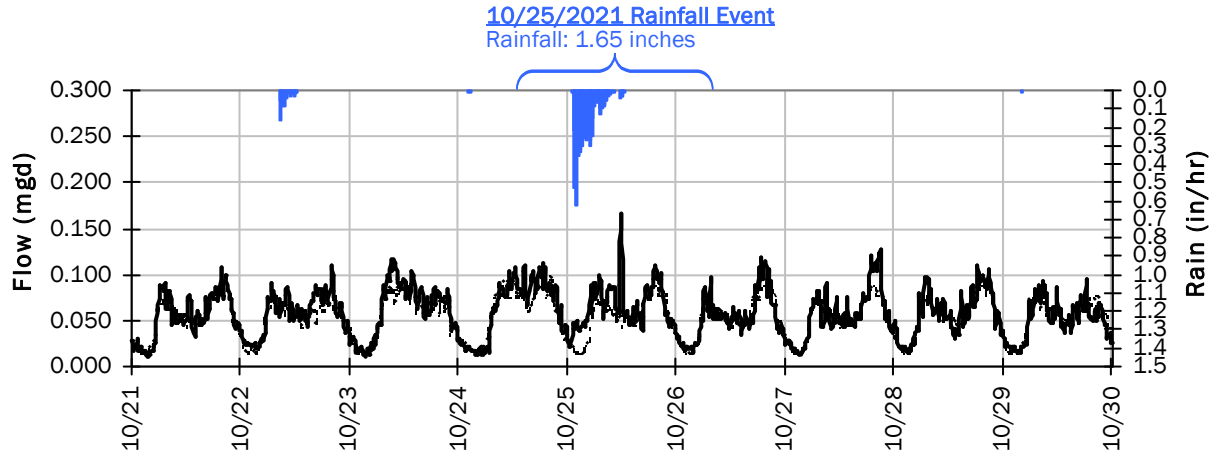


Pipe Diameter:	9.88	inches
Peak Measured Level:	4.14	inches
Peak d/D Ratio:	0.42	

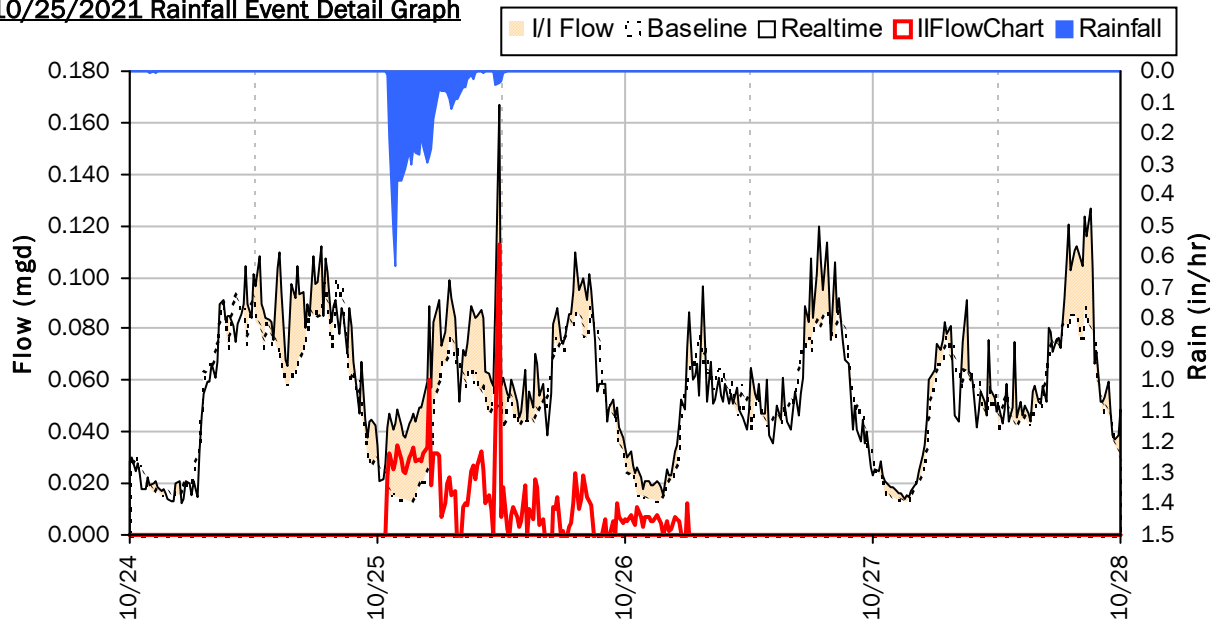
LOW DENSITY-2

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



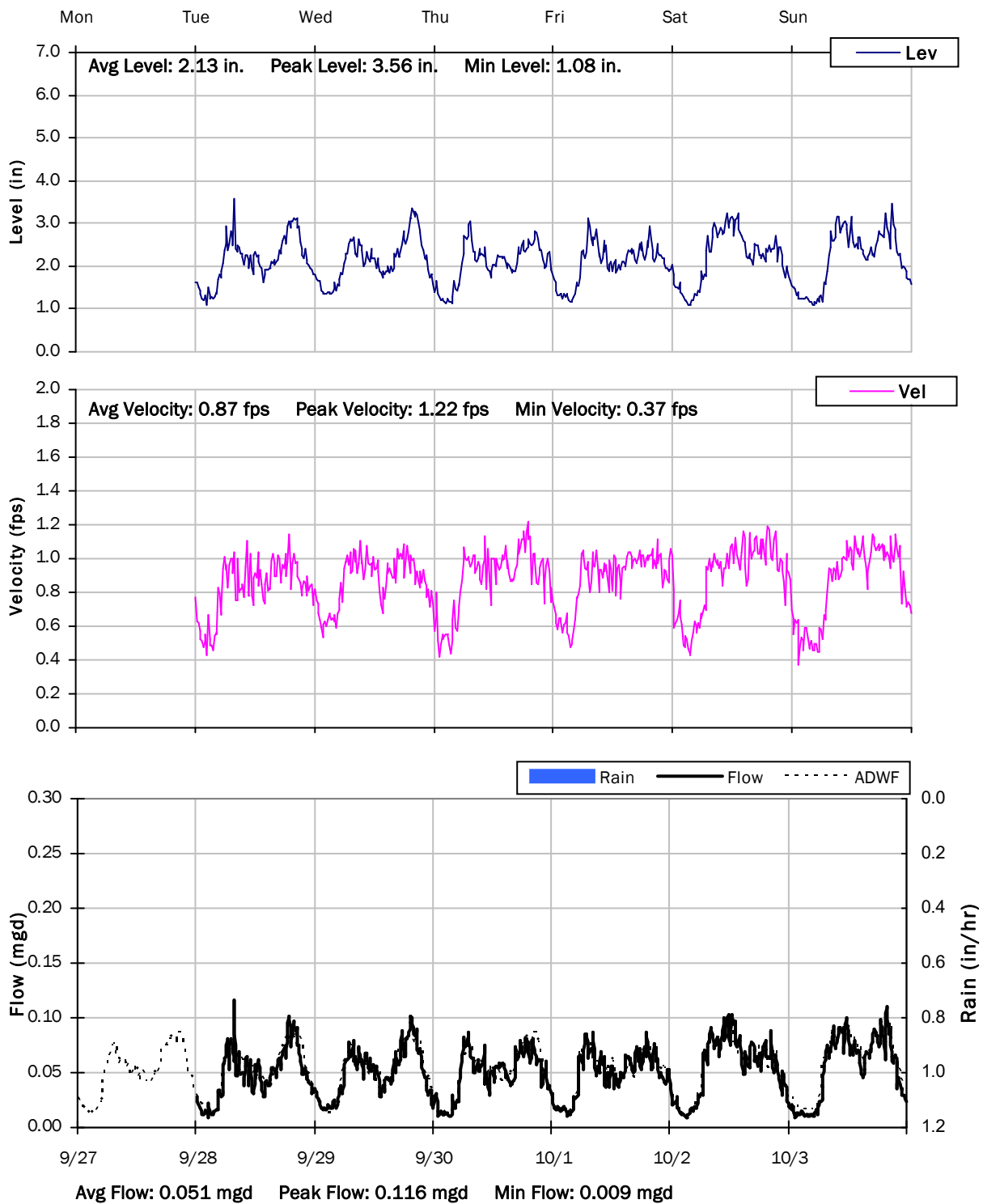
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.167 mgd	Peak I/I Rate:	0.113 mgd
PF:	3.18	Total I/I:	16,000 gallons
Peak Level:	4.14 in		
d/D Ratio:	0.42		

LOW DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

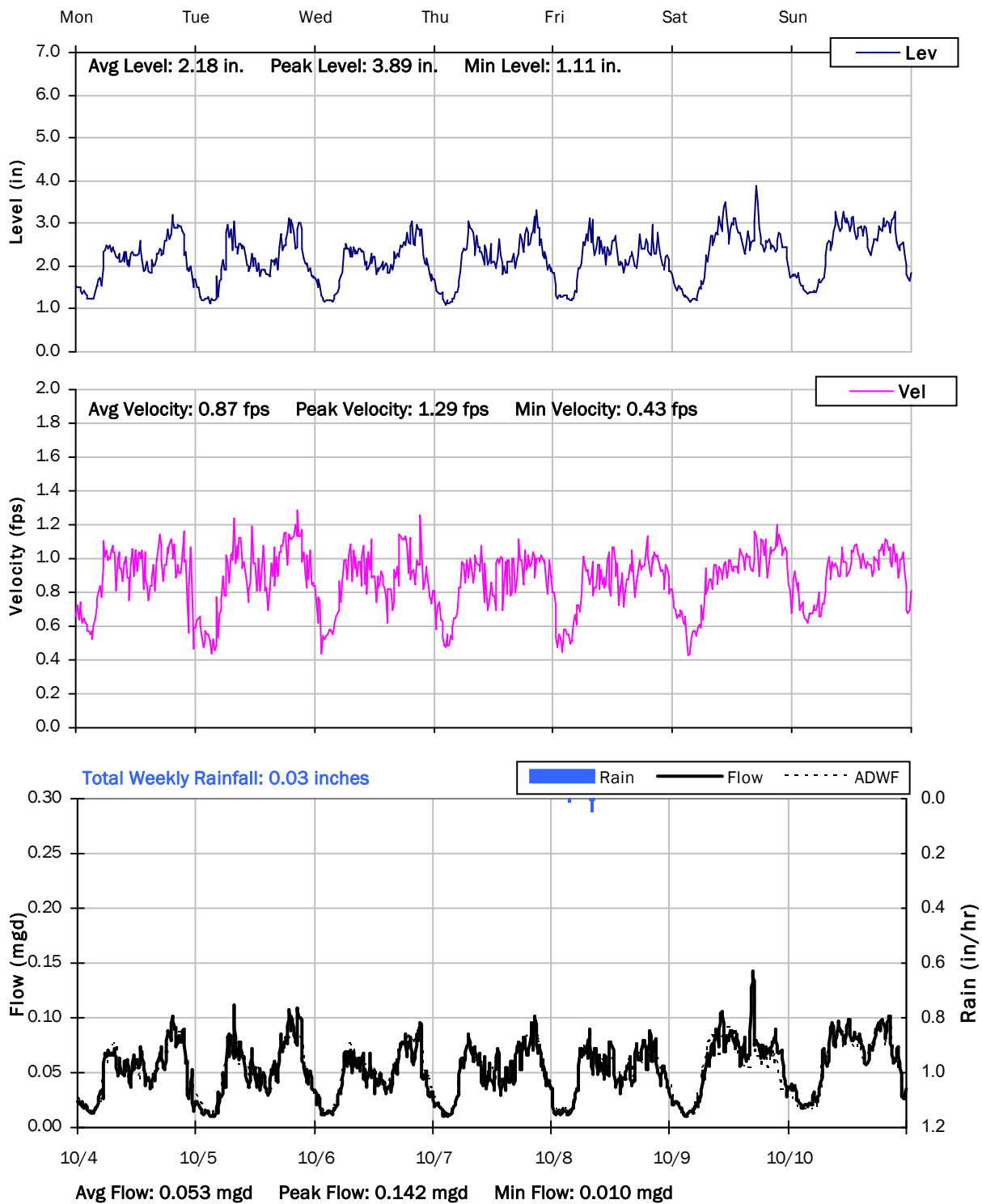
9/27/2021 to 10/4/2021



LOW DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

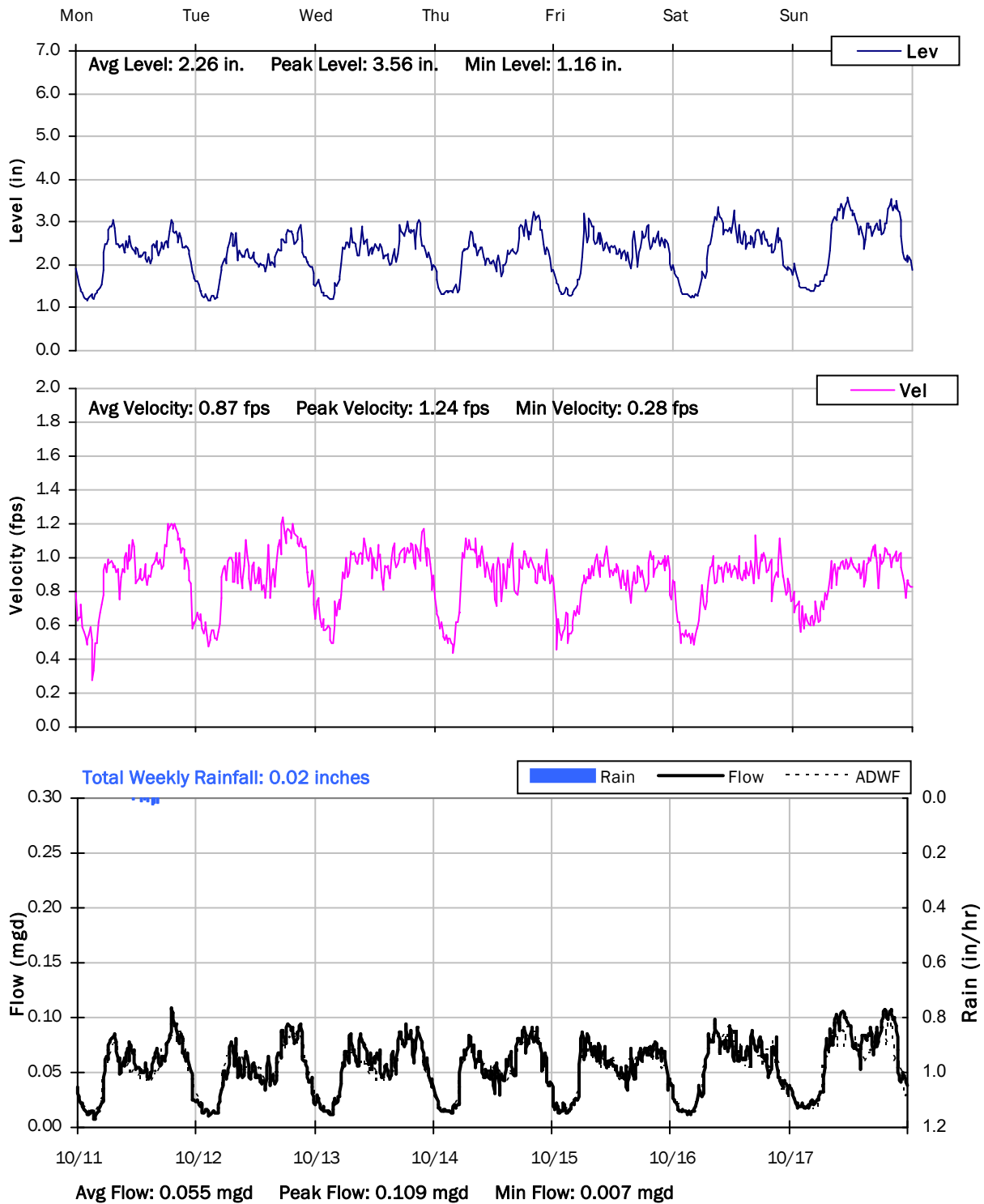
10/4/2021 to 10/11/2021



LOW DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

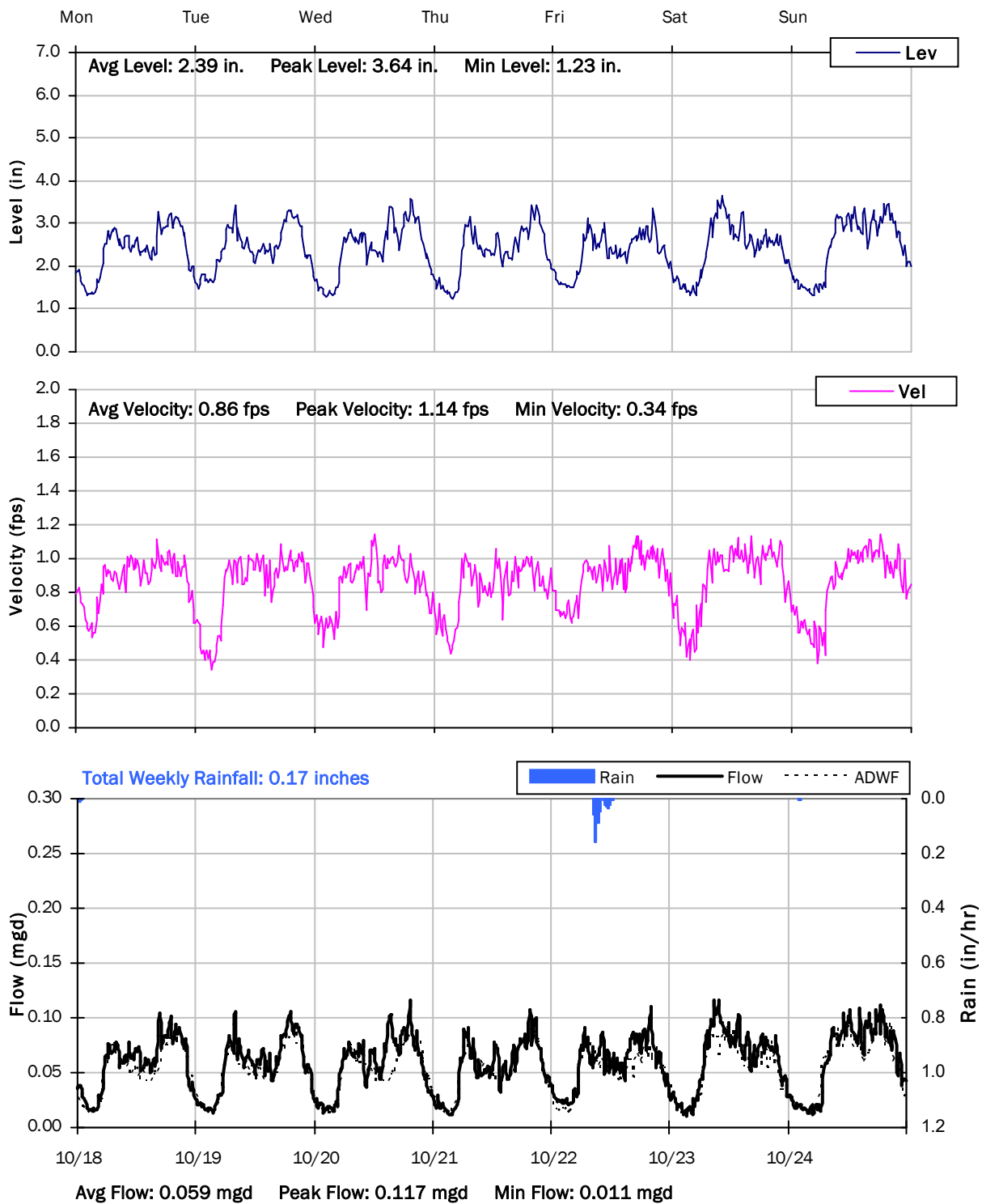
10/11/2021 to 10/18/2021



LOW DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

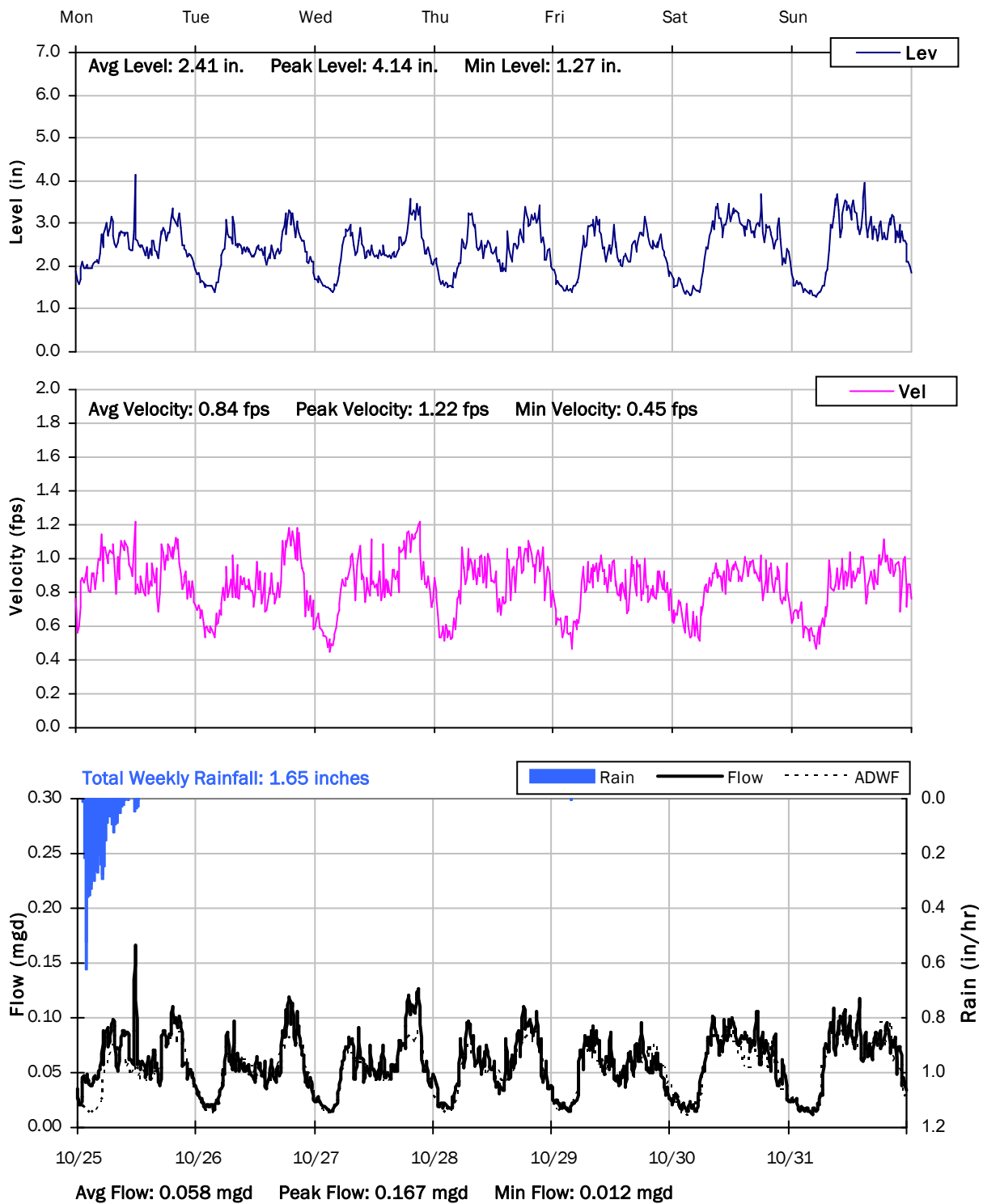
10/18/2021 to 10/25/2021



LOW DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



LOW DENSITY-3

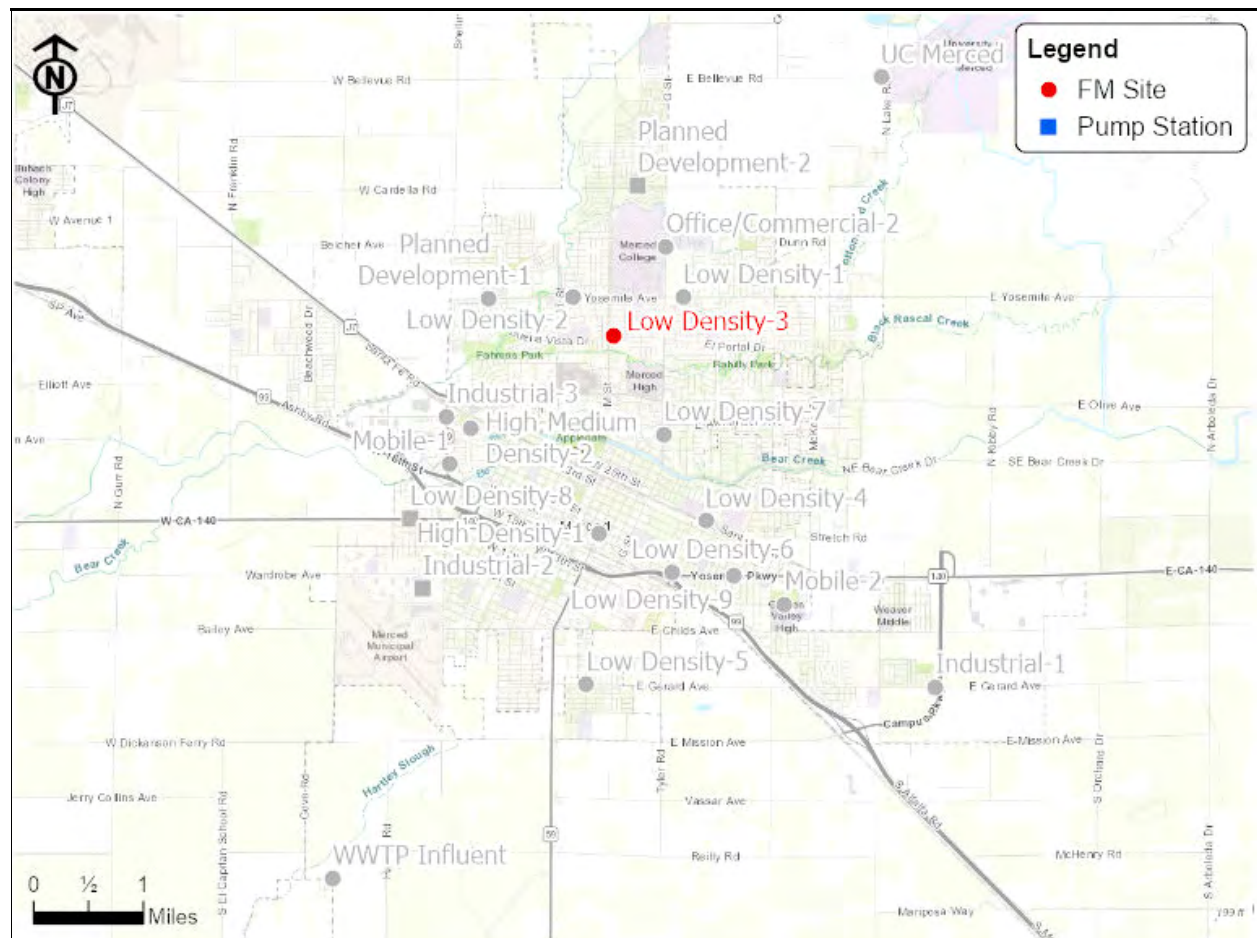
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Buena Vista Drive and Terri Court

Data Summary Report



Vicinity Map: Low Density-3

LOW DENSITY-3

Site Information

Location: Buena Vista Drive and Terri Court

Coordinates: 120.4774° W, 37.3271° N

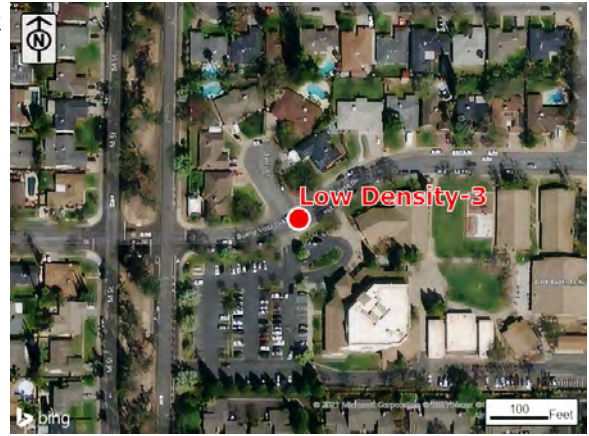
Rim Elevation (Earth): 181 feet

Measured Pipe Diameter: 10 inches

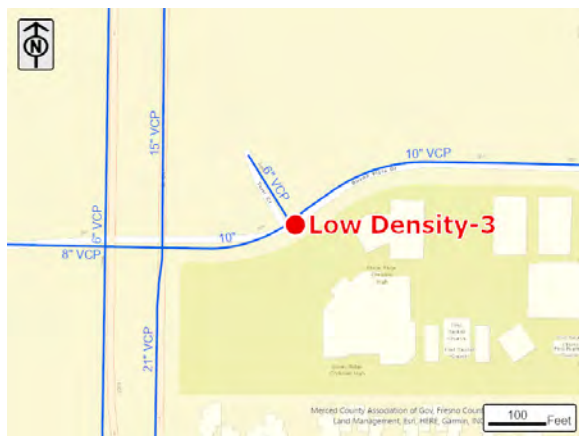
ADWF: 0.043 mgd

Peak Measured Flow: 0.119 mgd

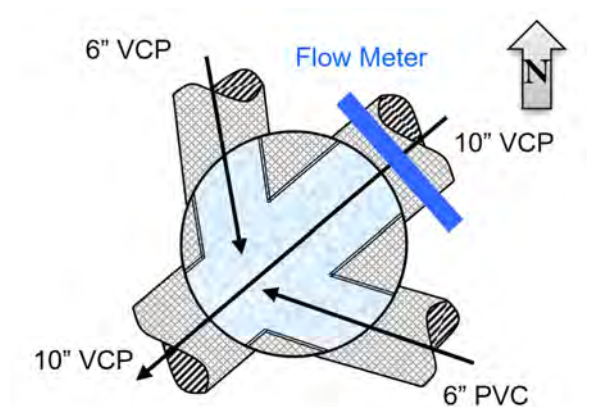
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-3

Additional Site Photos

Effluent Pipe



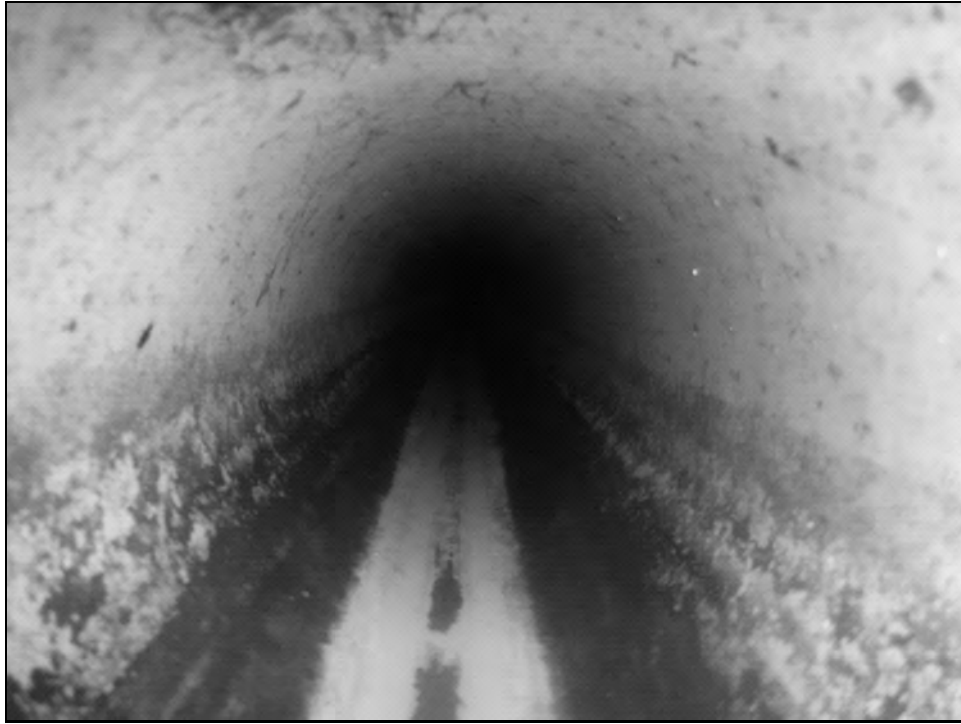
Monitored Northeast Influent Pipe



LOW DENSITY-3

Additional Site Photos

Southeast Influent Pipe



Northwest Influent Pipe

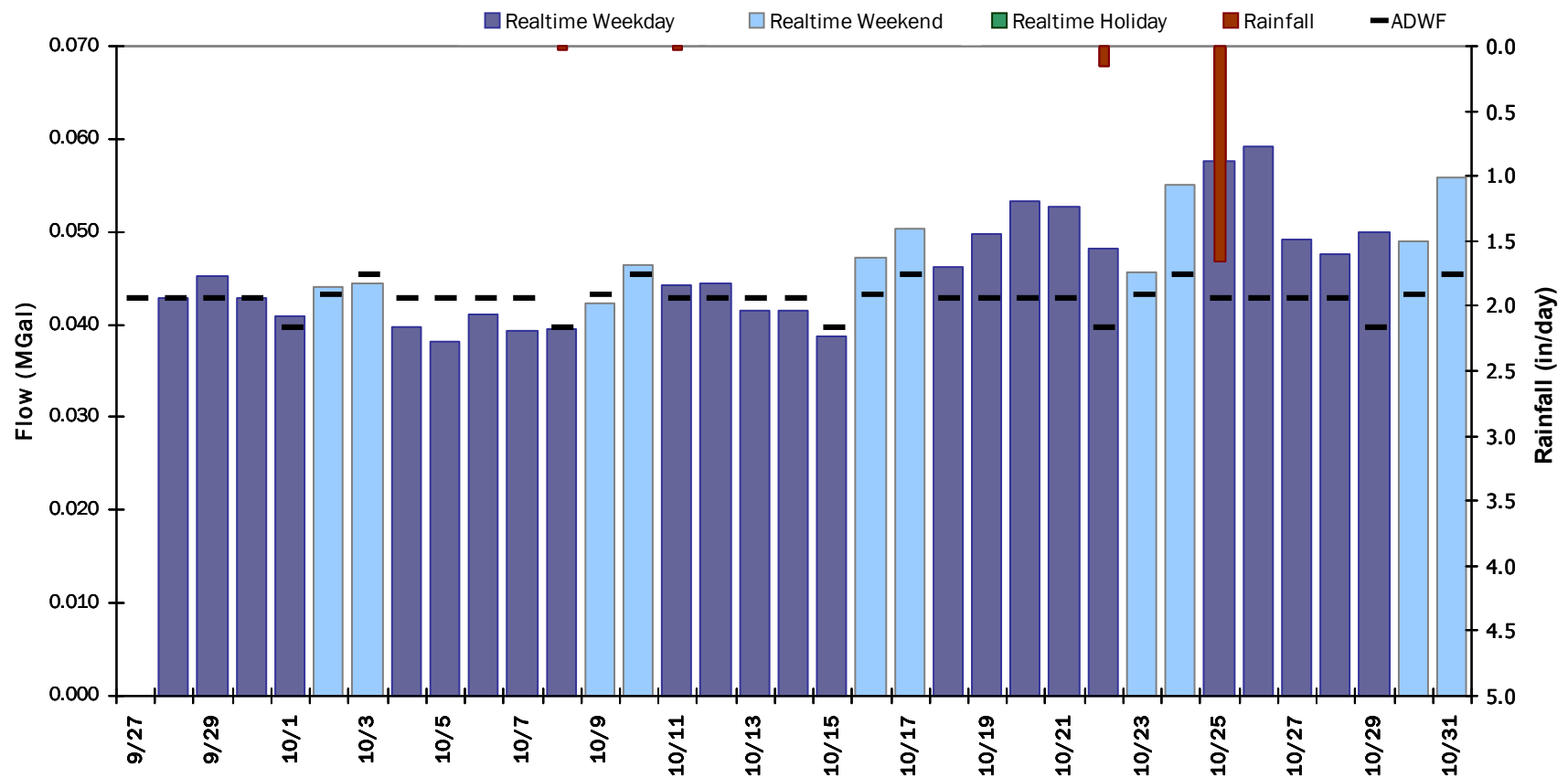


LOW DENSITY-3

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.046 MGal Peak Daily Flow: 0.059 MGal Min Daily Flow: 0.038 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-3

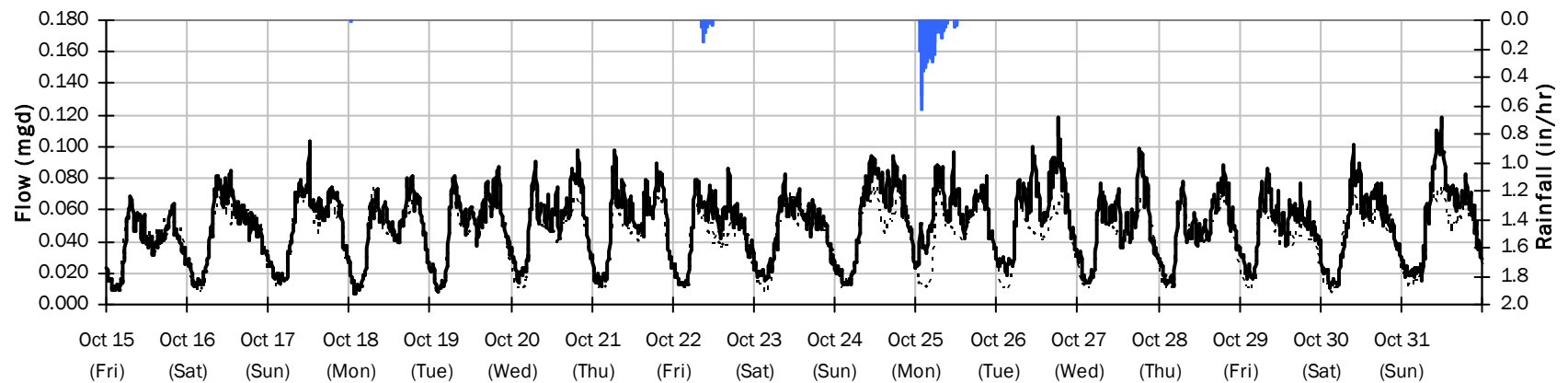
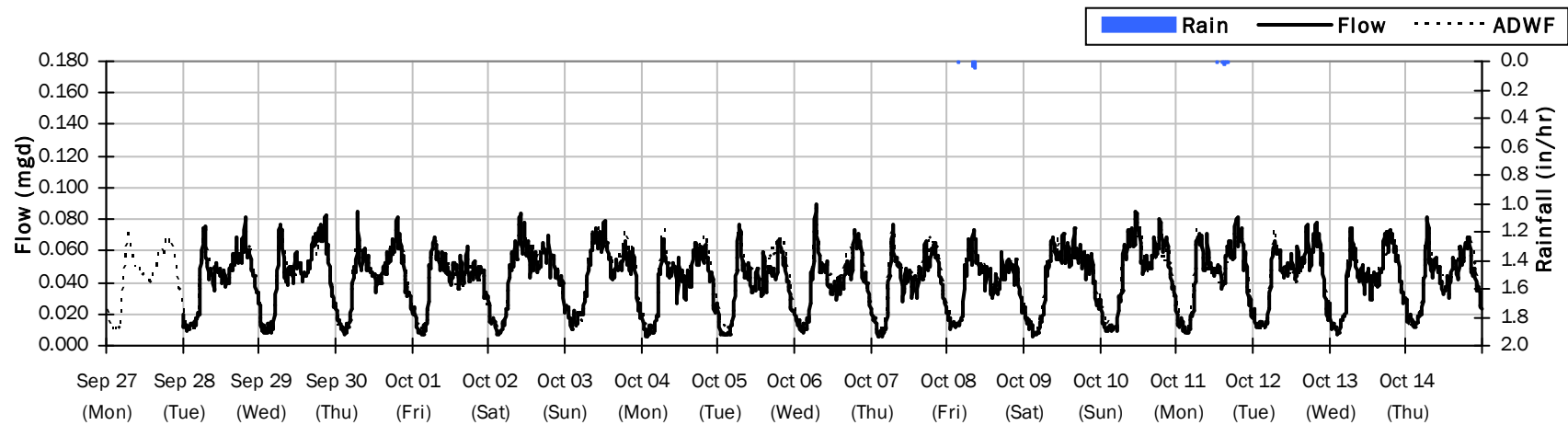
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.046 mgd

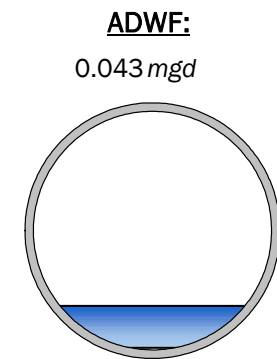
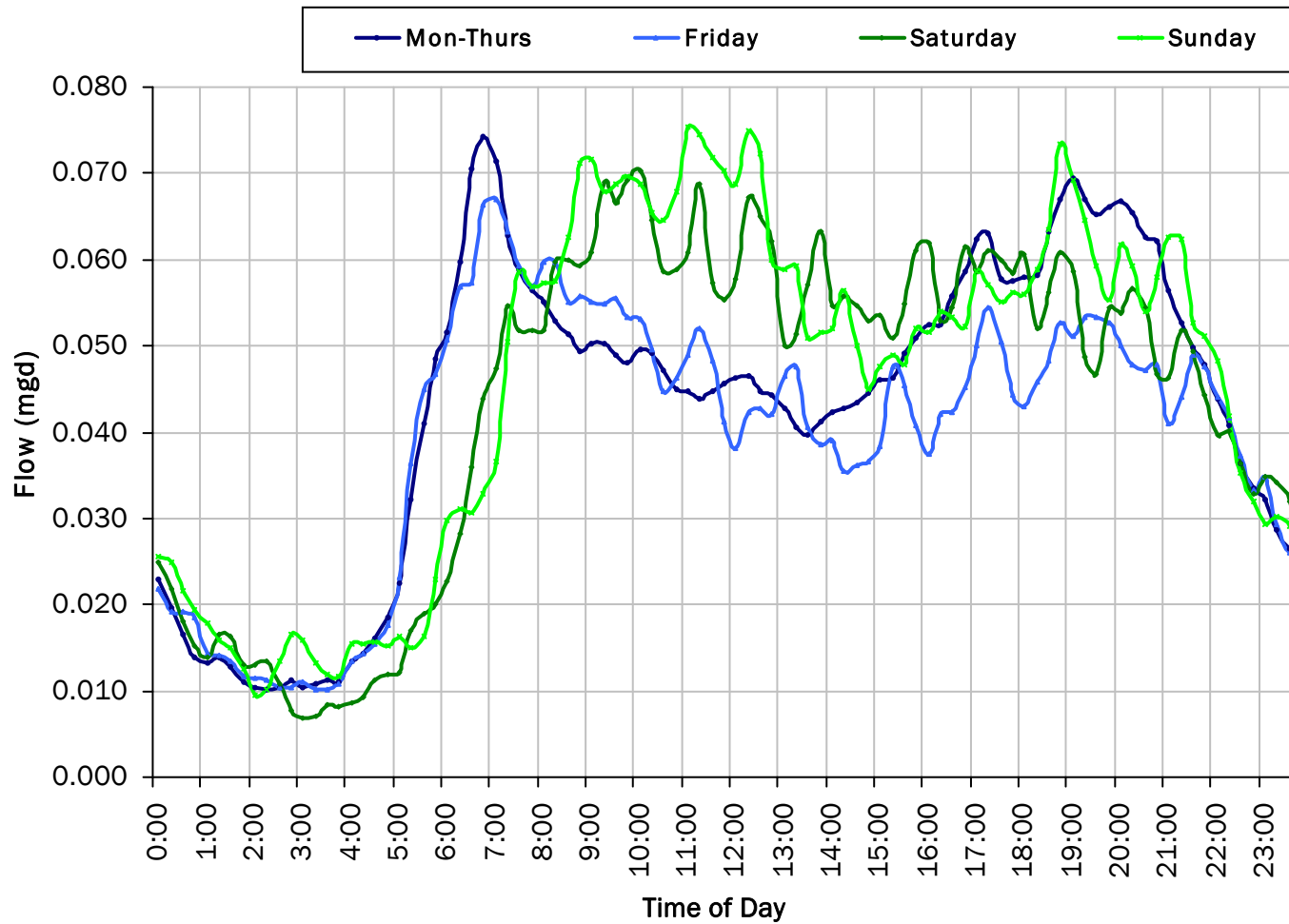
Period Peak Flow: 0.119 mgd

Period Min Flow: 0.005 mgd



LOW DENSITY-3

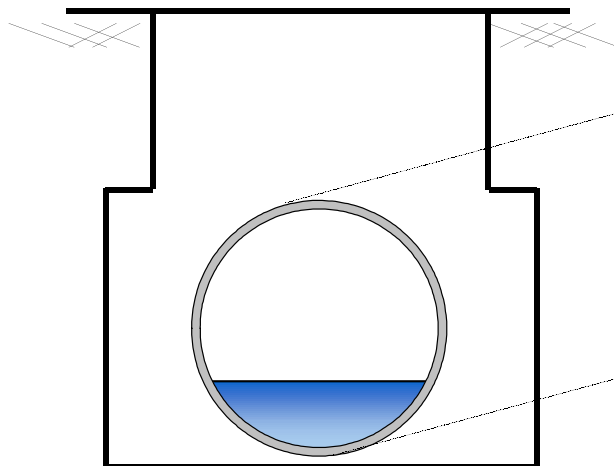
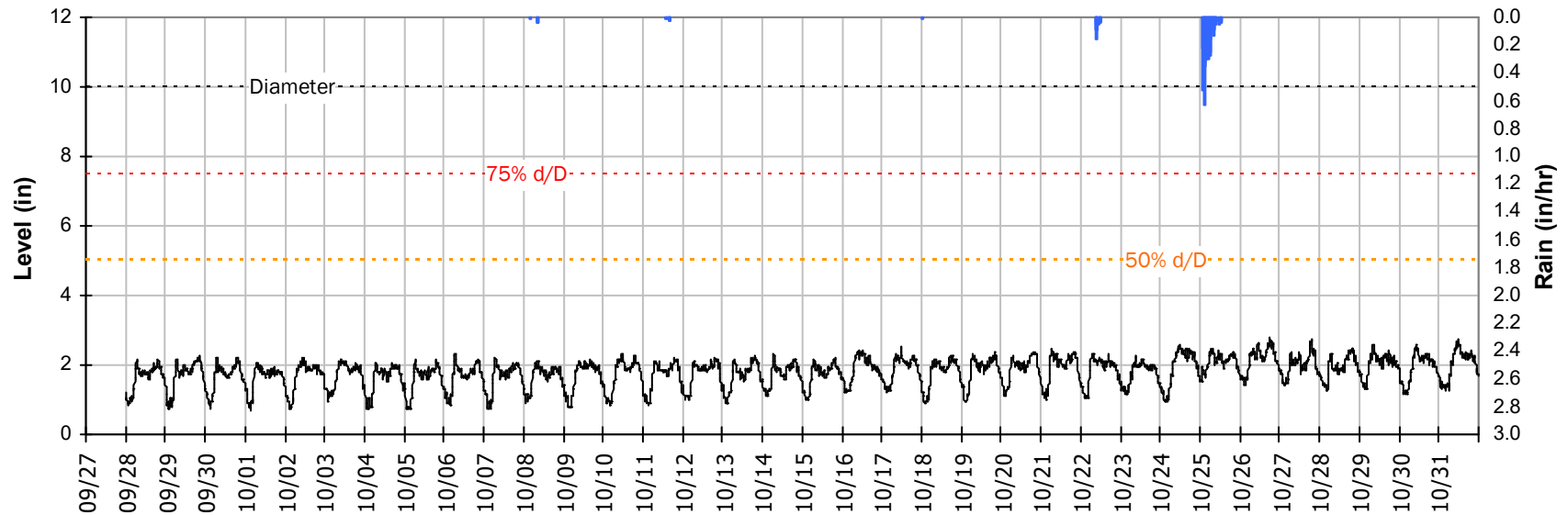
Average Dry Weather Flow Hydrographs



LOW DENSITY-3

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

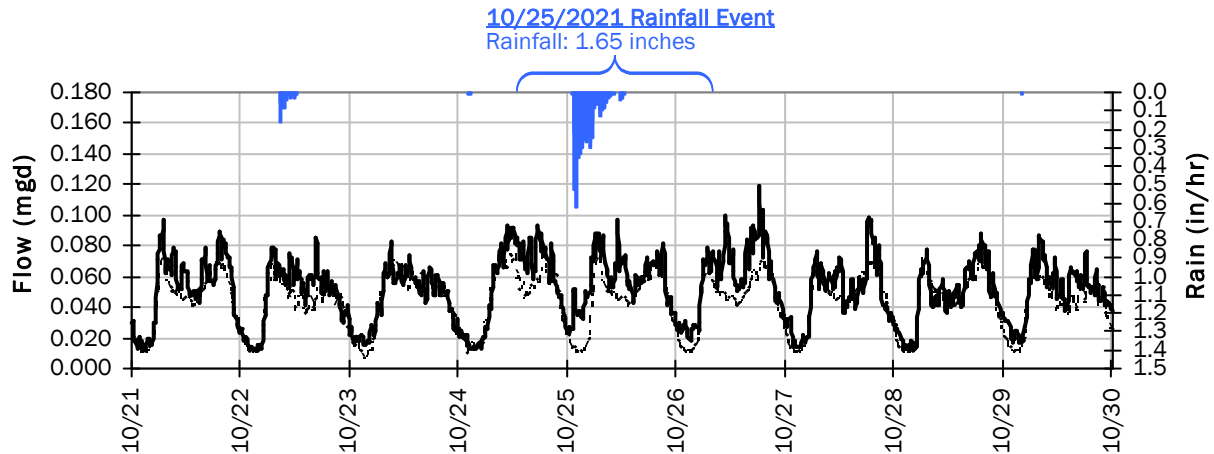


Pipe Diameter: 10 inches
Peak Measured Level: 2.78 inches
Peak d/D Ratio: 0.28

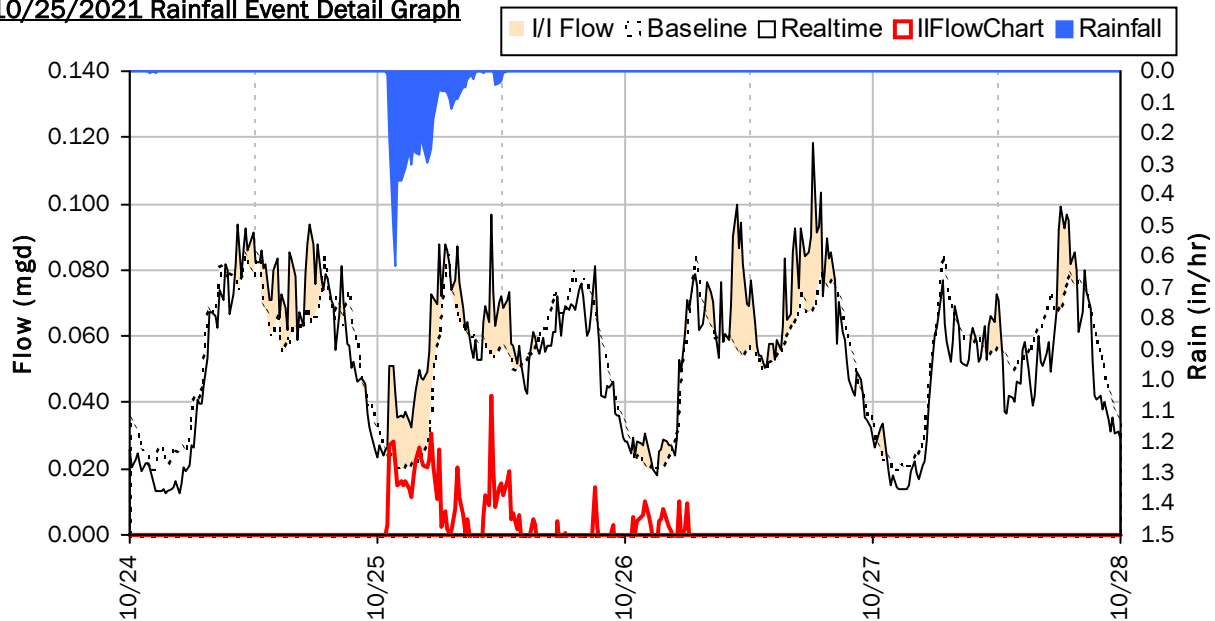
LOW DENSITY-3

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.097 mgd
PF: 2.26

Peak Level: 2.48 in
d/D Ratio: 0.25

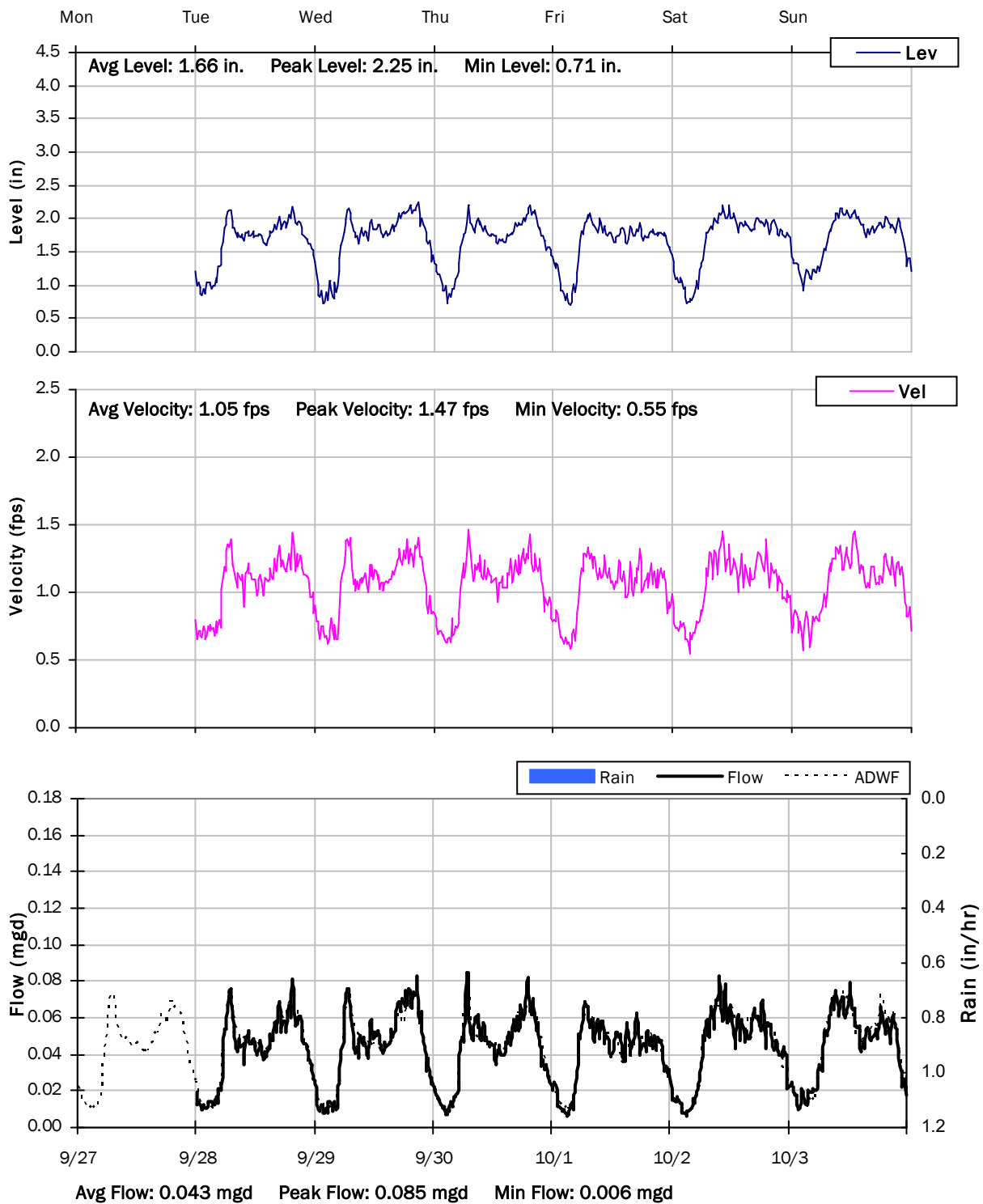
Inflow / Infiltration

Peak I/I Rate: 0.042 mgd
Total I/I: 6,000 gallons

LOW DENSITY-3

Weekly Level, Velocity and Flow Hydrographs

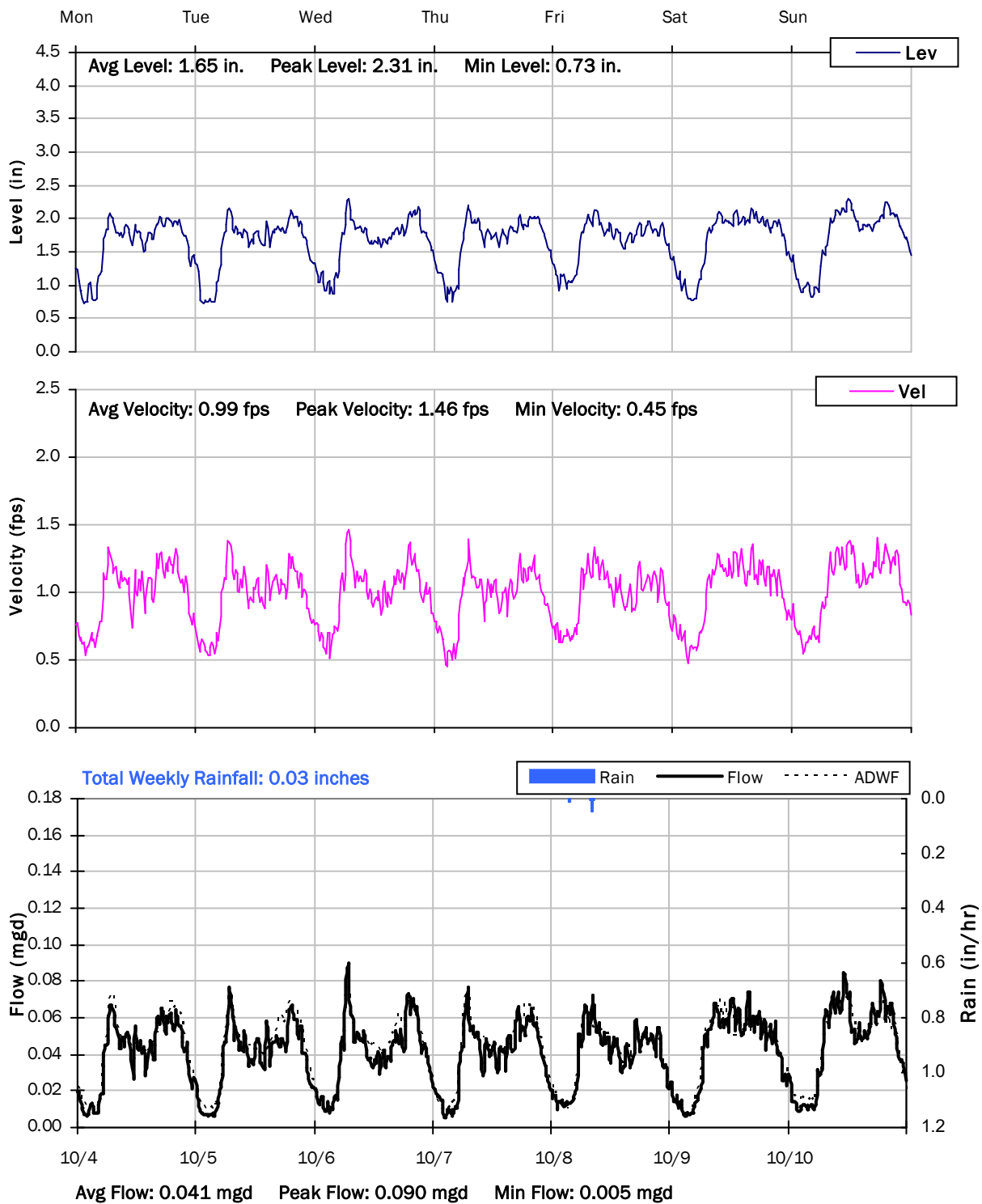
9/27/2021 to 10/4/2021



LOW DENSITY-3

Weekly Level, Velocity and Flow Hydrographs

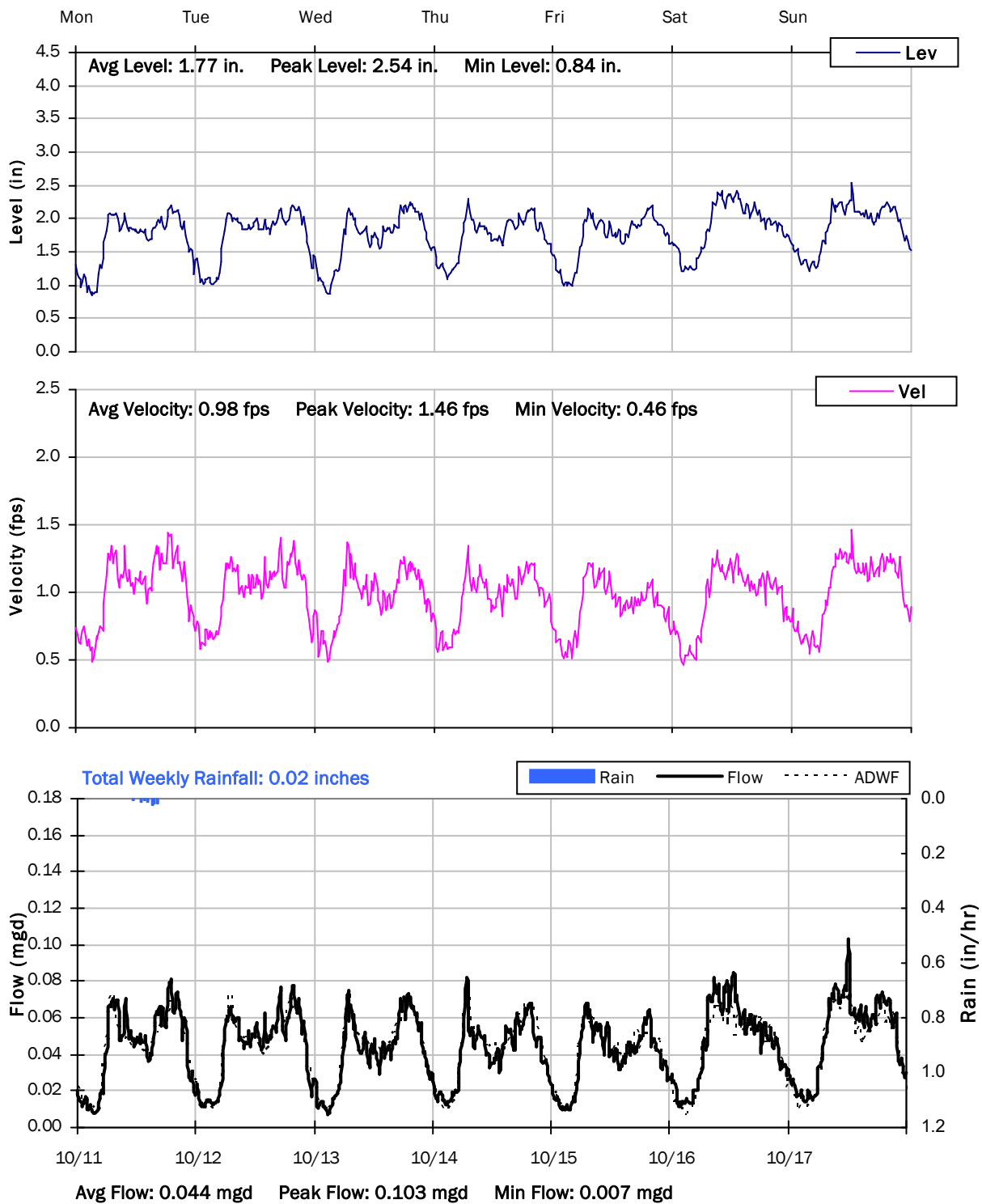
10/4/2021 to 10/11/2021



LOW DENSITY-3

Weekly Level, Velocity and Flow Hydrographs

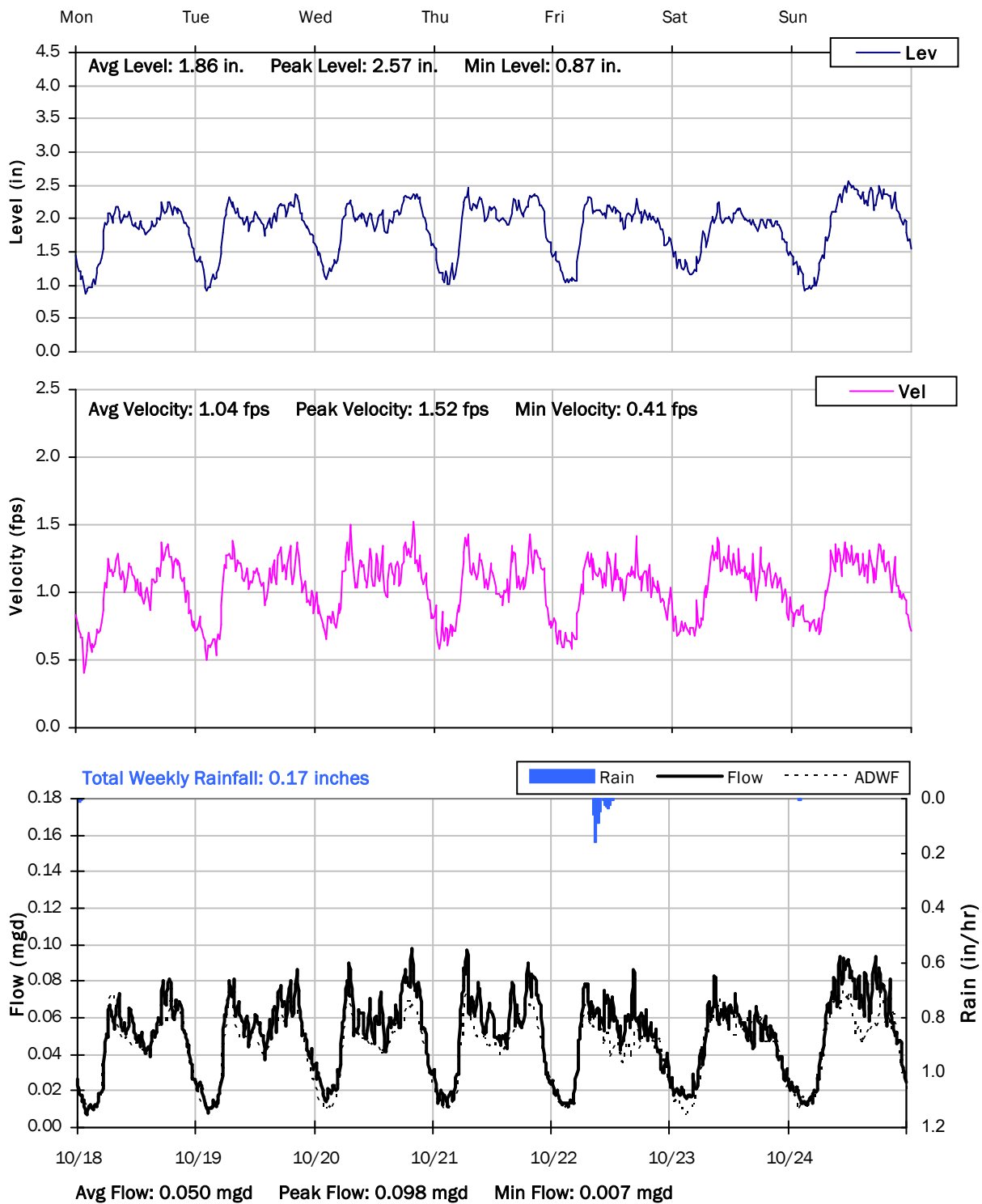
10/11/2021 to 10/18/2021



LOW DENSITY-3

Weekly Level, Velocity and Flow Hydrographs

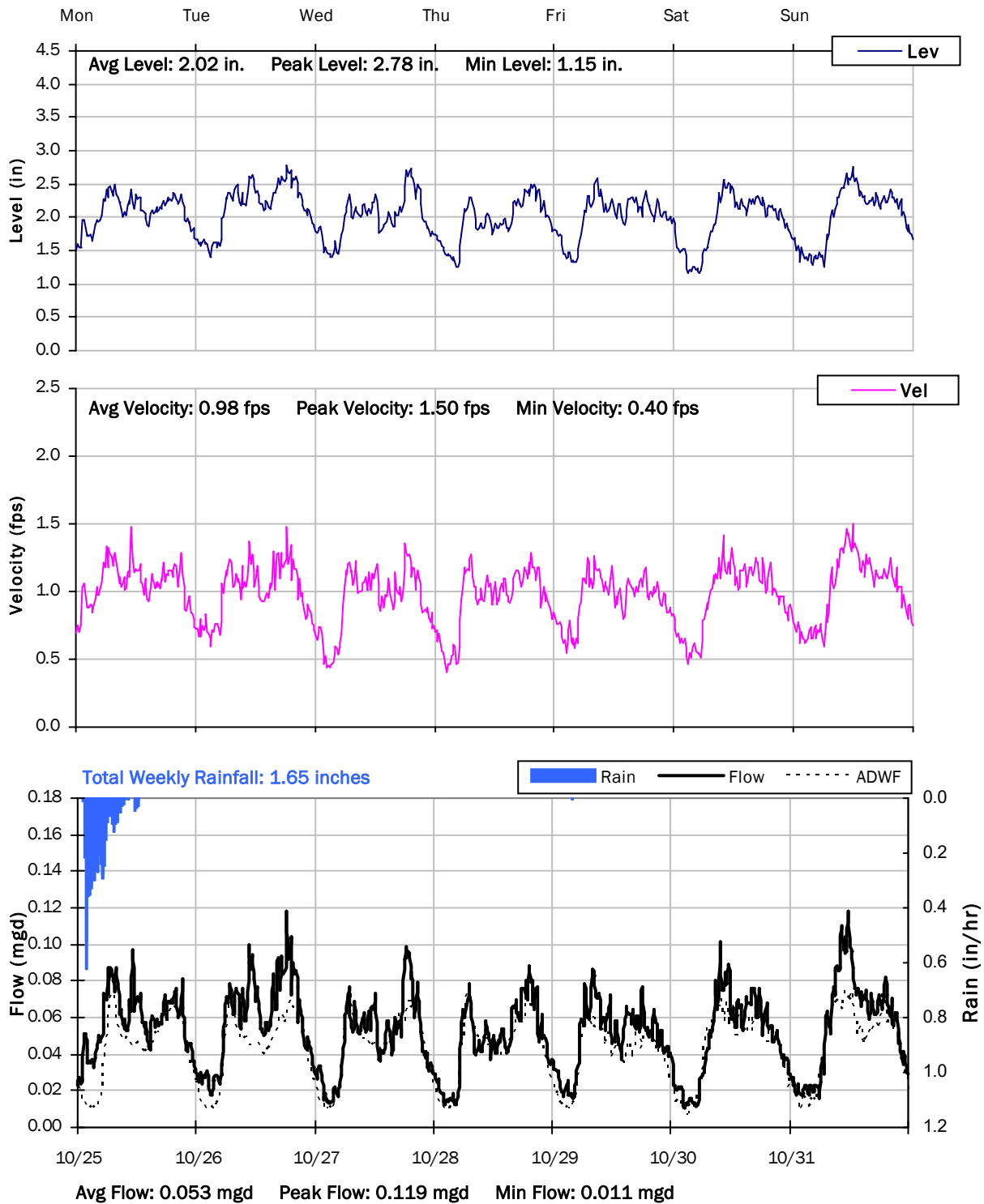
10/18/2021 to 10/25/2021



LOW DENSITY-3

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



LOW DENSITY-4

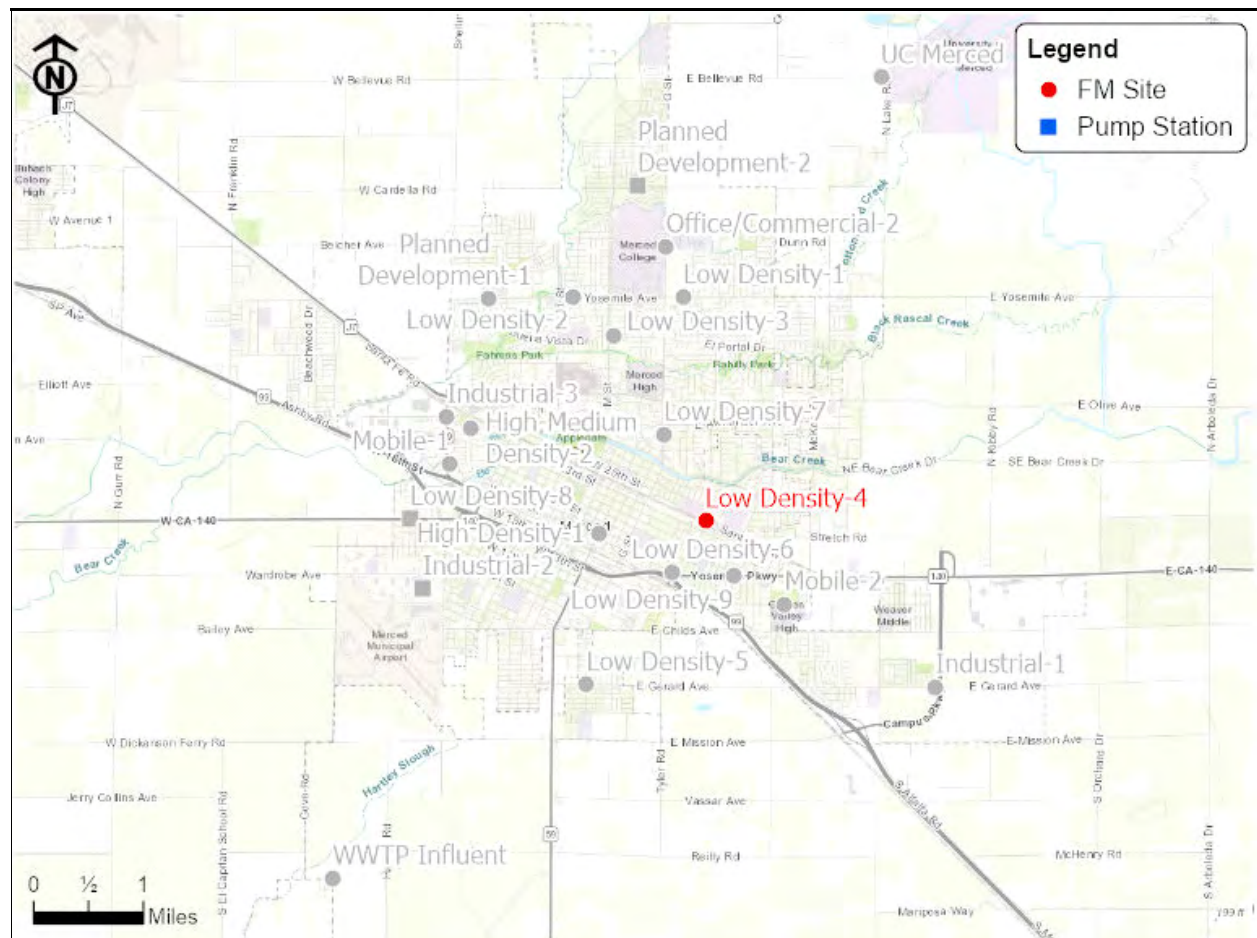
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: E Santa Fe Avenue west of Glen Avenue

Data Summary Report



Vicinity Map: Low Density-4

LOW DENSITY-4

Site Information

Location: E Santa Fe Avenue west of Glen Avenue

Coordinates: 120.4624° W, 37.3025° N

Rim Elevation (Earth): 182 feet

Measured Pipe Diameter: 16 inches

ADWF: 0.179 mgd

Peak Measured Flow: 0.334 mgd

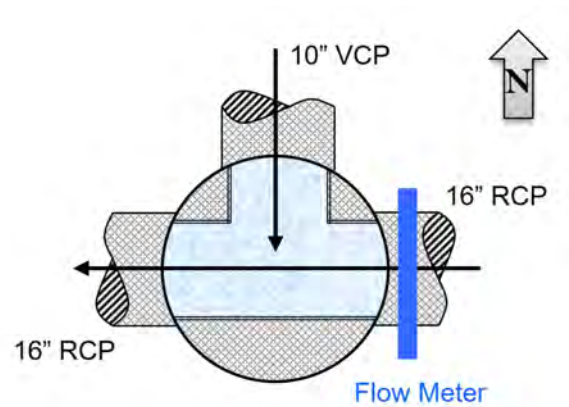
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-4

Additional Site Photos

Effluent Pipe



Monitored East Influent Pipe



LOW DENSITY-4

Additional Site Photos

Lower North Influent Pipe



Upper North Influent Pipe

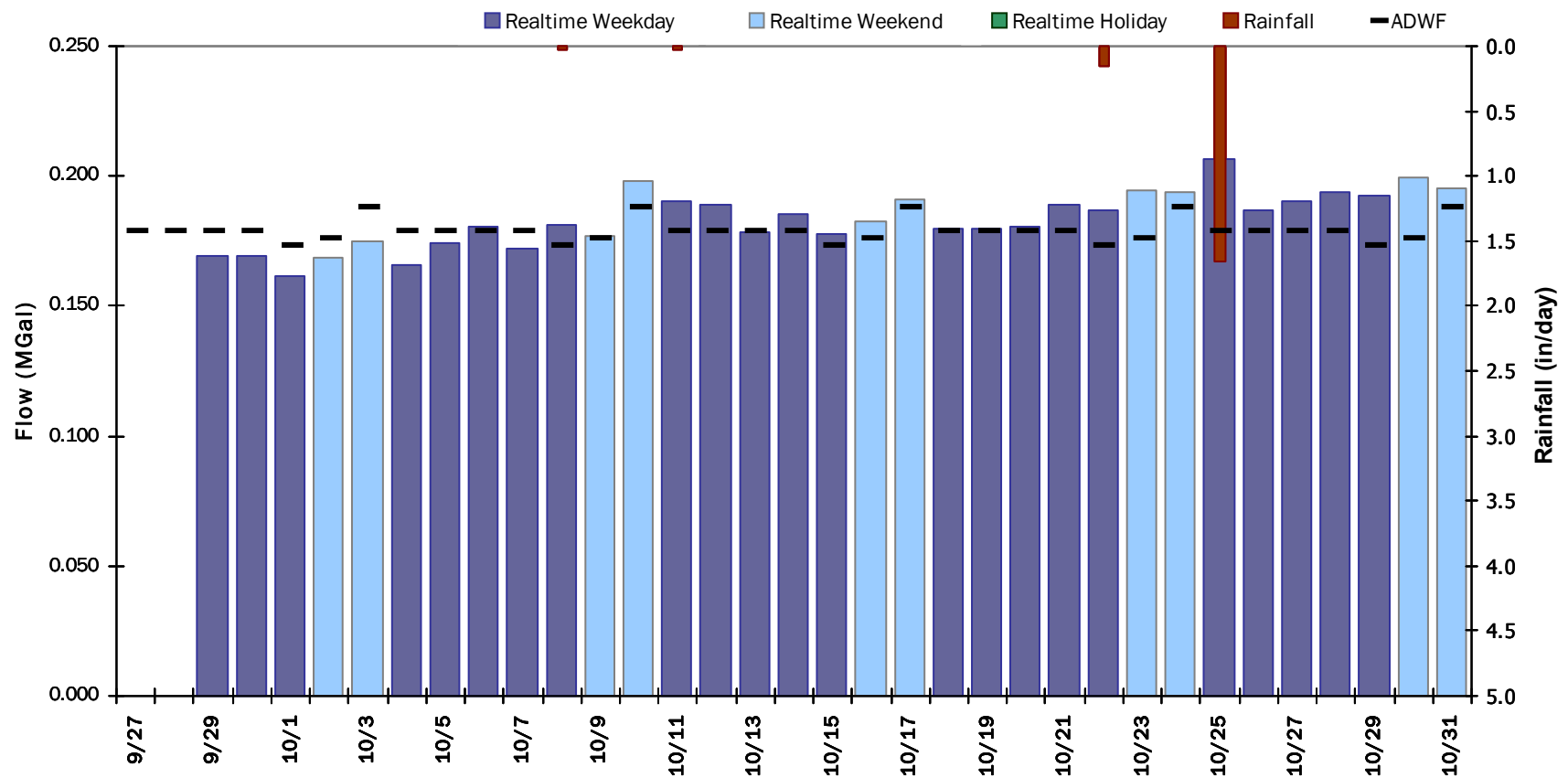


LOW DENSITY-4

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.183 MGal Peak Daily Flow: 0.206 MGal Min Daily Flow: 0.161 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-4

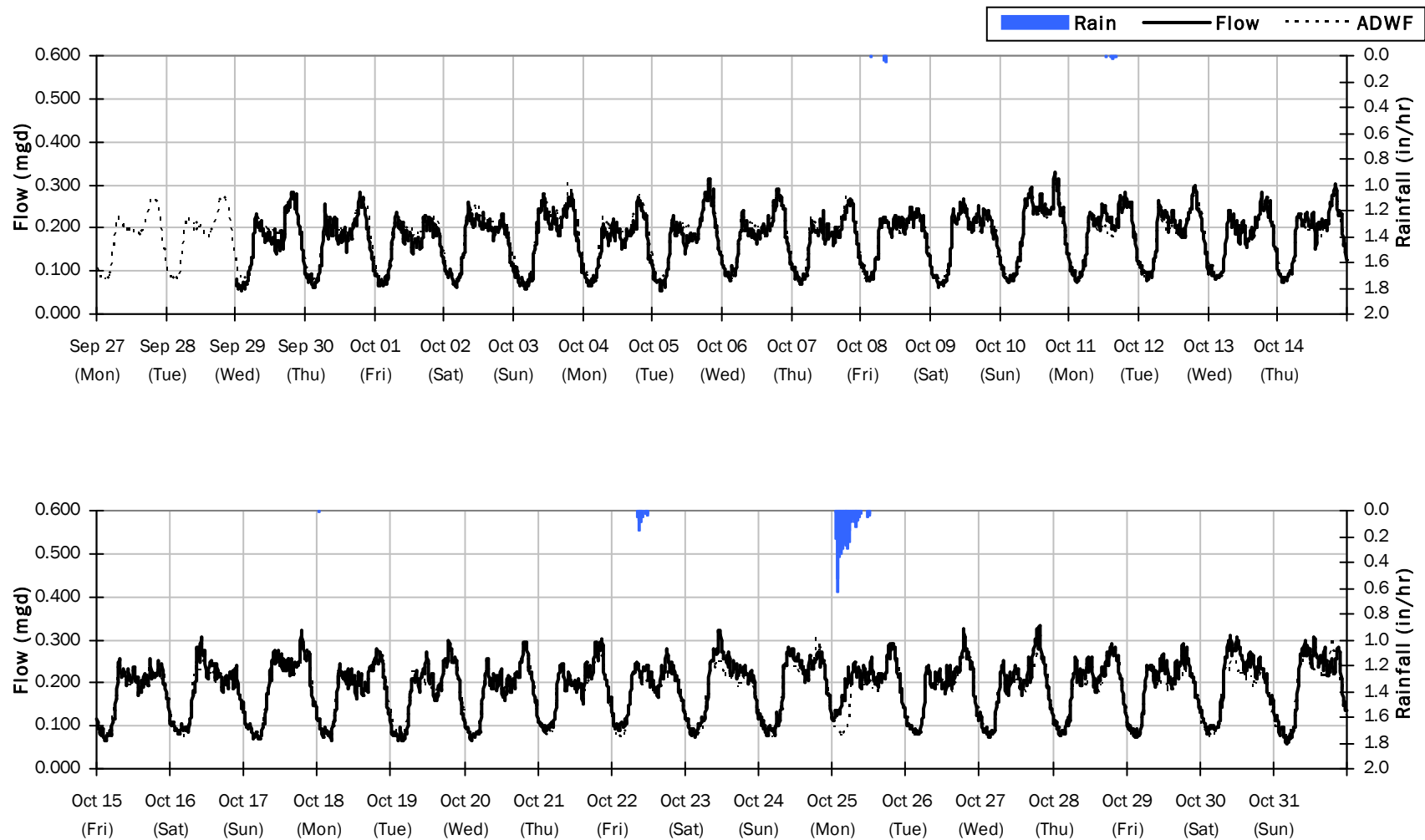
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.183 mgd

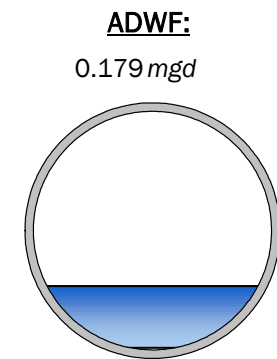
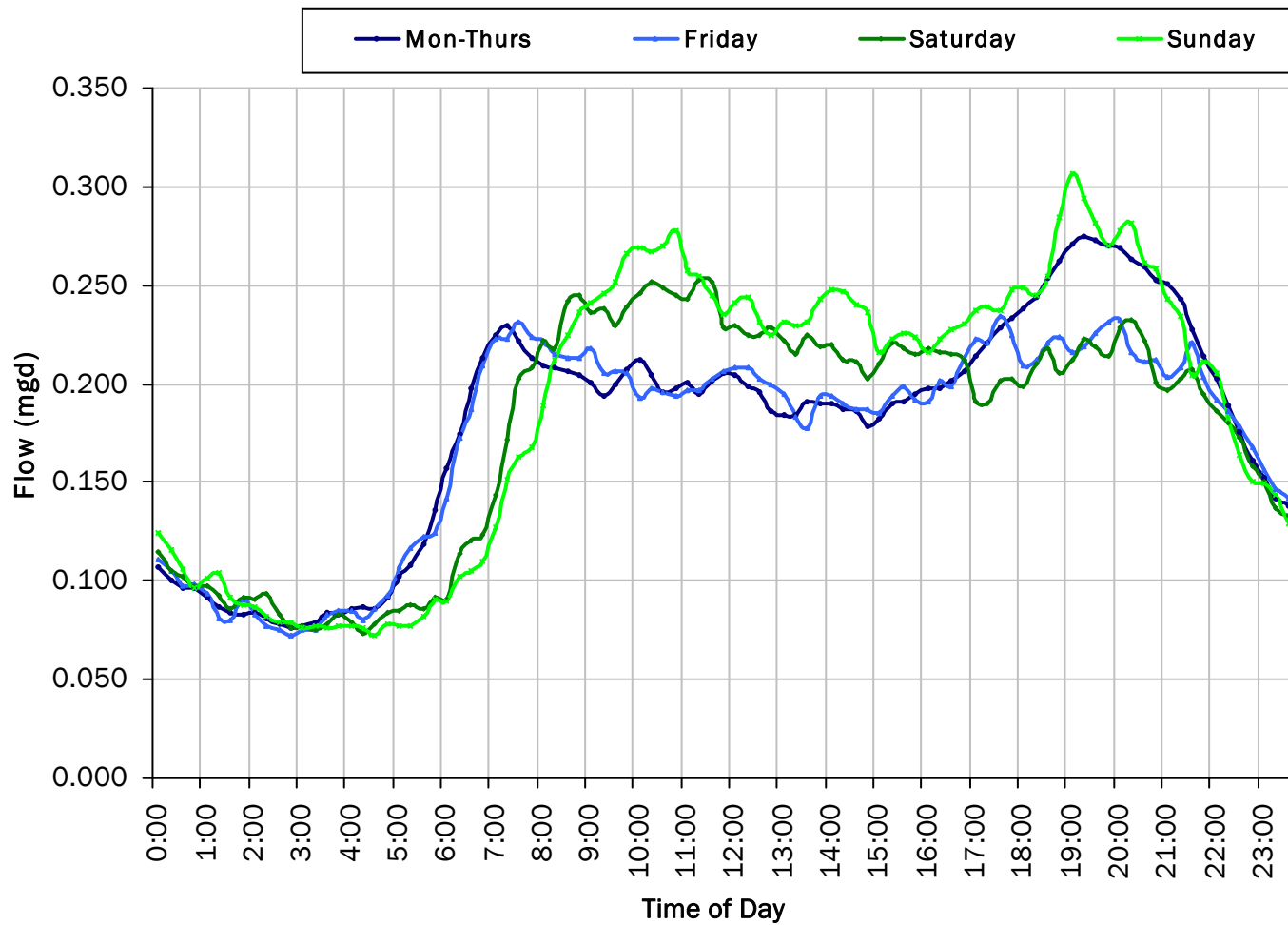
Period Peak Flow: 0.334 mgd

Period Min Flow: 0.053 mgd



LOW DENSITY-4

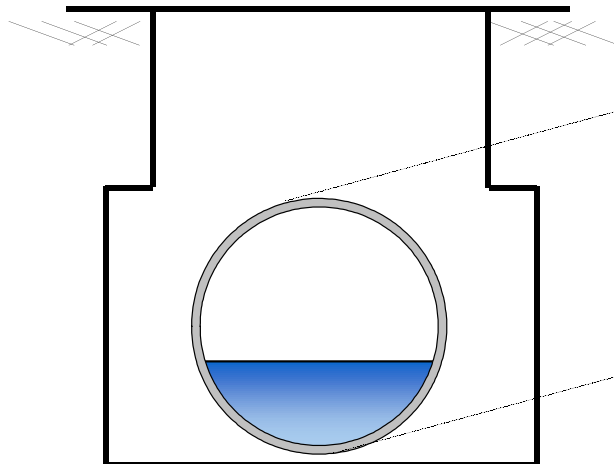
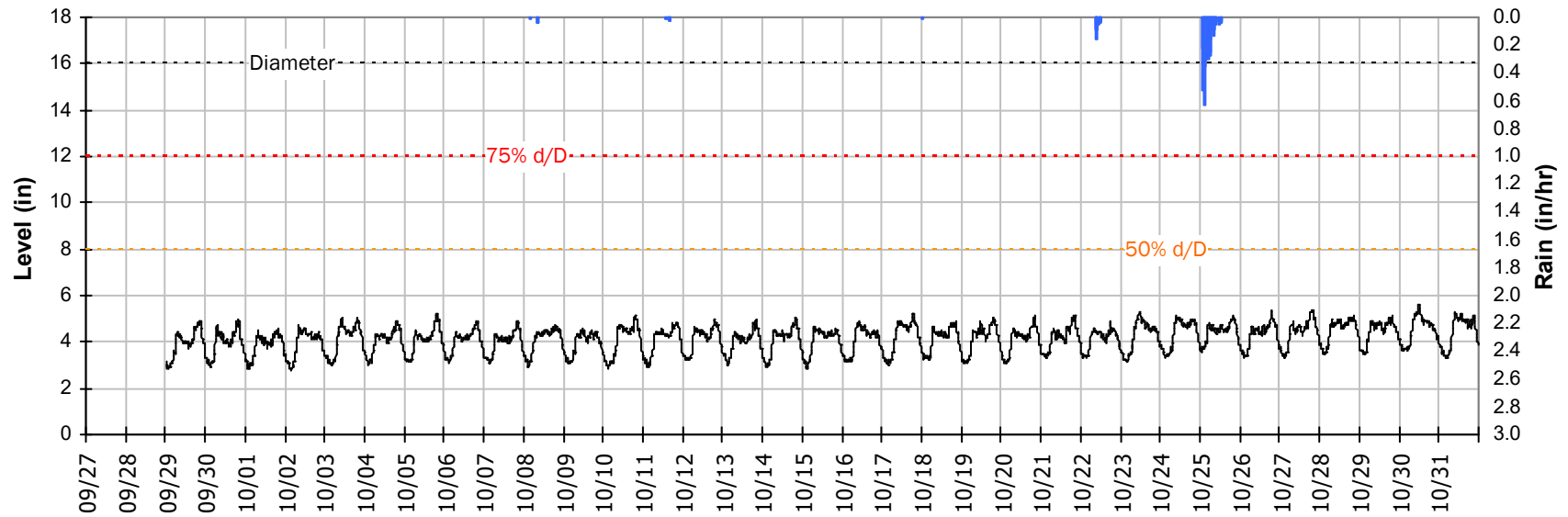
Average Dry Weather Flow Hydrographs



LOW DENSITY-4

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

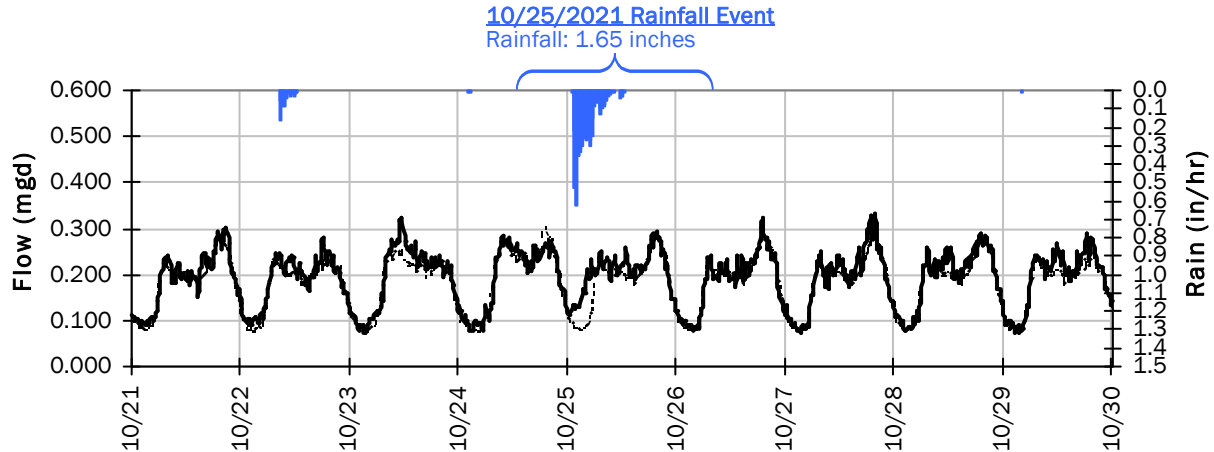


Pipe Diameter:	16	inches
Peak Measured Level:	5.61	inches
Peak d/D Ratio:	0.35	

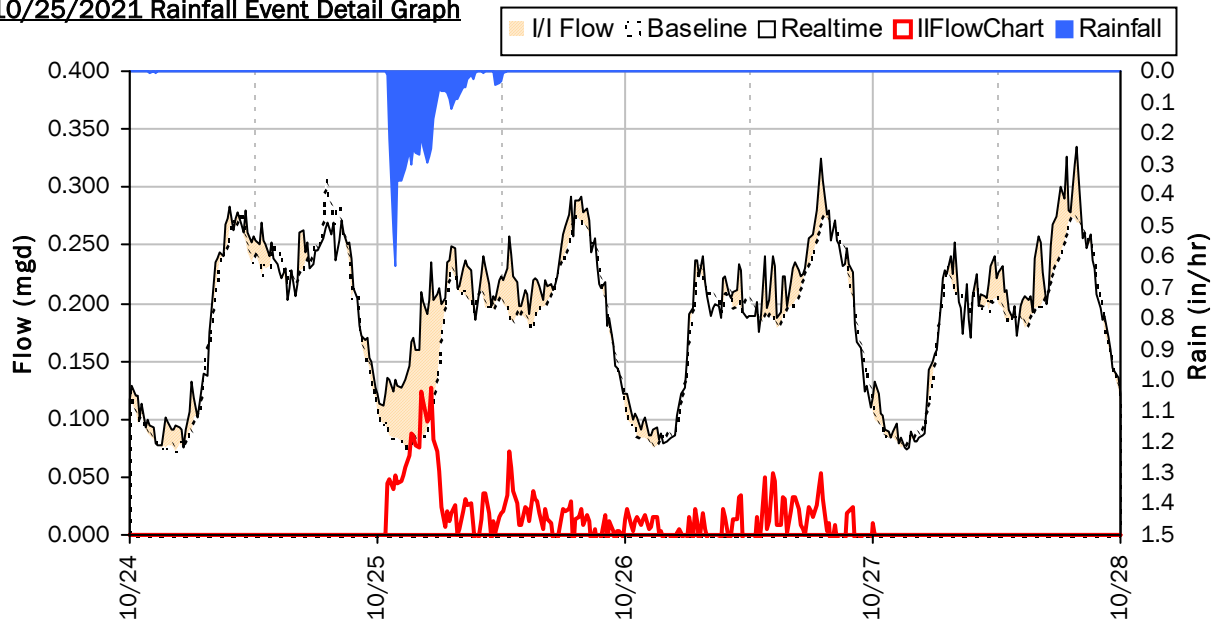
LOW DENSITY-4

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.324 mgd
PF: 1.81

Peak Level: 5.34 in
d/D Ratio: 0.33

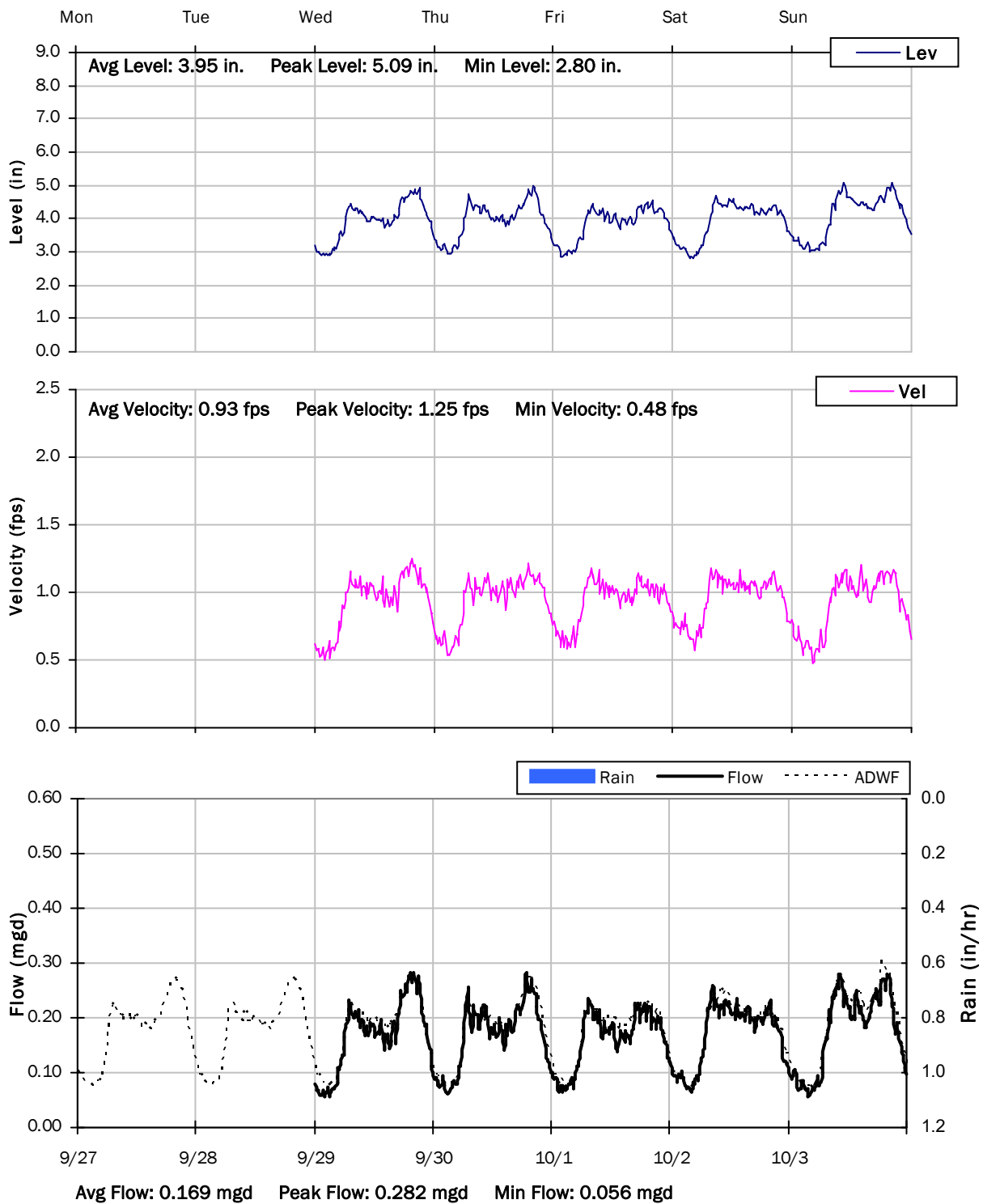
Inflow / Infiltration

Peak I/I Rate: 0.127 mgd
Total I/I: 35,000 gallons

LOW DENSITY-4

Weekly Level, Velocity and Flow Hydrographs

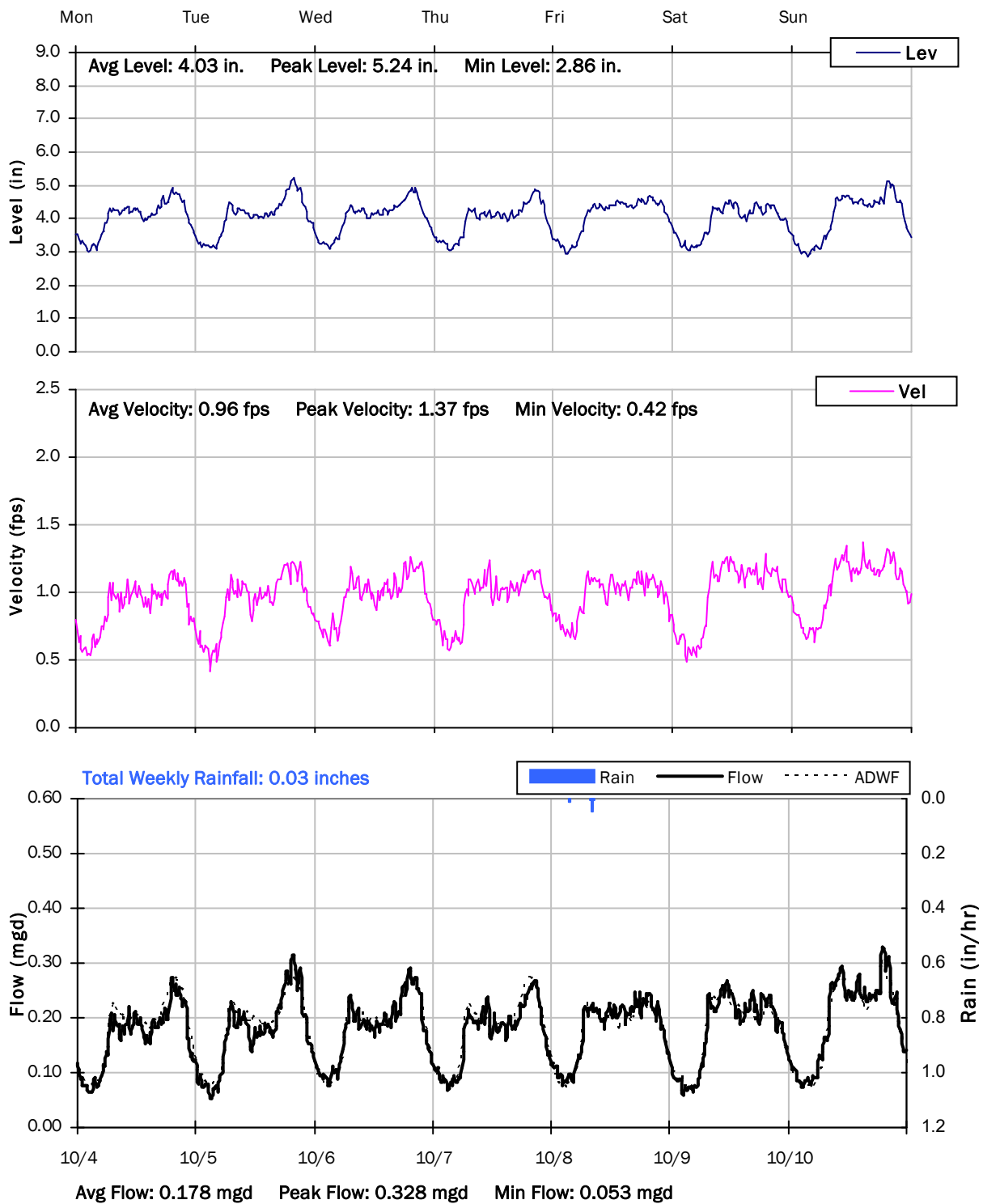
9/27/2021 to 10/4/2021



LOW DENSITY-4

Weekly Level, Velocity and Flow Hydrographs

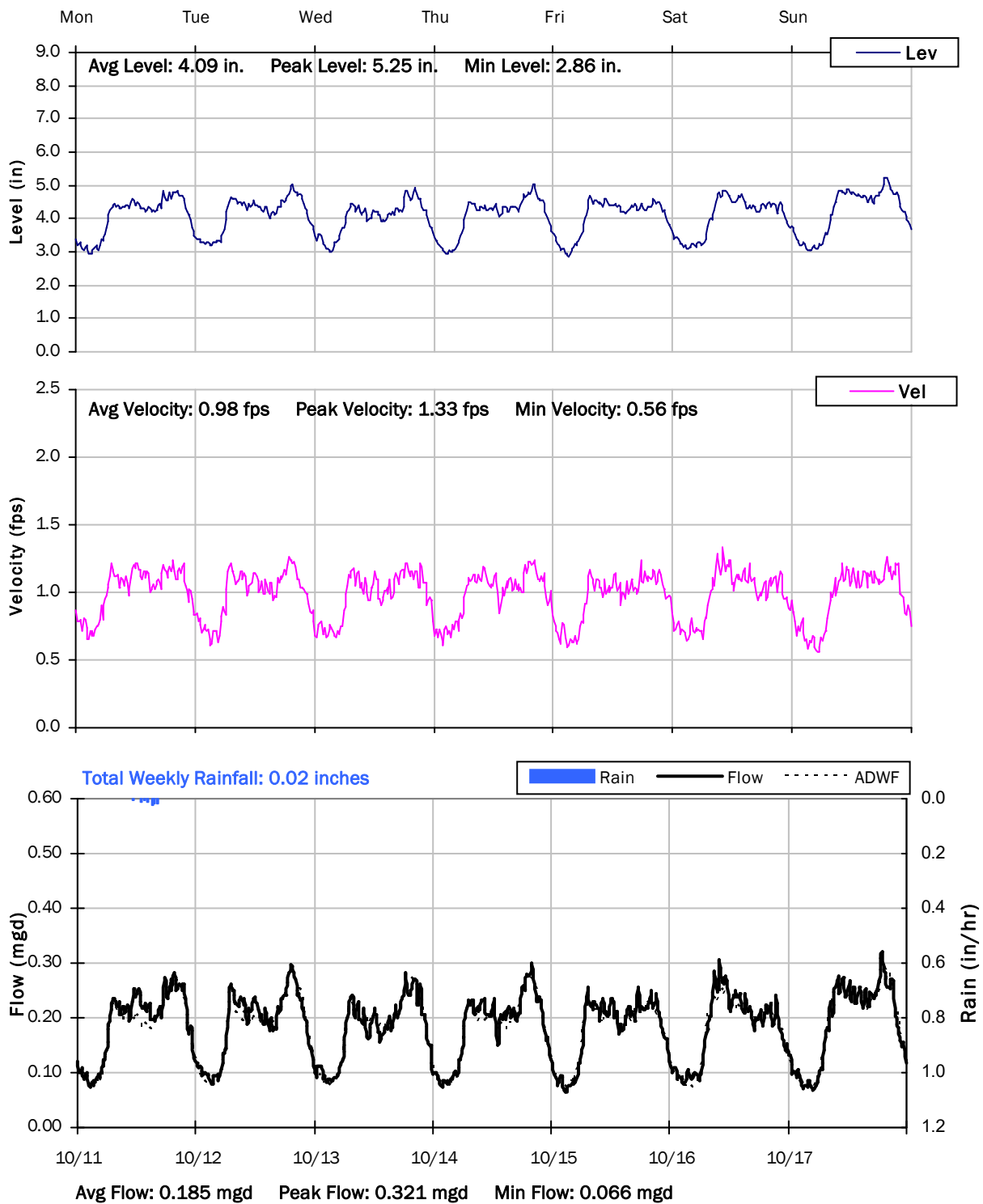
10/4/2021 to 10/11/2021



LOW DENSITY-4

Weekly Level, Velocity and Flow Hydrographs

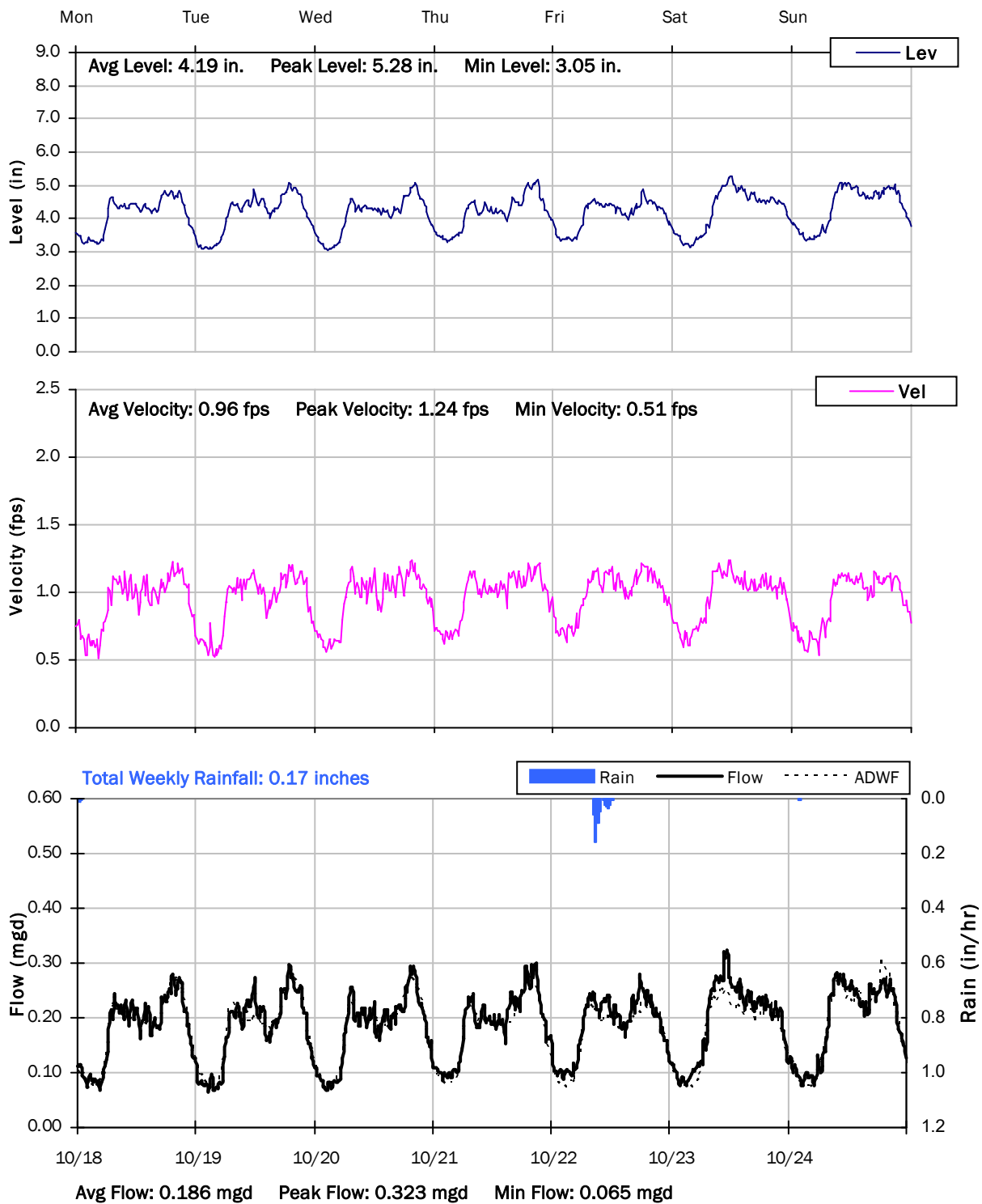
10/11/2021 to 10/18/2021



LOW DENSITY-4

Weekly Level, Velocity and Flow Hydrographs

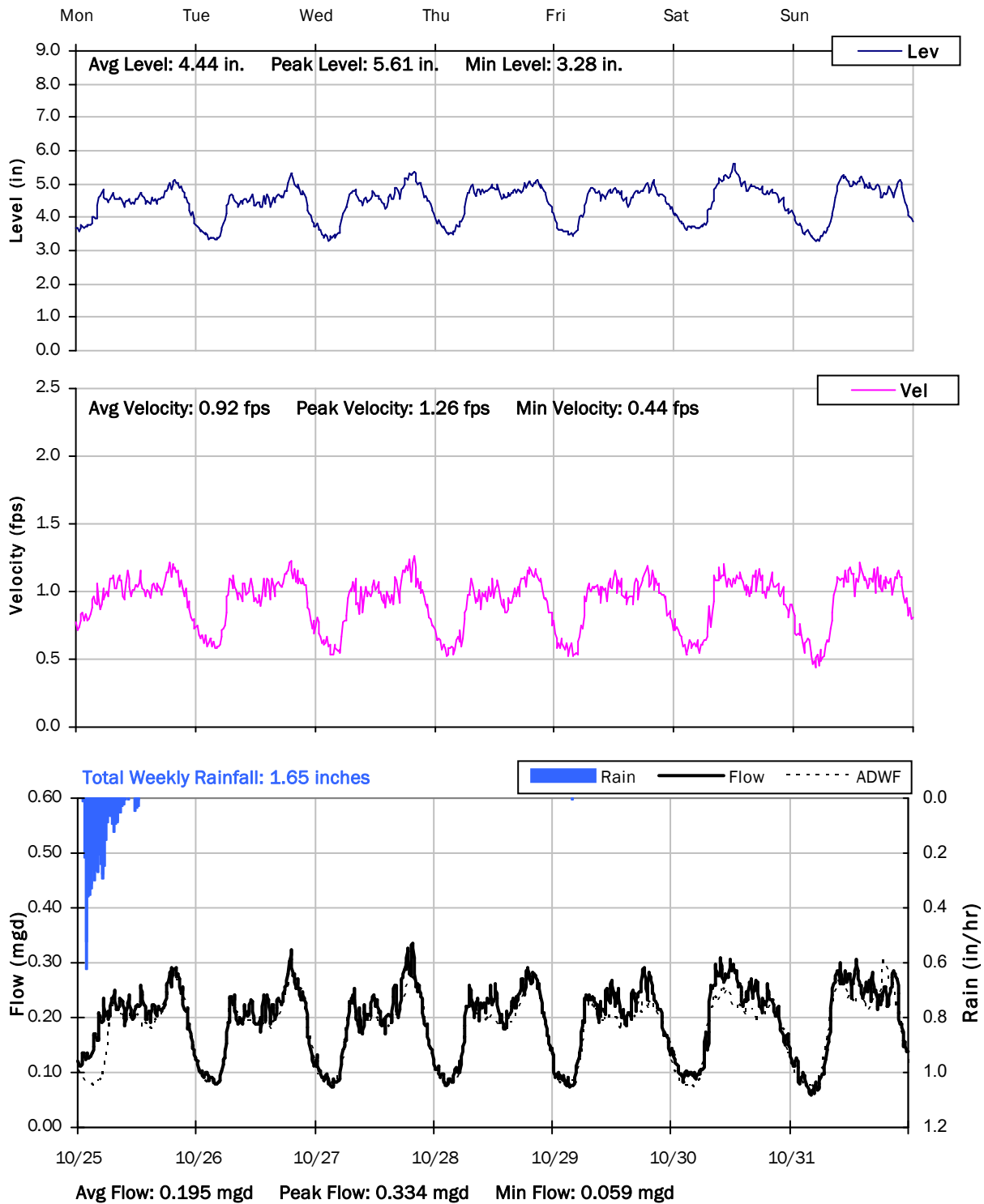
10/18/2021 to 10/25/2021



LOW DENSITY-4

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



LOW DENSITY-5

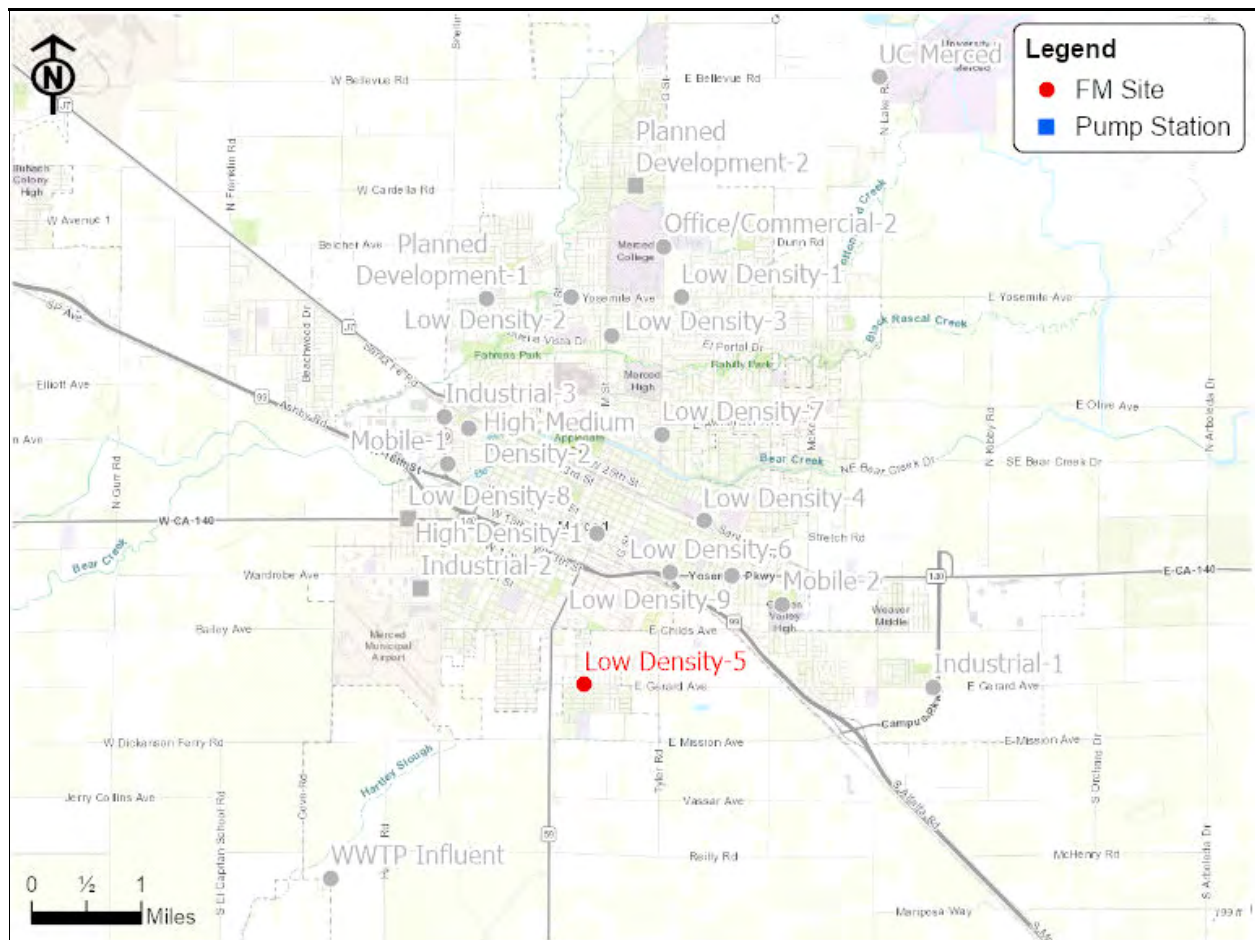
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Intersection of E Gerard Avenue and S G Street

Data Summary Report



Vicinity Map: Low Density-5

LOW DENSITY-5

Site Information

Location: Intersection of E Gerard Avenue
and S G Street

Coordinates: 120.4821° W, 37.2809° N

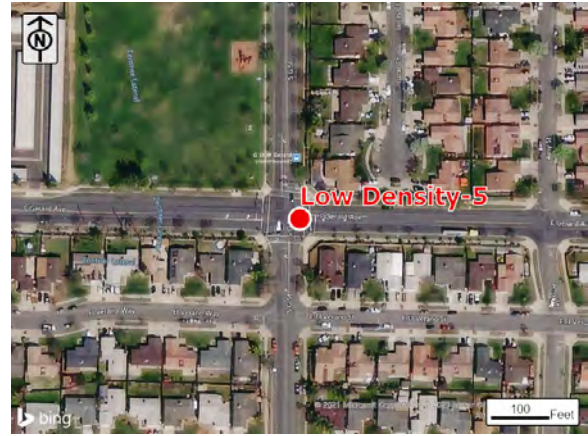
Rim Elevation (Earth): 167 feet

Measured Pipe Diameter: 11.5 inches

ADWF: 0.085 mgd

Peak Measured Flow: 0.213 mgd

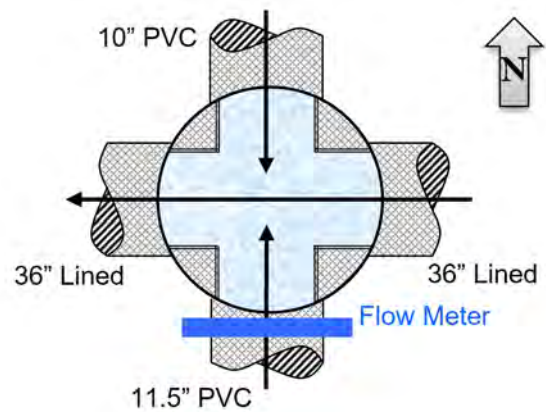
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-5

Additional Site Photos

Effluent Pipe



Monitored East Influent Pipe



LOW DENSITY-5

Additional Site Photos

South Influent Pipe



North Influent Pipe

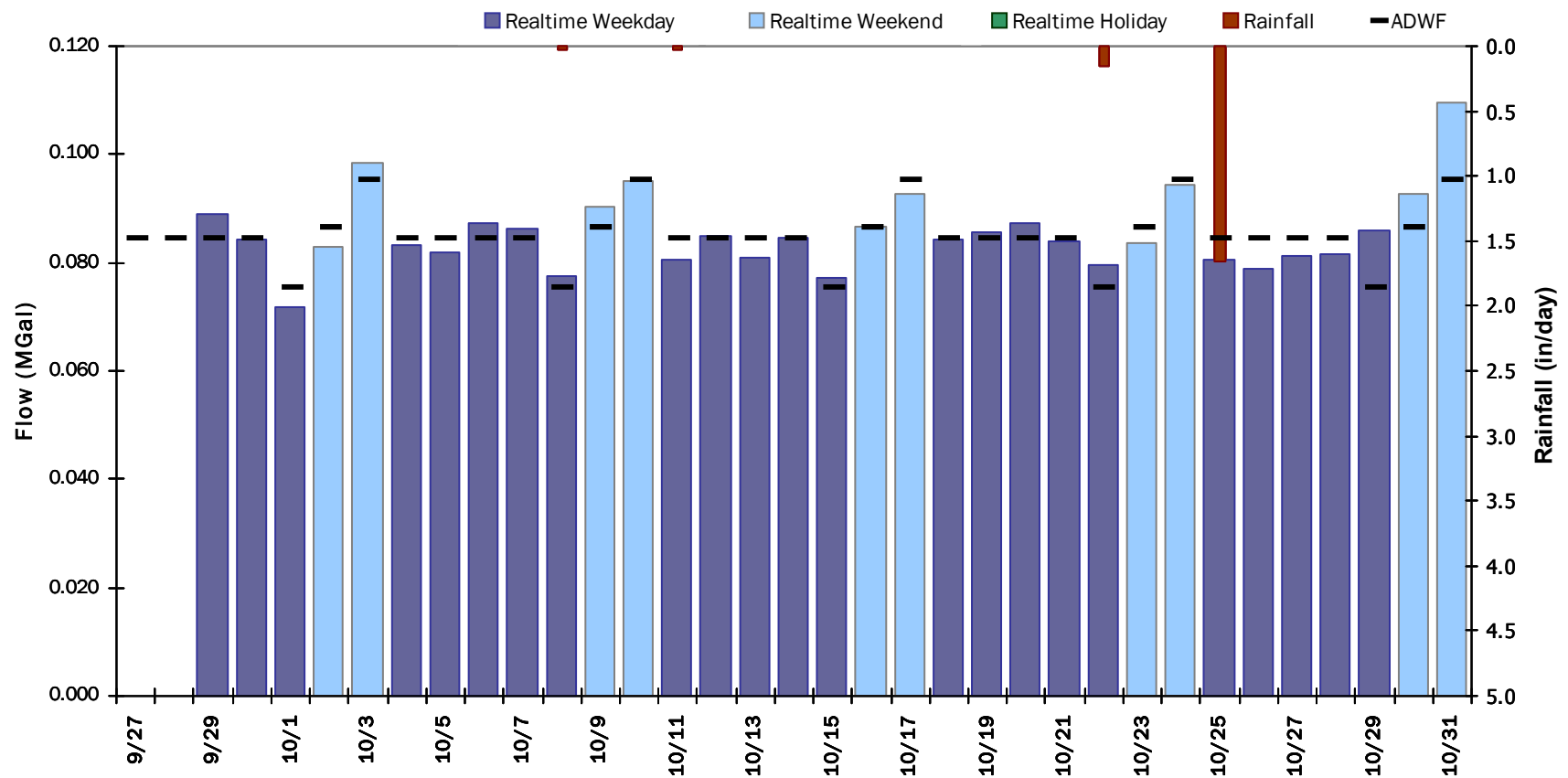


LOW DENSITY-5

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.086 MGal Peak Daily Flow: 0.109 MGal Min Daily Flow: 0.072 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-5

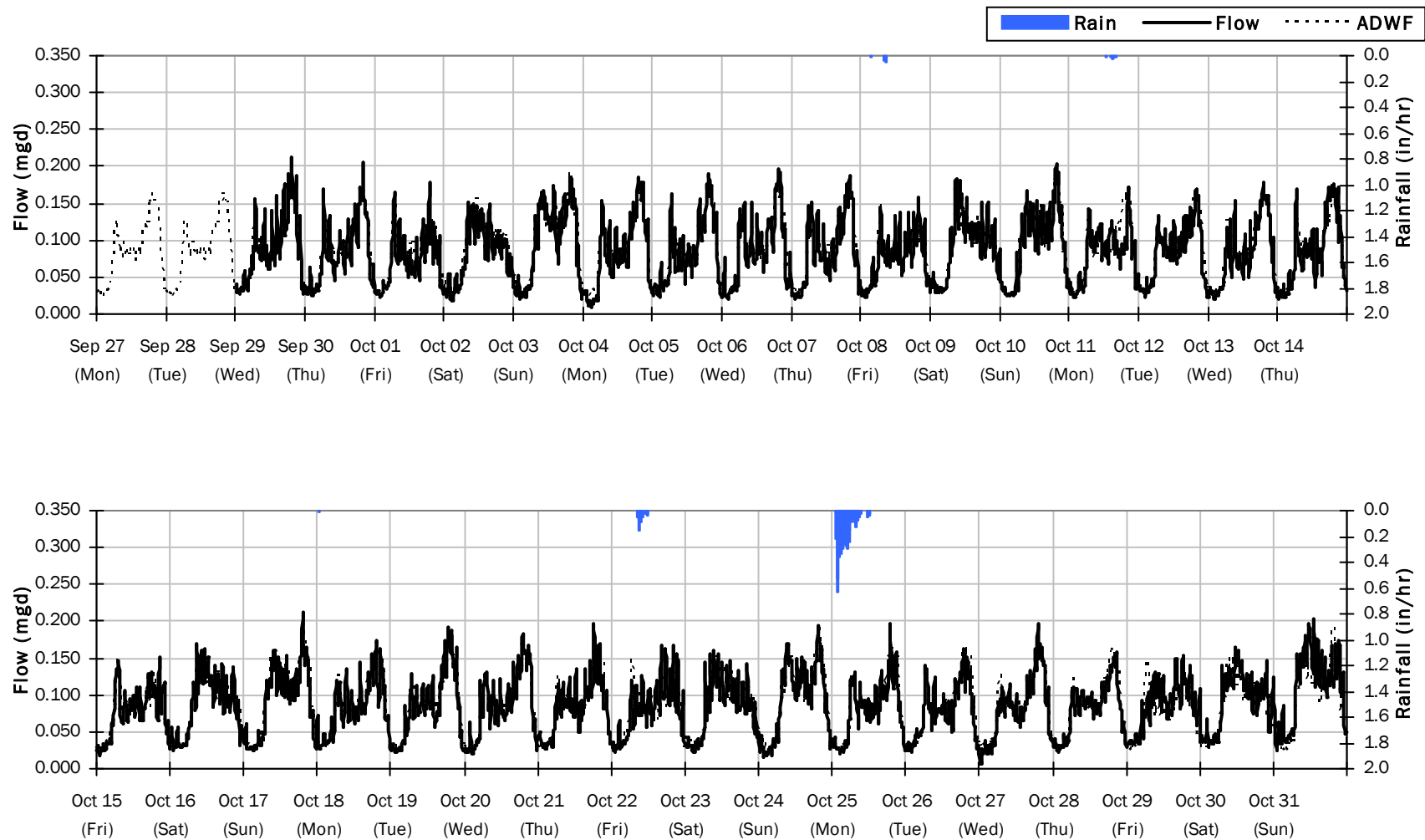
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.086 mgd

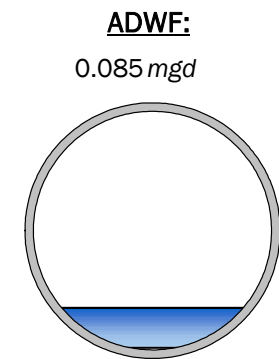
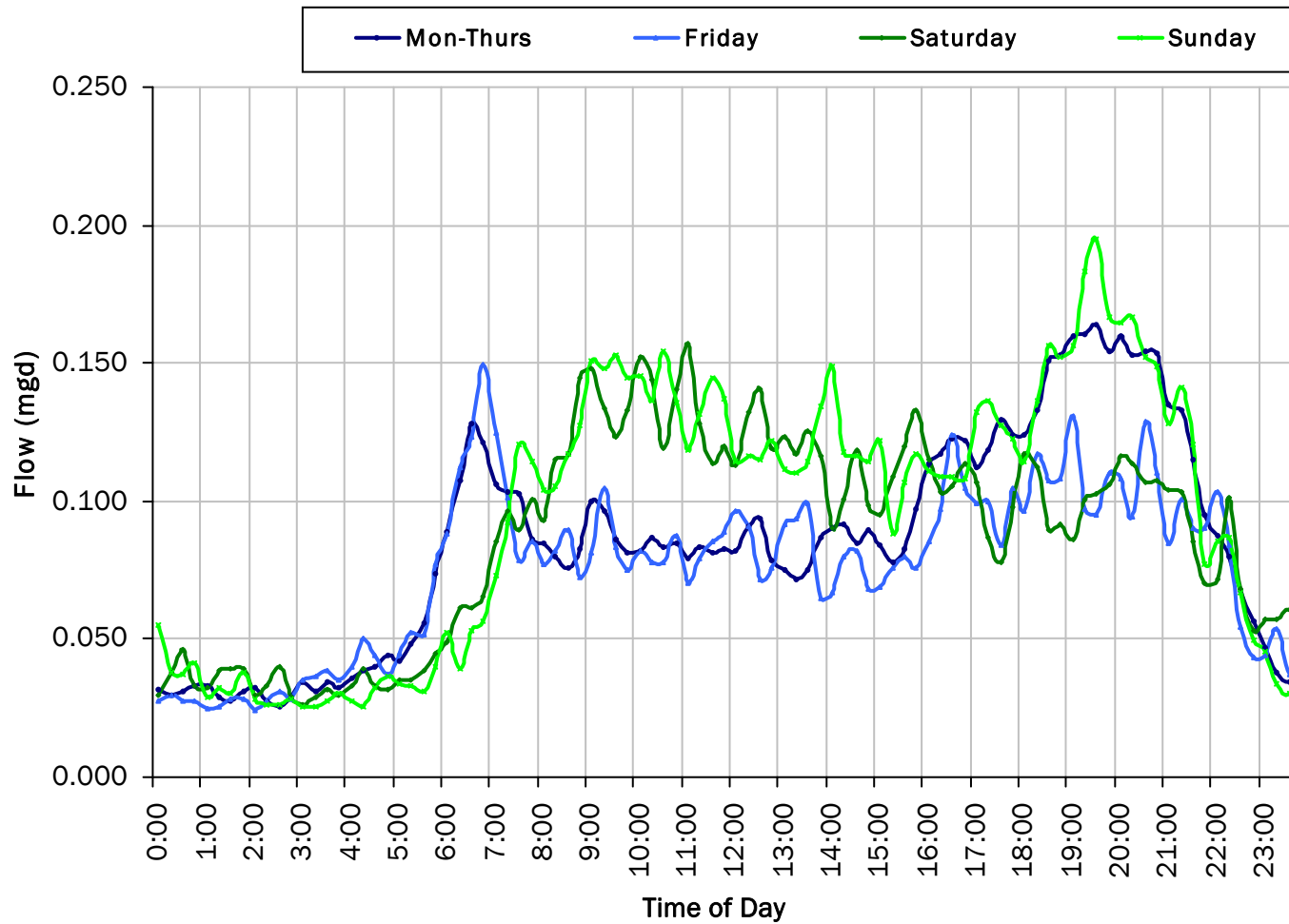
Period Peak Flow: 0.213 mgd

Period Min Flow: 0.006 mgd



LOW DENSITY-5

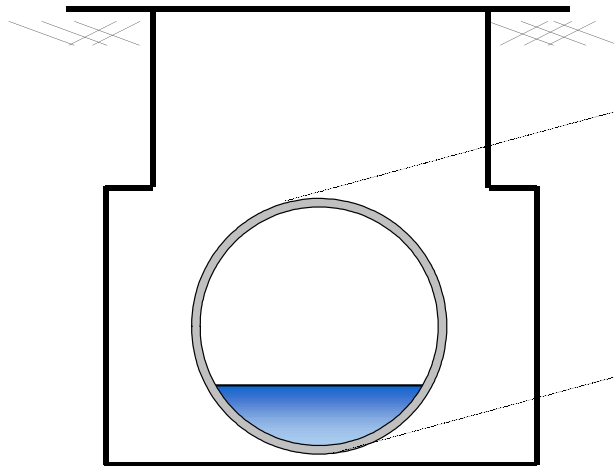
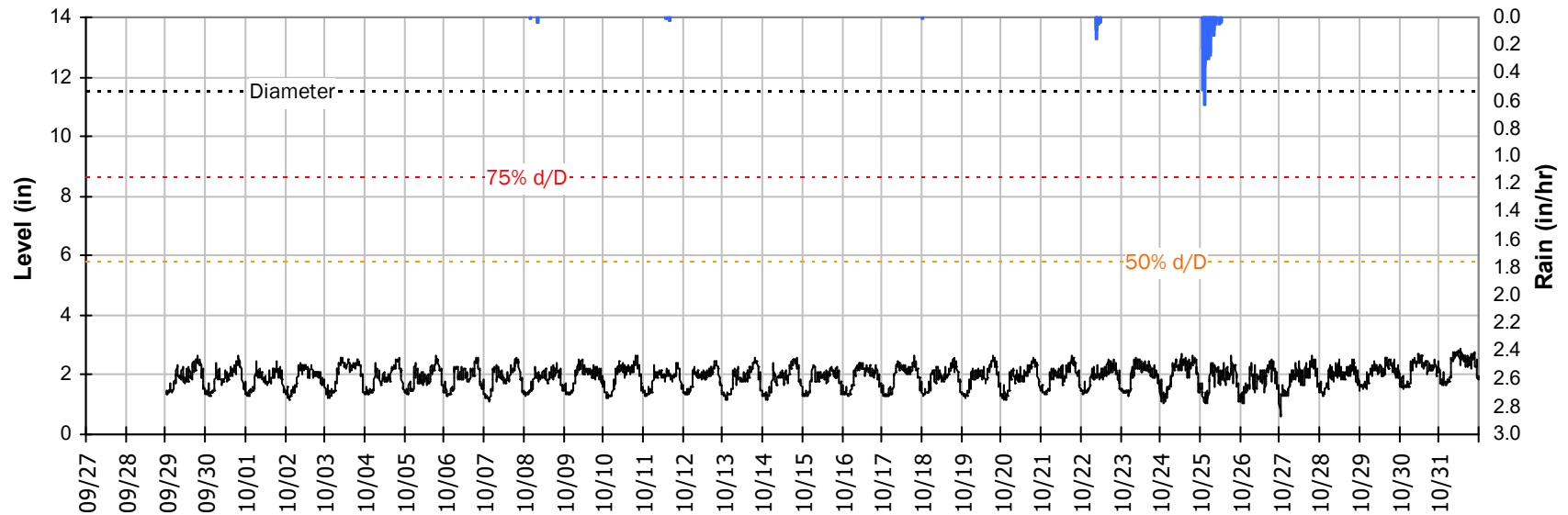
Average Dry Weather Flow Hydrographs



LOW DENSITY-5

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

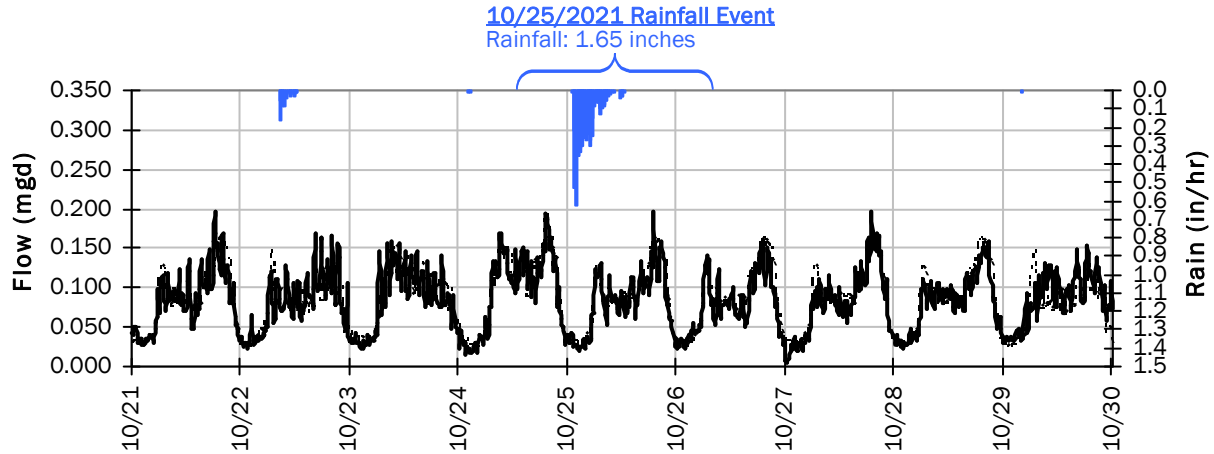


Pipe Diameter: 11.5 inches
Peak Measured Level: 2.9 inches
Peak d/D Ratio: 0.25

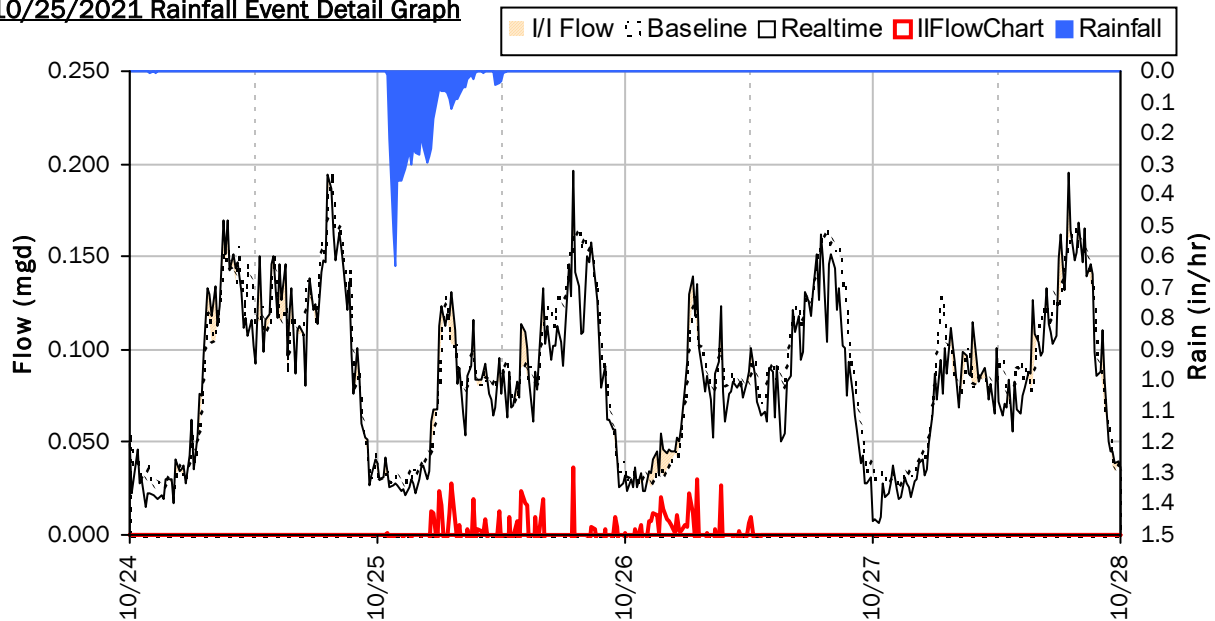
LOW DENSITY-5

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.196 mgd
PF: 2.30
Peak Level: 2.61 in
d/D Ratio: 0.23

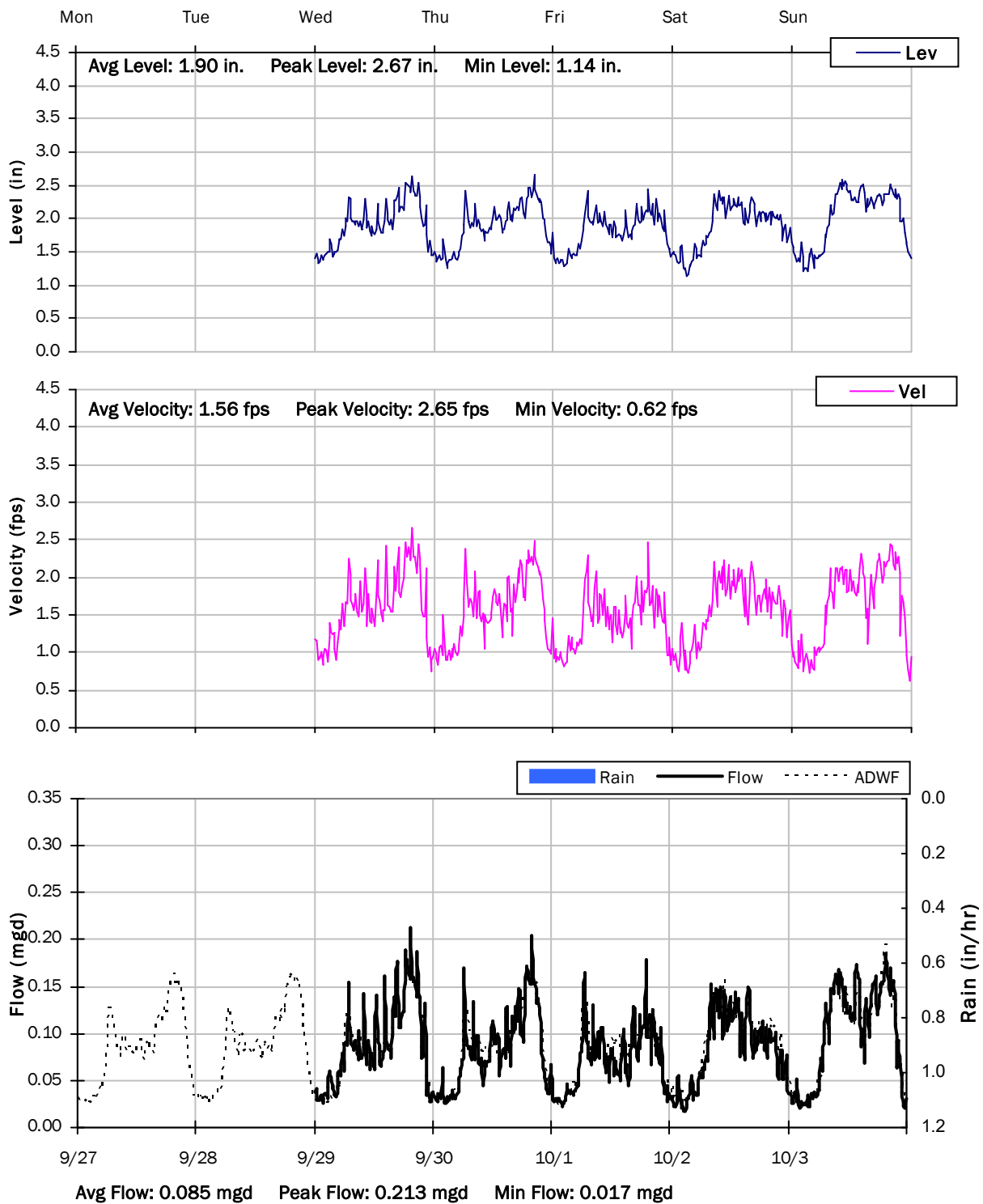
Inflow / Infiltration

Peak I/I Rate: 0.036 mgd
Total I/I: -3,000 gallons

LOW DENSITY-5

Weekly Level, Velocity and Flow Hydrographs

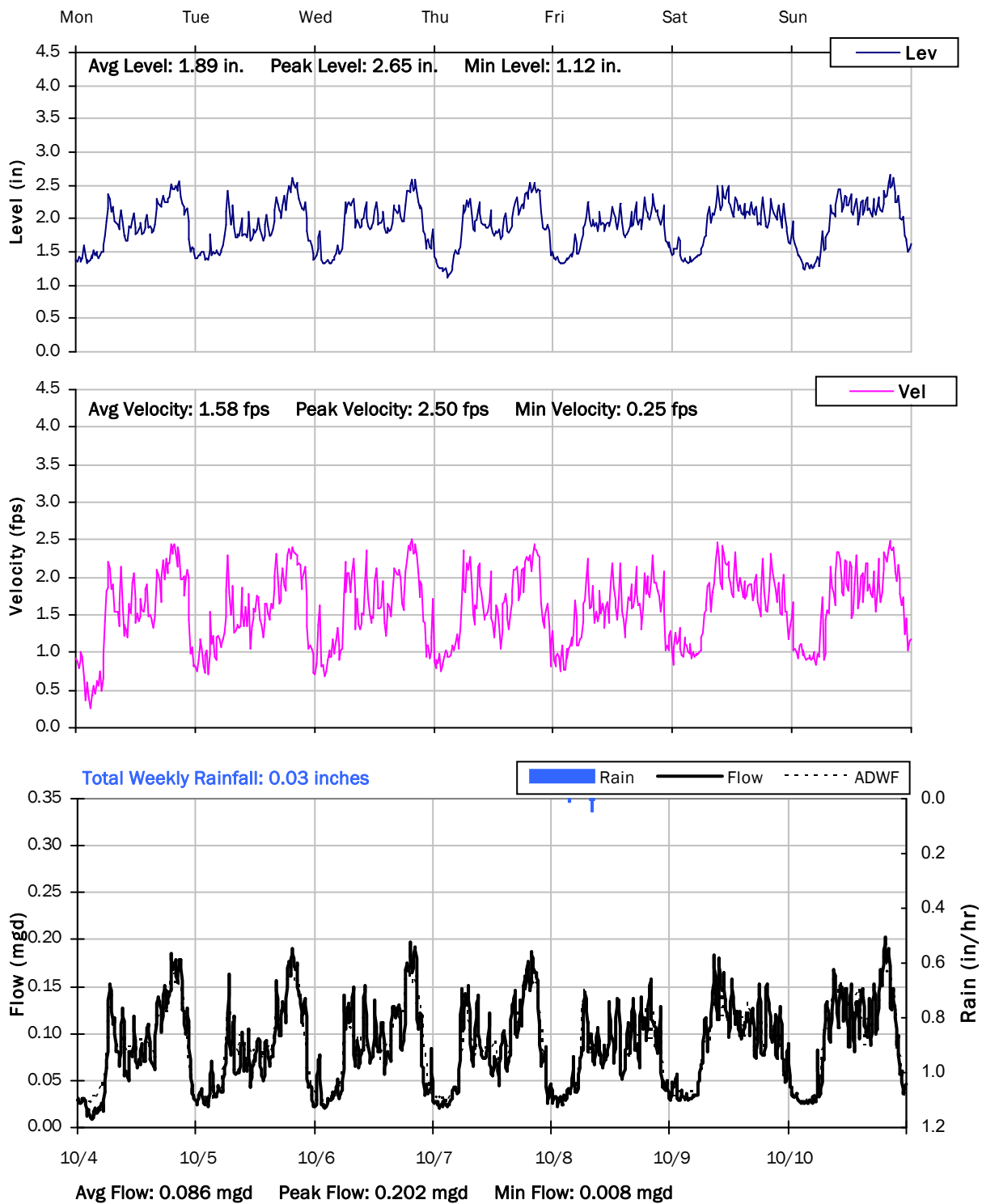
9/27/2021 to 10/4/2021



LOW DENSITY-5

Weekly Level, Velocity and Flow Hydrographs

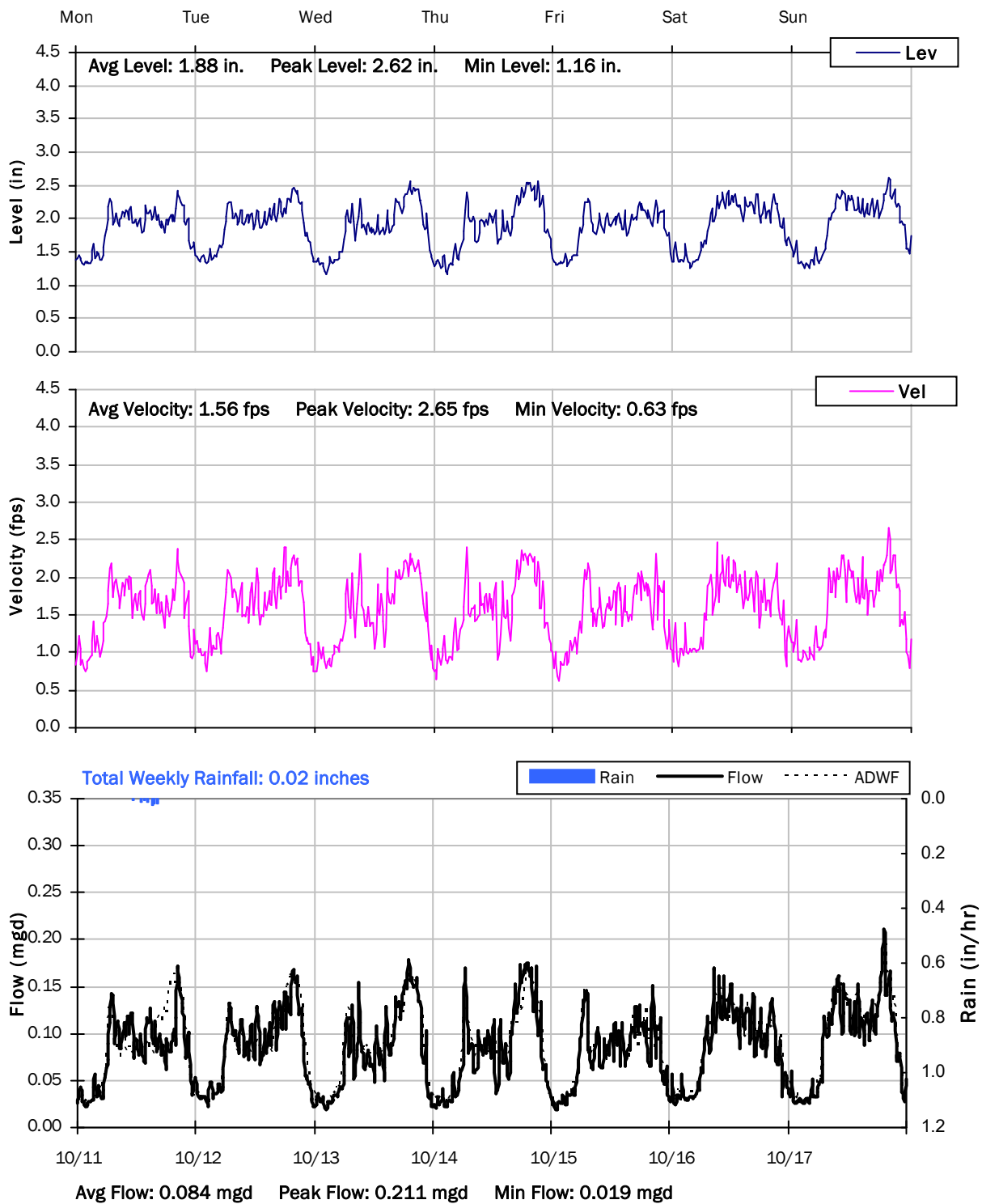
10/4/2021 to 10/11/2021



LOW DENSITY-5

Weekly Level, Velocity and Flow Hydrographs

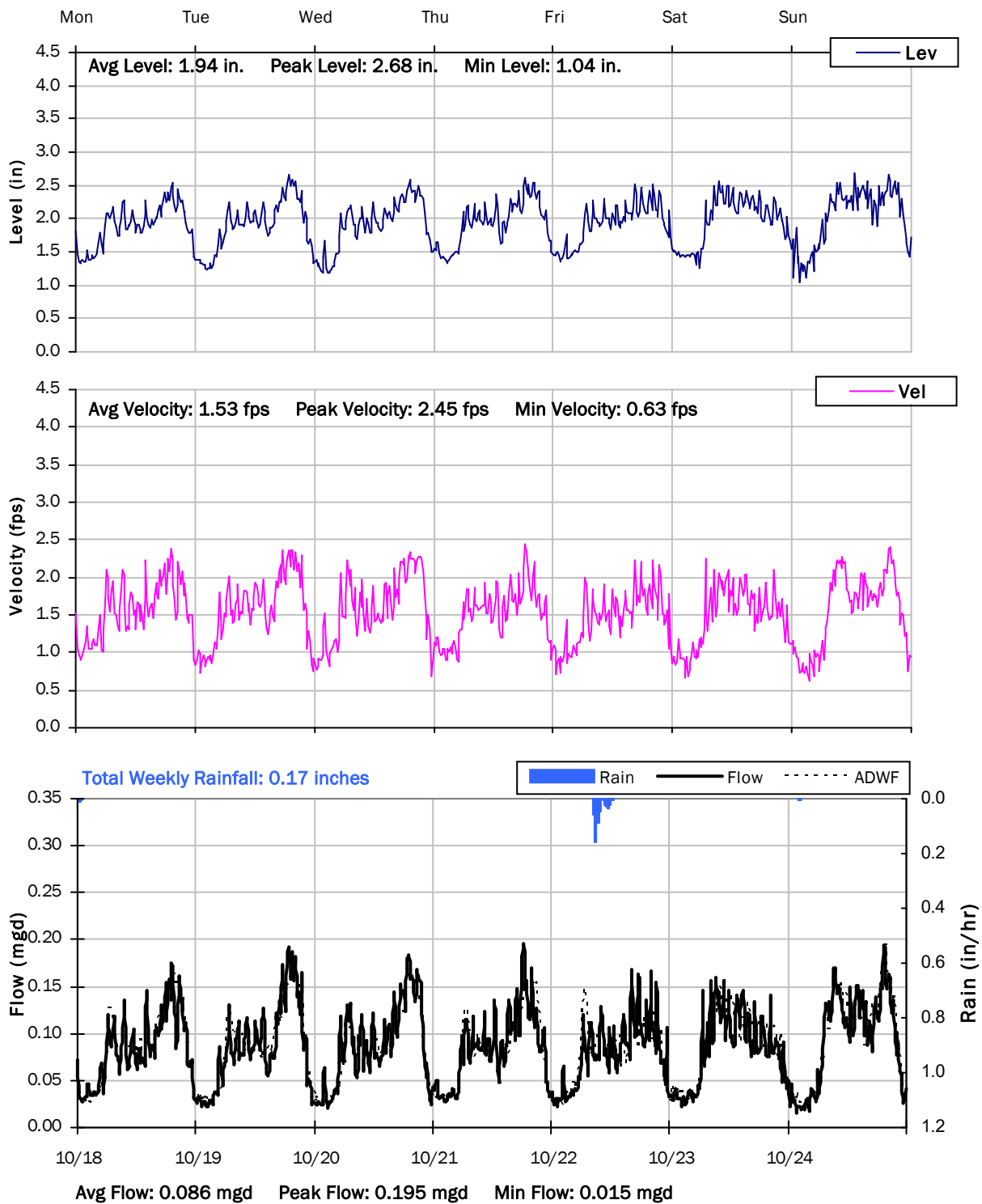
10/11/2021 to 10/18/2021



LOW DENSITY-5

Weekly Level, Velocity and Flow Hydrographs

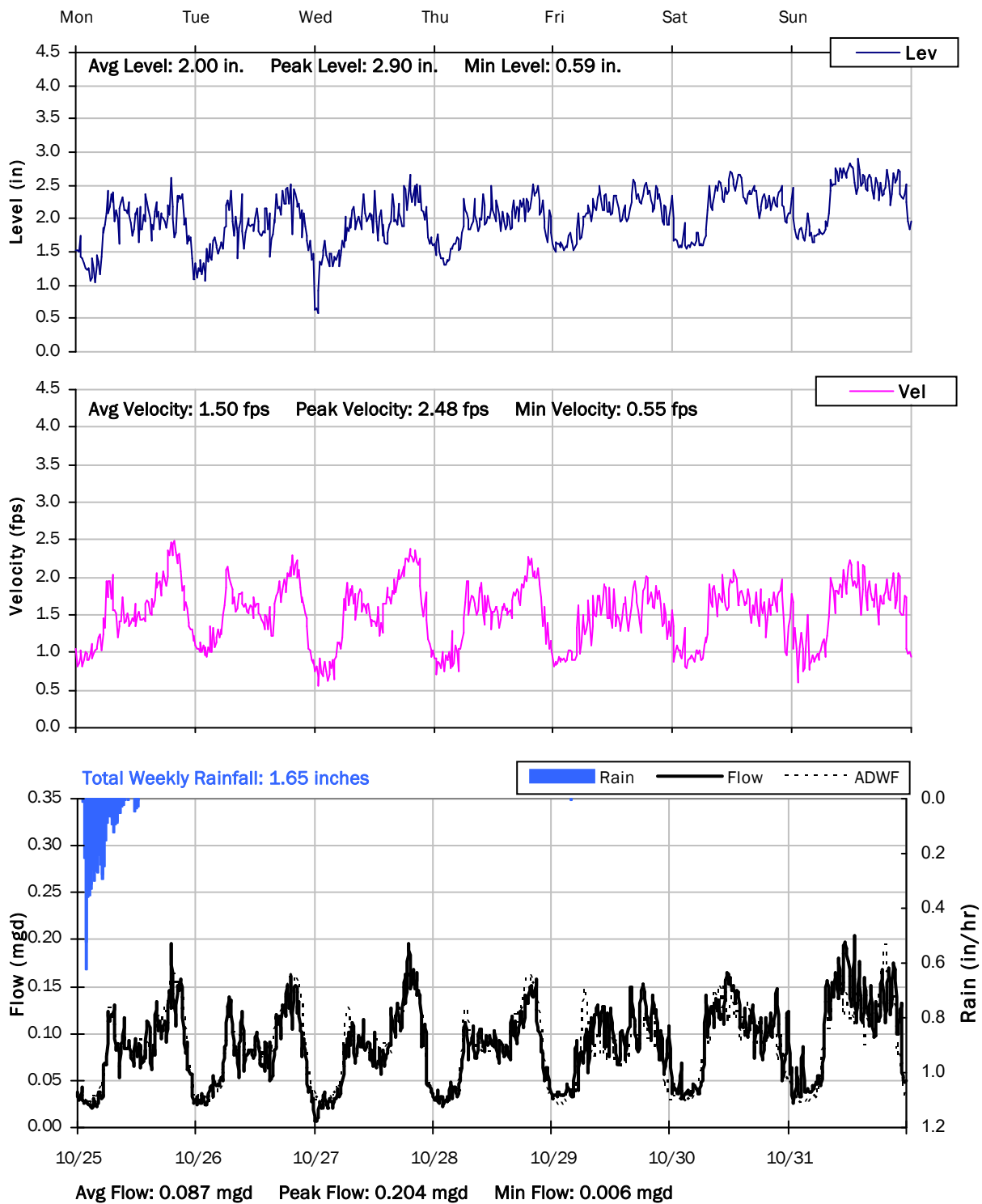
10/18/2021 to 10/25/2021



LOW DENSITY-5

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



LOW DENSITY-6

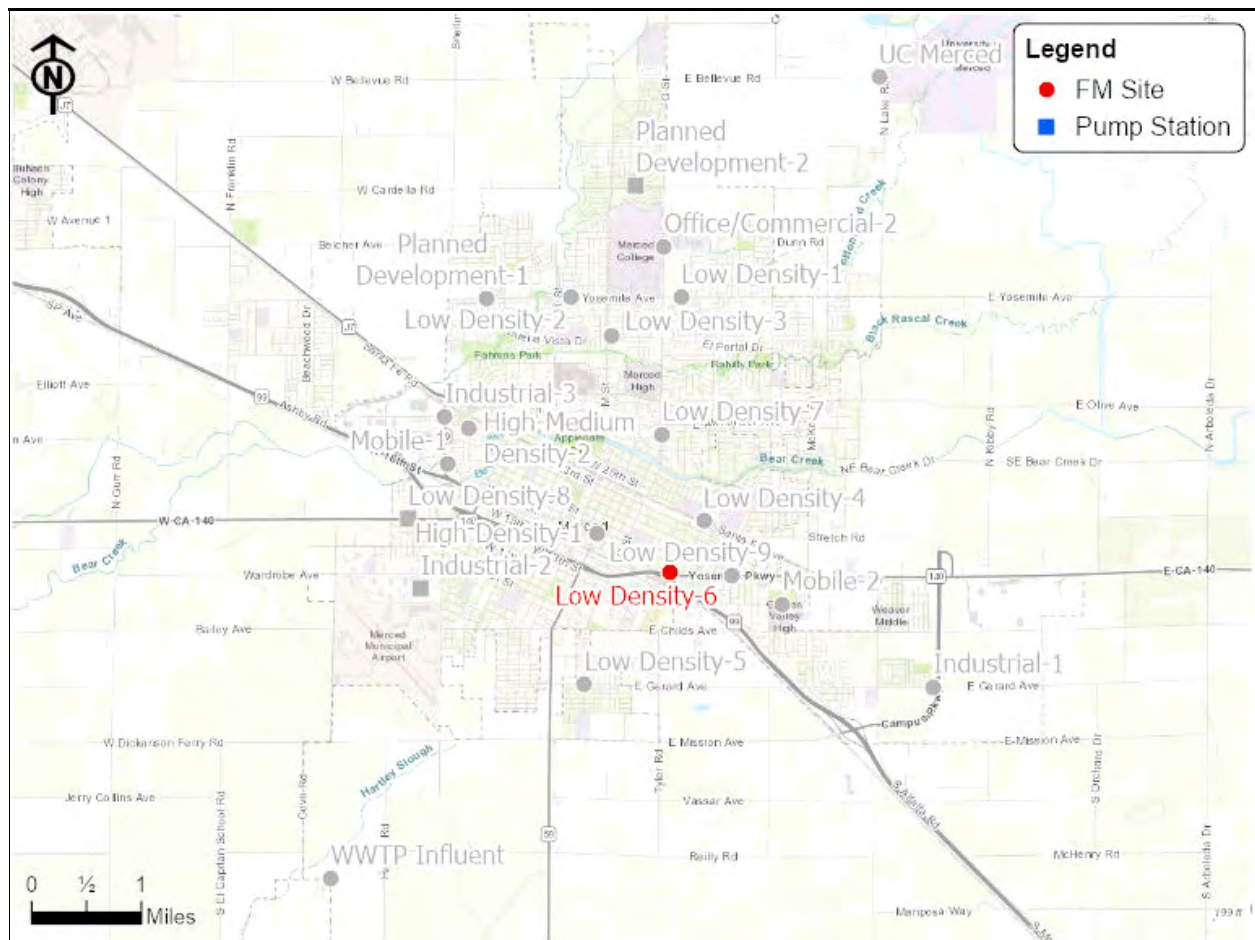
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: E Main Street between Orchard Lane and Cedar Avenue

Data Summary Report



Vicinity Map: Low Density-6

LOW DENSITY-6

Site Information

Location: E Main Street between Orchard Lane and Cedar Avenue

Coordinates: 120.4679° W, 37.2957° N

Rim Elevation (Earth): 173 feet

Measured Pipe Diameter: 12 inches

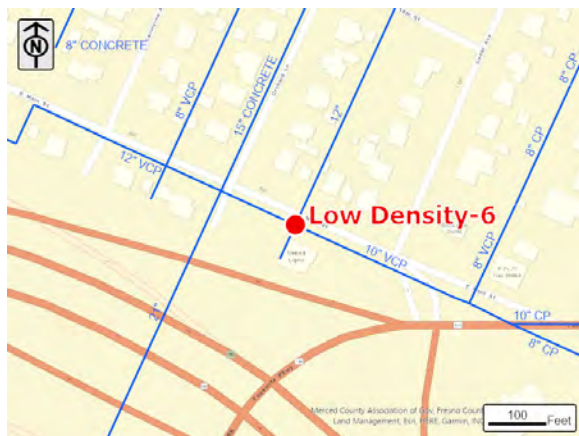
ADWF: 0.084 mgd

Peak Measured Flow: 0.188 mgd

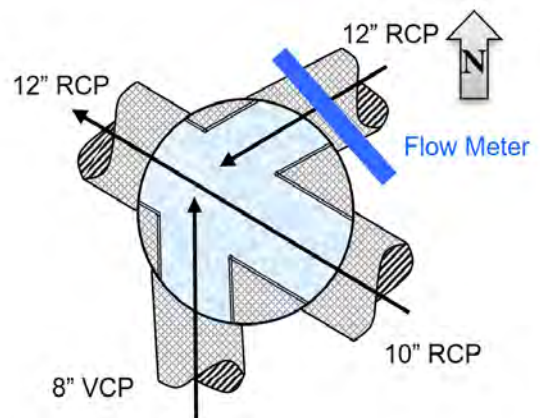
Sediment: 0.5 inches



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-6

Additional Site Photos

Effluent Pipe



Monitored Northeast Influent Pipe



LOW DENSITY-6

Additional Site Photos

Southeast Influent Pipe



Southwest Influent Pipe



LOW DENSITY-6

Additional Site Photos

Plugged Lateral Pipe

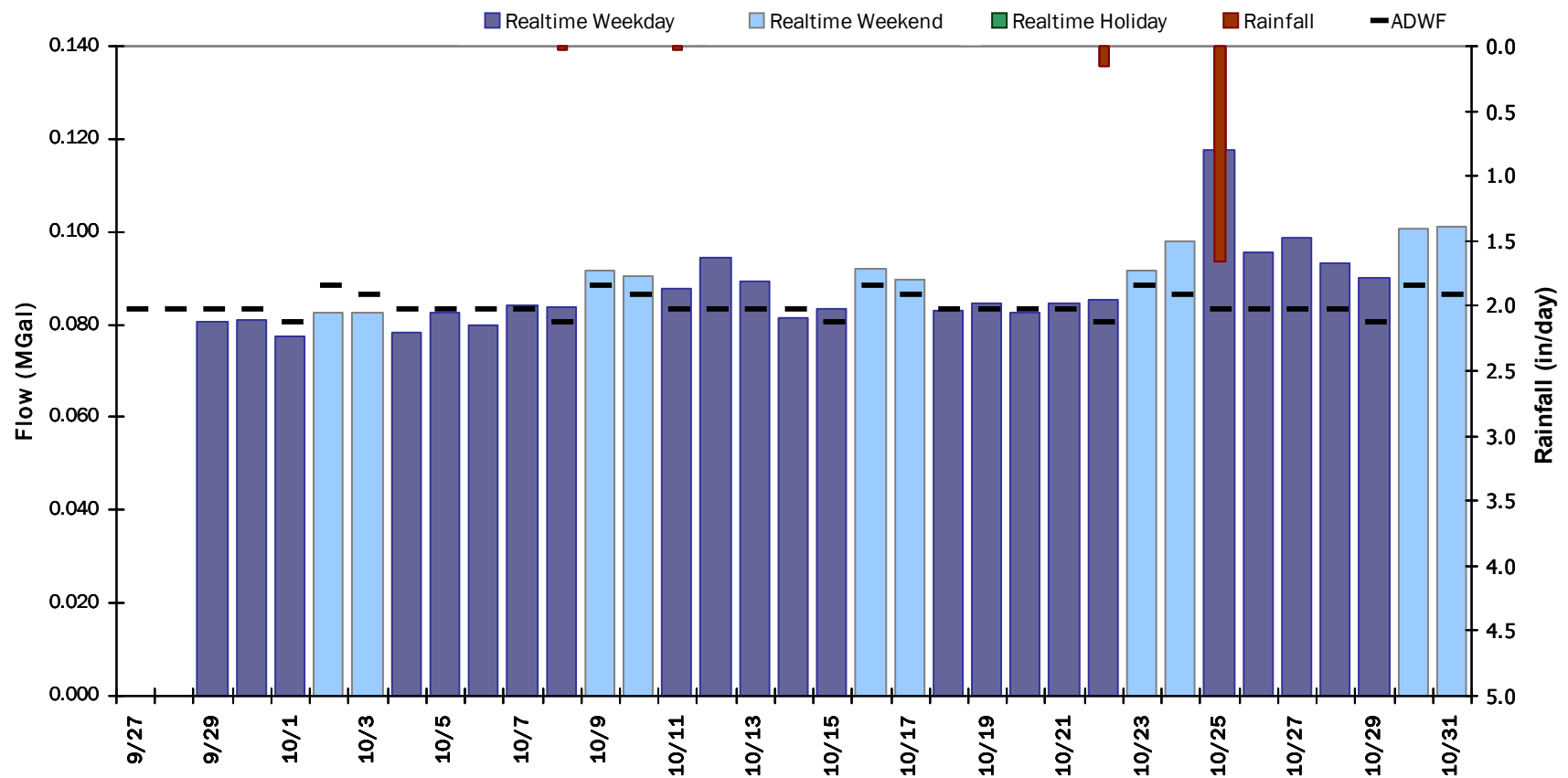


LOW DENSITY-6

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.088 MGal Peak Daily Flow: 0.118 MGal Min Daily Flow: 0.077 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-6

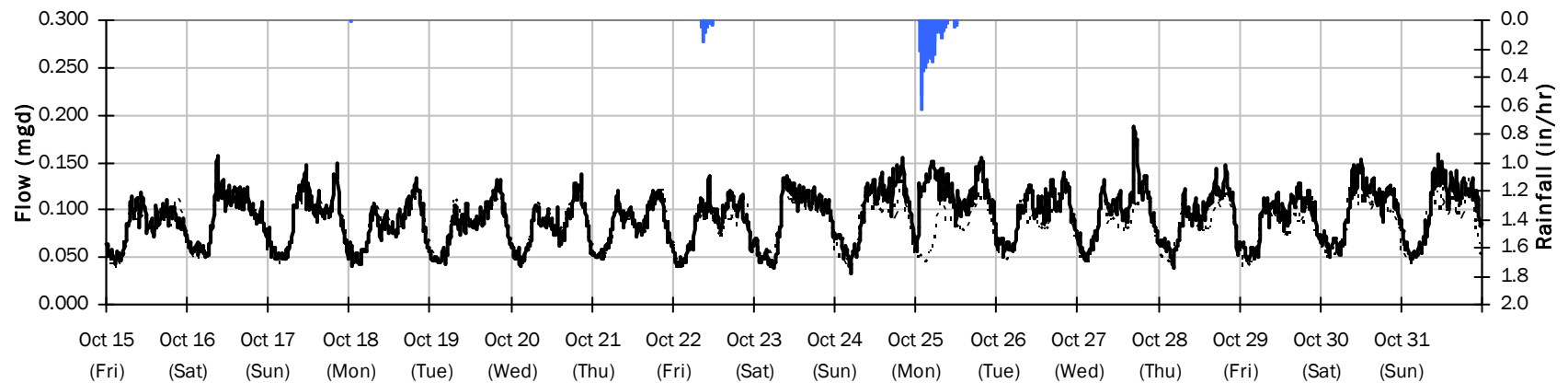
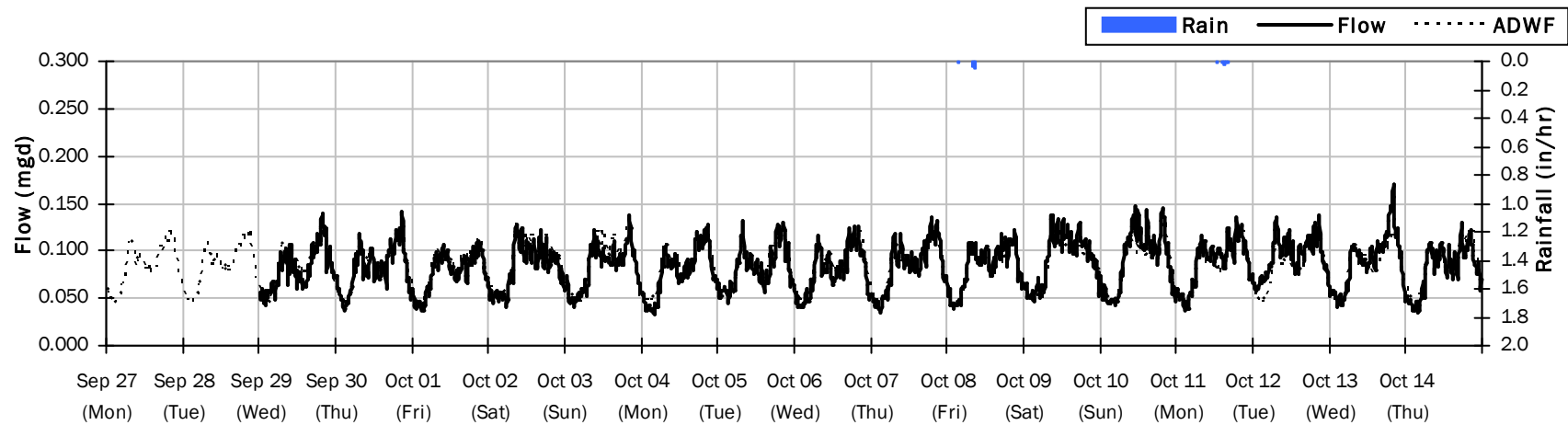
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.088 mgd

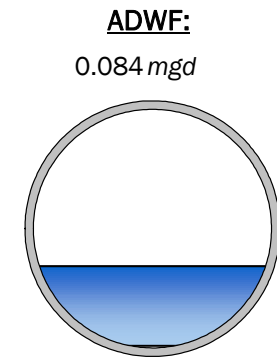
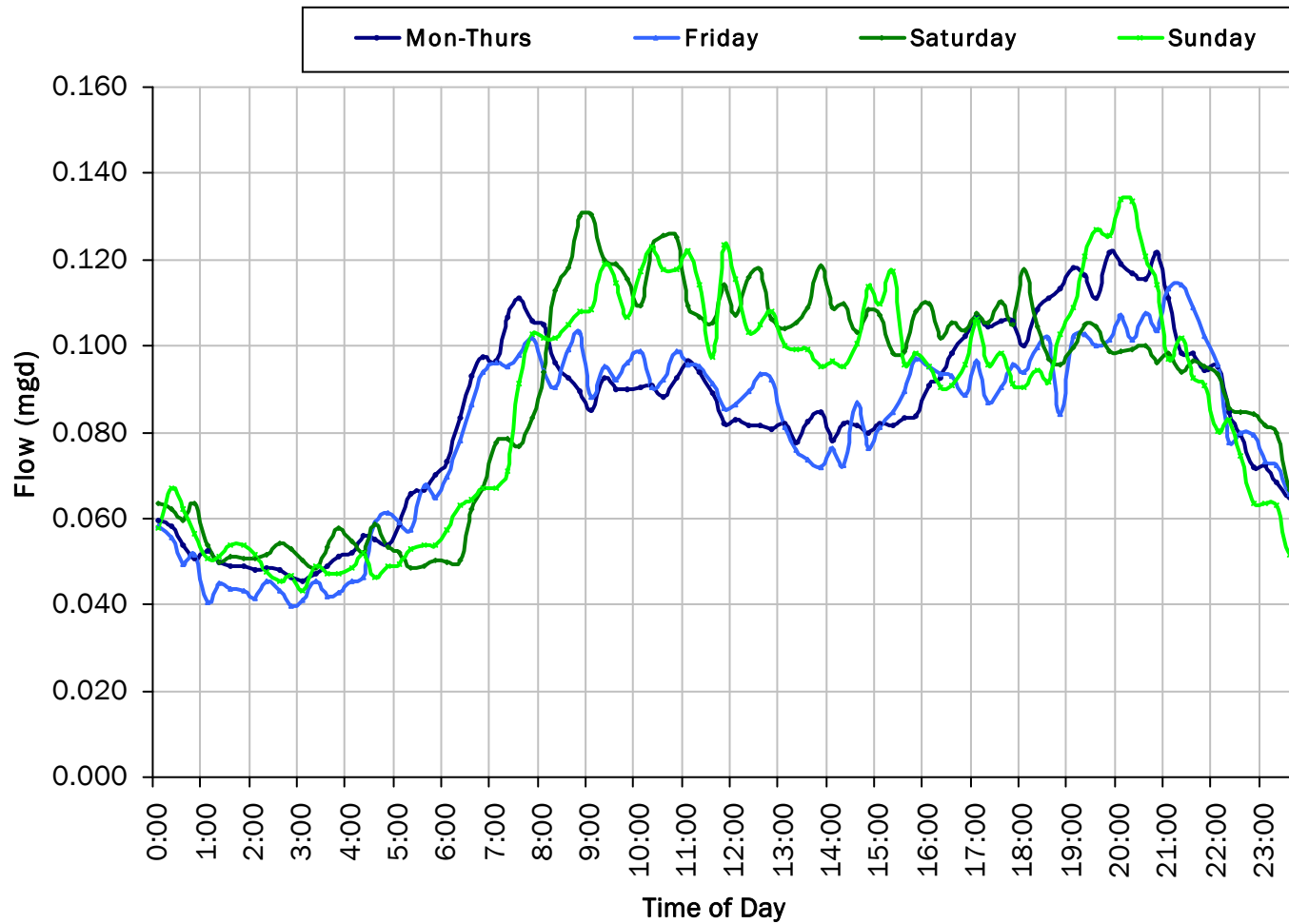
Period Peak Flow: 0.188 mgd

Period Min Flow: 0.032 mgd



LOW DENSITY-6

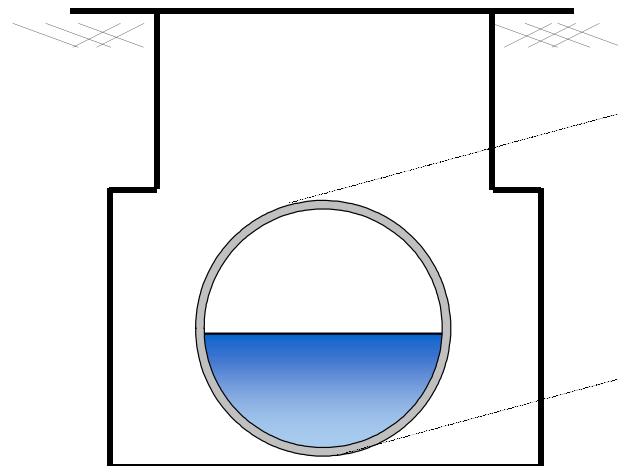
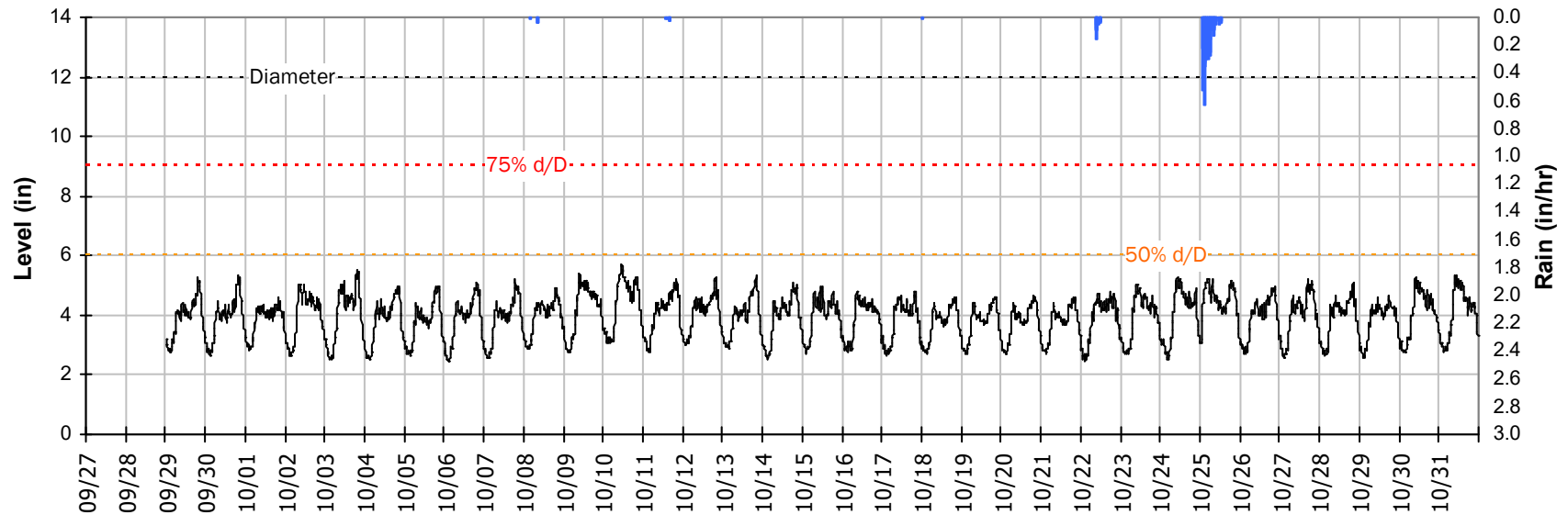
Average Dry Weather Flow Hydrographs



LOW DENSITY-6

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

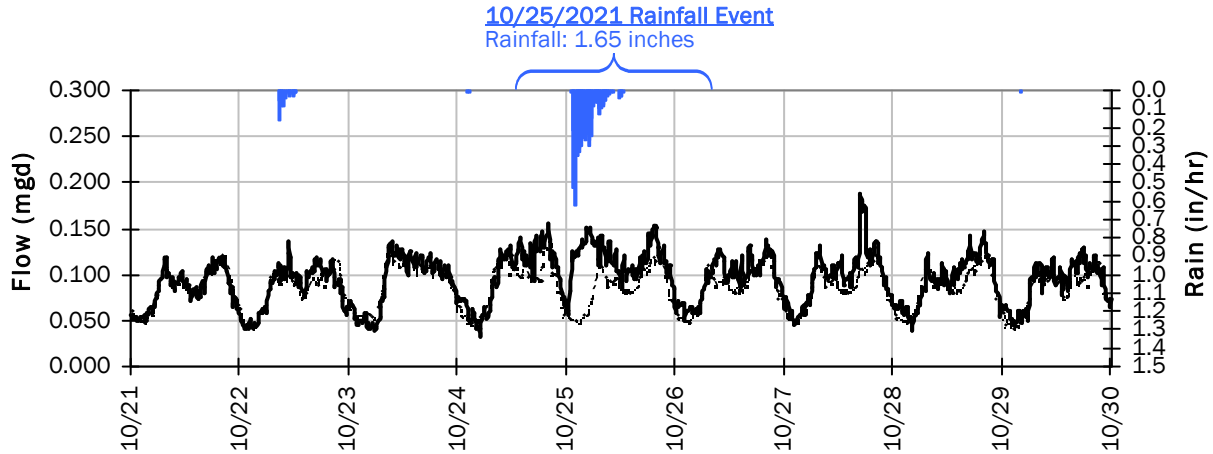


Pipe Diameter: 12 inches
Peak Measured Level: 5.74 inches
Peak d/D Ratio: 0.48

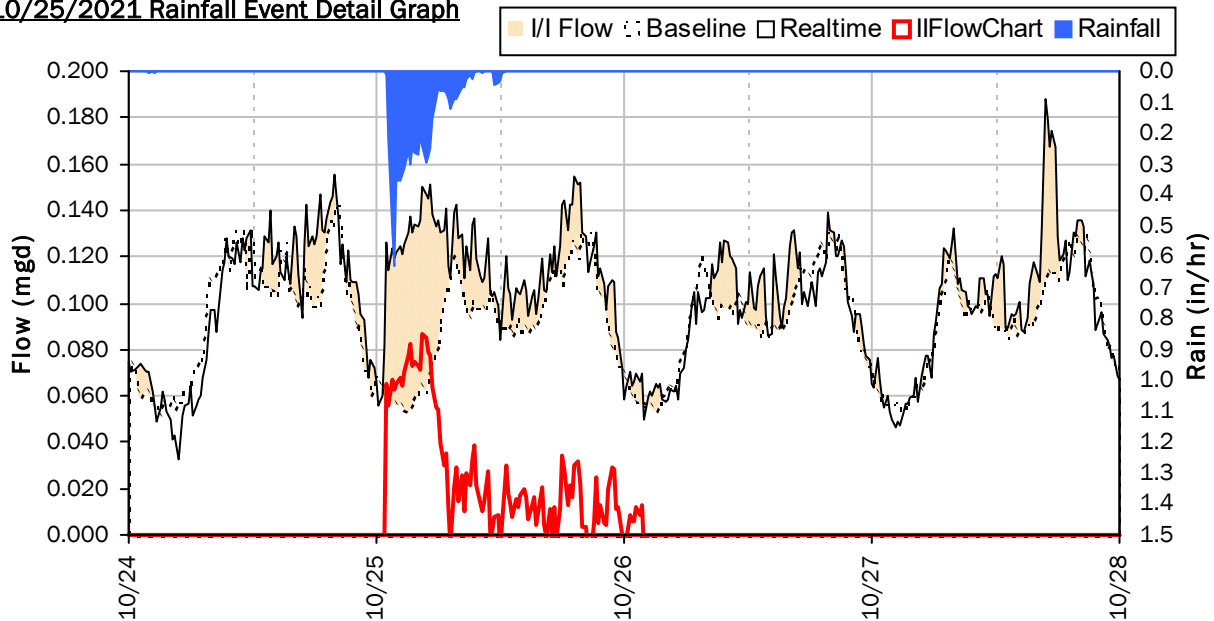
LOW DENSITY-6

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



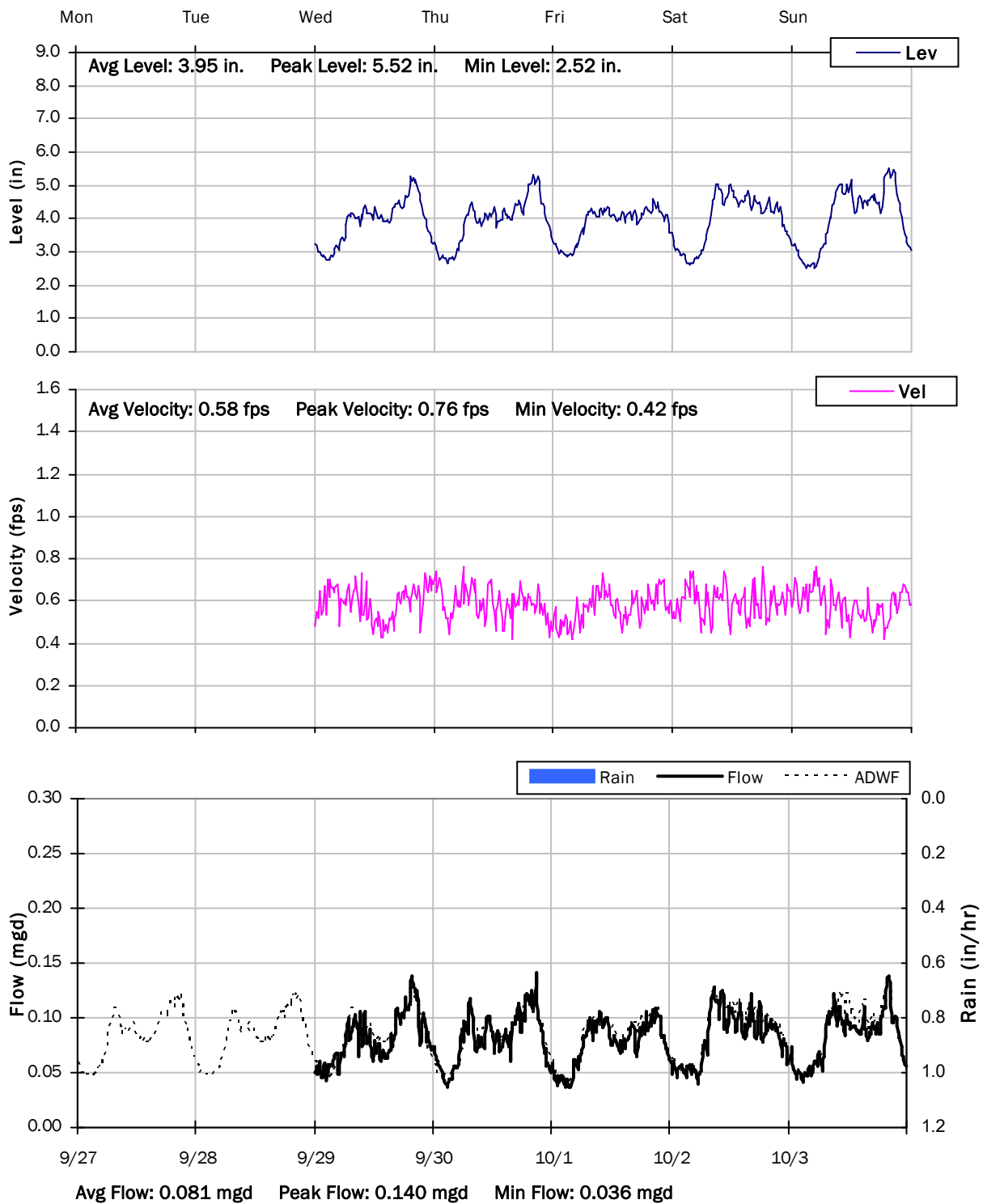
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.154 mgd	Peak I/I Rate:	0.087 mgd
PF:	1.83	Total I/I:	26,000 gallons
Peak Level:	5.24 in		
d/D Ratio:	0.44		

LOW DENSITY-6

Weekly Level, Velocity and Flow Hydrographs

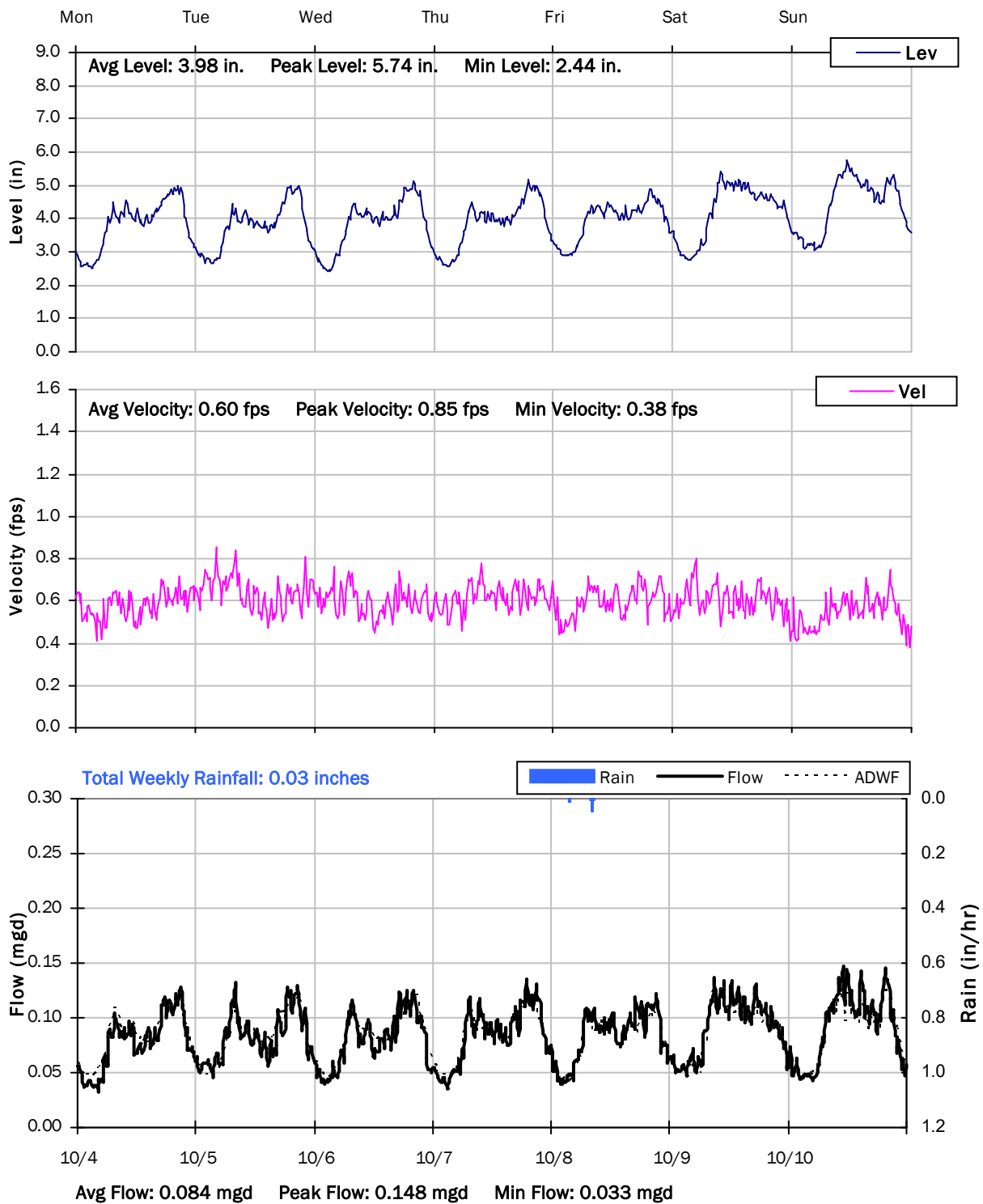
9/27/2021 to 10/4/2021



LOW DENSITY-6

Weekly Level, Velocity and Flow Hydrographs

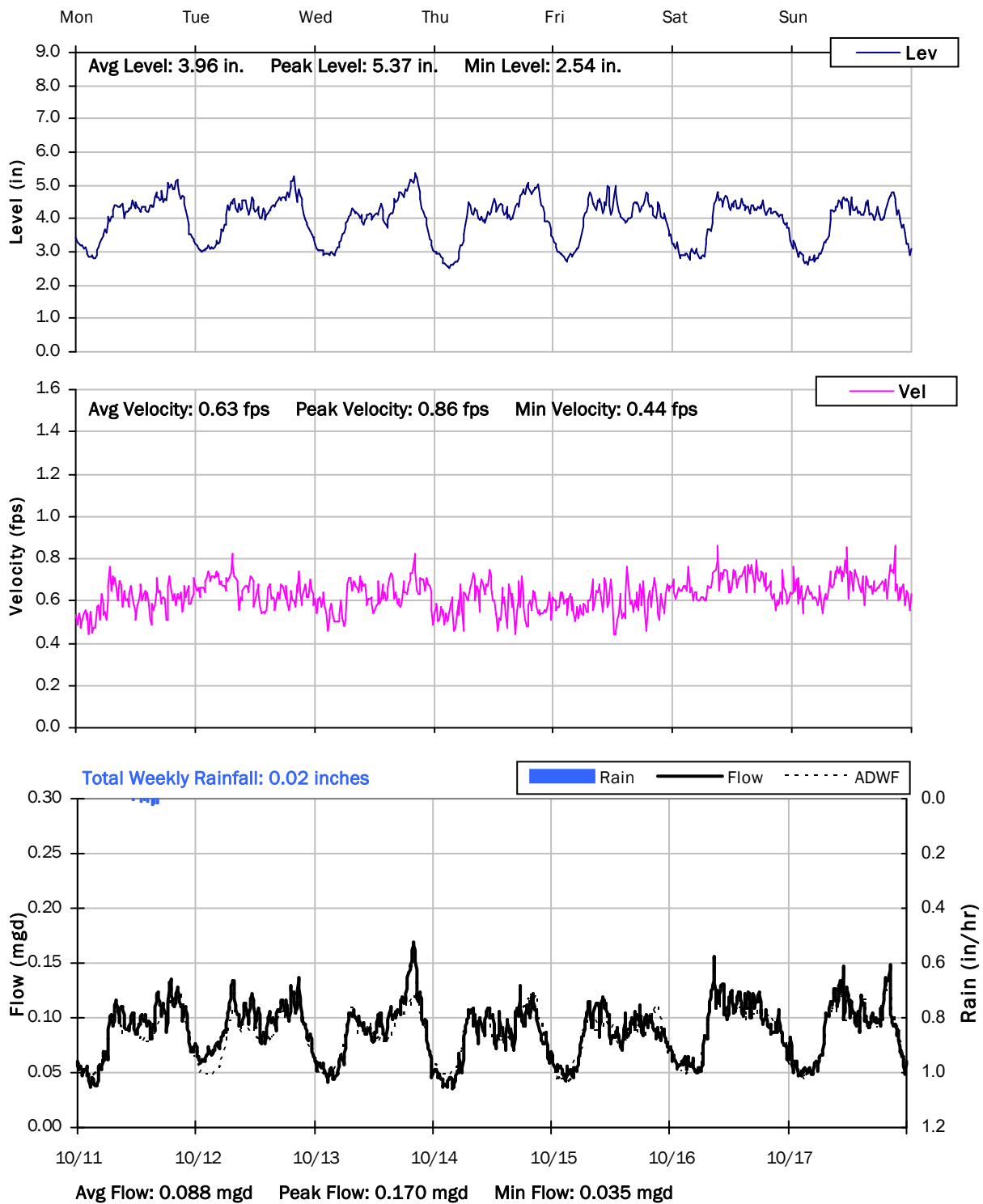
10/4/2021 to 10/11/2021



LOW DENSITY-6

Weekly Level, Velocity and Flow Hydrographs

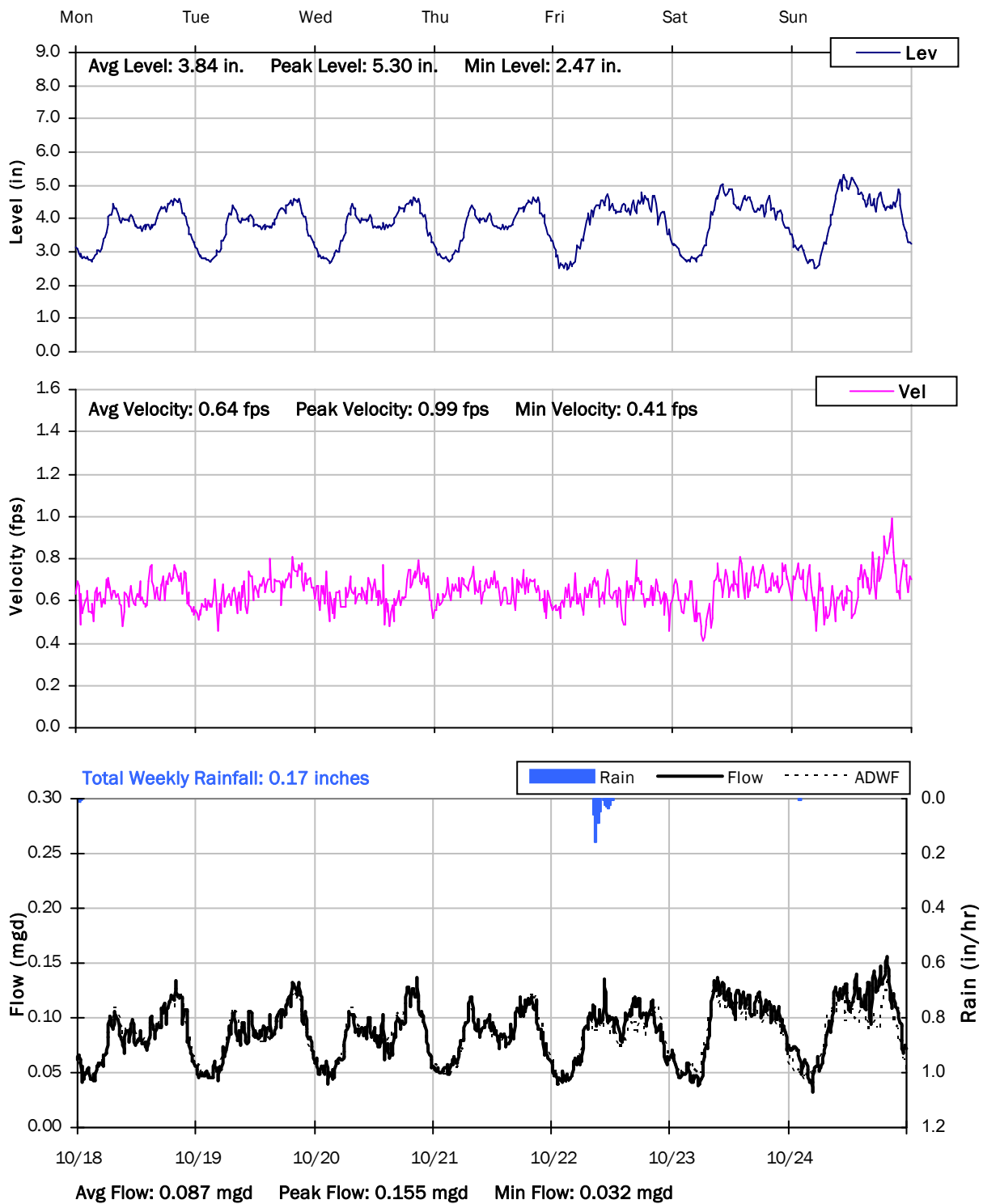
10/11/2021 to 10/18/2021



LOW DENSITY-6

Weekly Level, Velocity and Flow Hydrographs

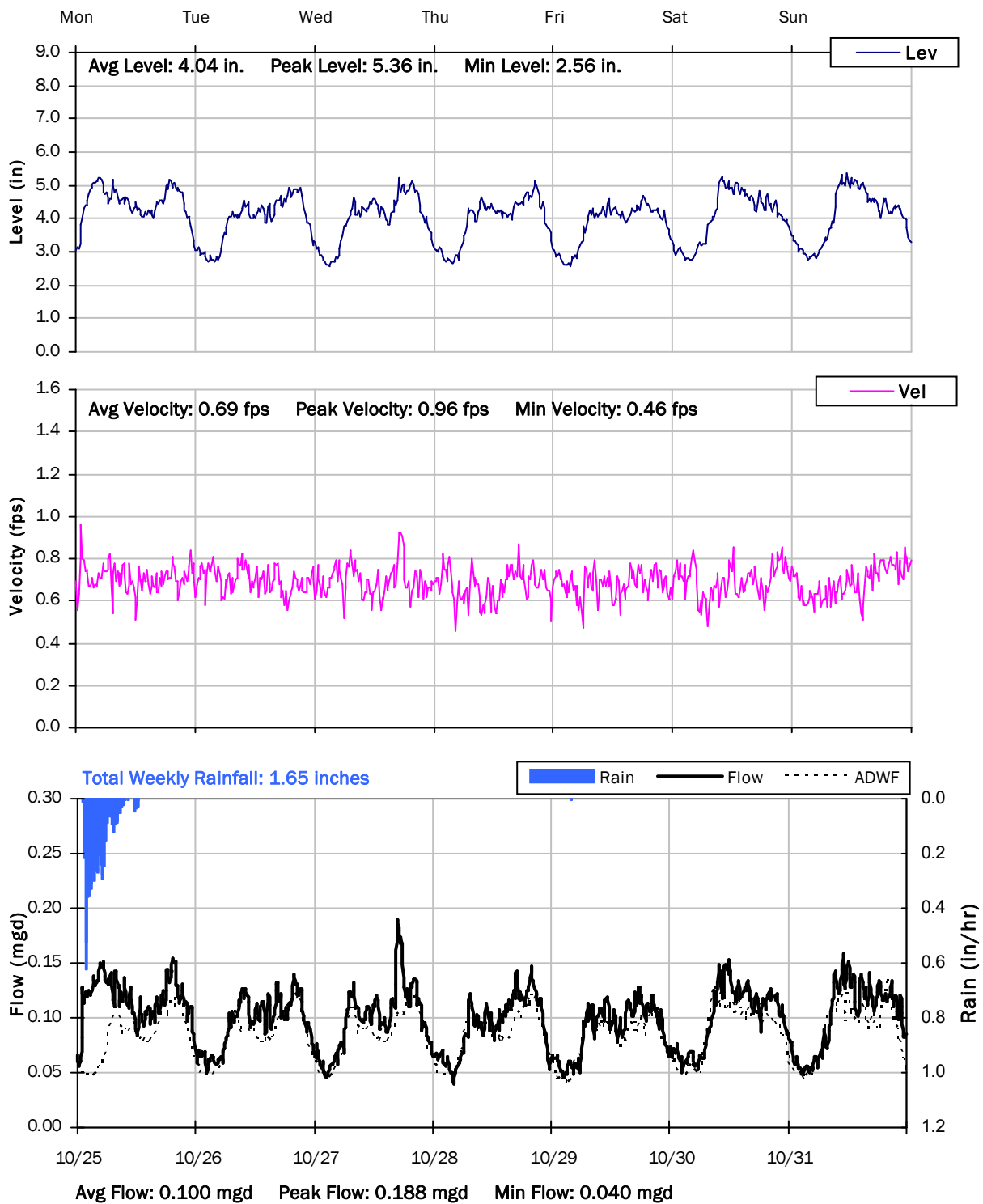
10/18/2021 to 10/25/2021



LOW DENSITY-6

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



LOW DENSITY-7

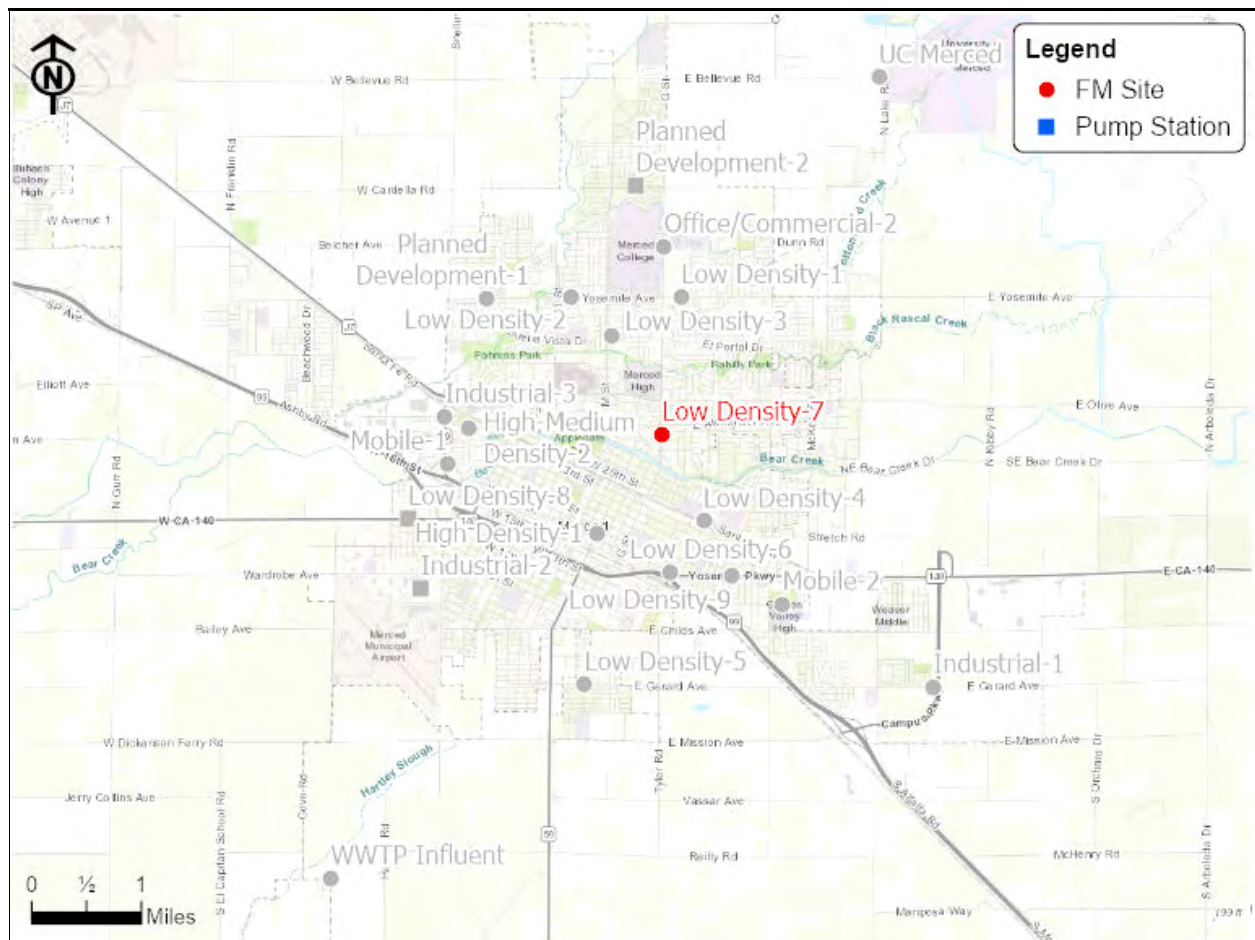
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: South of 2970 G Street

Data Summary Report



Vicinity Map: Low Density-7

LOW DENSITY-7

Site Information

Location: South of 2970 G Street

Coordinates: 120.4692° W, 37.3140° N

Rim Elevation (Earth): 178 feet

Measured Pipe Diameter: 10 inches

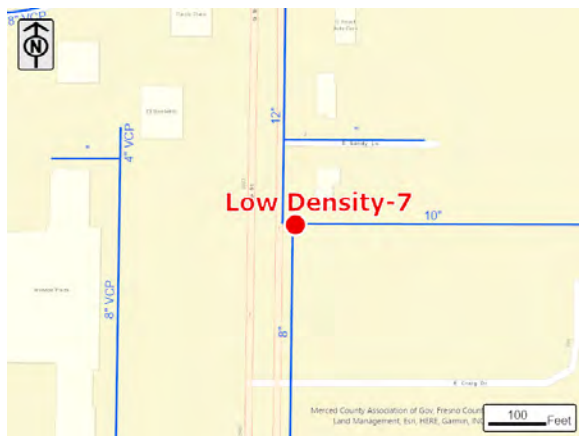
ADWF: 0.050 mgd

Peak Measured Flow: 0.154 mgd

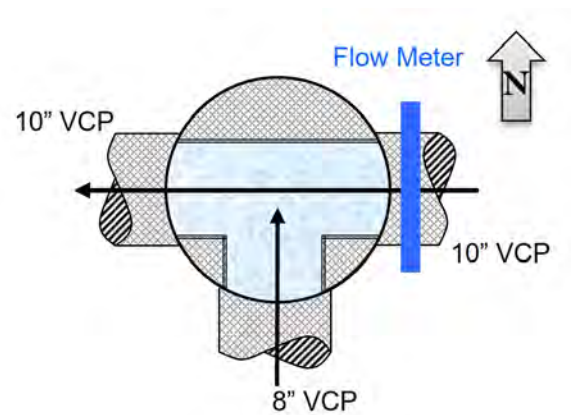
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-7

Additional Site Photos

Effluent Pipe



Monitored East Influent Pipe



LOW DENSITY-7

Additional Site Photos

South Influent Pipe

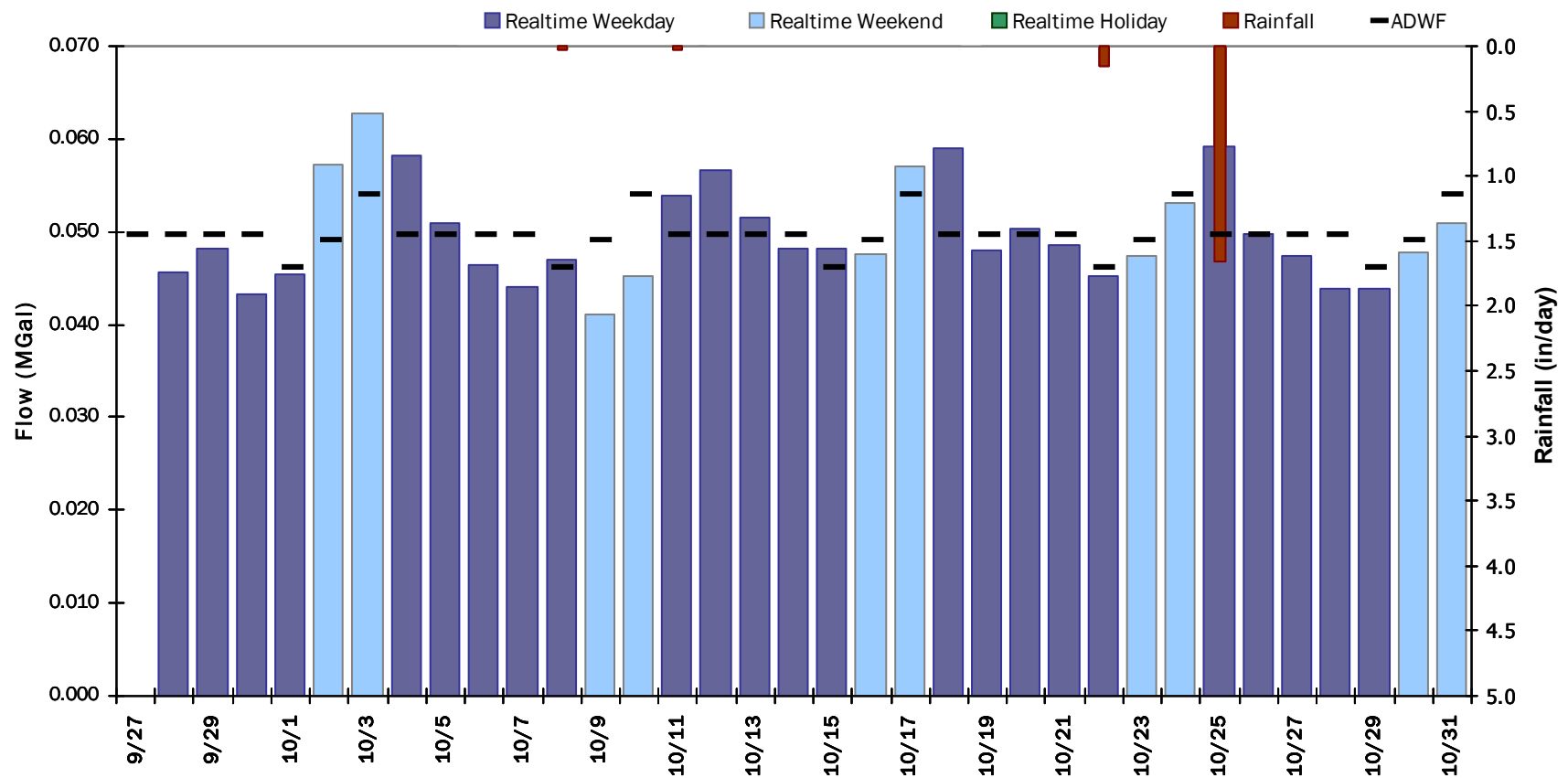


LOW DENSITY-7

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.050 MGal Peak Daily Flow: 0.063 MGal Min Daily Flow: 0.041 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-7

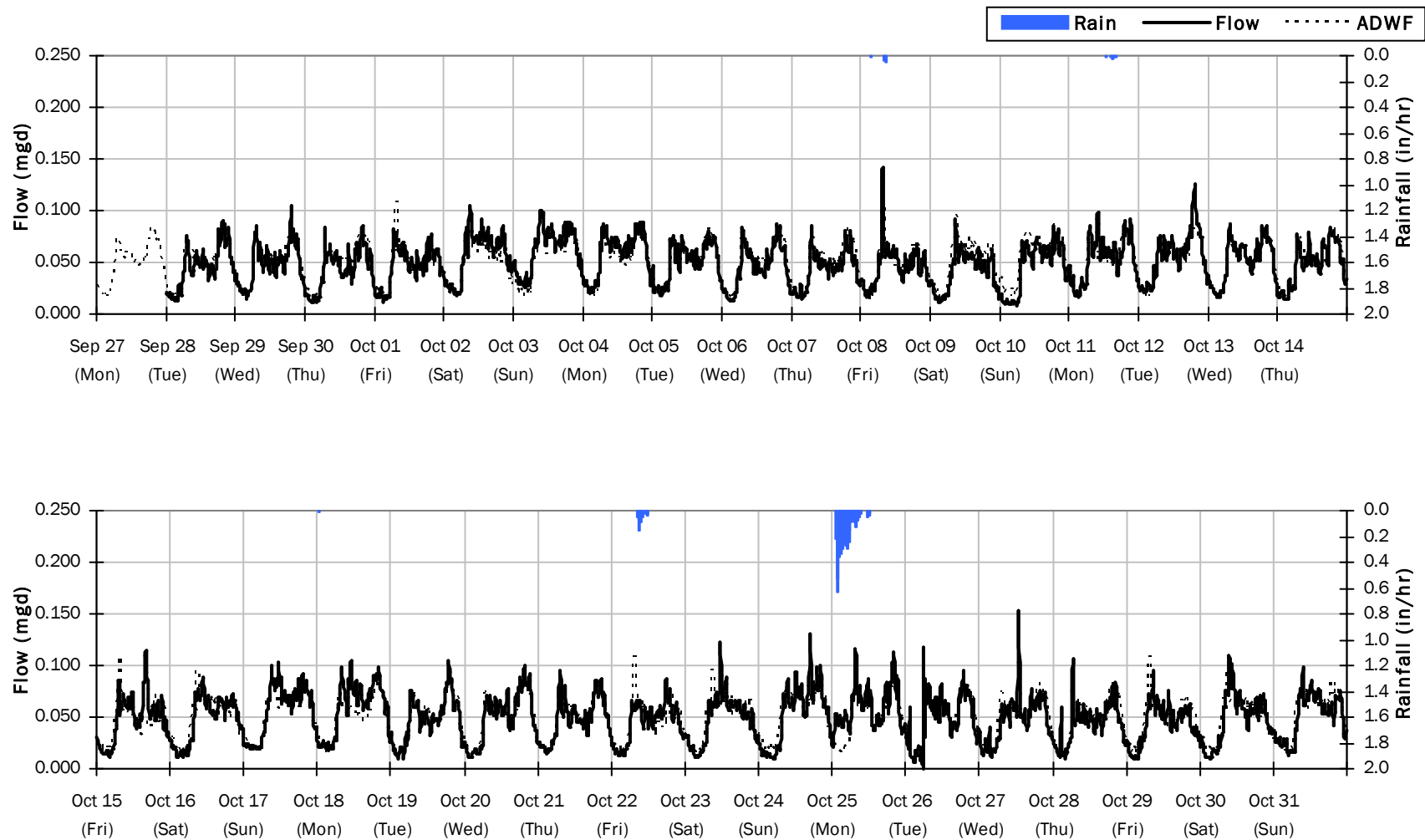
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.050 mgd

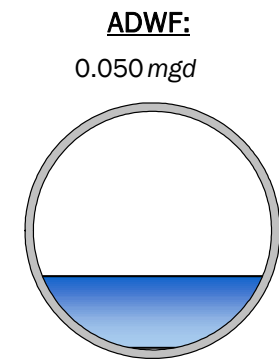
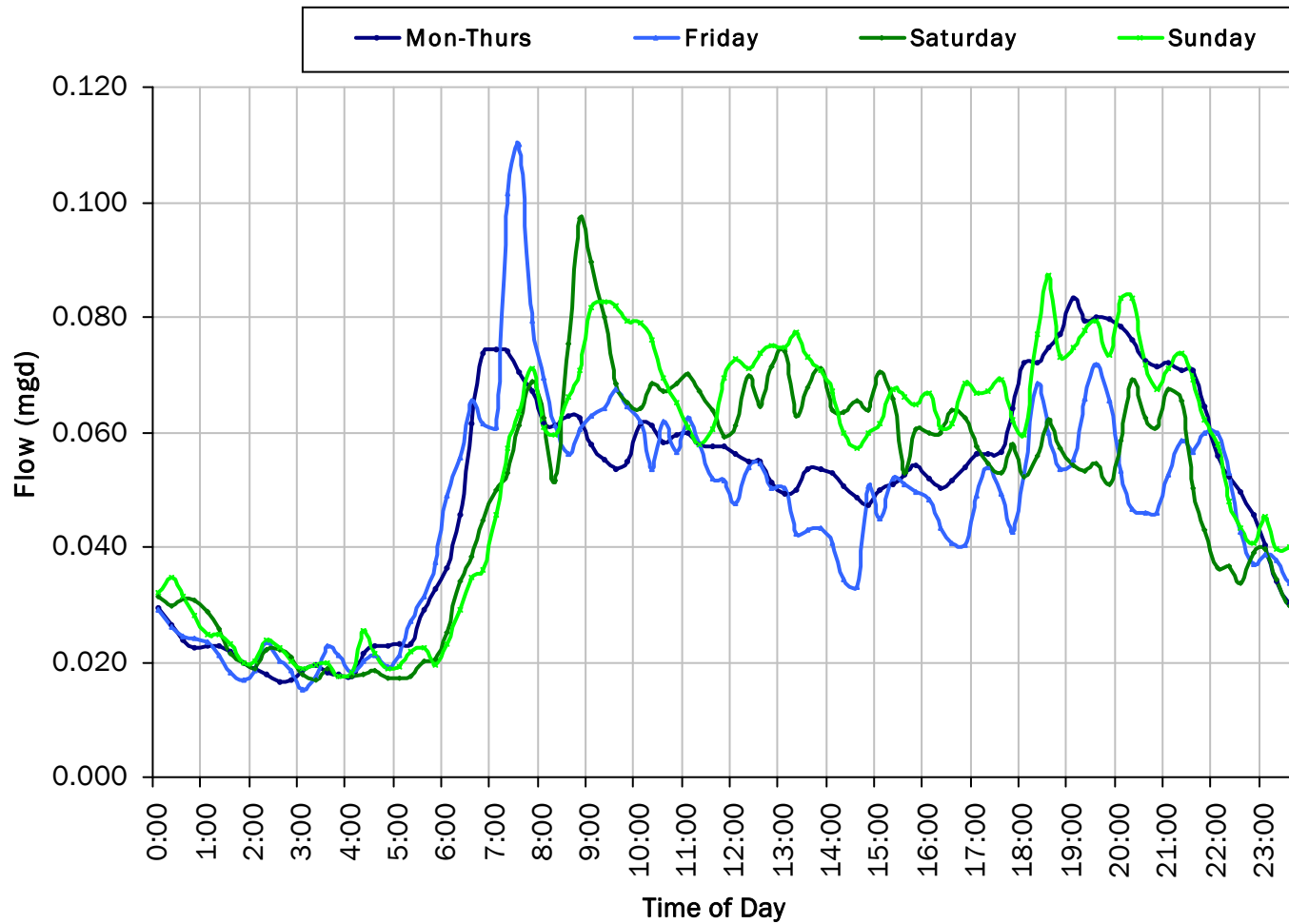
Period Peak Flow: 0.154 mgd

Period Min Flow: 0.002 mgd



LOW DENSITY-7

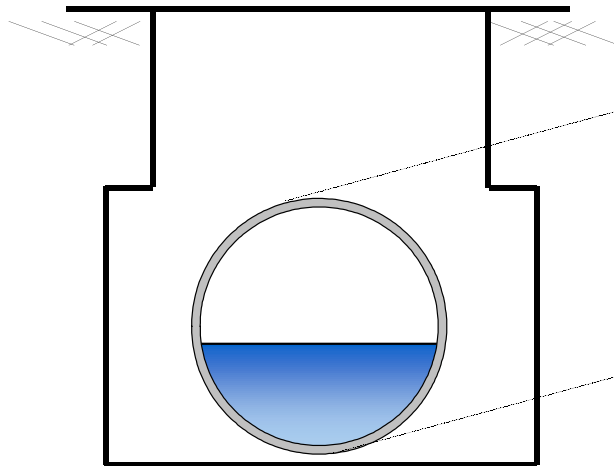
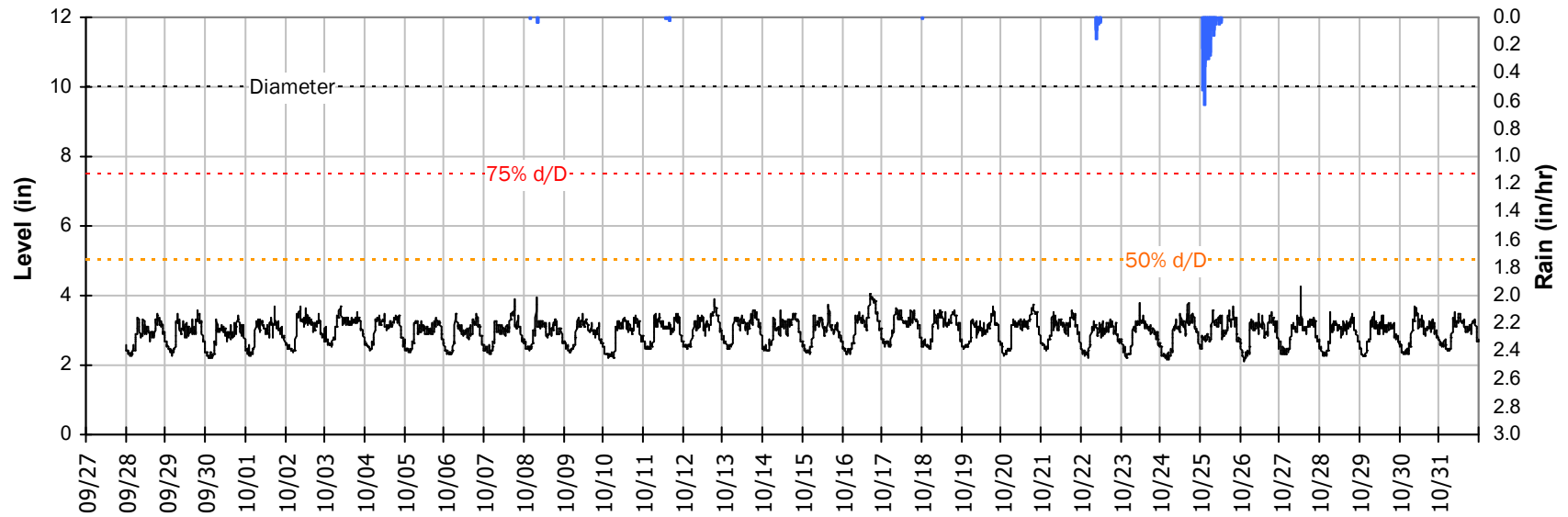
Average Dry Weather Flow Hydrographs



LOW DENSITY-7

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

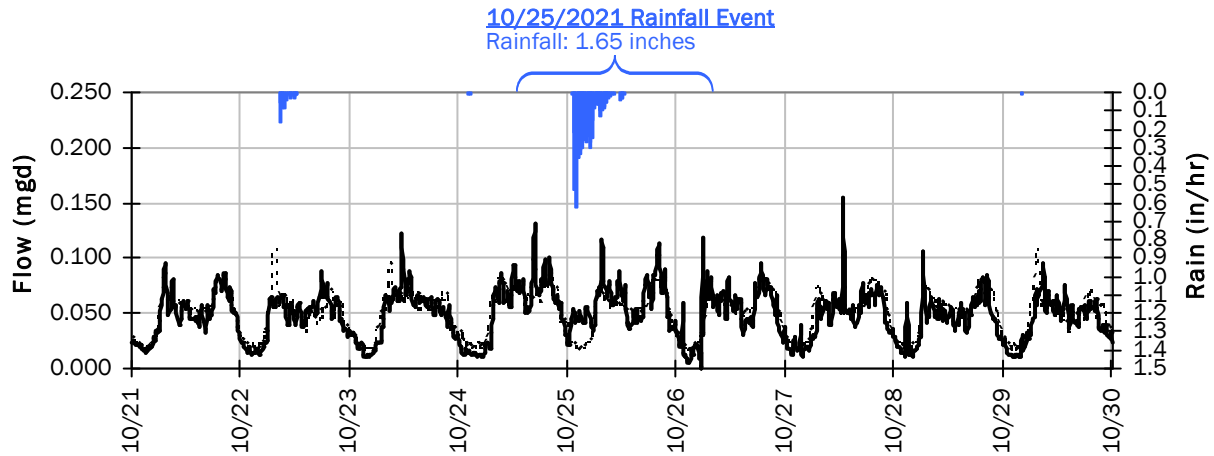


Pipe Diameter:	10	inches
Peak Measured Level:	4.26	inches
Peak d/D Ratio:	0.43	

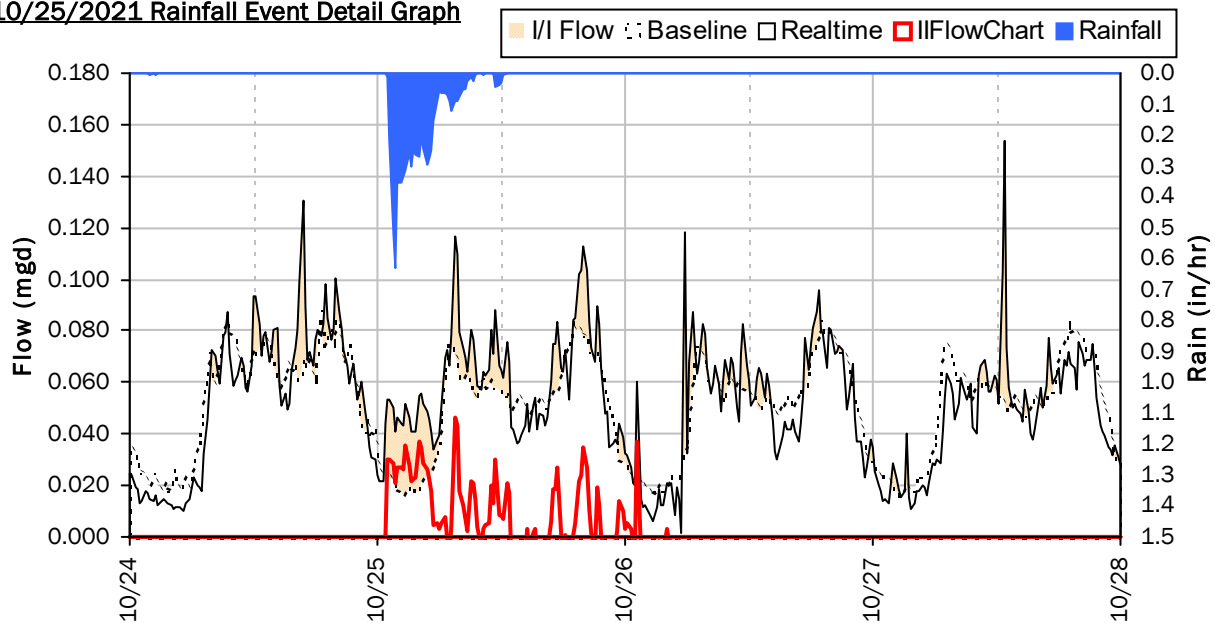
LOW DENSITY-7

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



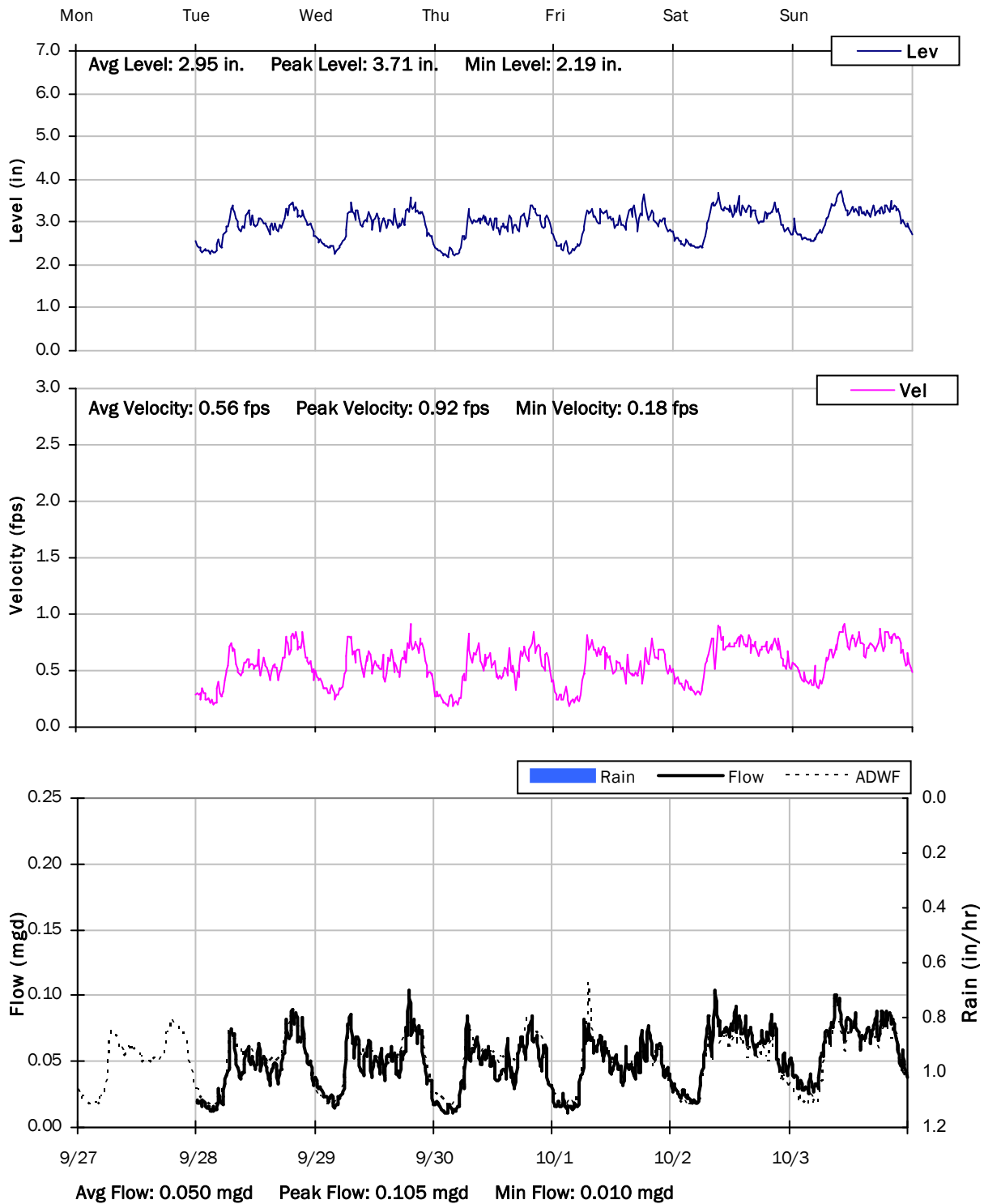
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.117 mgd	Peak I/I Rate:	0.046 mgd
PF:	2.34	Total I/I:	9,000 gallons
Peak Level:	3.68 in		
d/D Ratio:	0.37		

LOW DENSITY-7

Weekly Level, Velocity and Flow Hydrographs

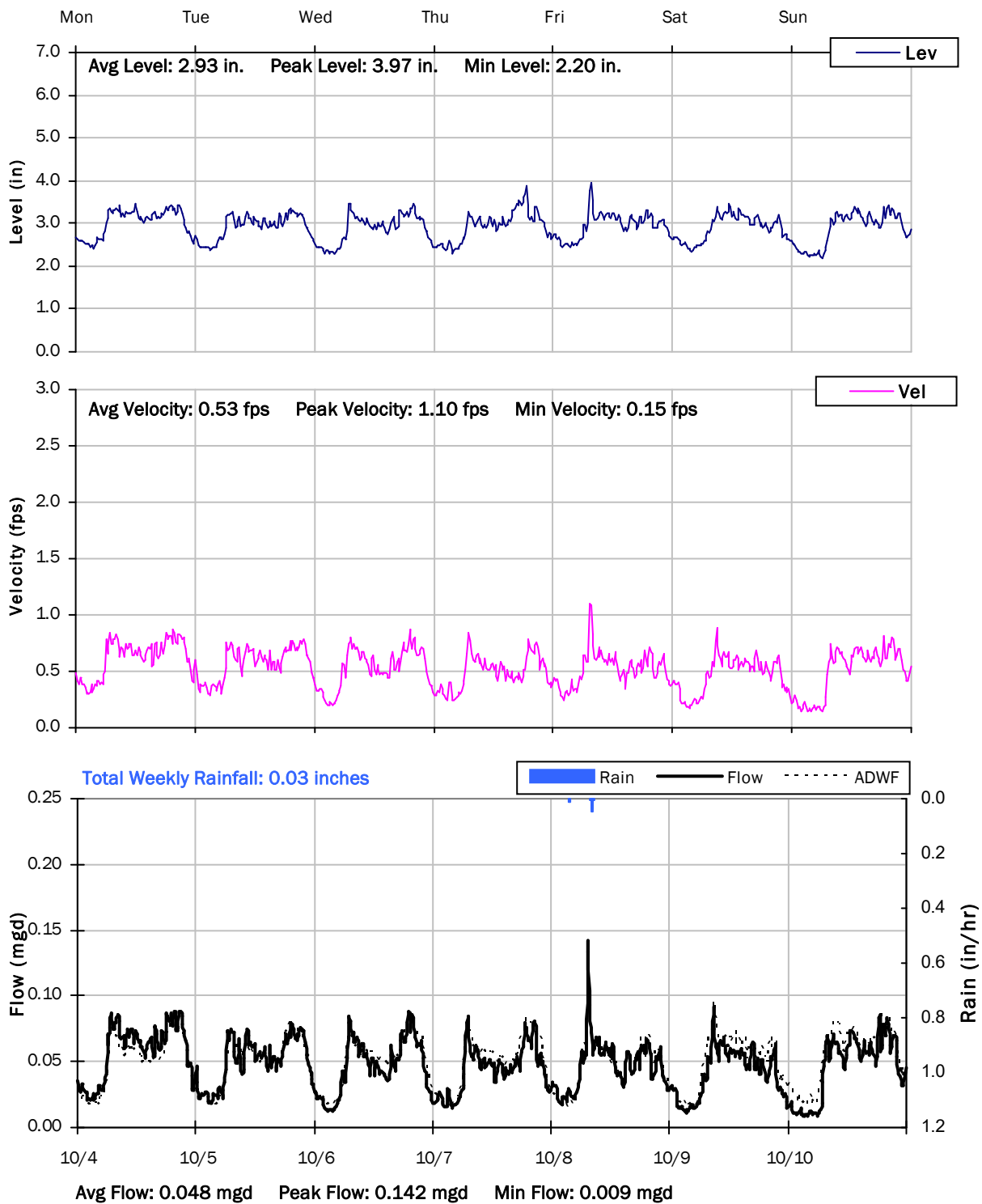
9/27/2021 to 10/4/2021



LOW DENSITY-7

Weekly Level, Velocity and Flow Hydrographs

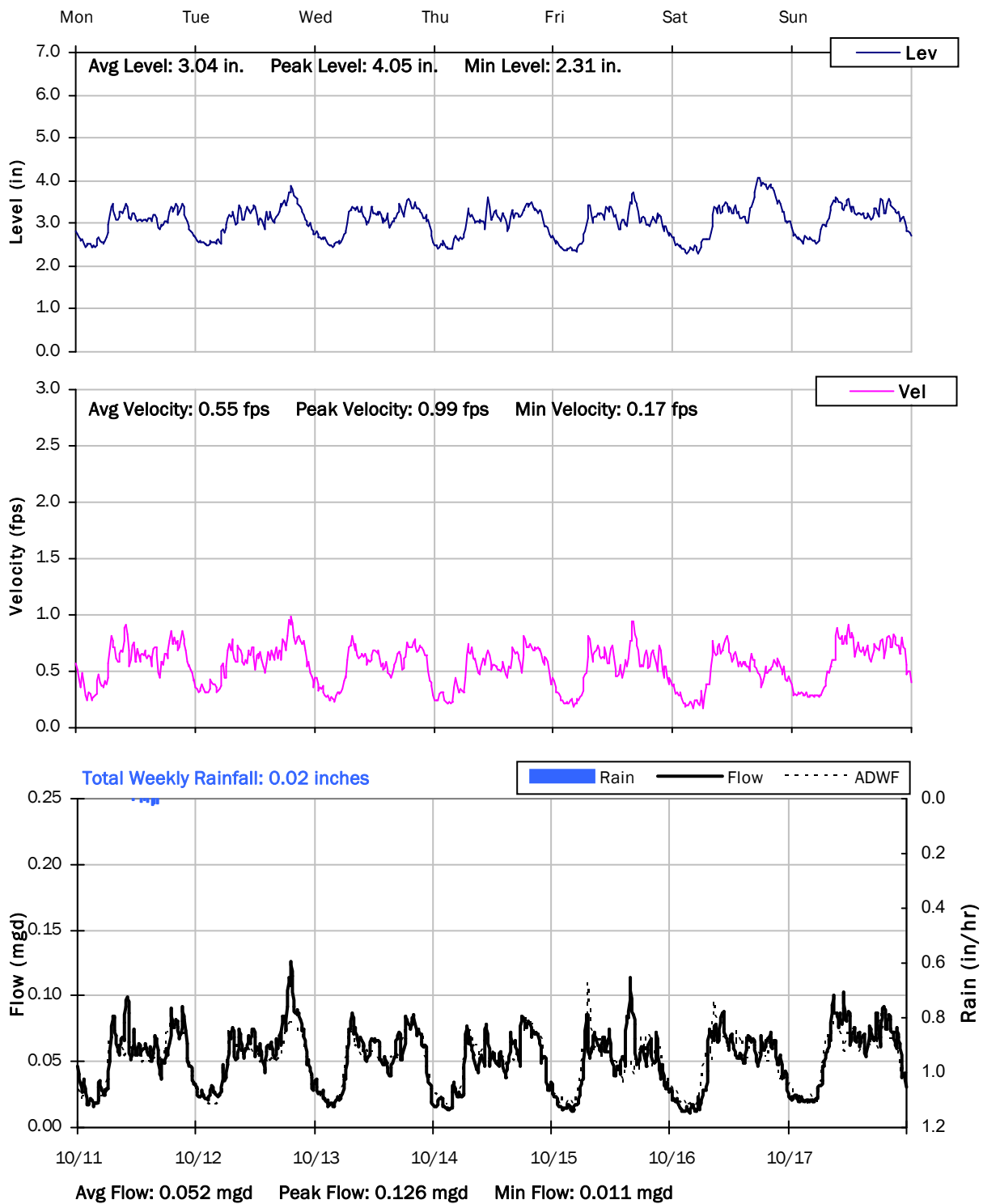
10/4/2021 to 10/11/2021



LOW DENSITY-7

Weekly Level, Velocity and Flow Hydrographs

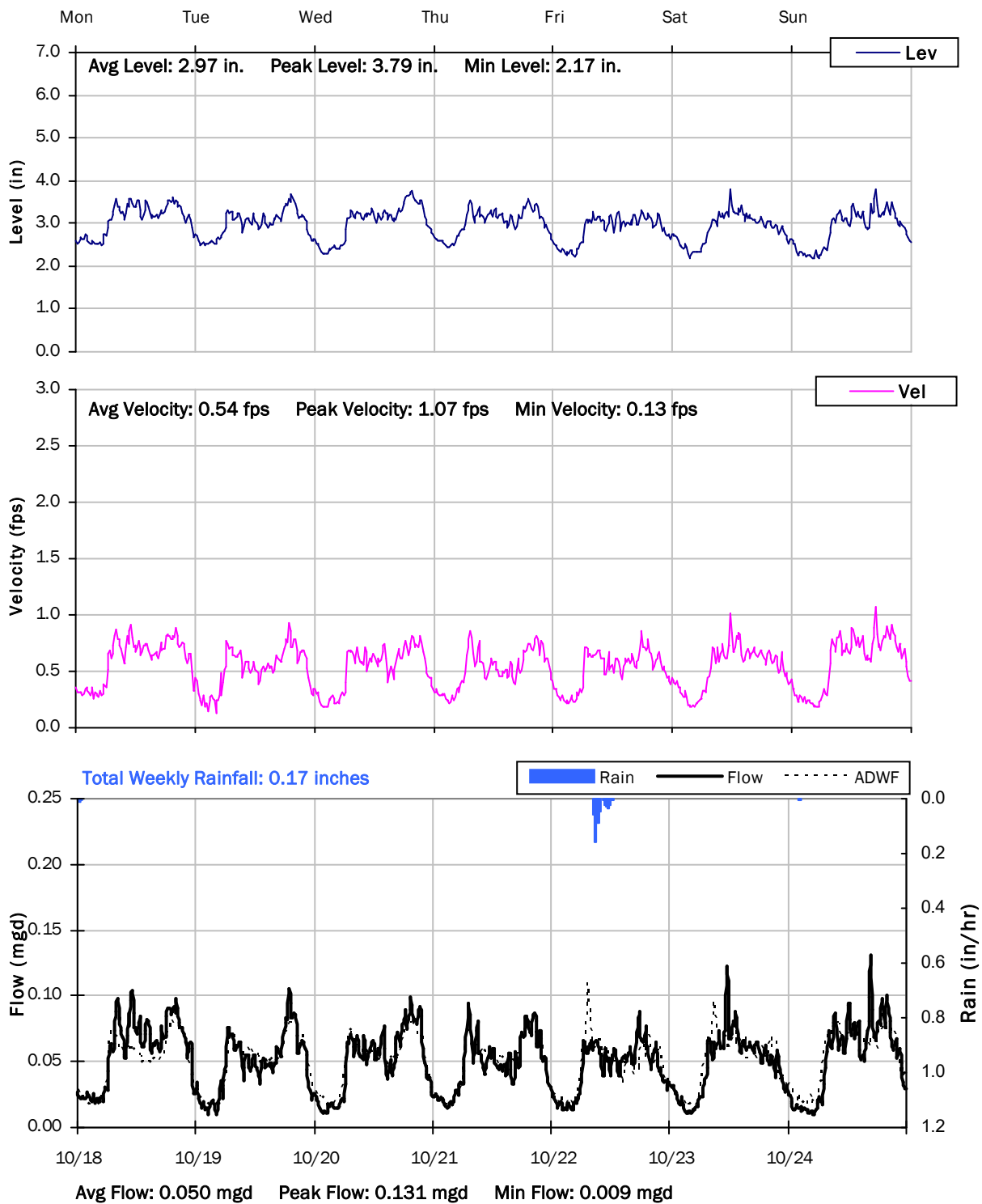
10/11/2021 to 10/18/2021



LOW DENSITY-7

Weekly Level, Velocity and Flow Hydrographs

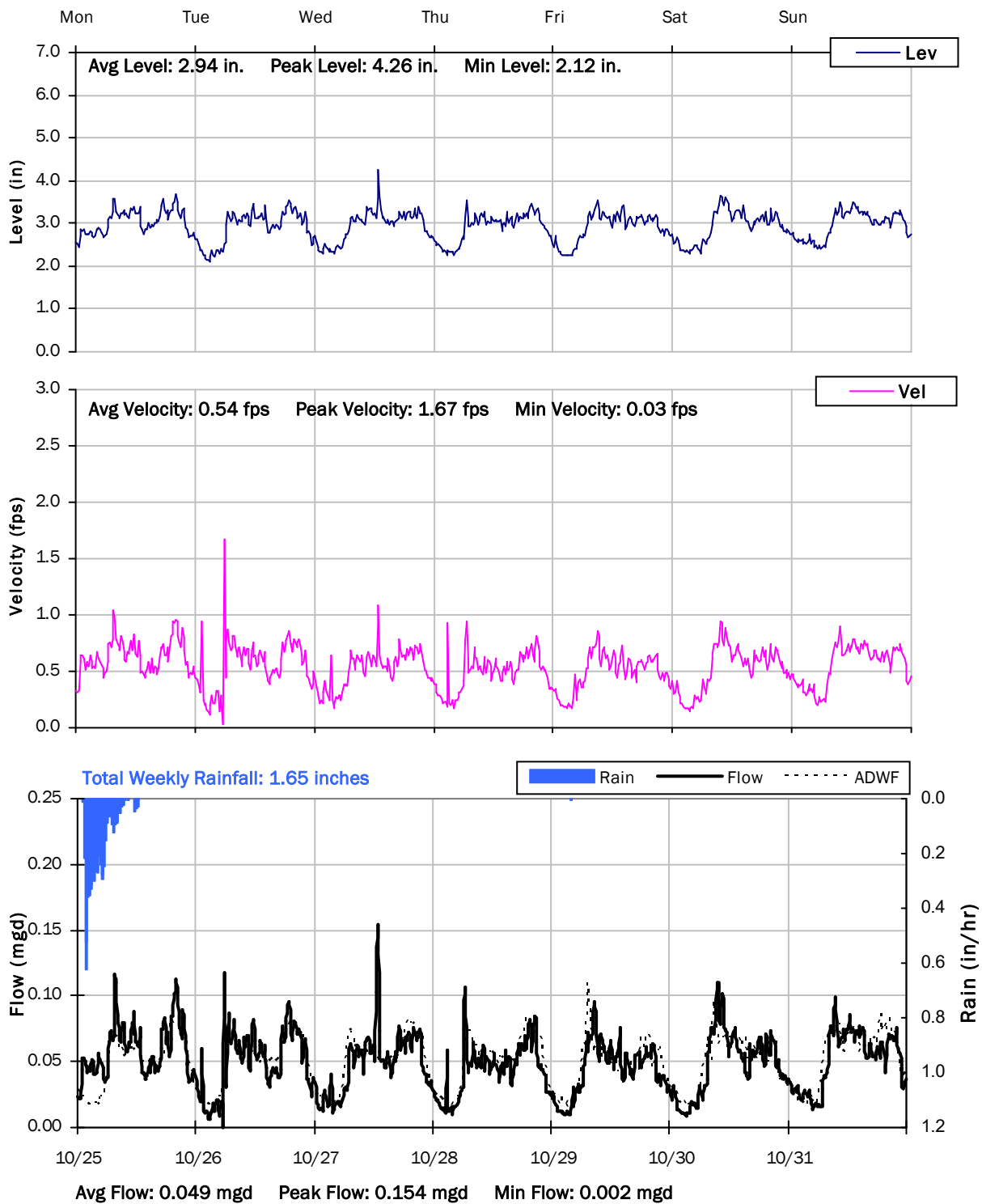
10/18/2021 to 10/25/2021



LOW DENSITY-7

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



LOW DENSITY-8

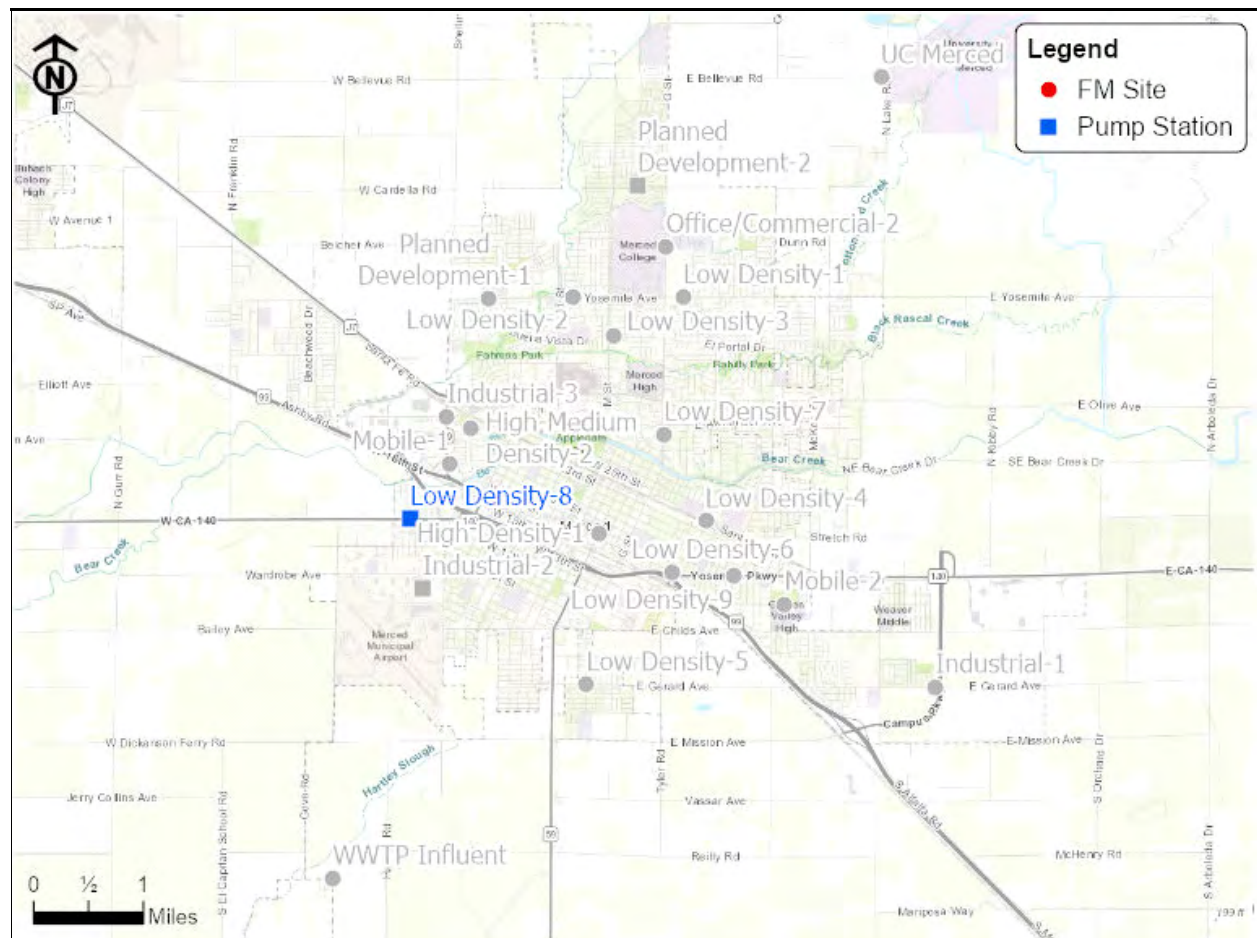
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Pump Station on Central Yosemite Highway west of Sydney Lane

Data Summary Report



Vicinity Map: Low Density-8

LOW DENSITY-8

Site Information

Location: Pump Station on Central
Yosemite Highway west of
Sydney Lane

Coordinates: 120.5112° W, 37.3029° N

Rim Elevation (Earth): 165 feet

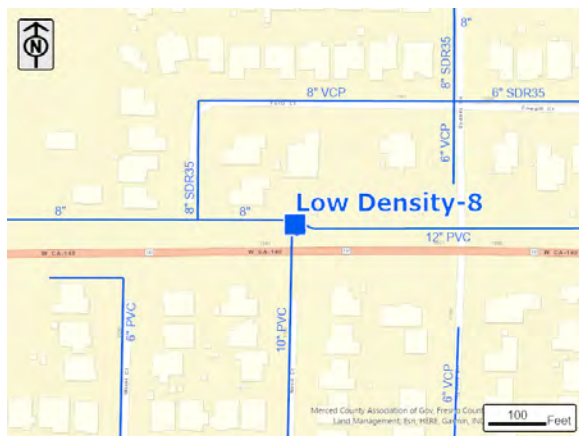
ADWF: 0.117 mgd

Peak Measured Flow: 0.306 mgd

Sediment: None



Satellite Map



Sanitary Map



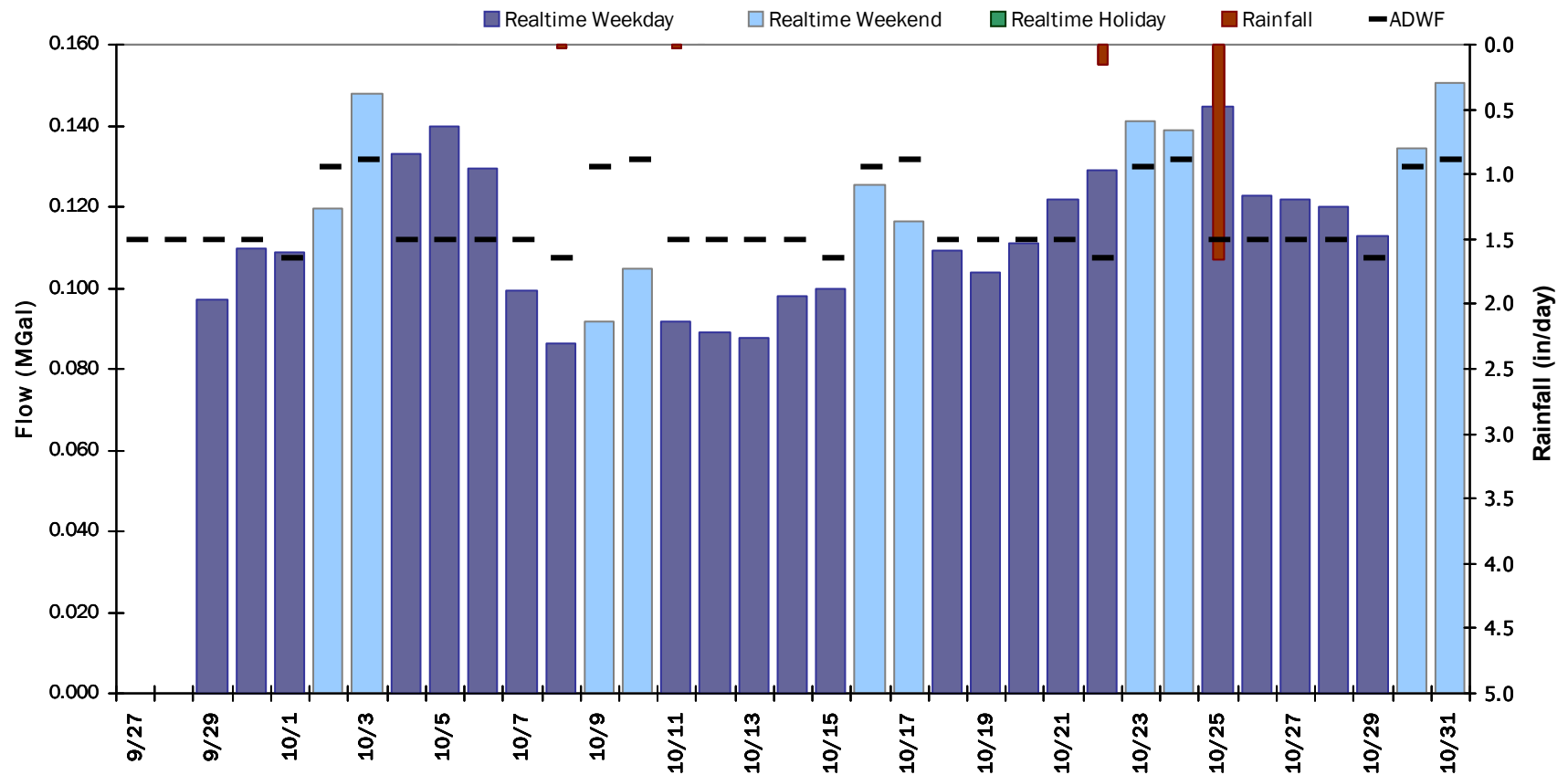
View from Street



Plan View

LOW DENSITY-8

Period Flow Summary: Daily Flow Totals



LOW DENSITY-8

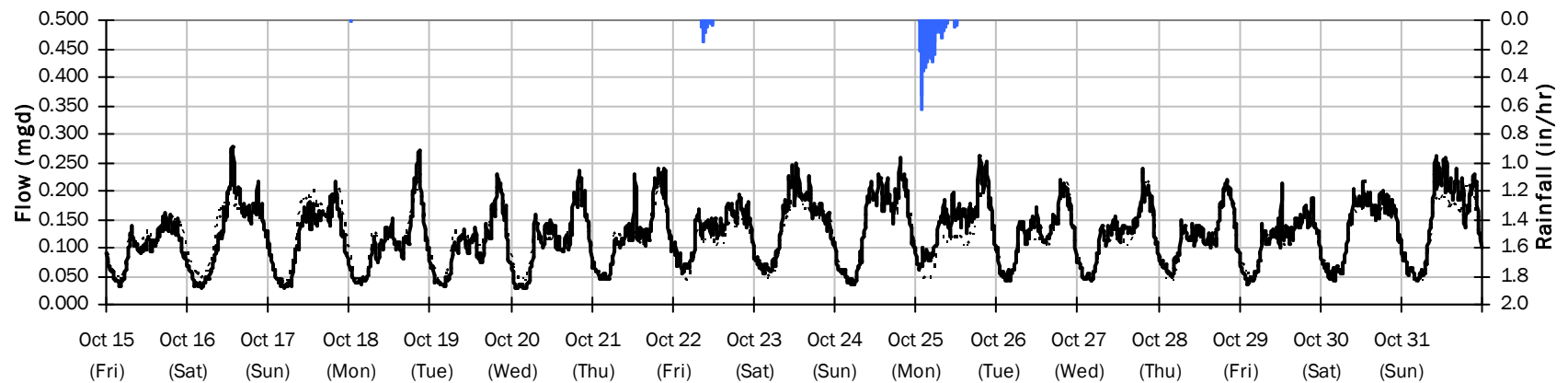
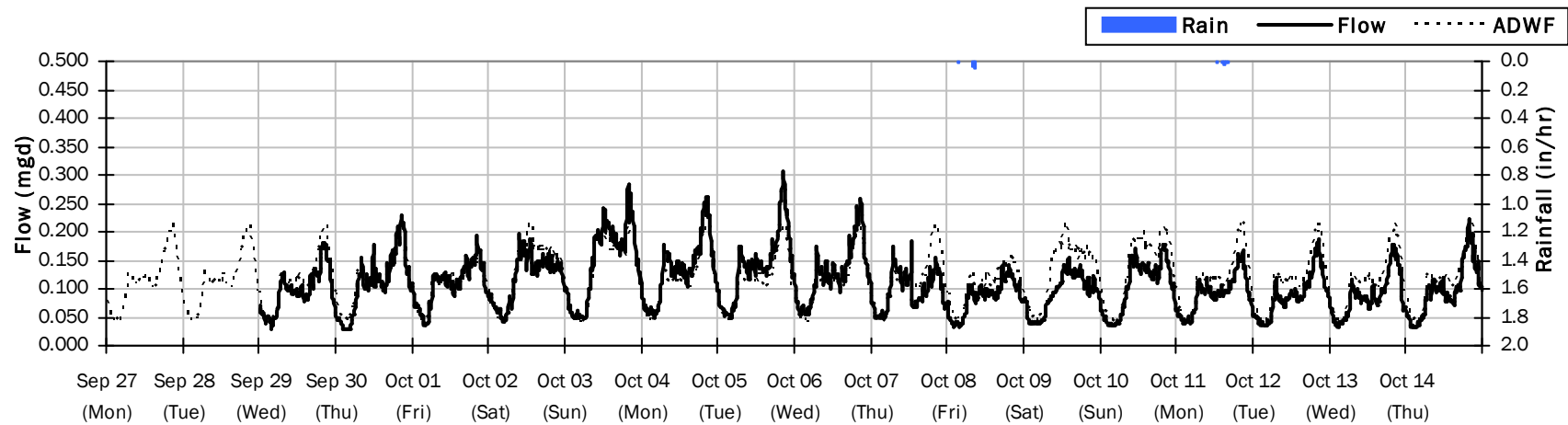
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.116 mgd

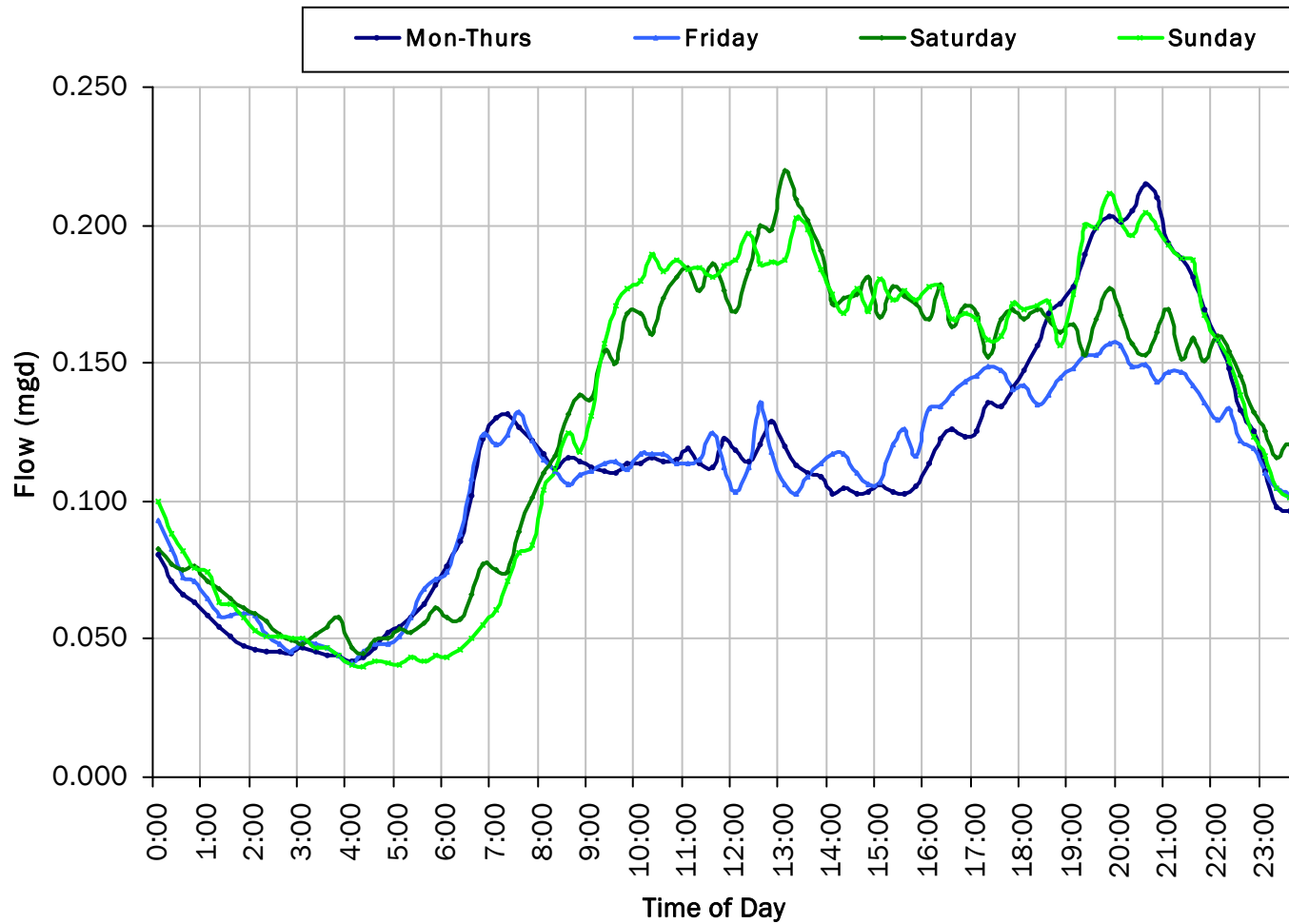
Period Peak Flow: 0.306 mgd

Period Min Flow: 0.028 mgd



LOW DENSITY-8

Average Dry Weather Flow Hydrographs

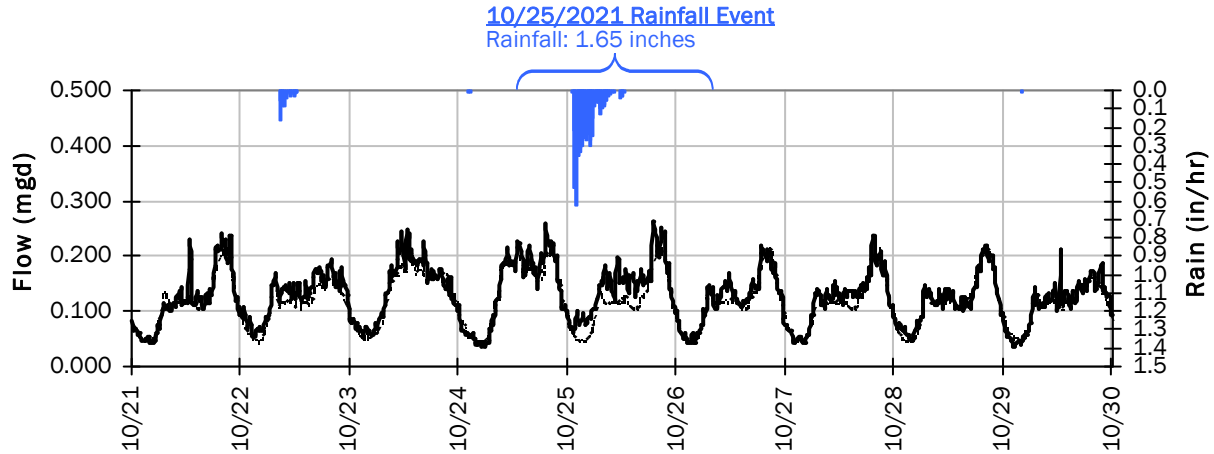


ADWF:
0.117 mgd

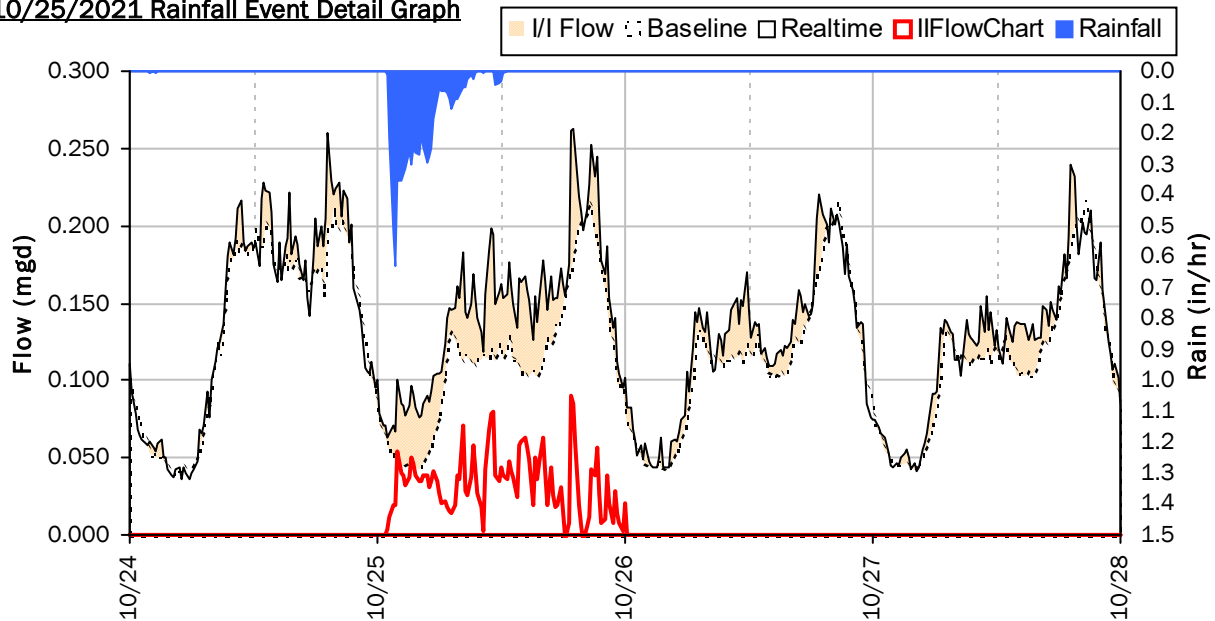
LOW DENSITY-8

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 0.262 mgd
PF: 2.25

Peak Level: in
d/D Ratio:

Inflow / Infiltration

Peak I/I Rate: 0.091 mgd
Total I/I: 33,000 gallons

LOW DENSITY-9

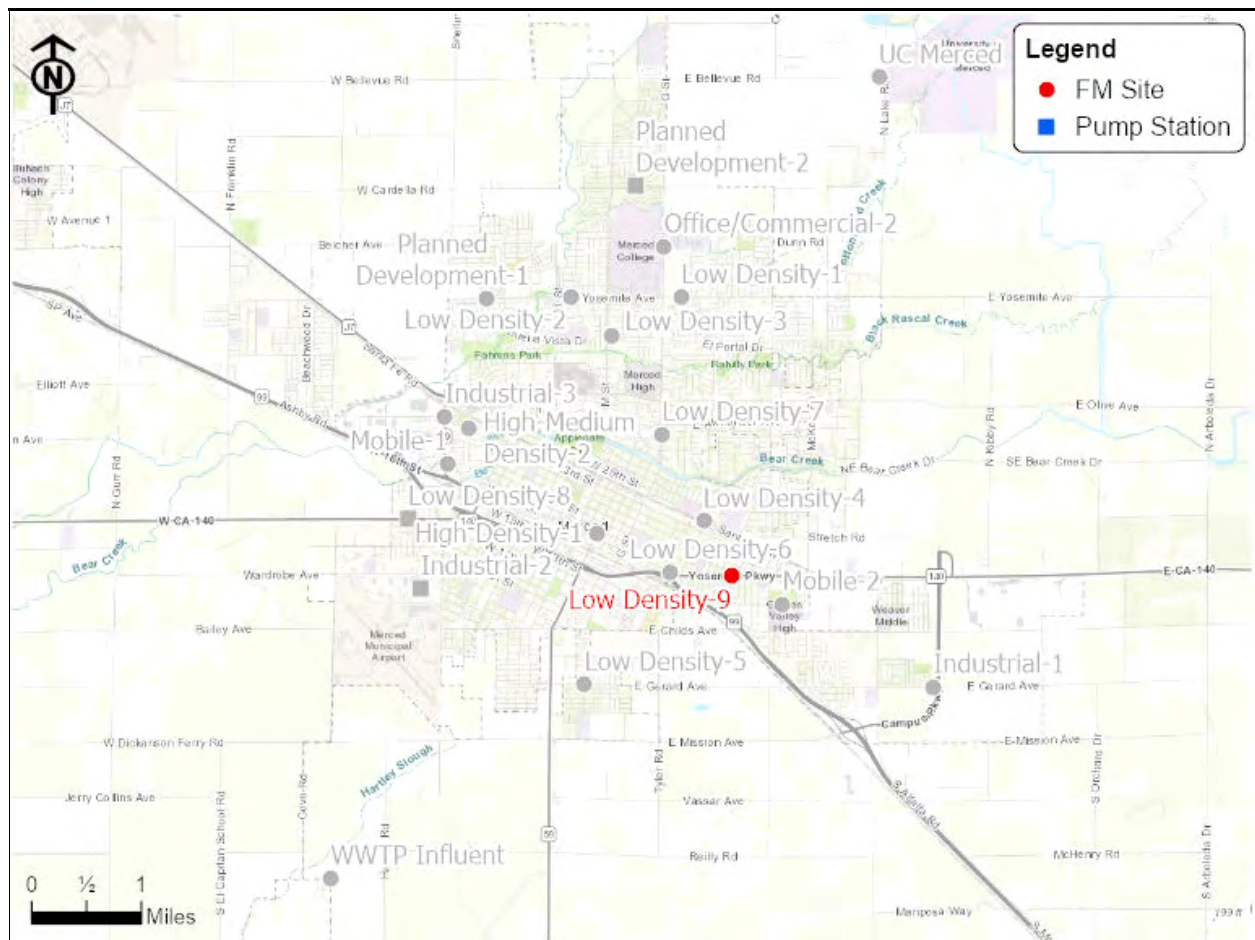
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Central Yosemite Highway at Shirley Street

Data Summary Report



Vicinity Map: Low Density-9

LOW DENSITY-9

Site Information

Location: Central Yosemite Highway at Shirley Street

Coordinates: 120.4578° W, 37.2952° N

Rim Elevation (Earth): 178 feet

Measured Pipe Diameter: 7.75 inches

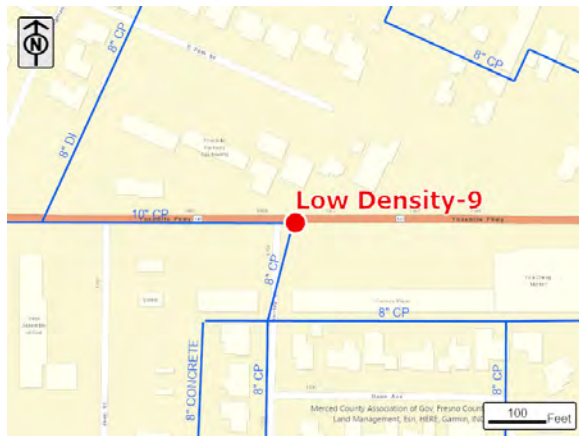
ADWF: 0.020 mgd

Peak Measured Flow: 0.072 mgd

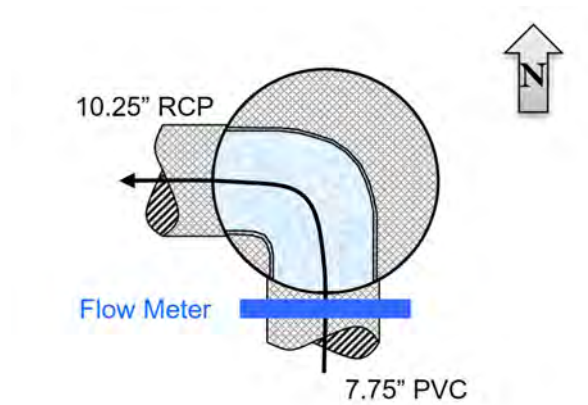
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

LOW DENSITY-9

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

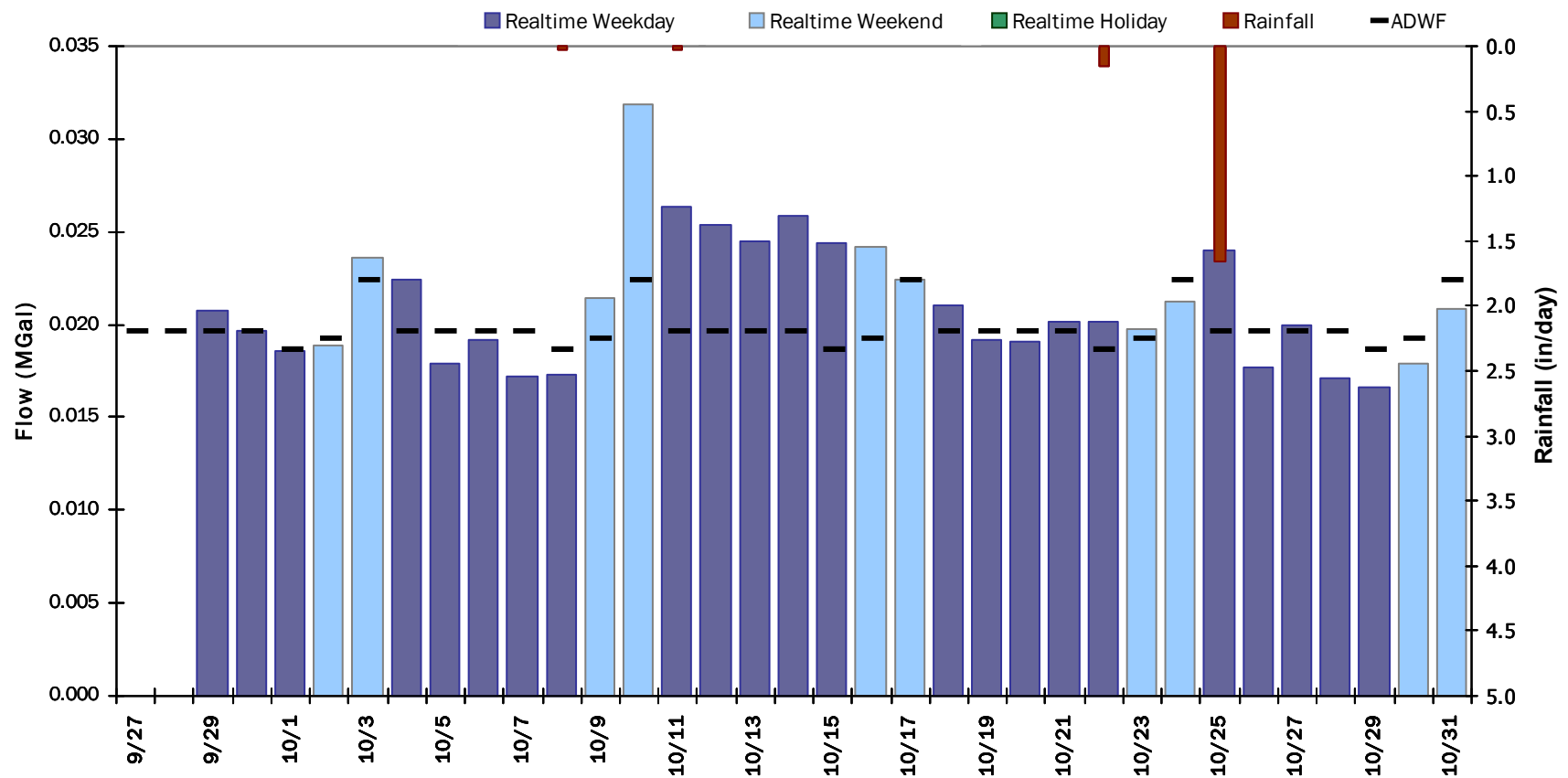


LOW DENSITY-9

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.021 MGal Peak Daily Flow: 0.032 MGal Min Daily Flow: 0.017 MGal

Total Rainfall: 1.87 inches



LOW DENSITY-9

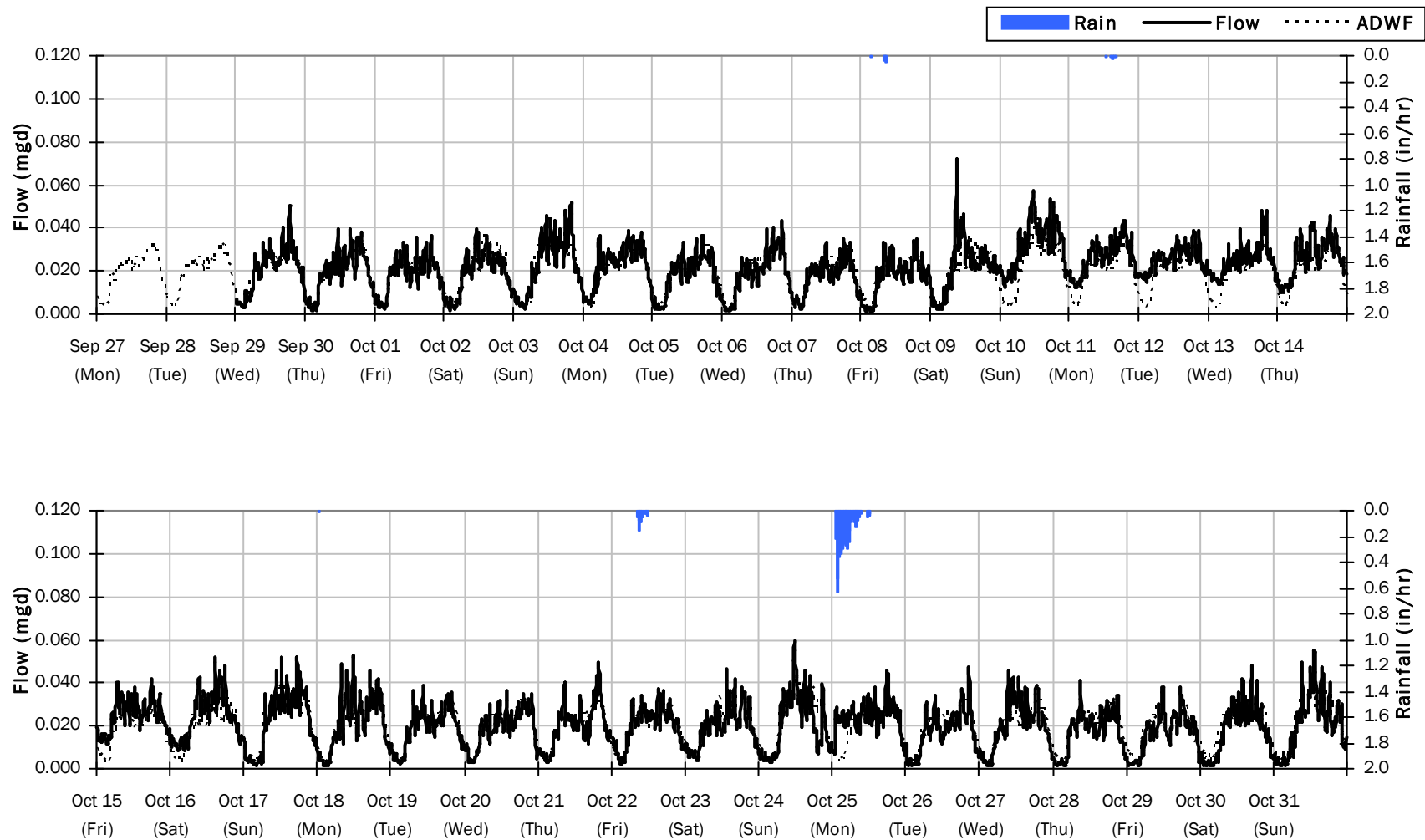
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.021 mgd

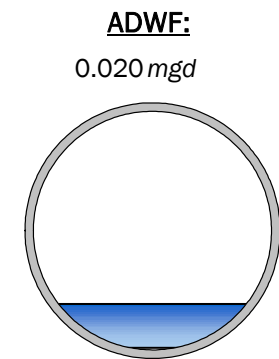
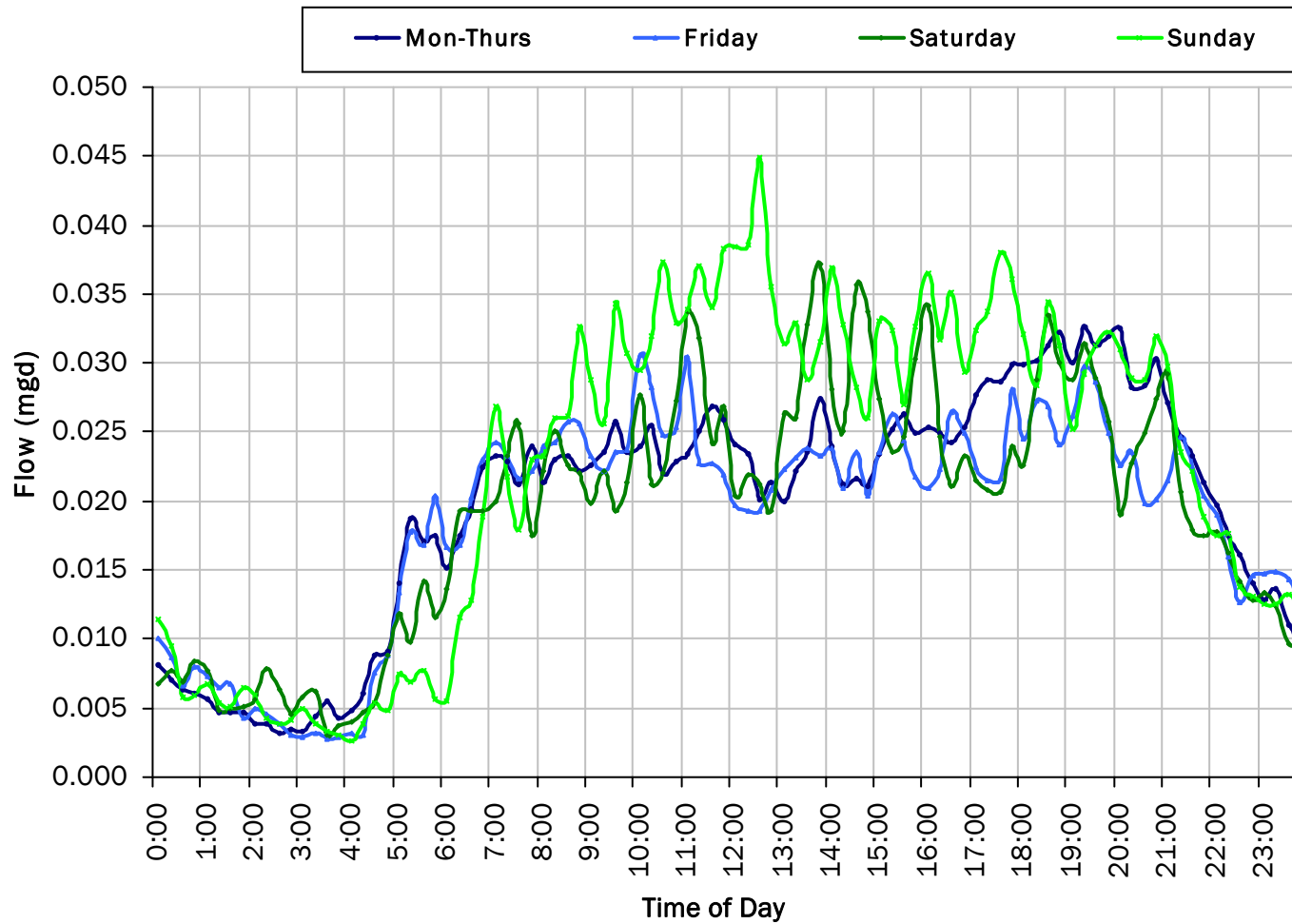
Period Peak Flow: 0.072 mgd

Period Min Flow: 0.001 mgd



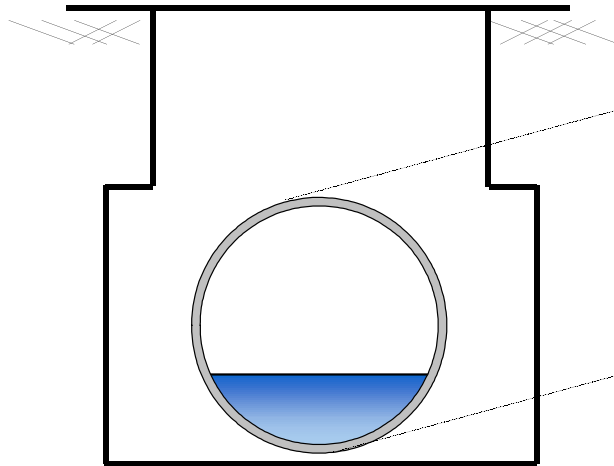
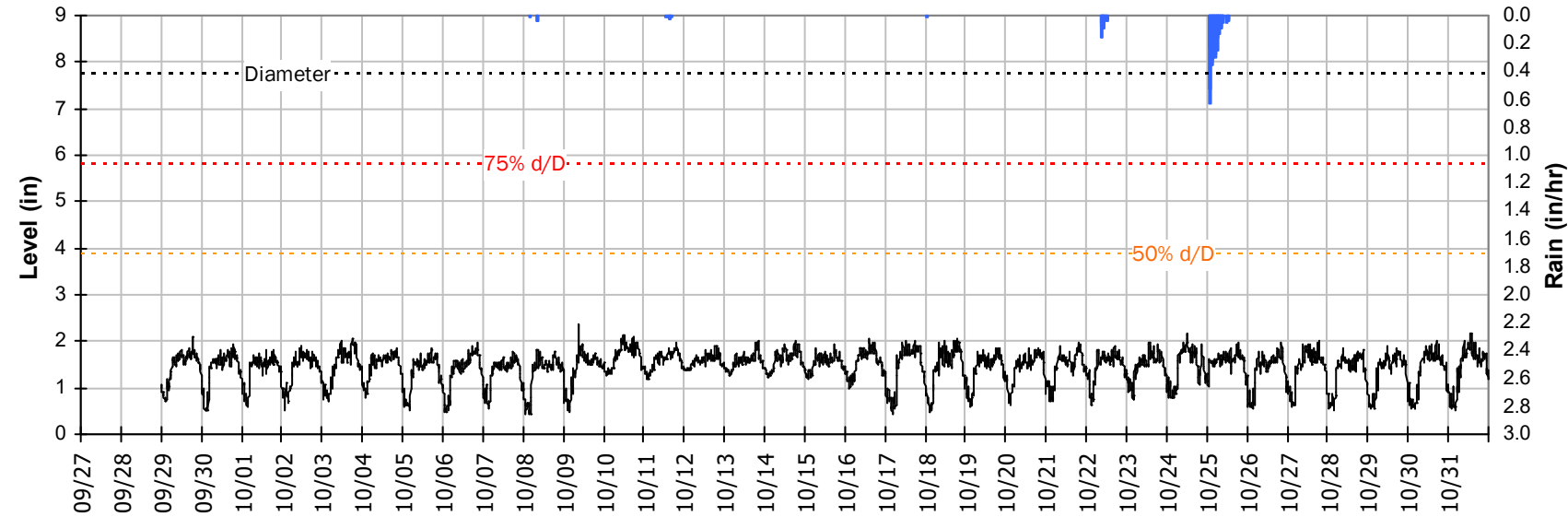
LOW DENSITY-9

Average Dry Weather Flow Hydrographs



LOW DENSITY-9
Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

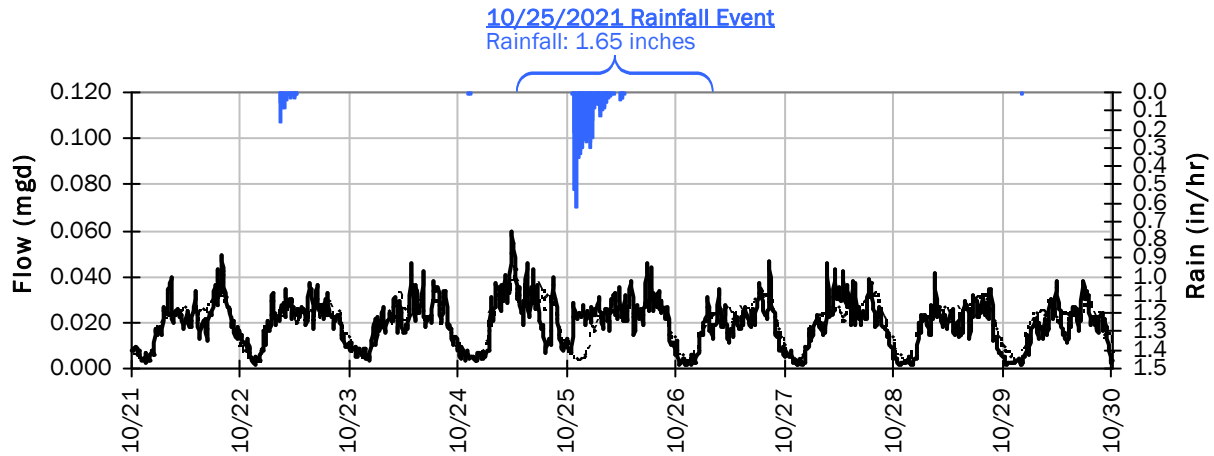


Pipe Diameter: 7.75 inches
Peak Measured Level: 2.31 inches
Peak d/D Ratio: 0.30

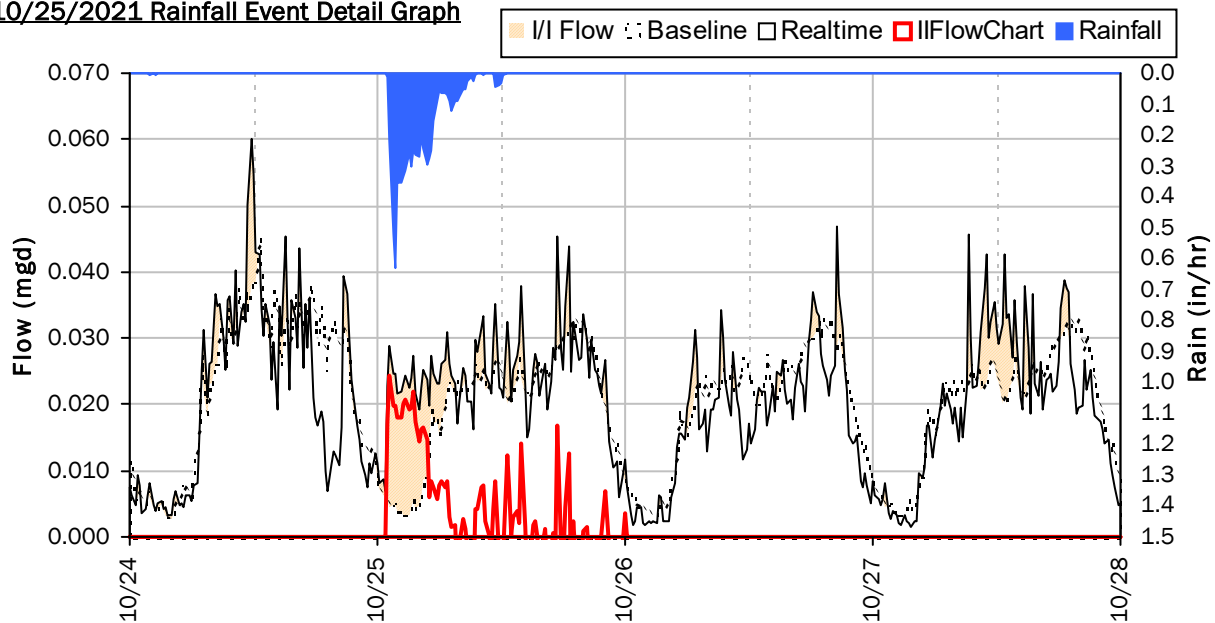
LOW DENSITY-9

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



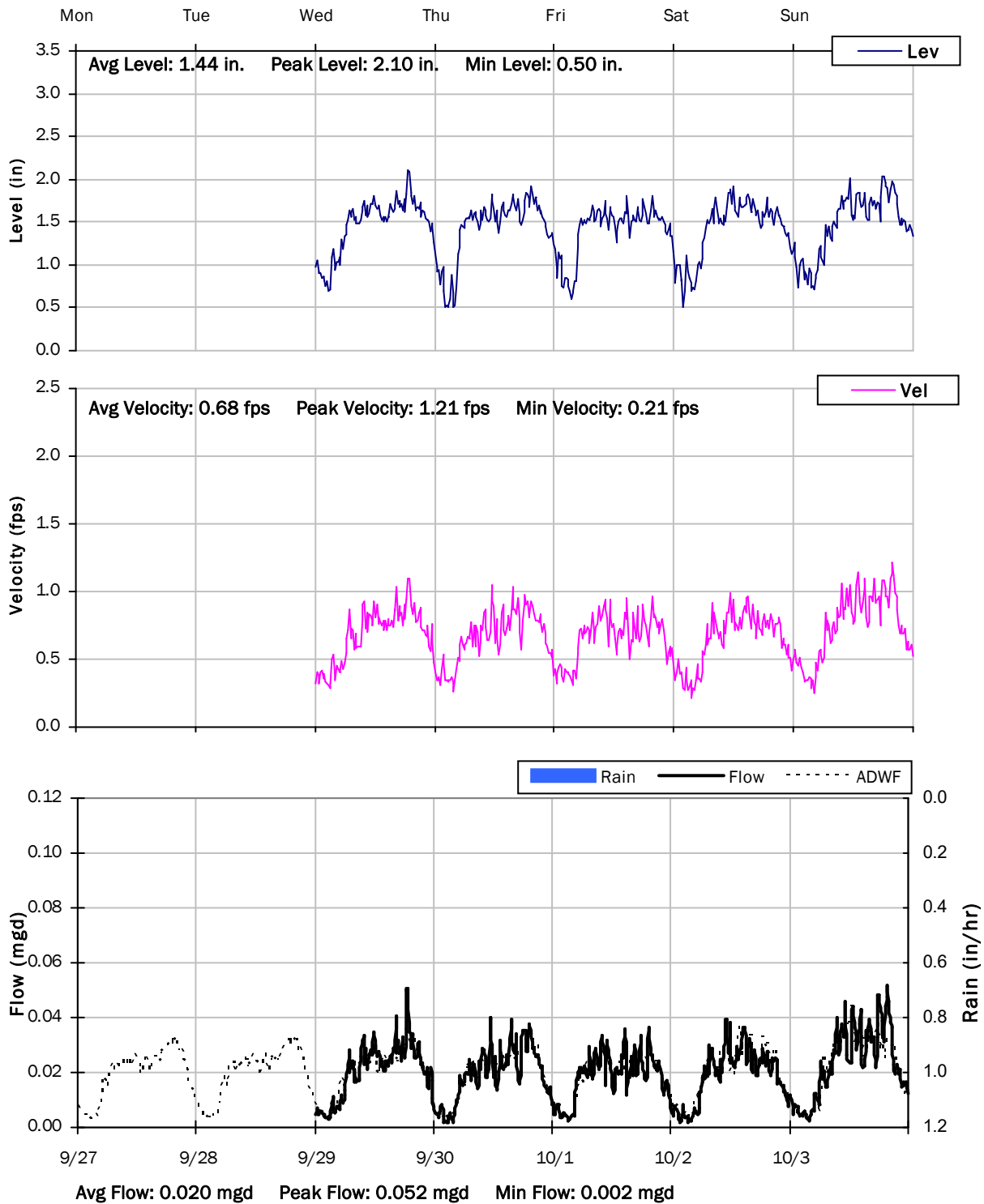
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.046 mgd	Peak I/I Rate:	0.024 mgd
PF:	2.29	Total I/I:	4,000 gallons
Peak Level:	1.98 in		
d/D Ratio:	0.26		

LOW DENSITY-9

Weekly Level, Velocity and Flow Hydrographs

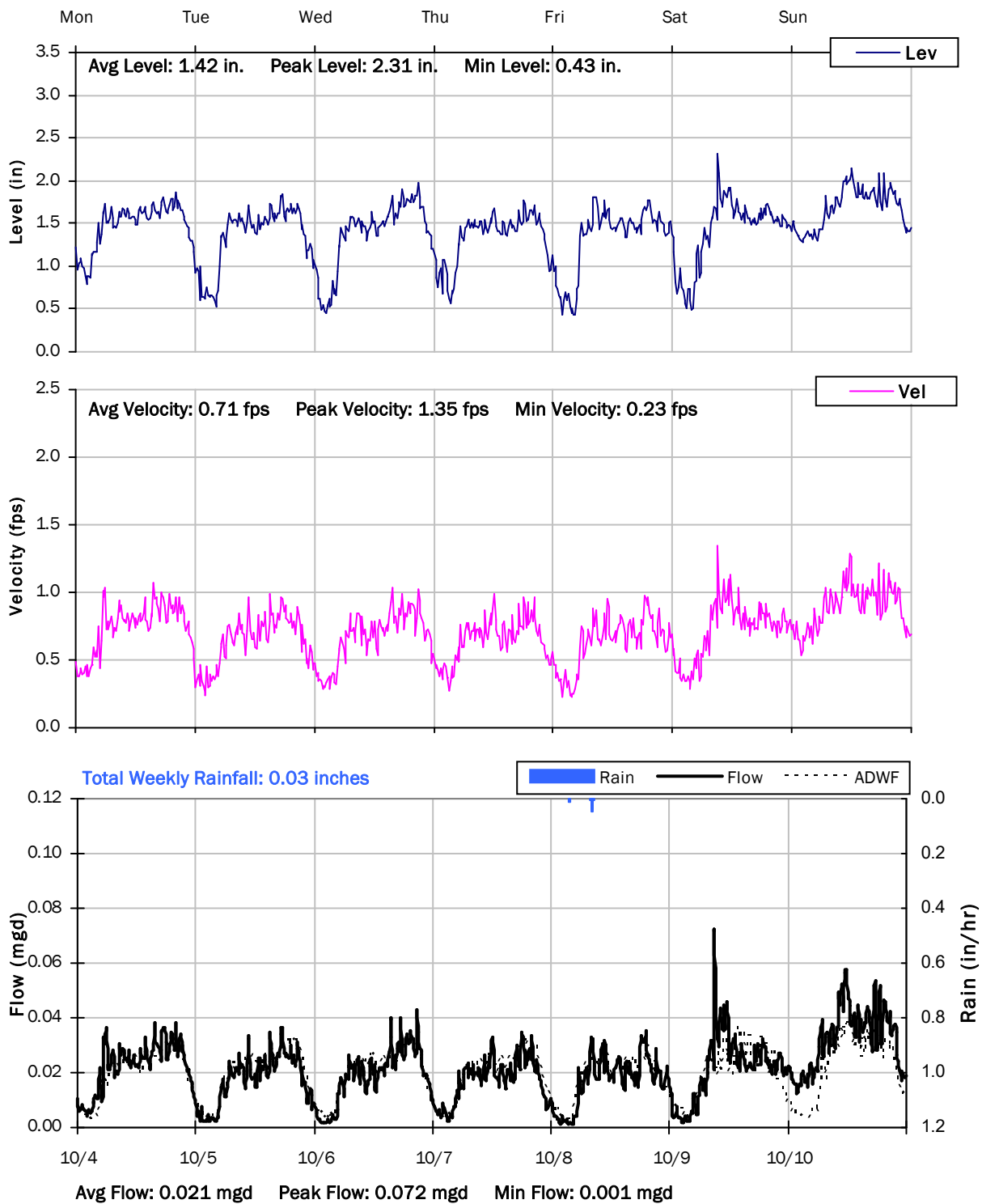
9/27/2021 to 10/4/2021



LOW DENSITY-9

Weekly Level, Velocity and Flow Hydrographs

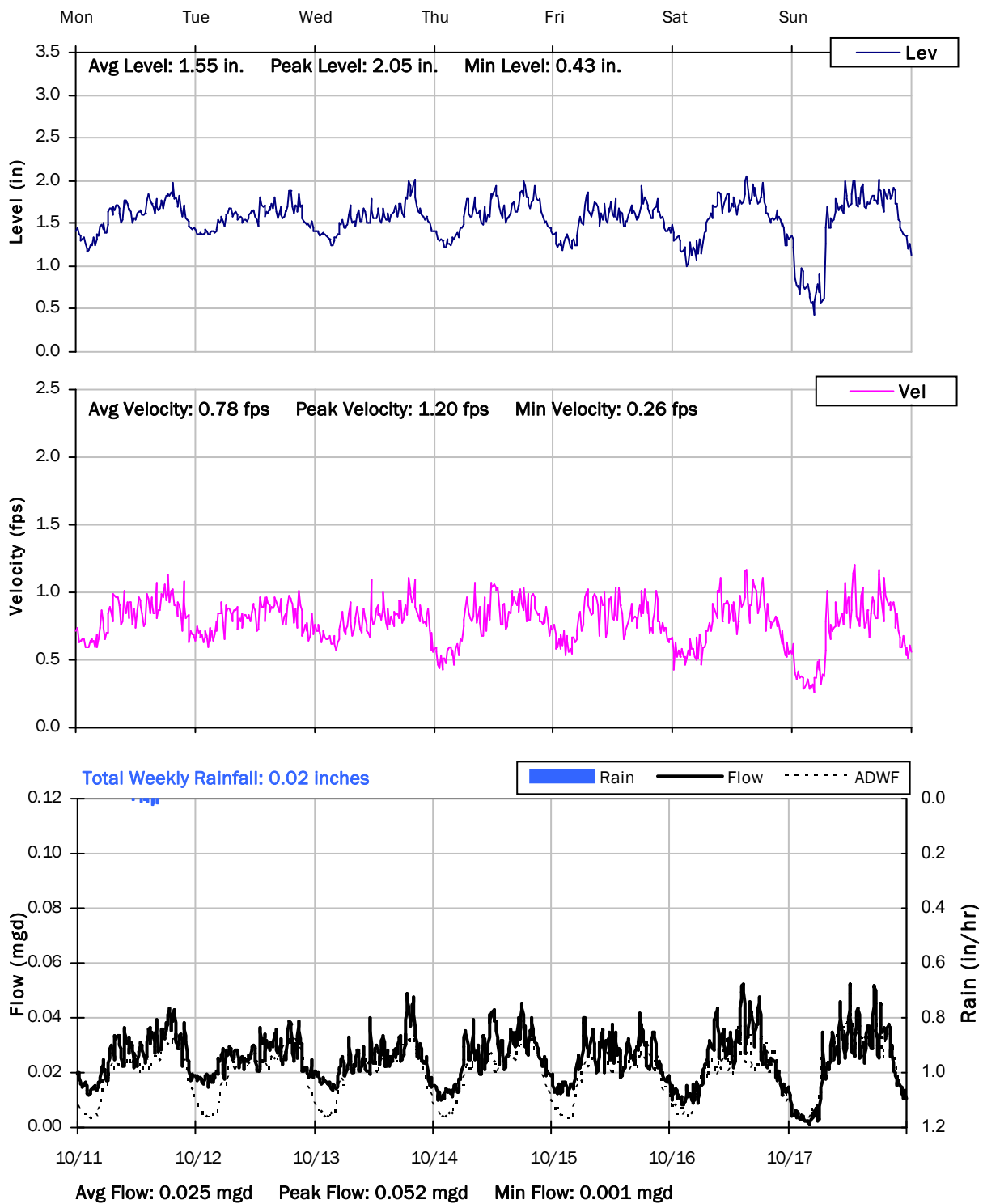
10/4/2021 to 10/11/2021



LOW DENSITY-9

Weekly Level, Velocity and Flow Hydrographs

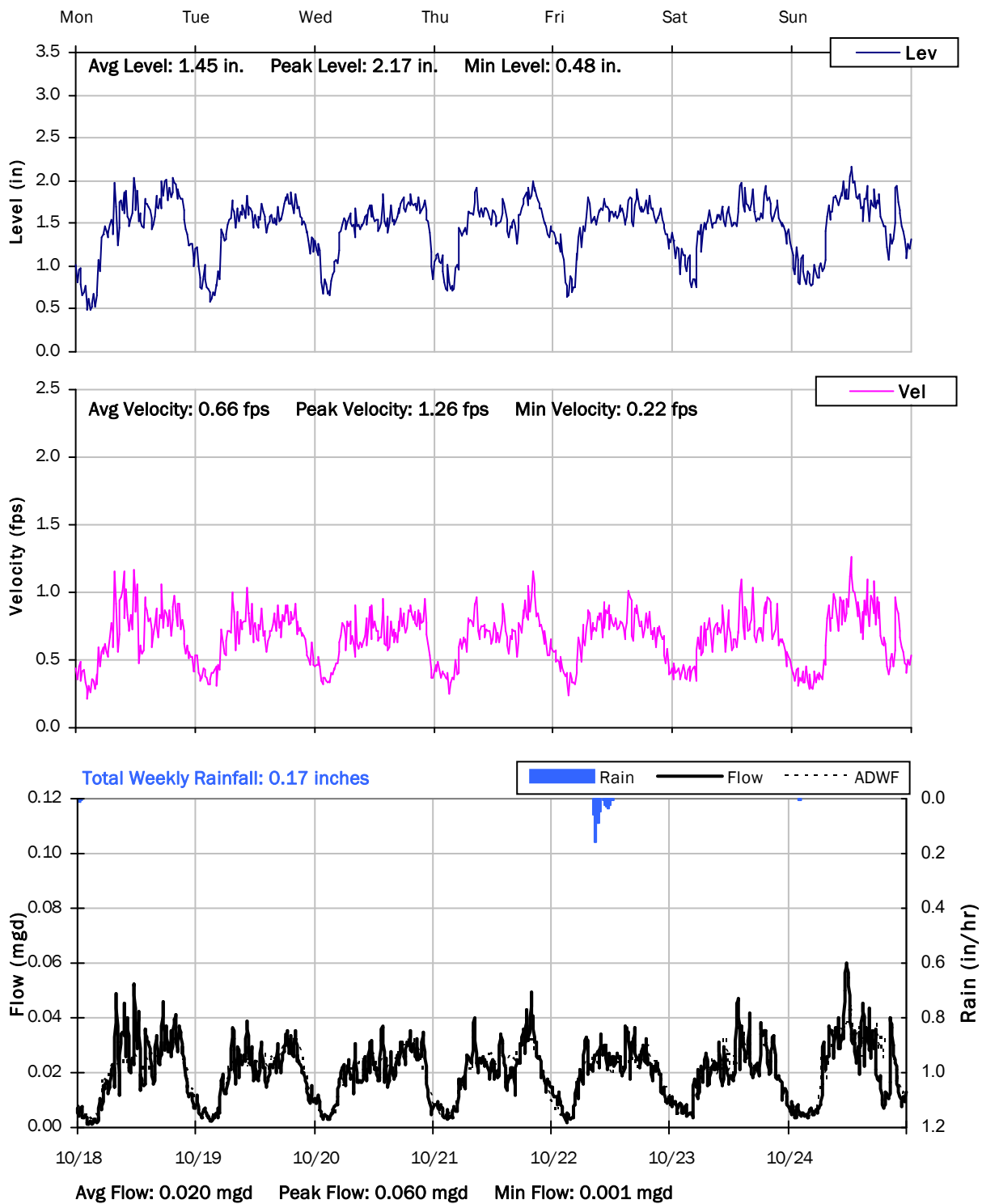
10/11/2021 to 10/18/2021



LOW DENSITY-9

Weekly Level, Velocity and Flow Hydrographs

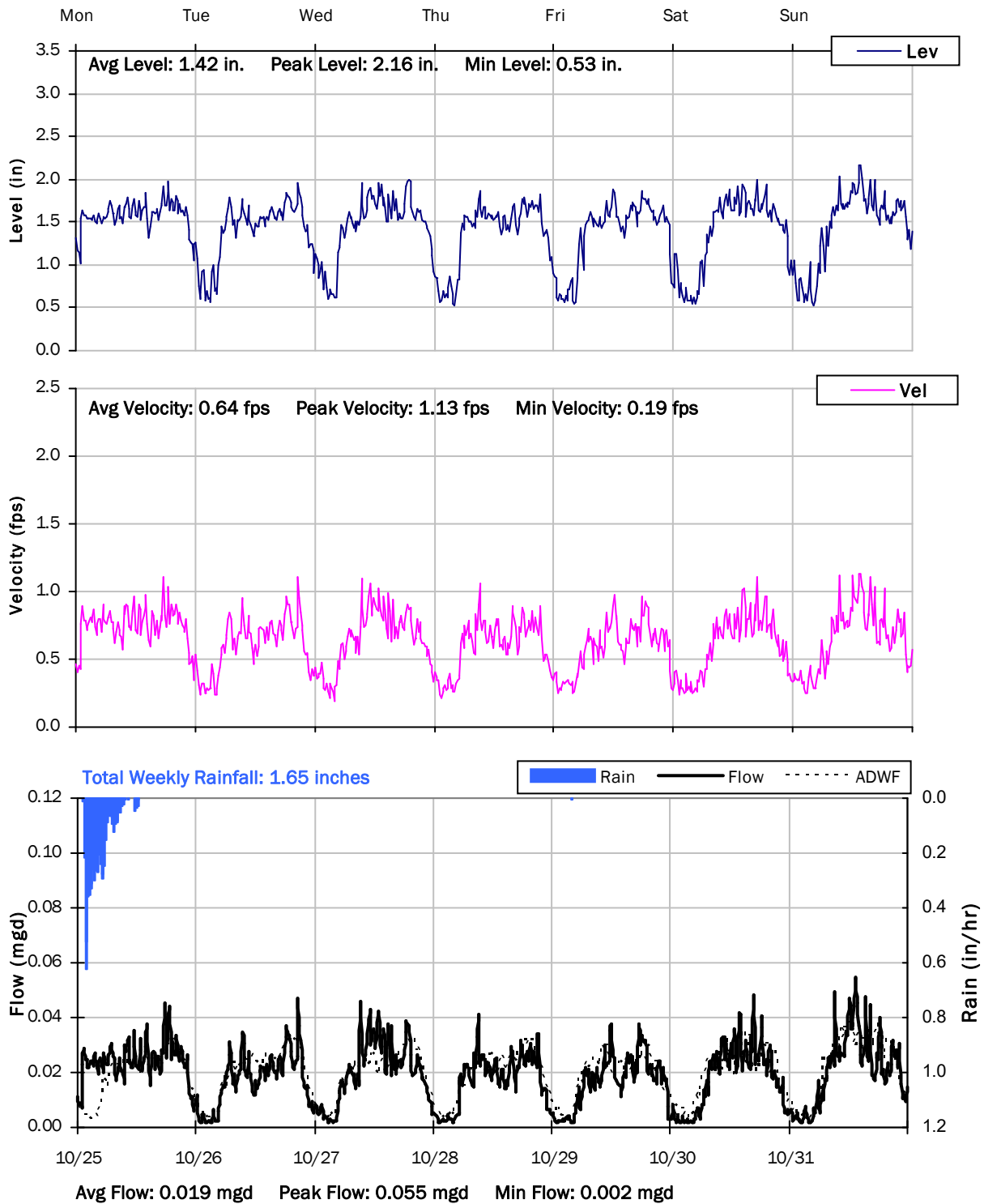
10/18/2021 to 10/25/2021



LOW DENSITY-9

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



HIGH-MEDIUM DENSITY-2

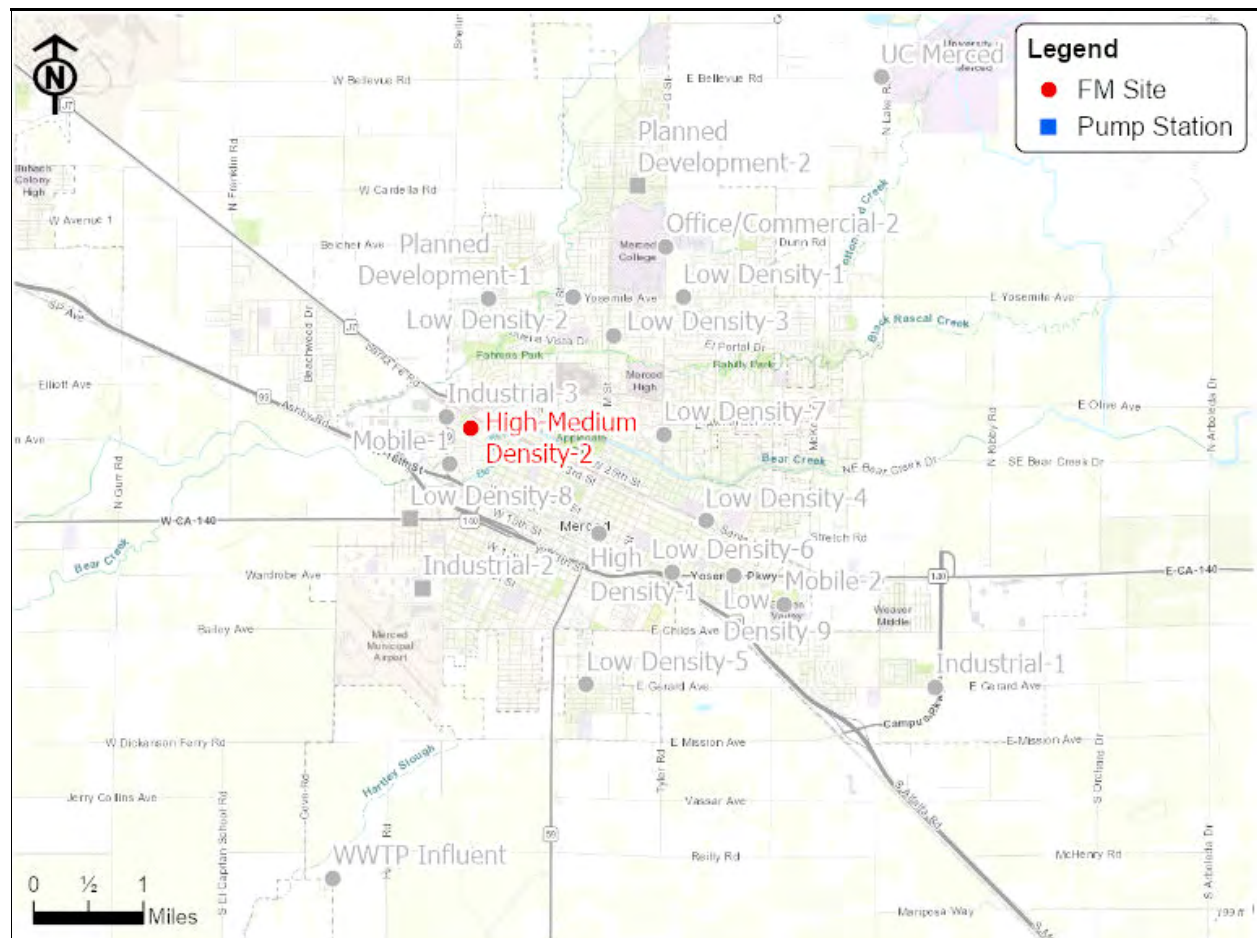
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Willowbrook Drive at Stonybrook Avenue

Data Summary Report



Vicinity Map: High-Medium Density-2

HIGH-MEDIUM DENSITY-2

Site Information

Location: Willowbrook Drive at Stonybrook Avenue

Coordinates: 120.5011° W, 37.3148° N

Rim Elevation (Earth): 172 feet

Measured Pipe Diameter: 10 inches

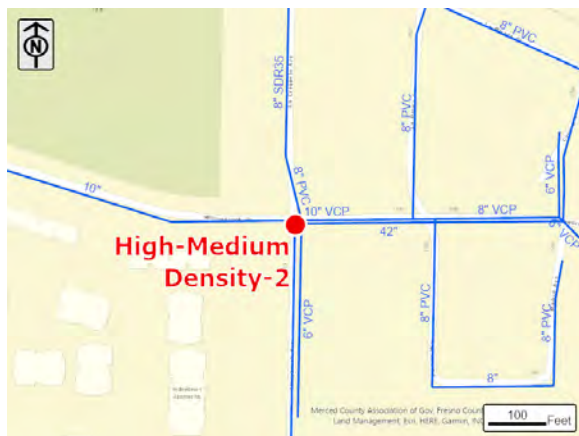
ADWF: 0.057 mgd

Peak Measured Flow: 0.156 mgd

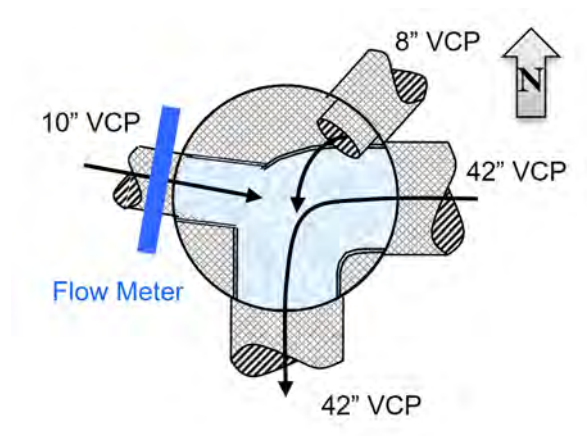
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

HIGH-MEDIUM DENSITY-2

Additional Site Photos

Effluent Pipe



Monitored West Influent Pipe



HIGH-MEDIUM DENSITY-2

Additional Site Photos

Northeast Influent Pipe



East Influent Pipe

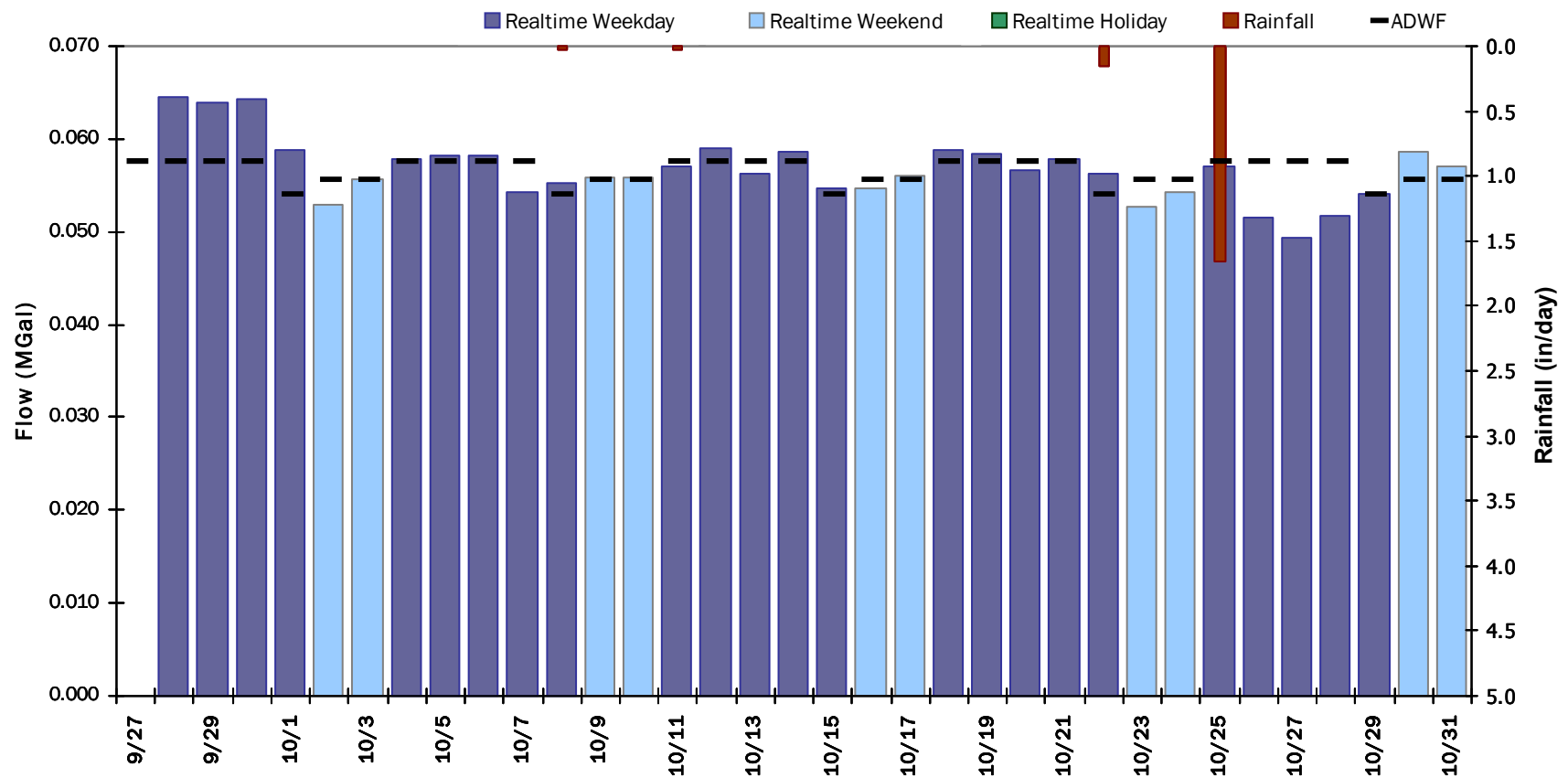


HIGH-MEDIUM DENSITY-2

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.057 MGal Peak Daily Flow: 0.065 MGal Min Daily Flow: 0.049 MGal

Total Rainfall: 1.87 inches



HIGH-MEDIUM DENSITY-2

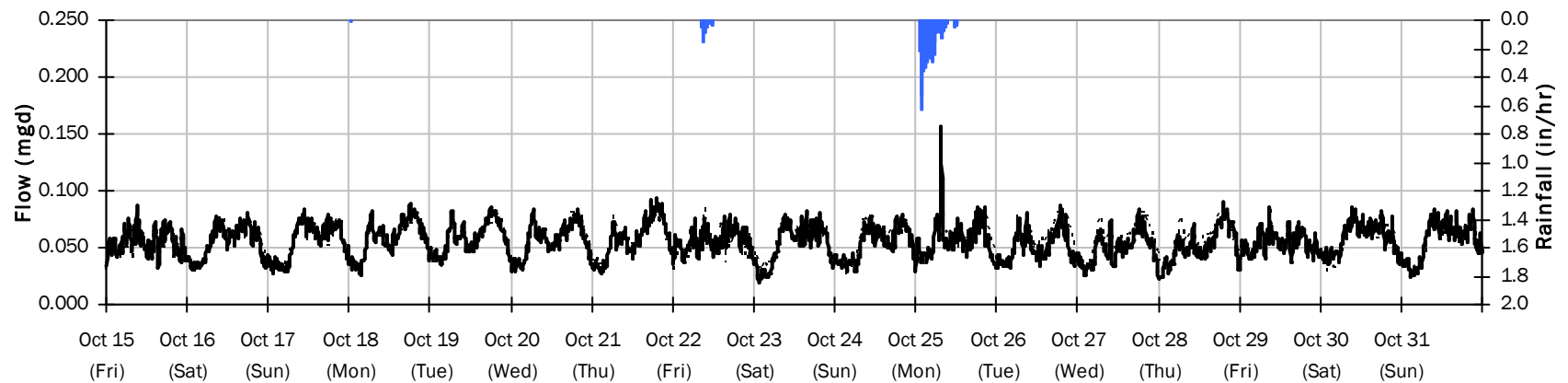
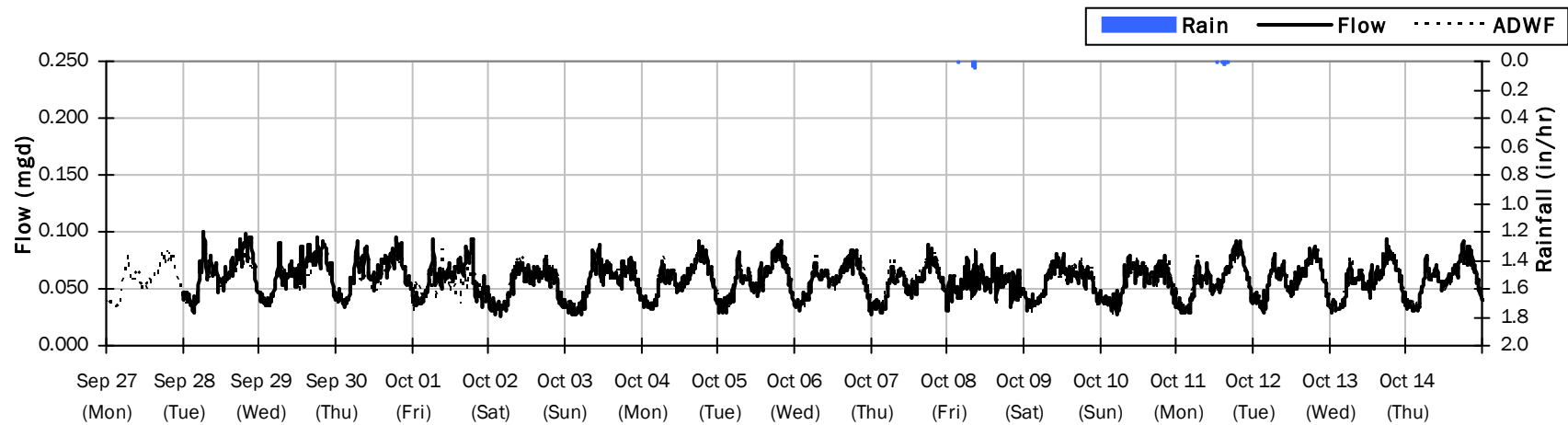
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.057 mgd

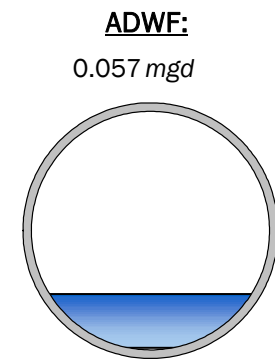
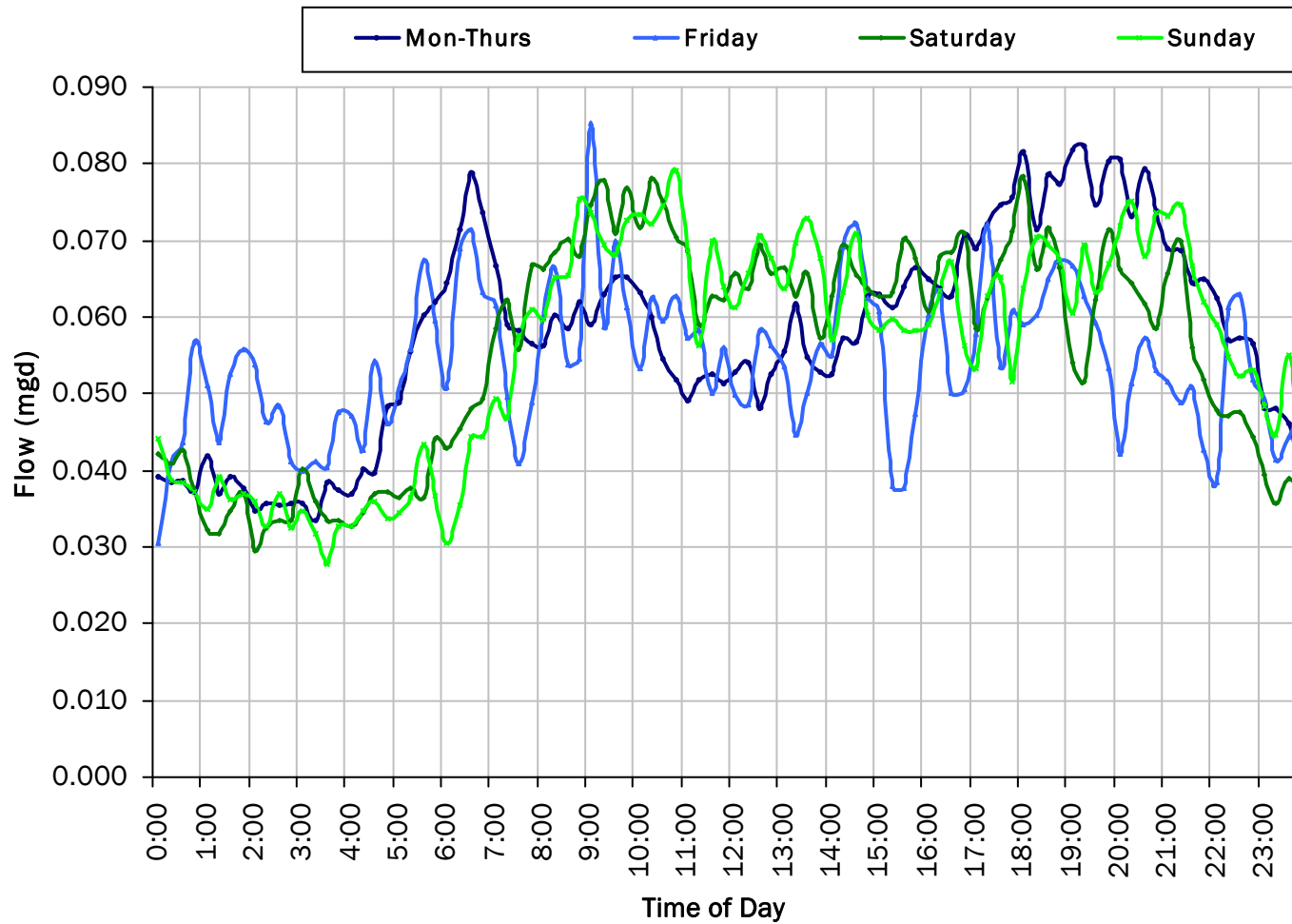
Period Peak Flow: 0.156 mgd

Period Min Flow: 0.020 mgd



HIGH-MEDIUM DENSITY-2

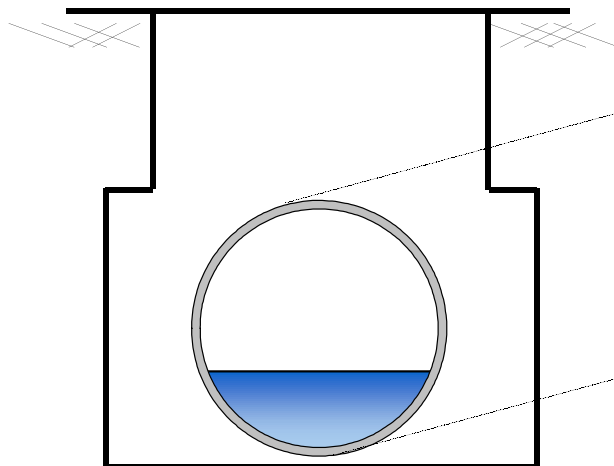
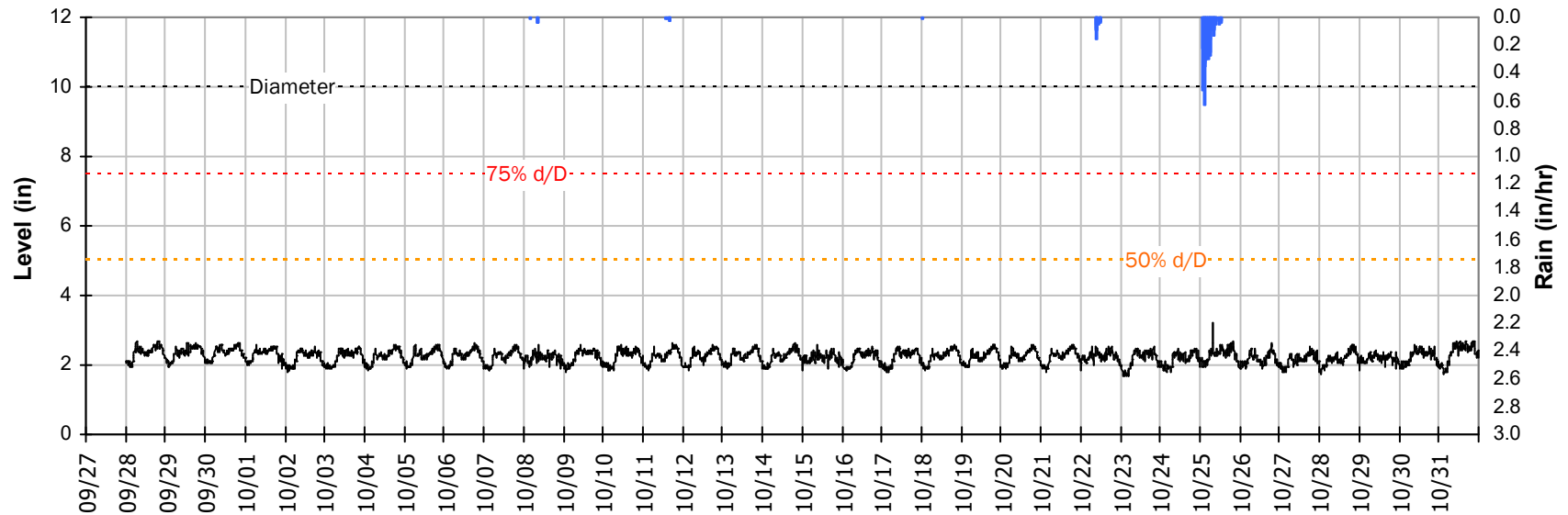
Average Dry Weather Flow Hydrographs



HIGH-MEDIUM DENSITY-2

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

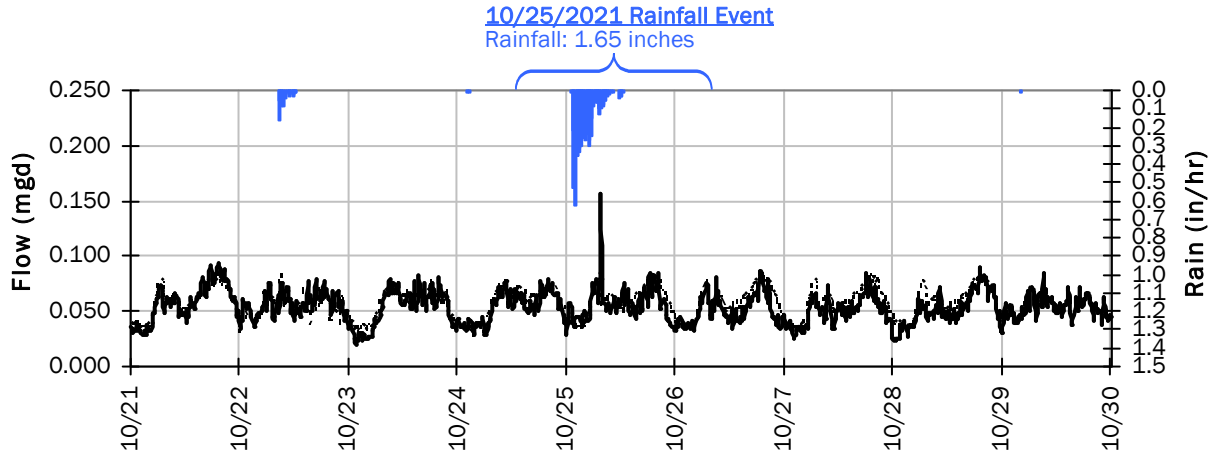


Pipe Diameter: 10 inches
Peak Measured Level: 3.22 inches
Peak d/D Ratio: 0.32

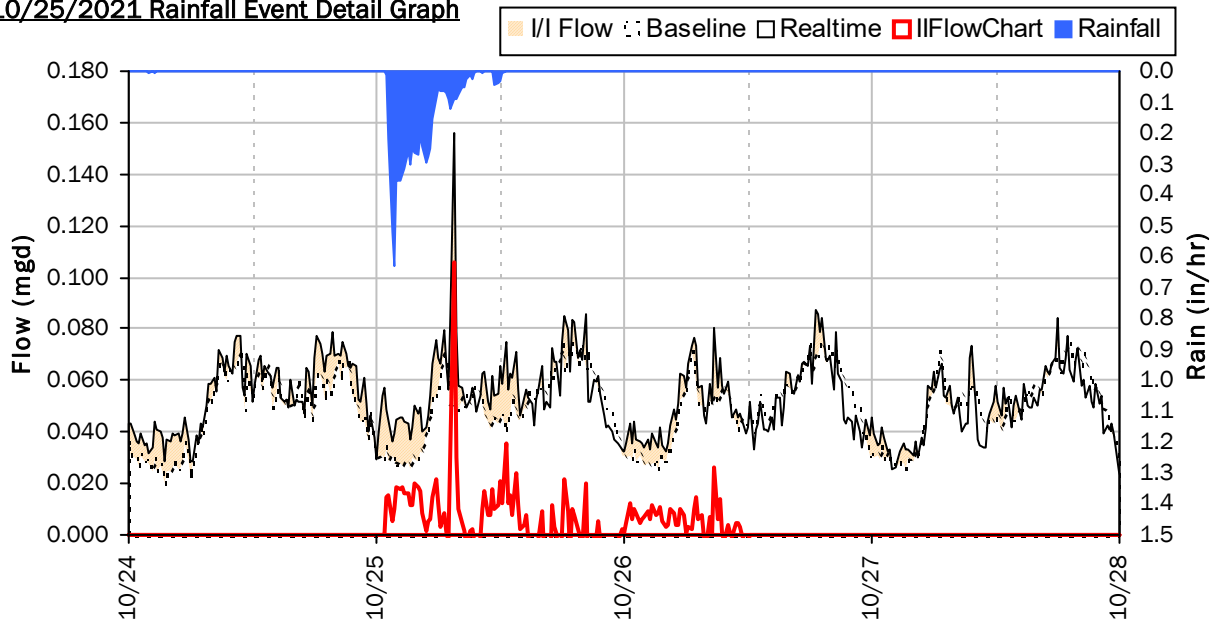
HIGH-MEDIUM DENSITY-2

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



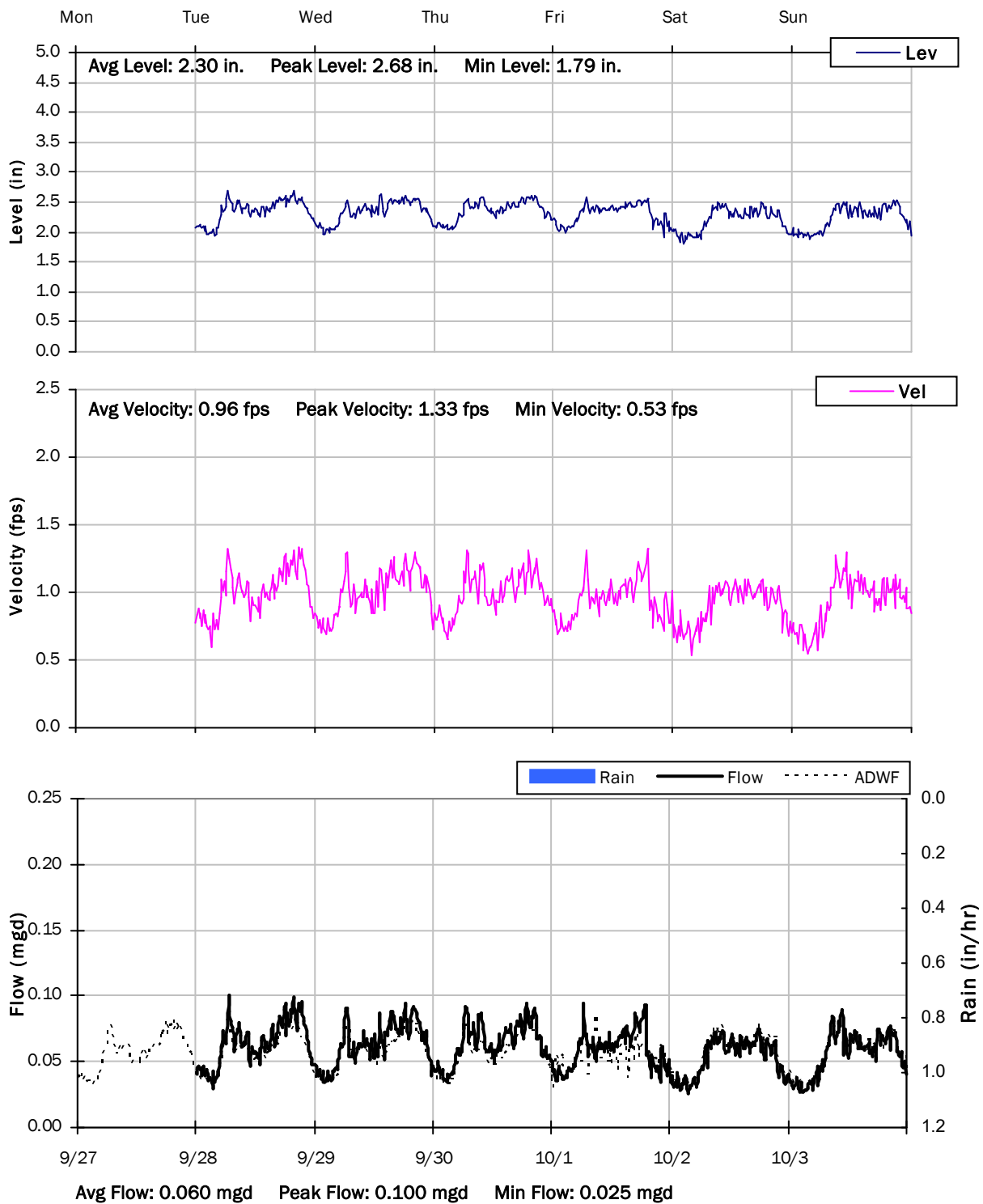
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.156 mgd	Peak I/I Rate:	0.106 mgd
PF:	2.76	Total I/I:	10,000 gallons
Peak Level:	3.22 in		
d/D Ratio:	0.32		

HIGH-MEDIUM DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

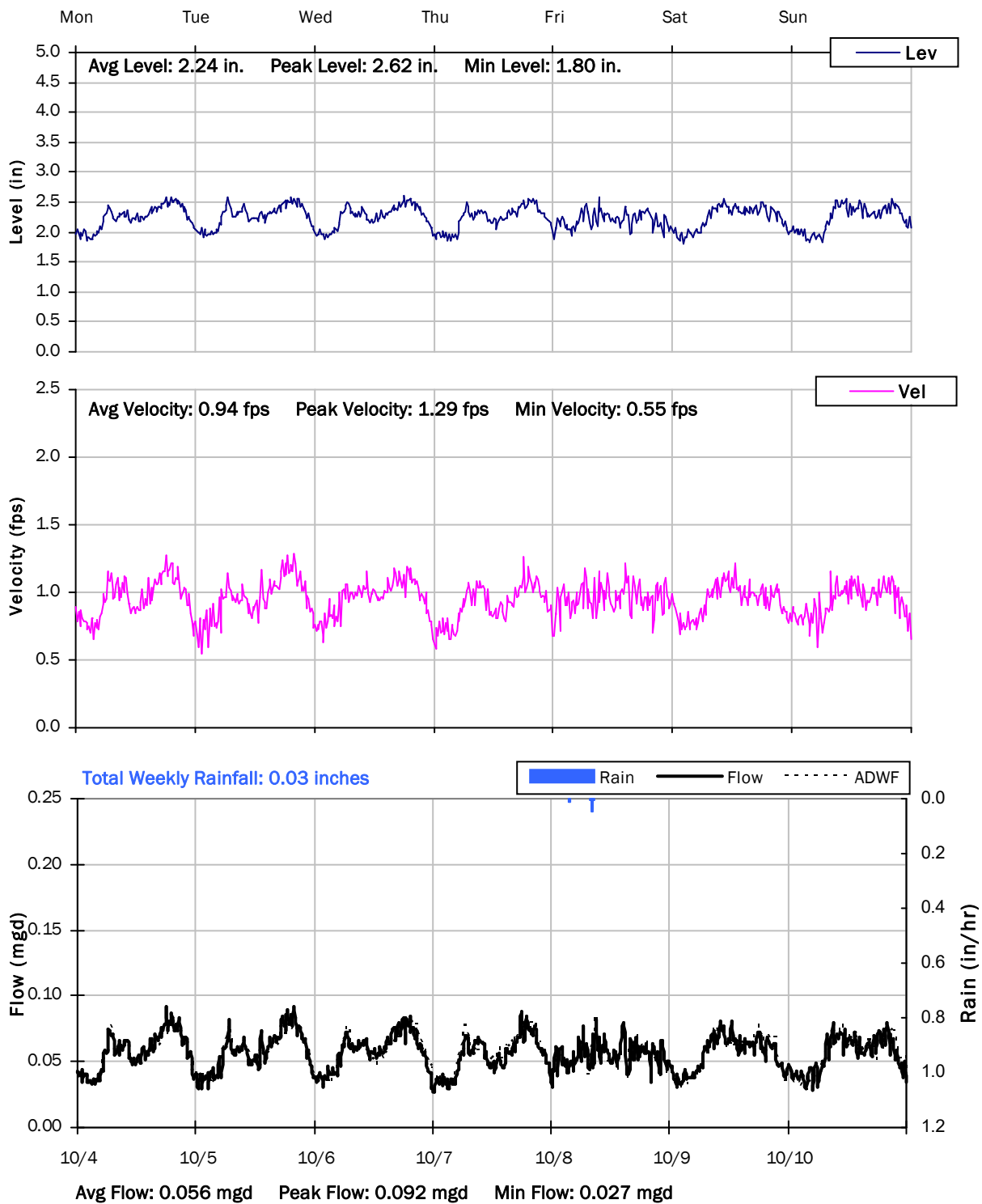
9/27/2021 to 10/4/2021



HIGH-MEDIUM DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

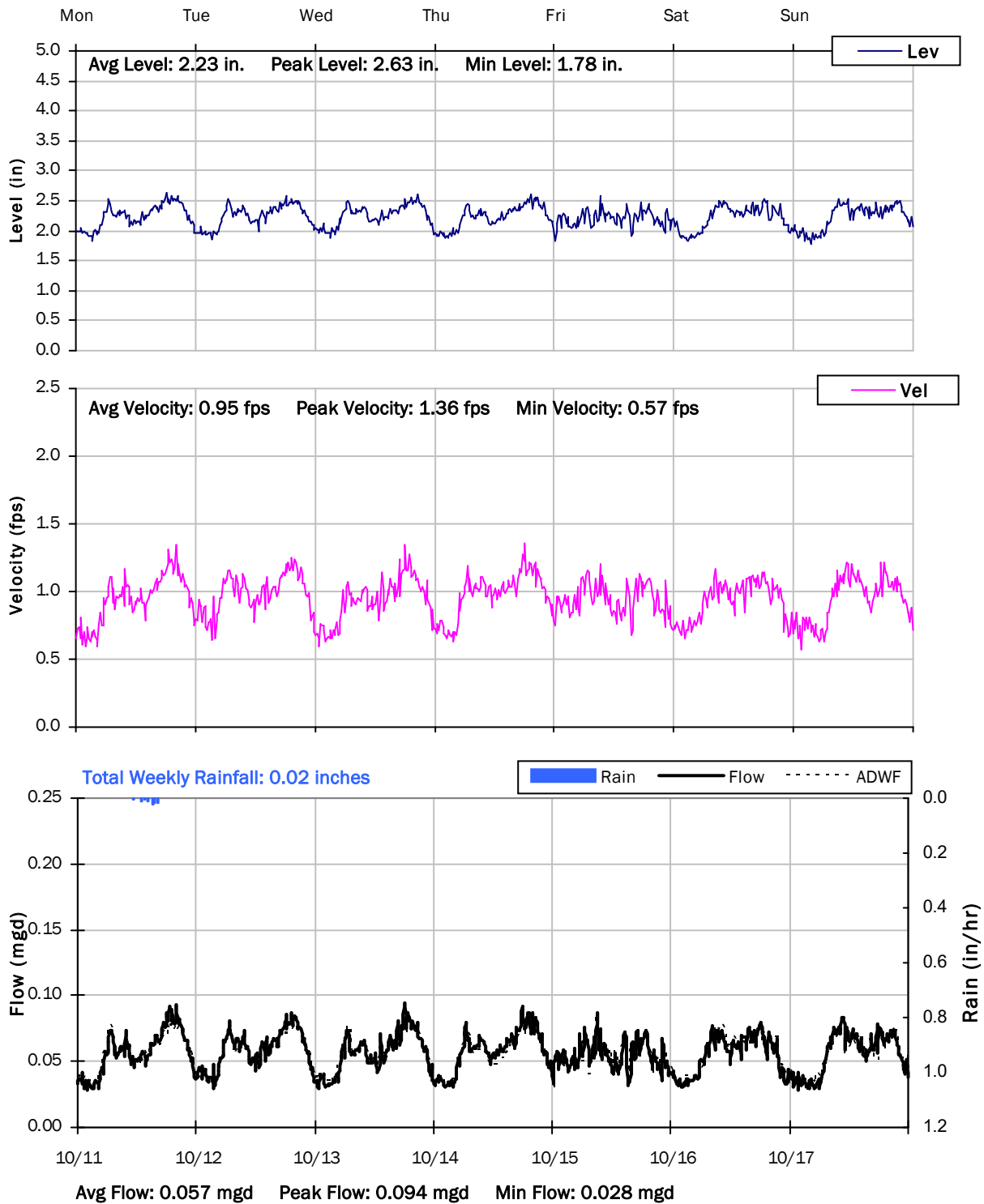
10/4/2021 to 10/11/2021



HIGH-MEDIUM DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

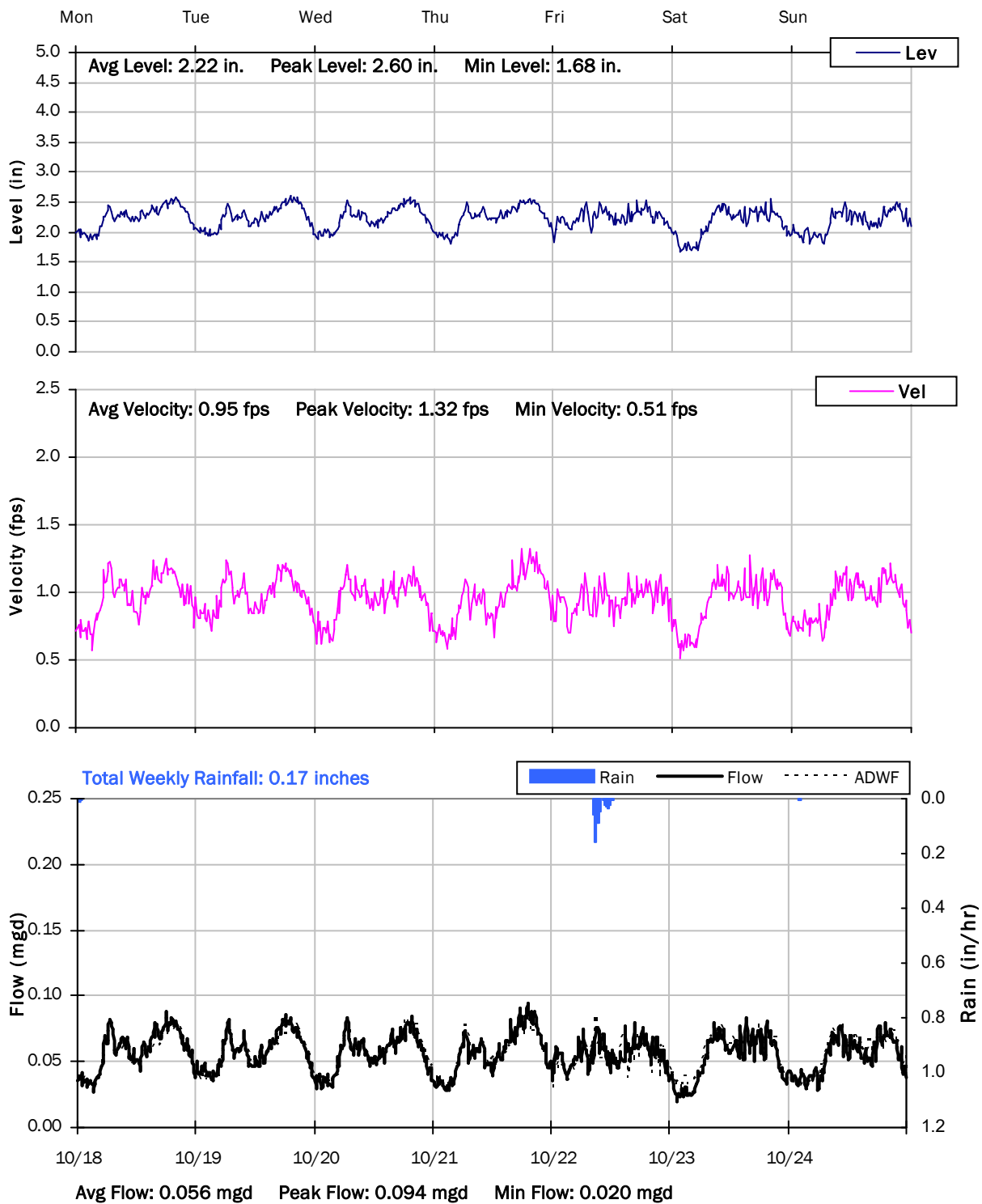
10/11/2021 to 10/18/2021



HIGH-MEDIUM DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

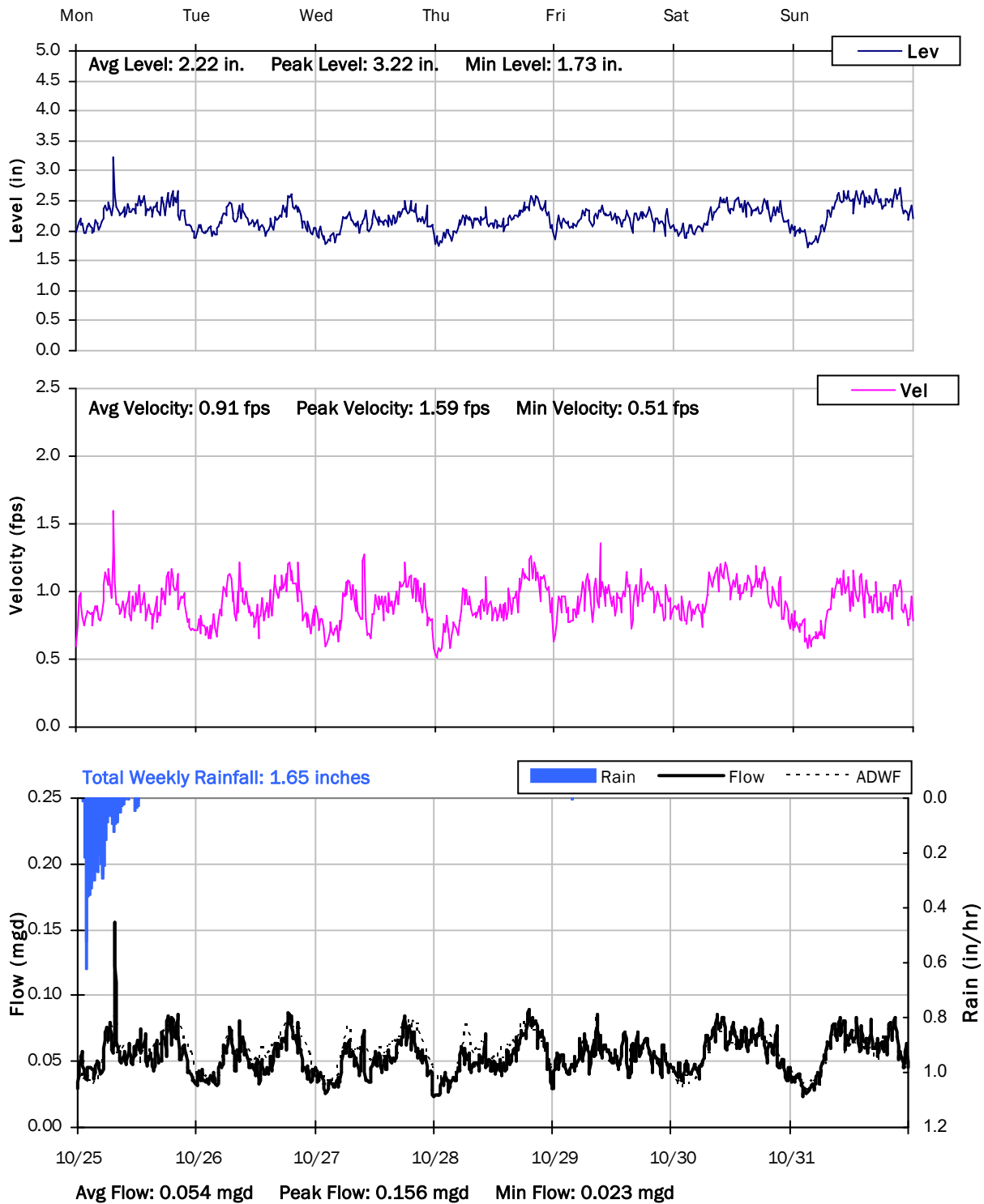
10/18/2021 to 10/25/2021



HIGH-MEDIUM DENSITY-2

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



HIGH DENSITY-1

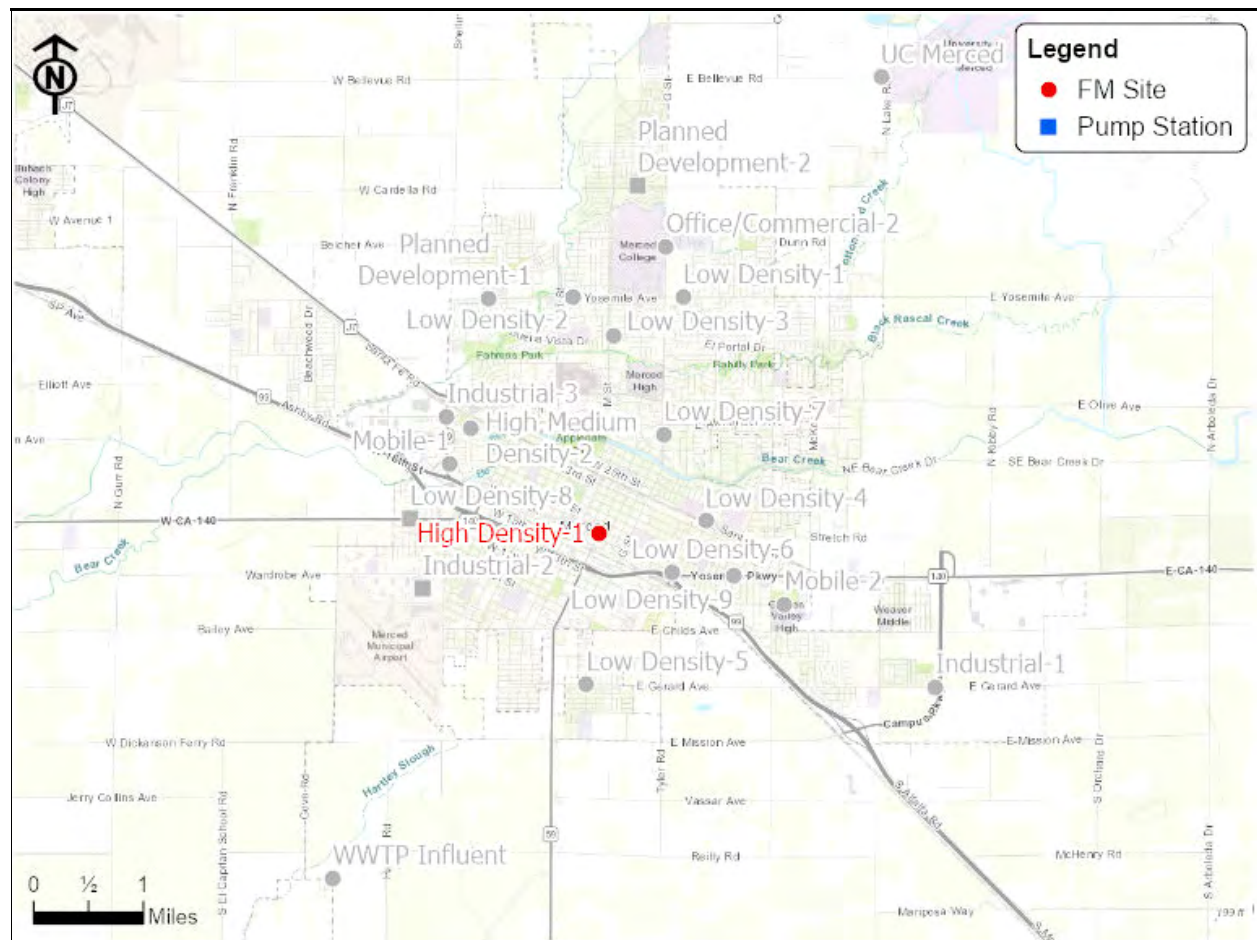
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Martin Luther King Jr Way between W 18th Street and W Main Street

Data Summary Report



Vicinity Map: High Density-1

HIGH DENSITY-1

Site Information

Location: Martin Luther King Jr Way
between W 18th Street and W
Main Street

Coordinates: 120.4800° W, 37.3008° N

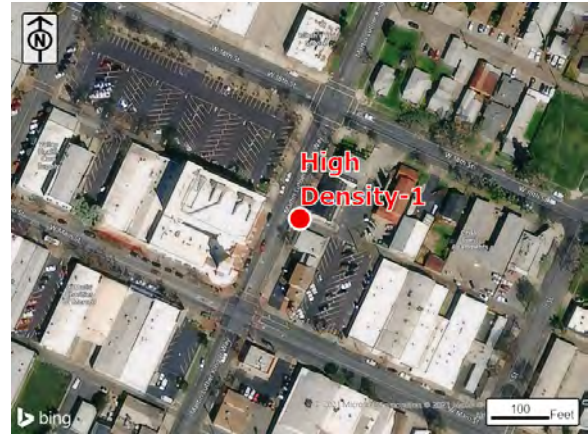
Rim Elevation (Earth): 175 feet

Measured Pipe Diameter: 10.25 inches

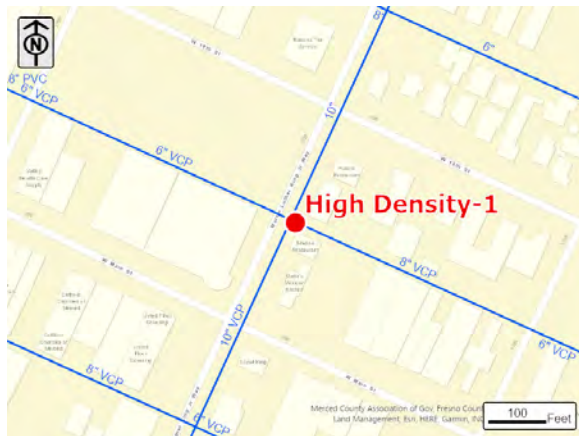
ADWF: 0.052 mgd

Peak Measured Flow: 0.258 mgd

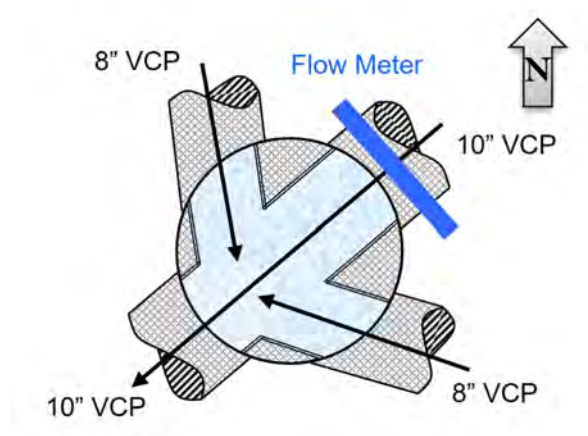
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

HIGH DENSITY-1

Additional Site Photos

Effluent Pipe



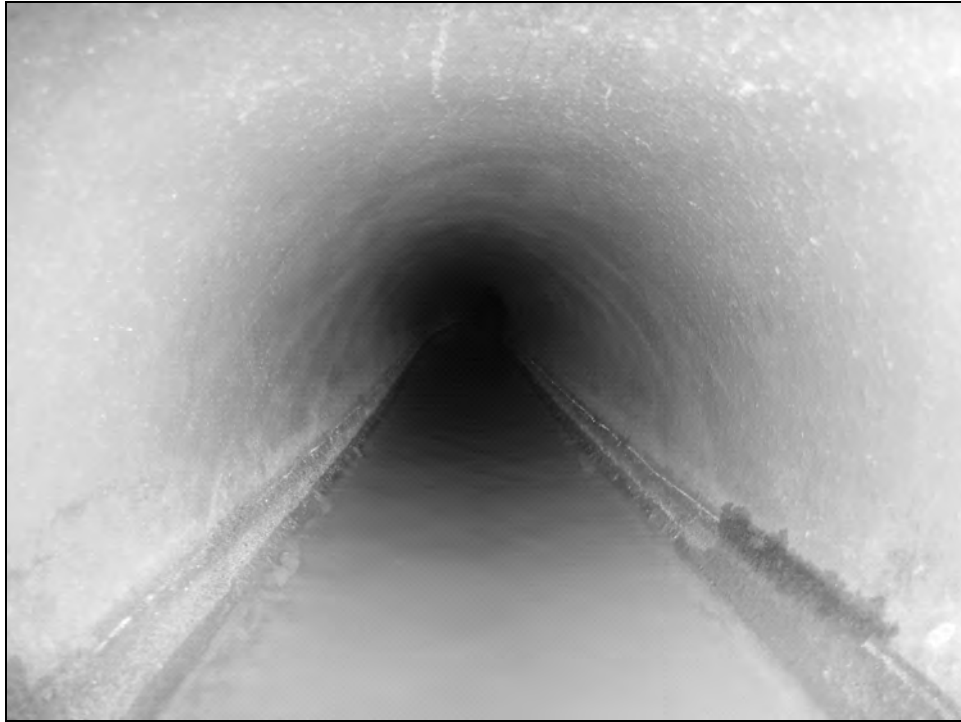
Monitored Northeast Influent Pipe



HIGH DENSITY-1

Additional Site Photos

Southeast Influent Pipe



Northwest Influent Pipe

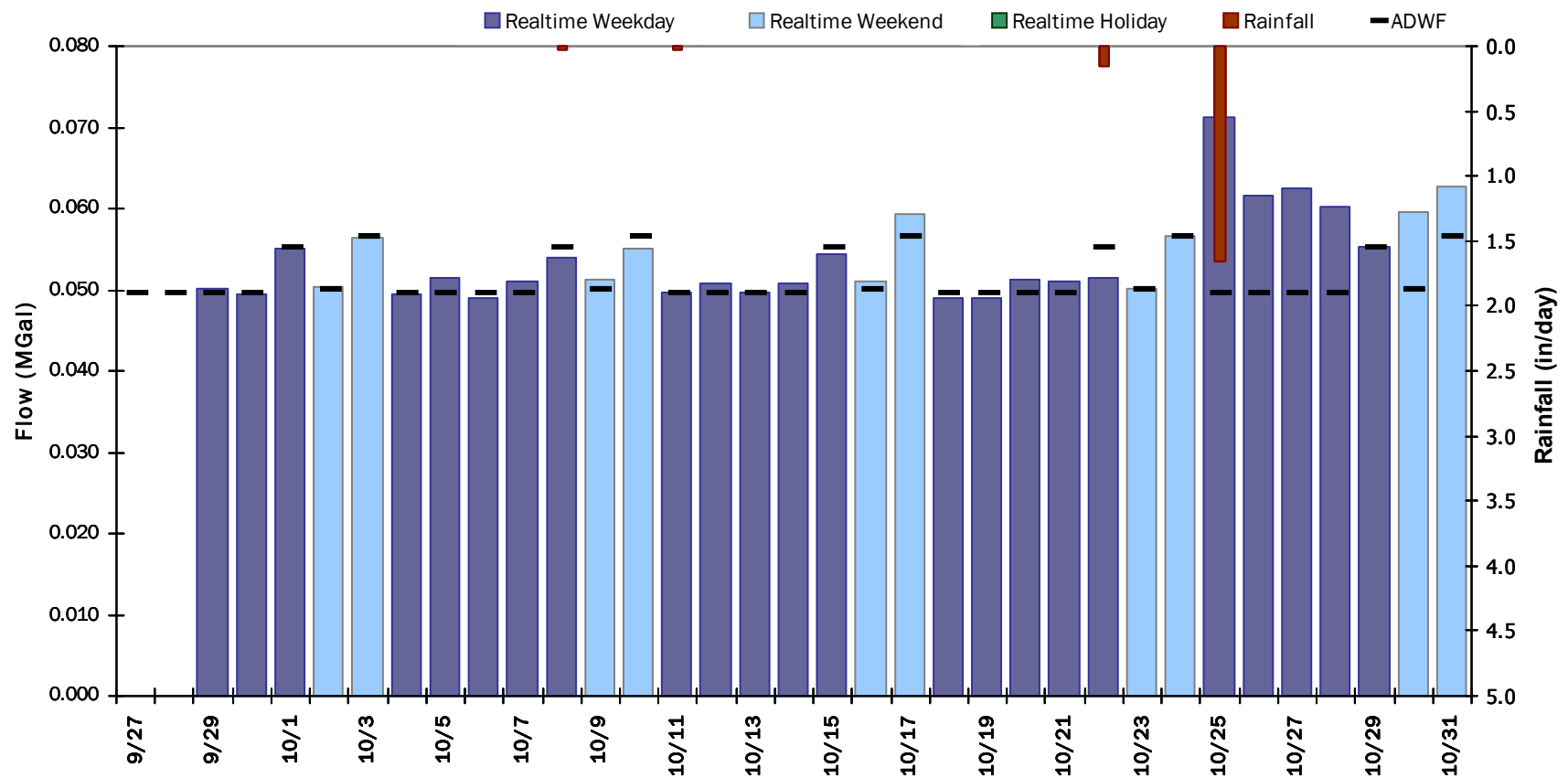


HIGH DENSITY-1

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 0.054 MGal Peak Daily Flow: 0.071 MGal Min Daily Flow: 0.049 MGal

Total Rainfall: 1.87 inches



HIGH DENSITY-1

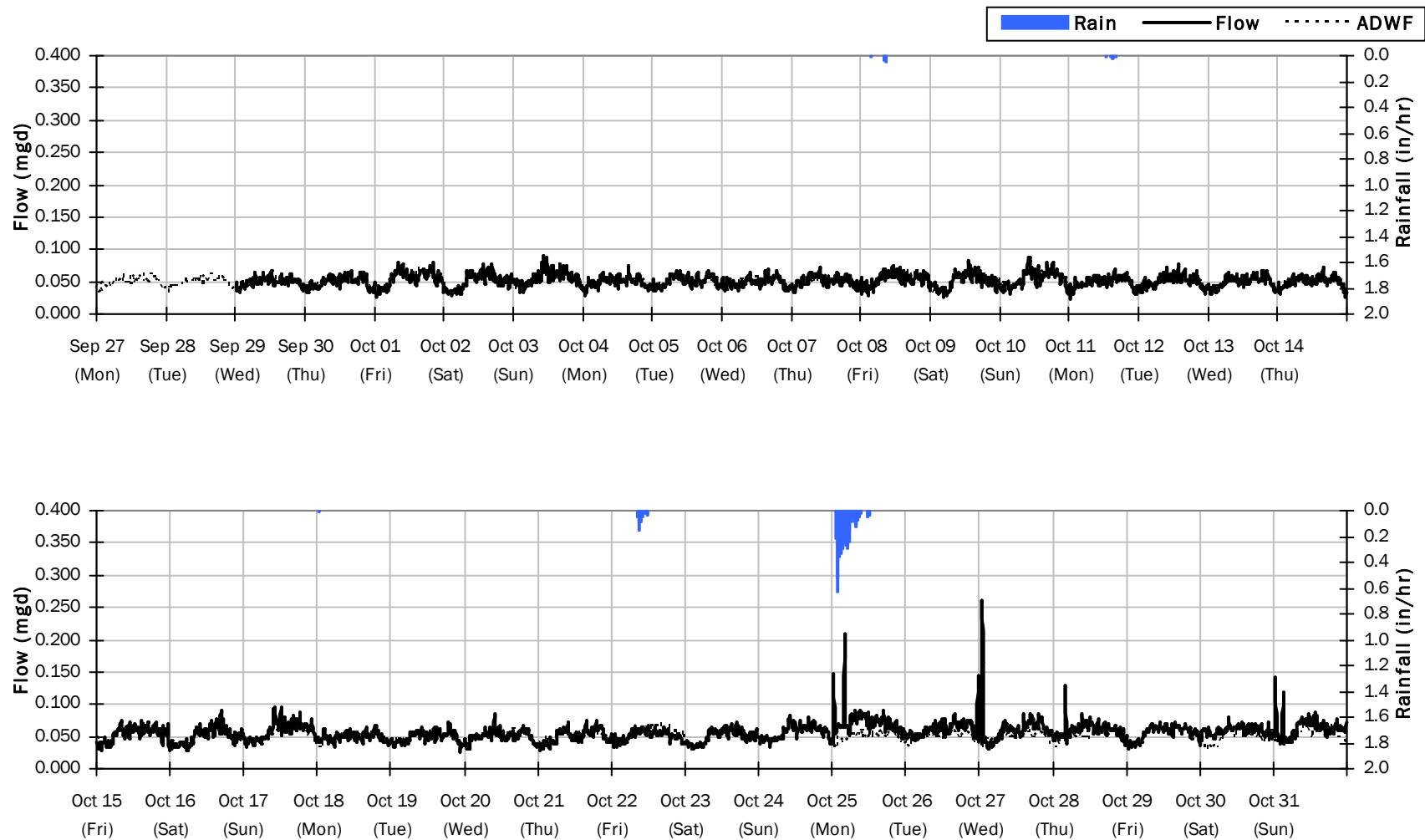
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 0.054 mgd

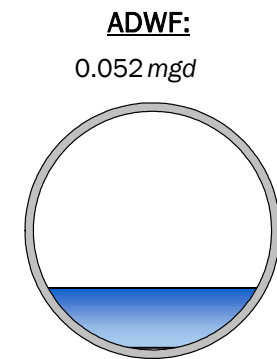
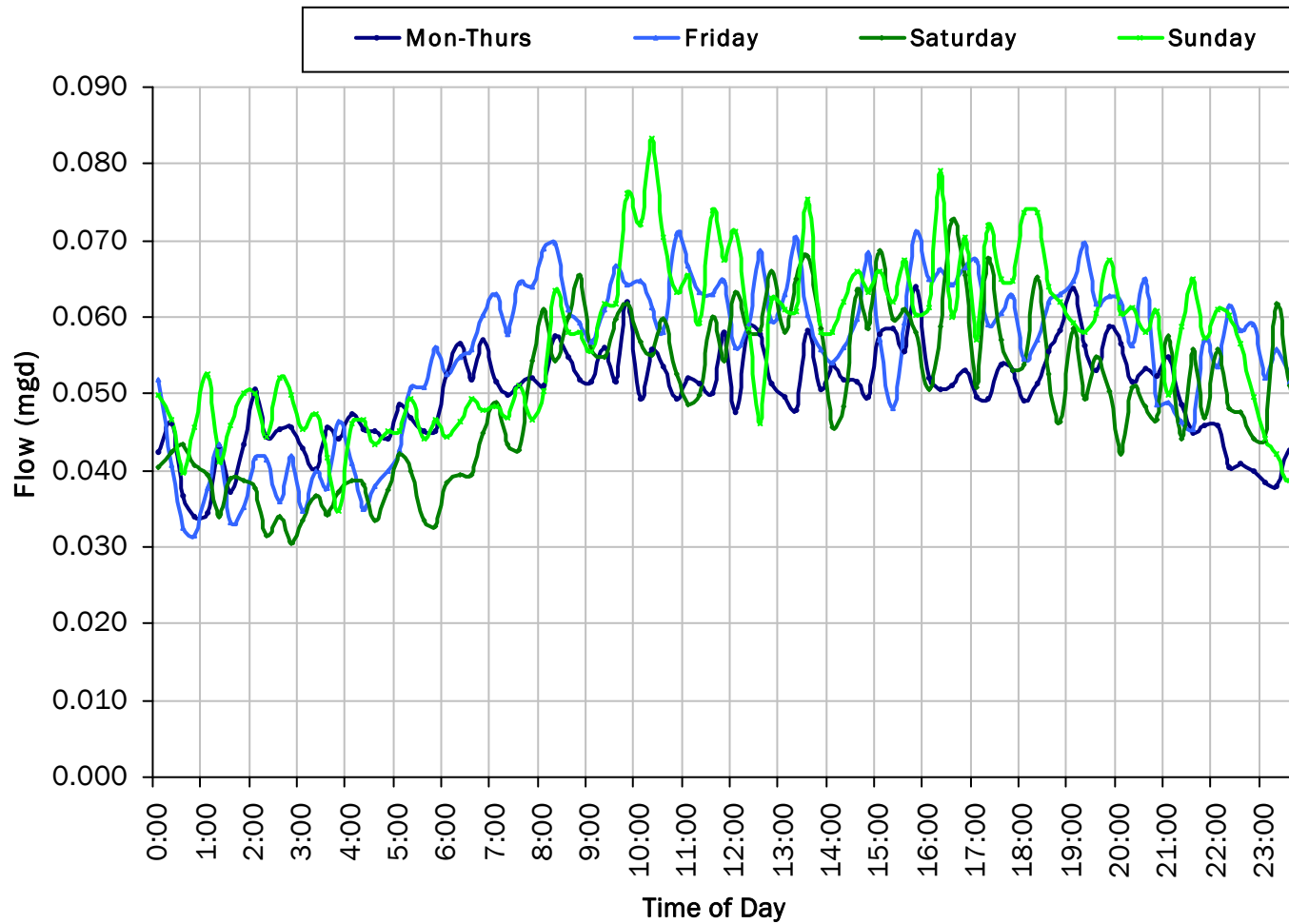
Period Peak Flow: 0.258 mgd

Period Min Flow: 0.022 mgd



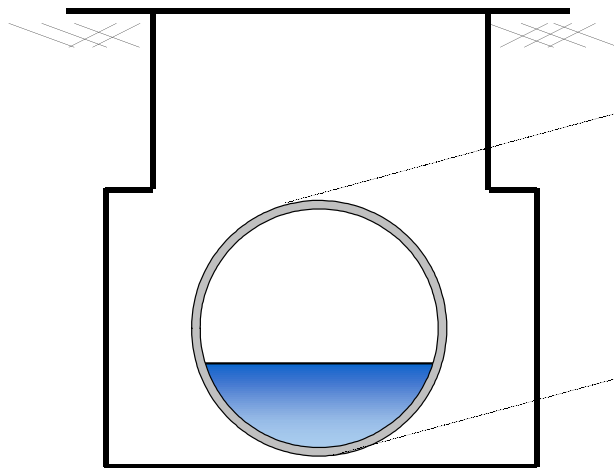
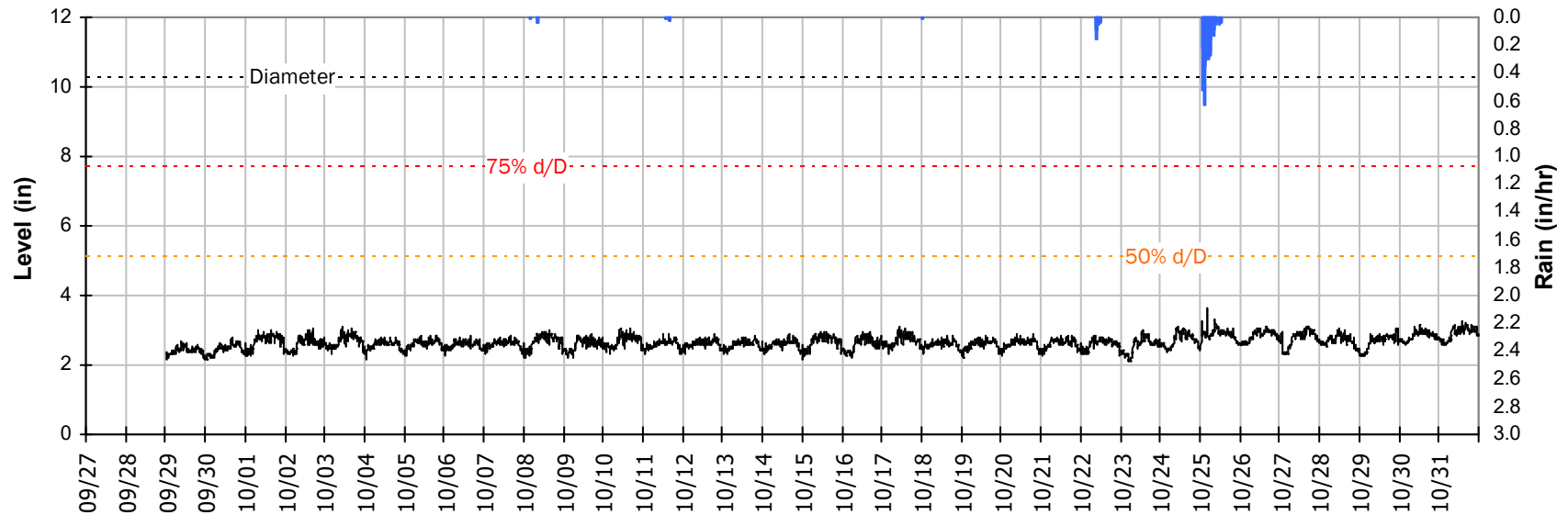
HIGH DENSITY-1

Average Dry Weather Flow Hydrographs



HIGH DENSITY-1 Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

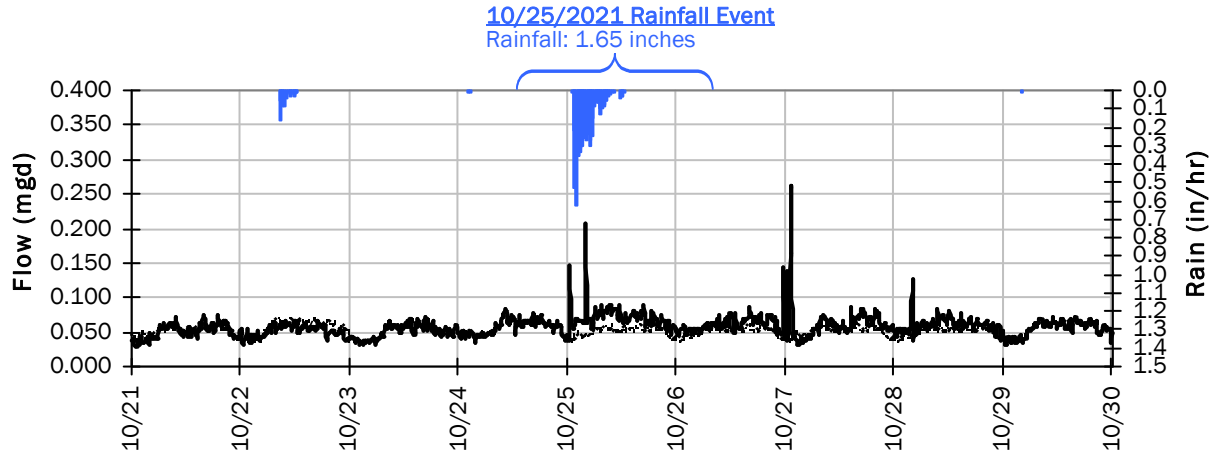


Pipe Diameter: 10.3 inches
Peak Measured Level: 3.64 inches
Peak d/D Ratio: 0.36

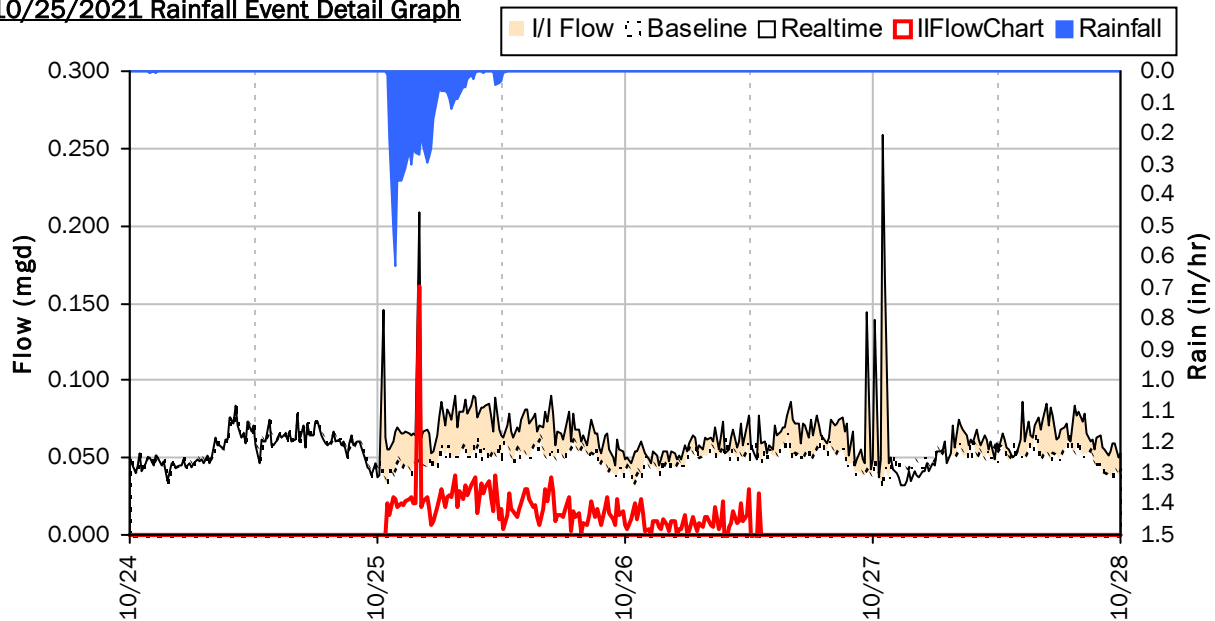
HIGH DENSITY-1

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



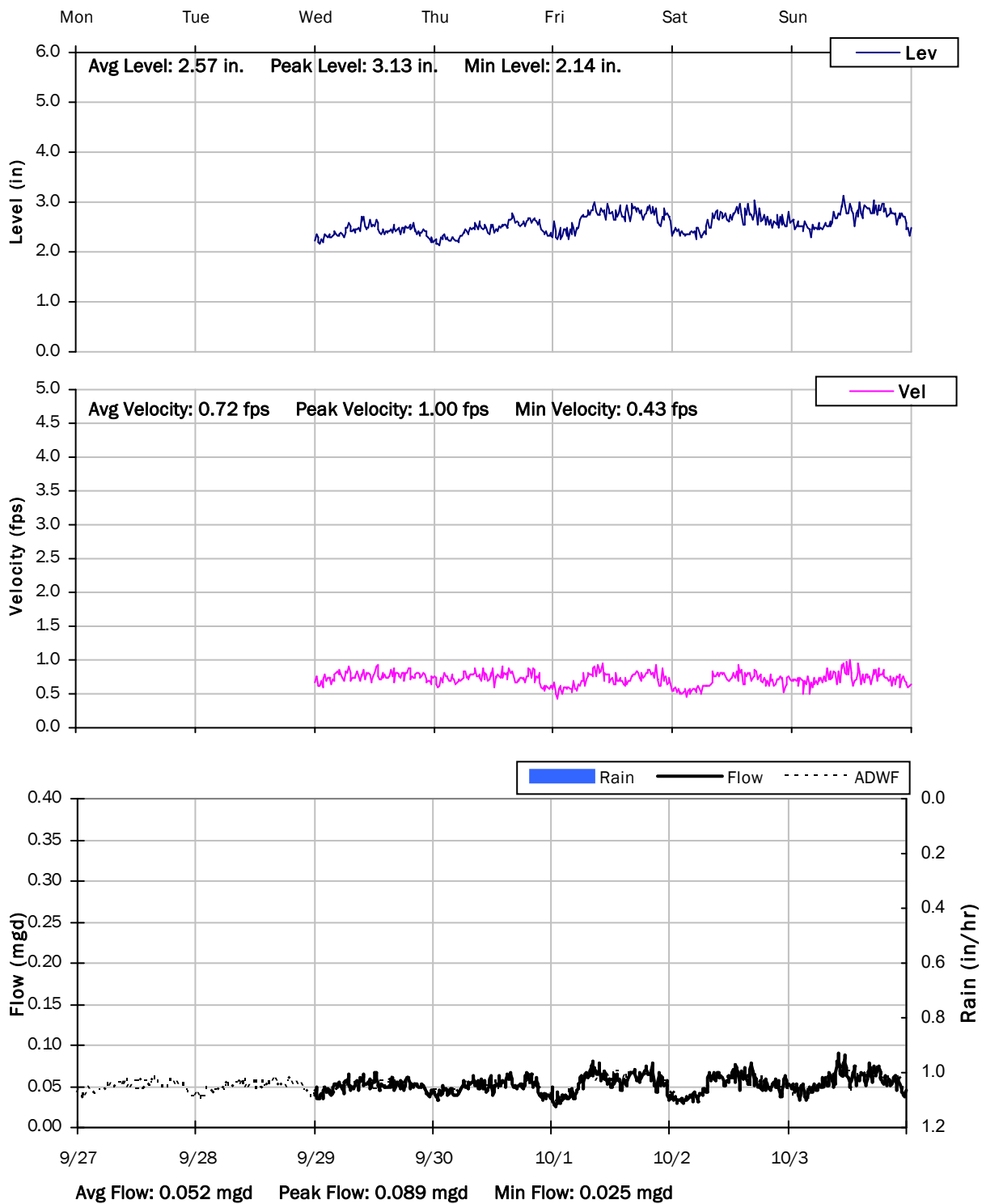
Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.208 mgd	Peak I/I Rate:	0.161 mgd
PF:	4.04	Total I/I:	25,000 gallons
Peak Level:	3.64 in		
d/D Ratio:	0.36		

HIGH DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

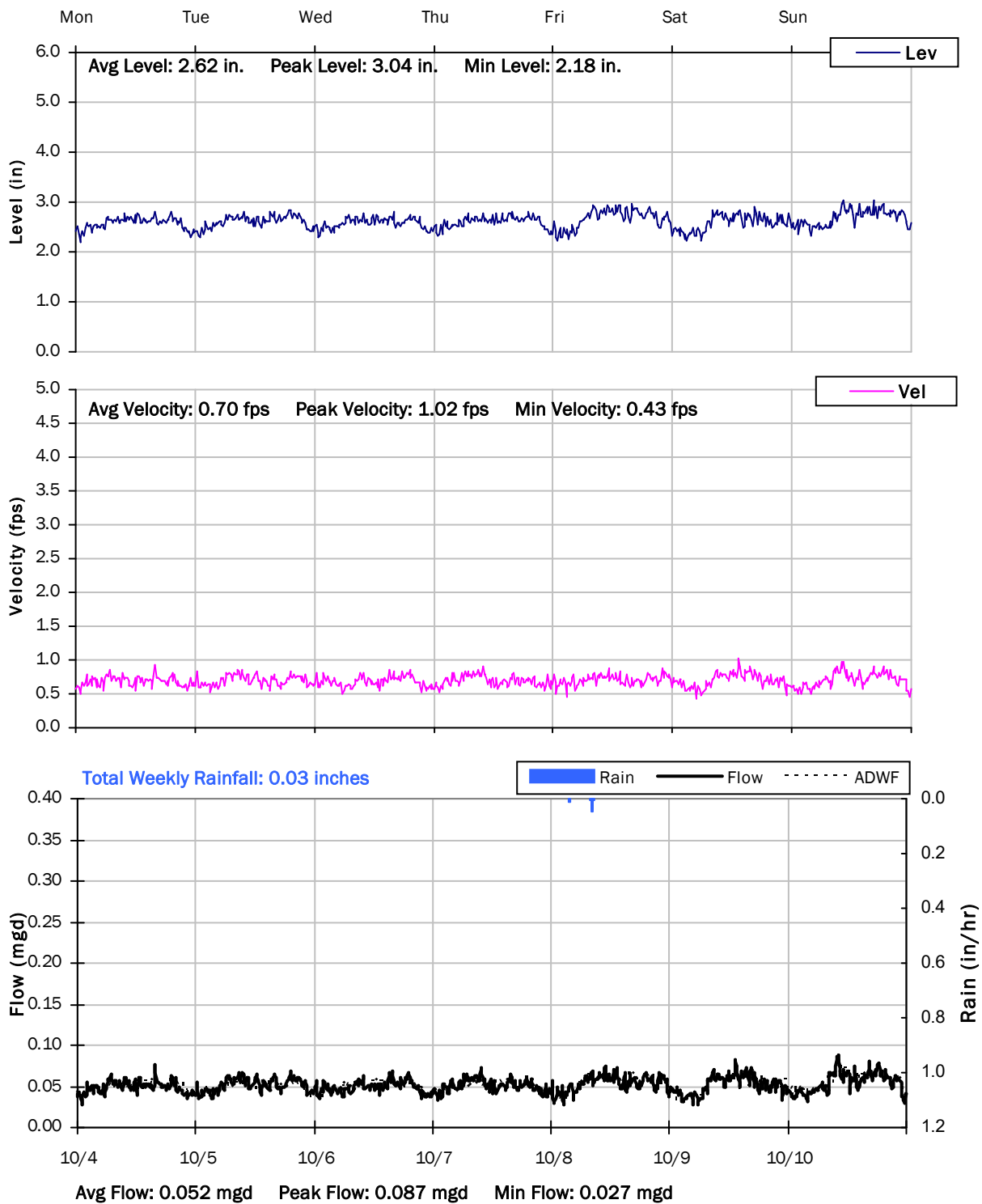
9/27/2021 to 10/4/2021



HIGH DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

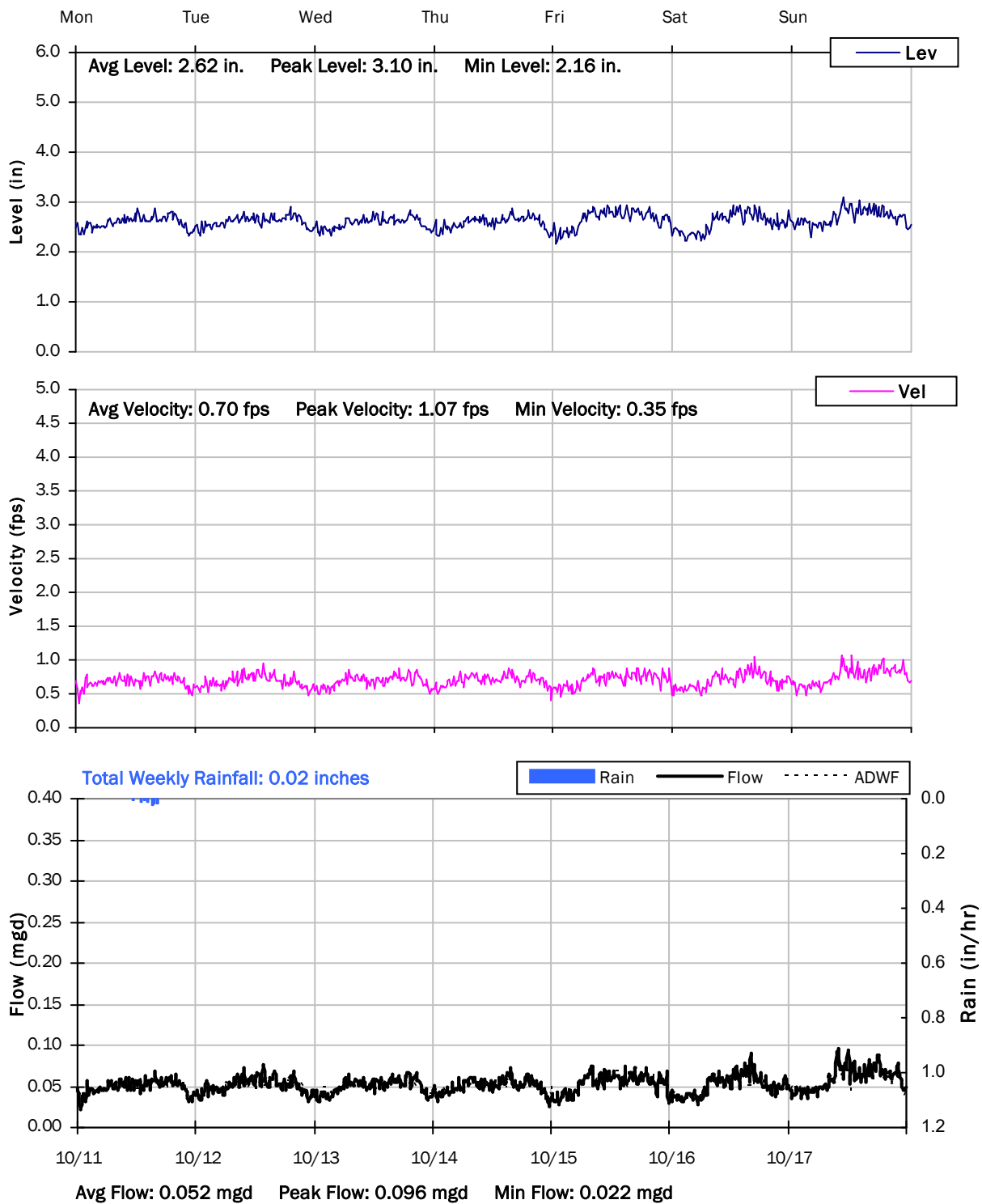
10/4/2021 to 10/11/2021



HIGH DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

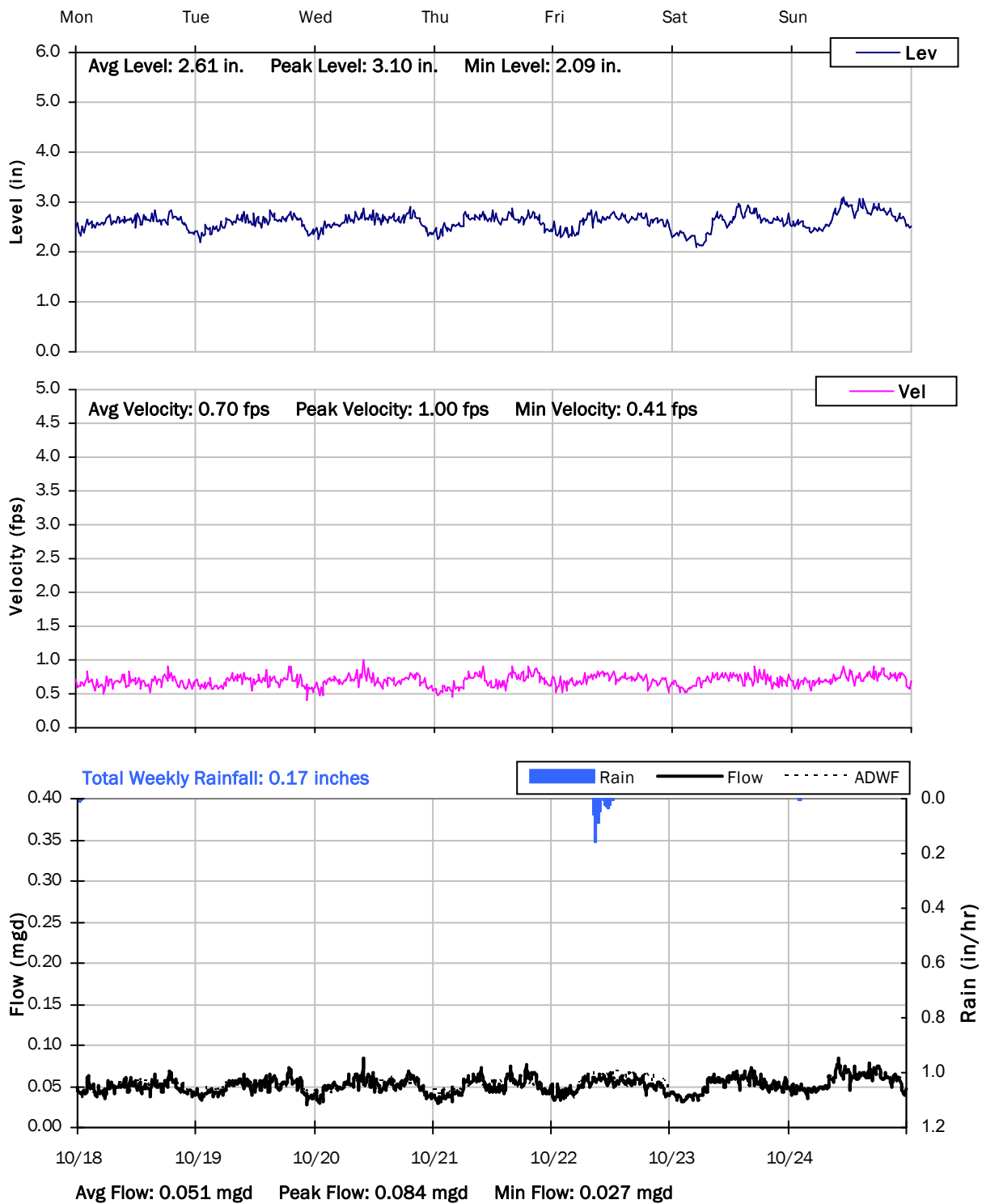
10/11/2021 to 10/18/2021



HIGH DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

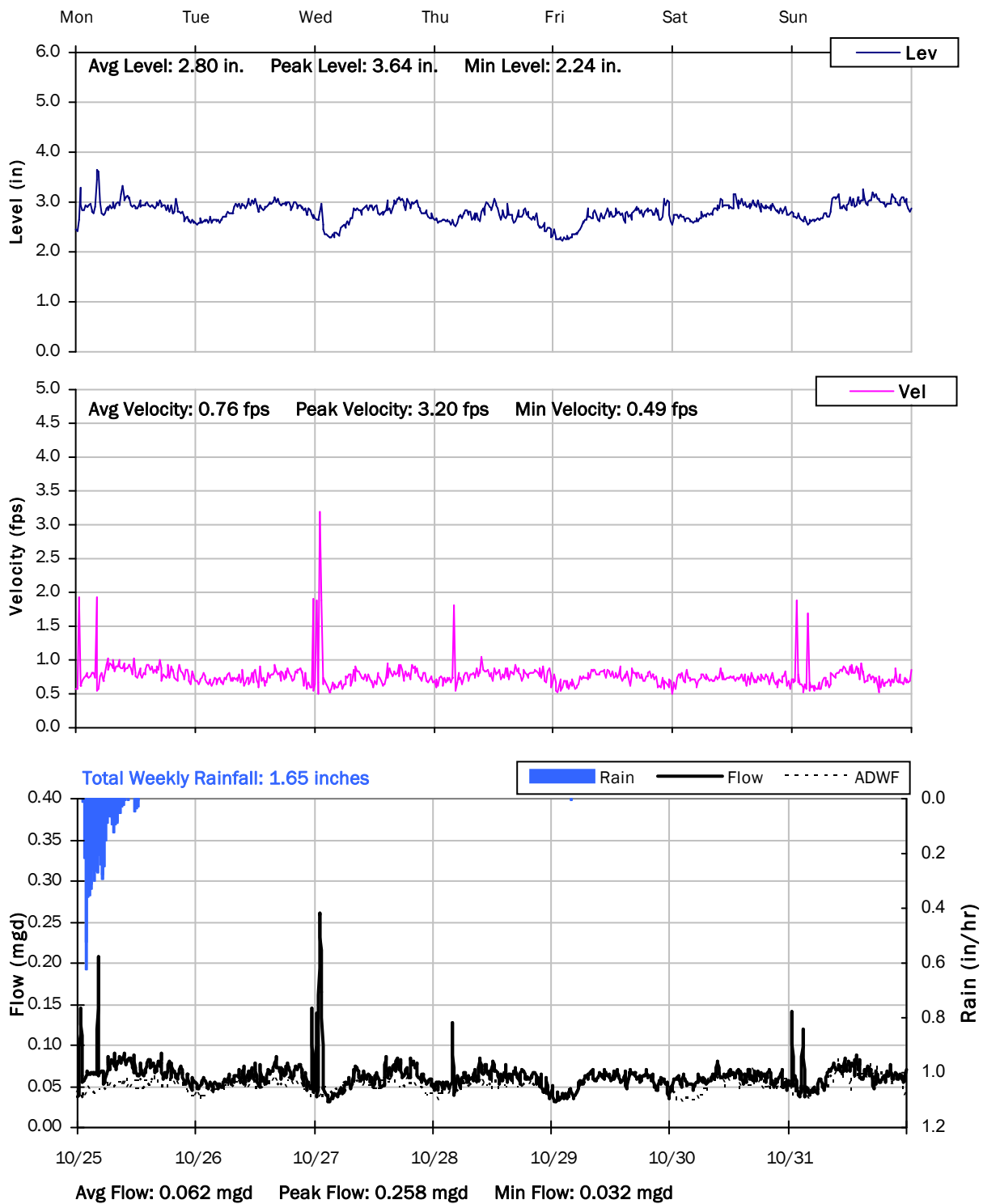
10/18/2021 to 10/25/2021



HIGH DENSITY-1

Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



WWTP INFLUENT

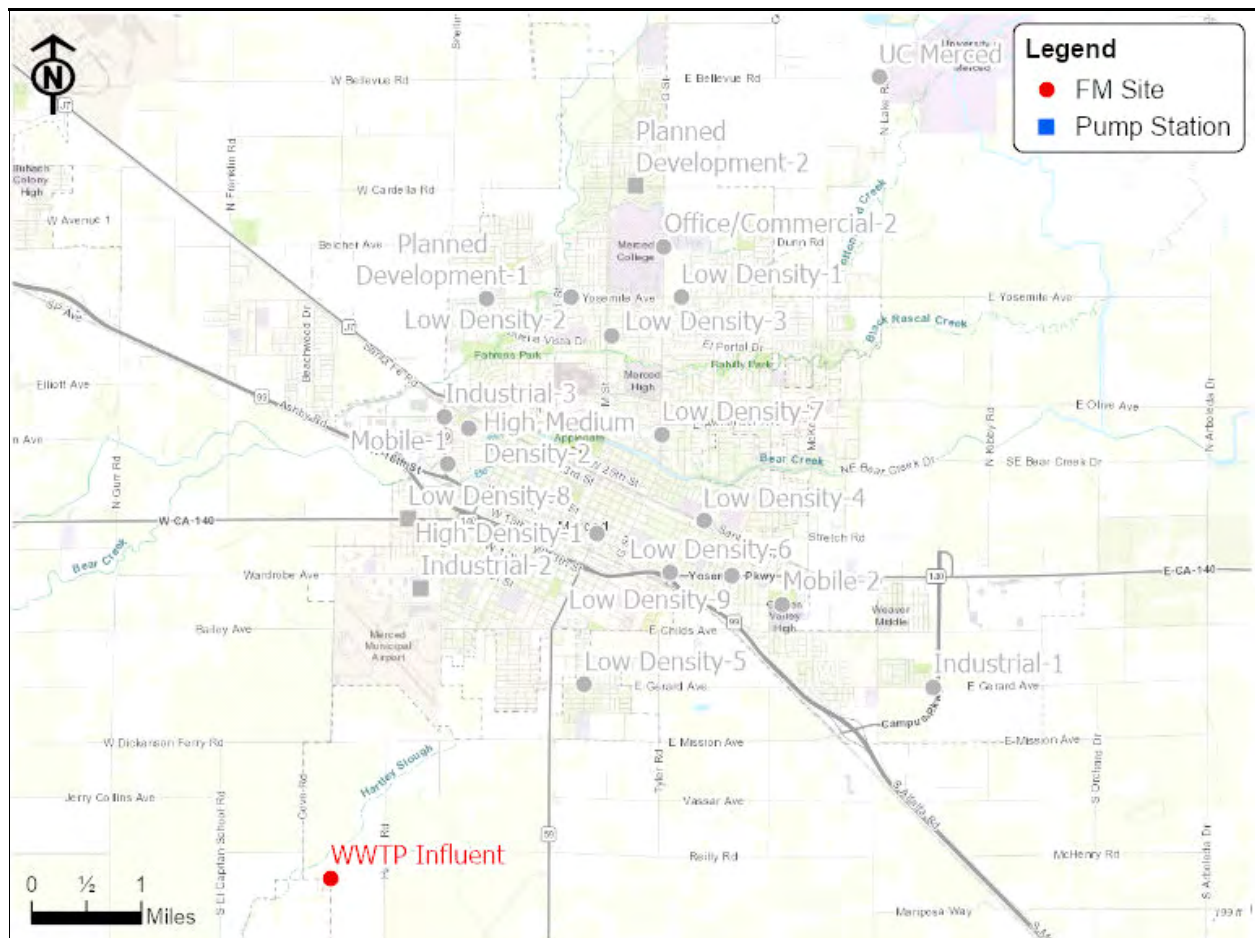
City of Merced, CA

Sanitary Sewer Flow Monitoring

September 27, 2021 - October 31, 2021

Location: Northeast corner of Treatment Plant on Gove Road

Data Summary Report



Vicinity Map: WWTP Influent

WWTP INFLUENT

Site Information

Location: Northeast corner of Treatment Plant on Gove Road

Coordinates: 120.5240° W, 37.2552° N

Rim Elevation (Earth): 144 feet

Measured Pipe Diameter: 60 inches

ADWF: 6.880 mgd

Peak Measured Flow: 9.778 mgd

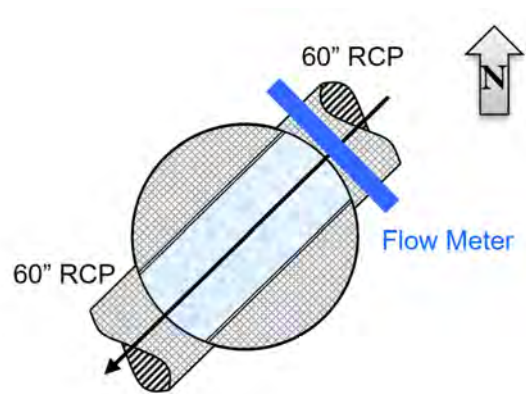
Sediment: None



Satellite Map



Sanitary Map



Flow Sketch



View from Street



Plan View

WWTP INFLUENT

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

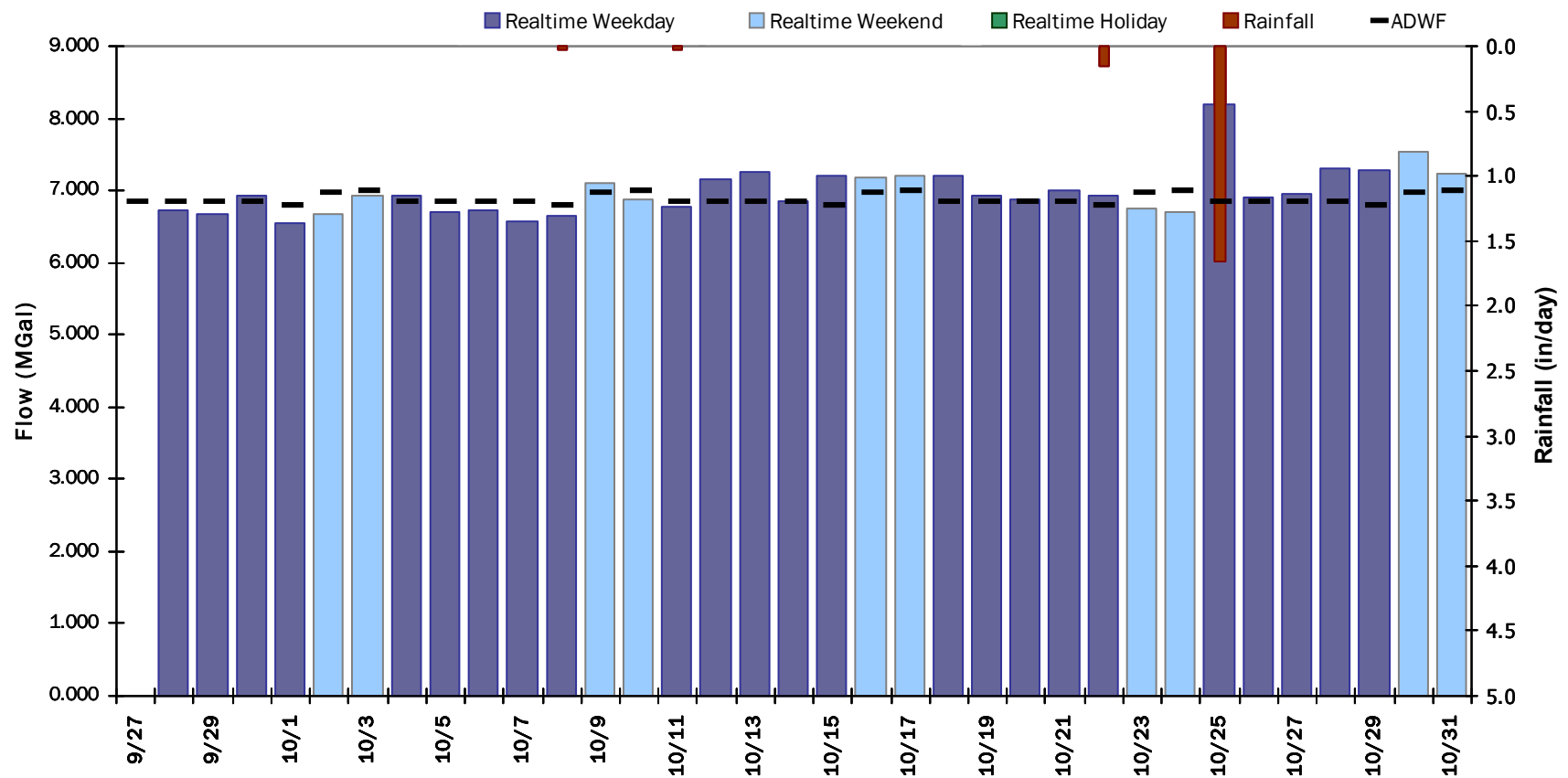


WWTP INFLUENT

Period Flow Summary: Daily Flow Totals

Avg Daily Flow: 6.983 MGal Peak Daily Flow: 8.197 MGal Min Daily Flow: 6.541 MGal

Total Rainfall: 1.87 inches



WWTP INFLUENT

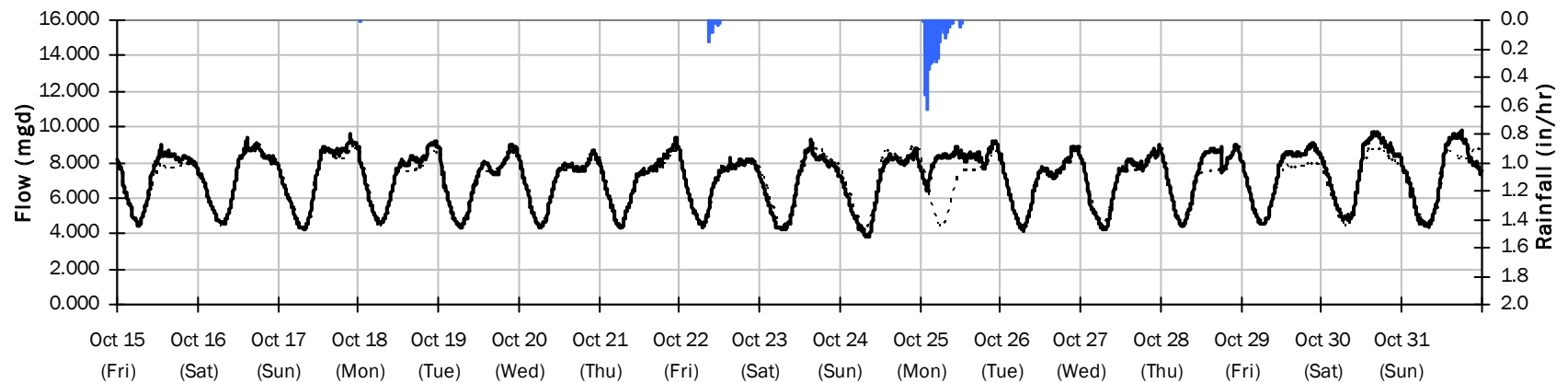
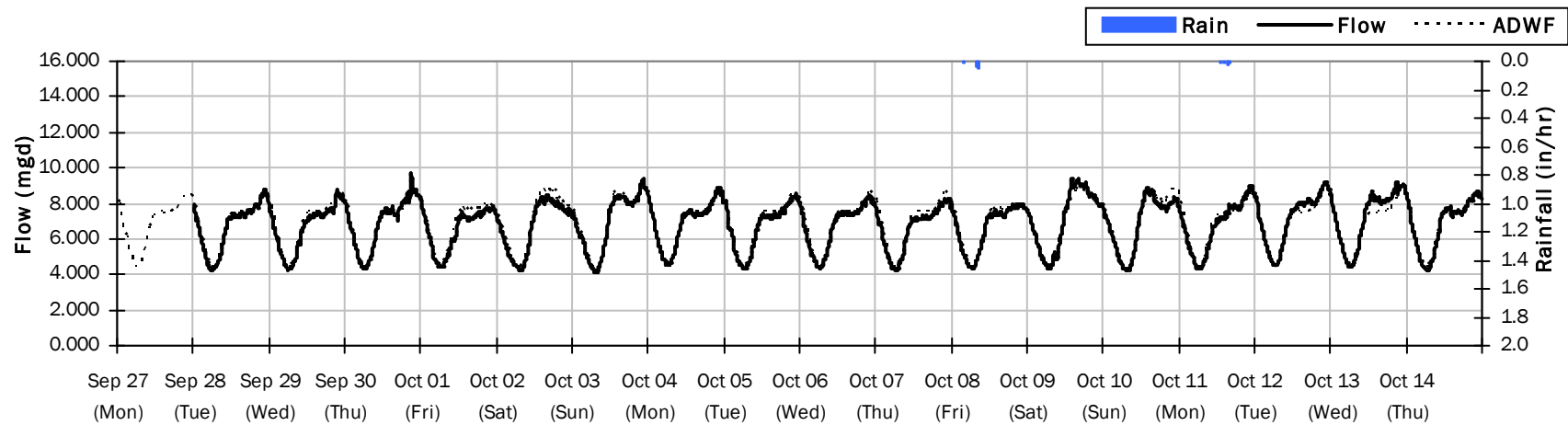
Flow Summary: 9/27/2021 to 10/31/2021

Period Rainfall: 1.87 inches

Period Avg Flow: 6.983 mgd

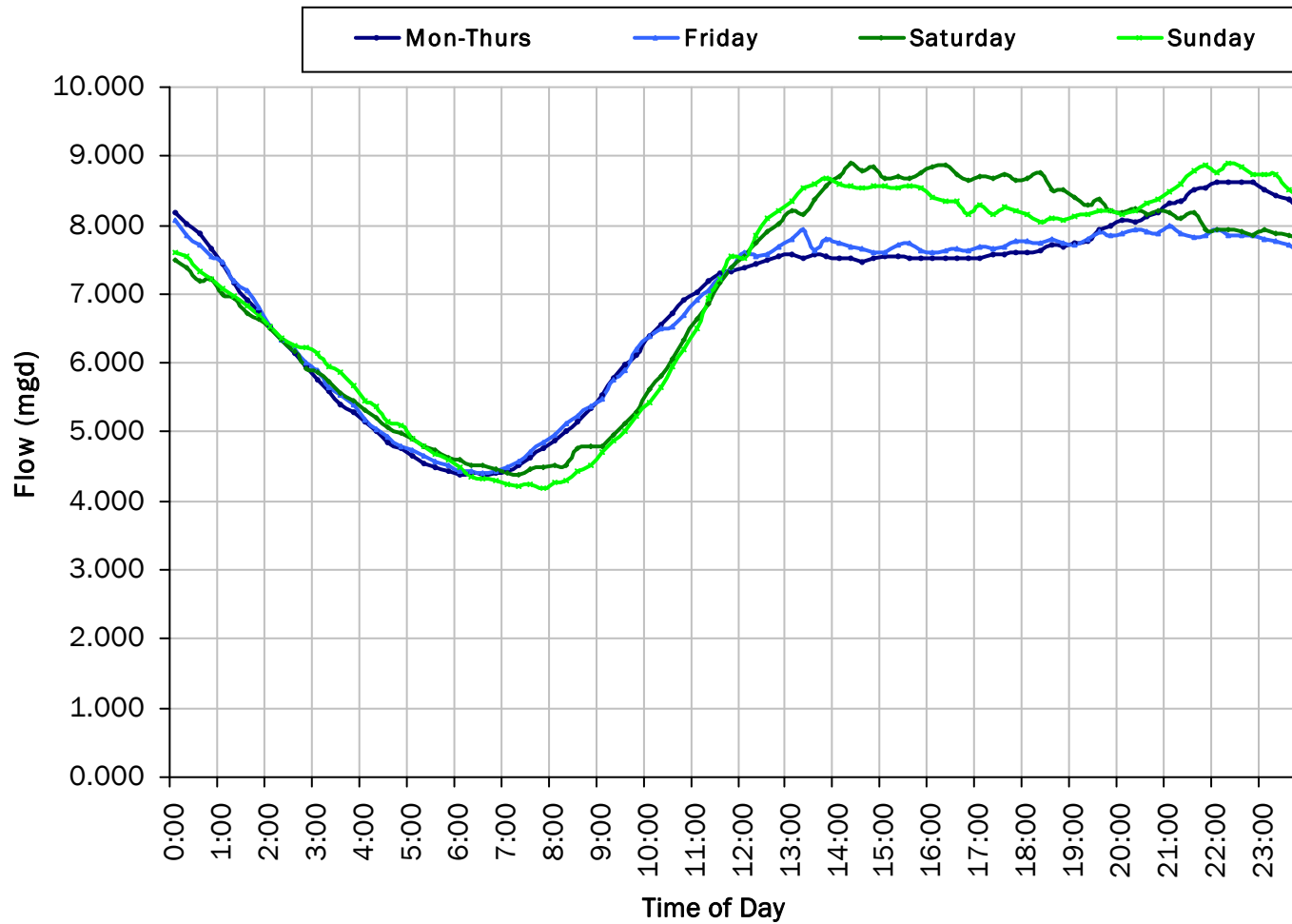
Period Peak Flow: 9.778 mgd

Period Min Flow: 3.804 mgd

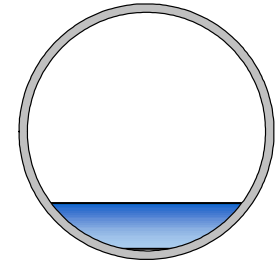


WWTP INFLUENT

Average Dry Weather Flow Hydrographs



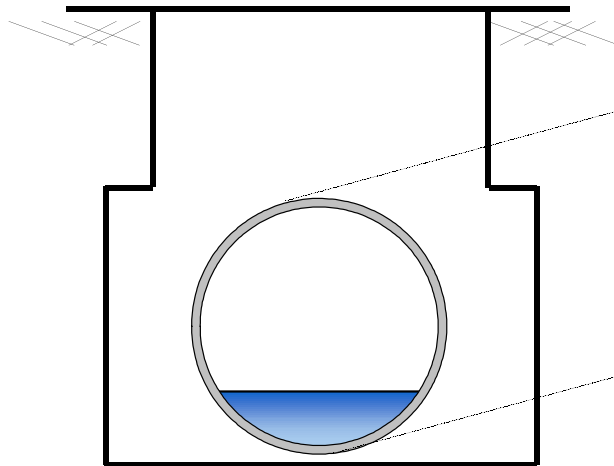
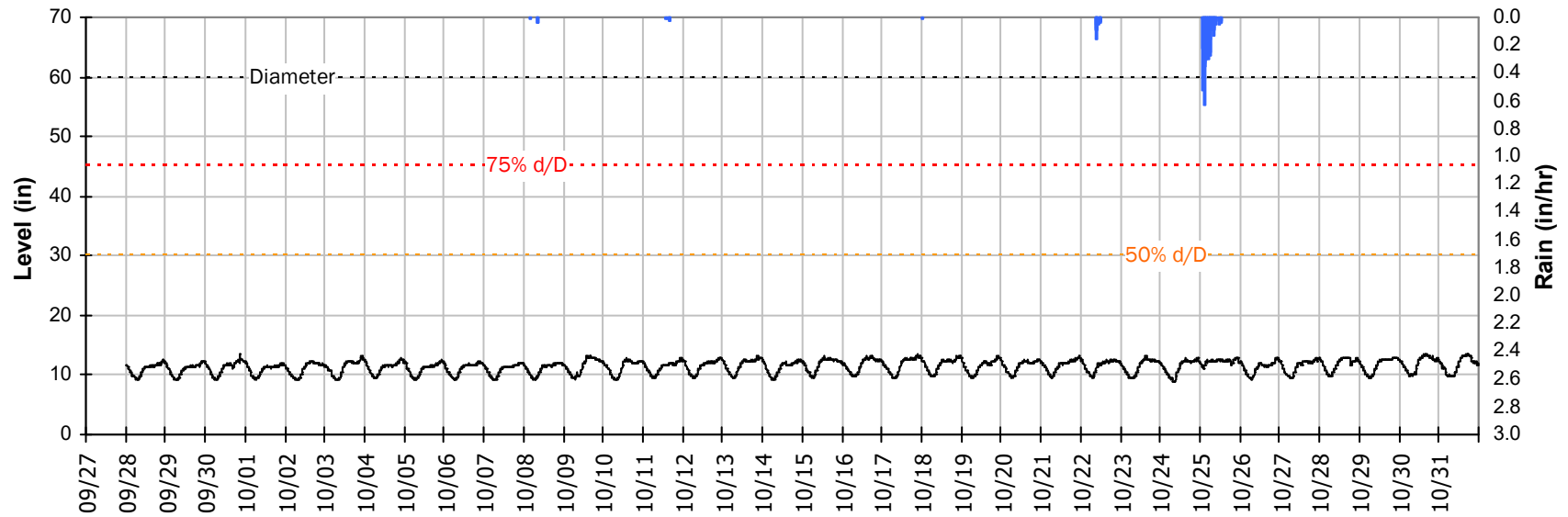
ADWF:
6.880 mgd



WWTP INFLUENT

Site Capacity and Surge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

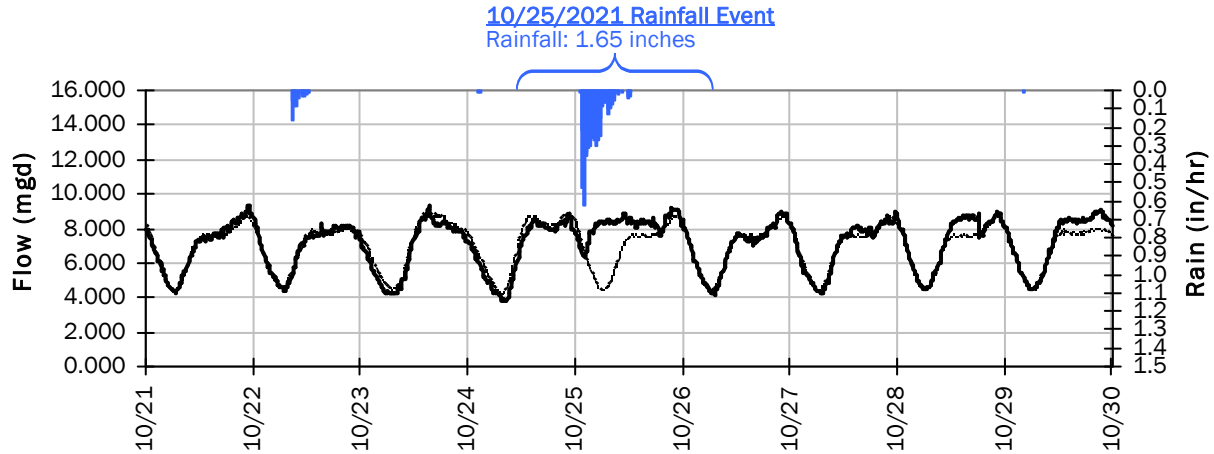


Pipe Diameter: 60 inches
Peak Measured Level: 13.6 inches
Peak d/D Ratio: 0.23

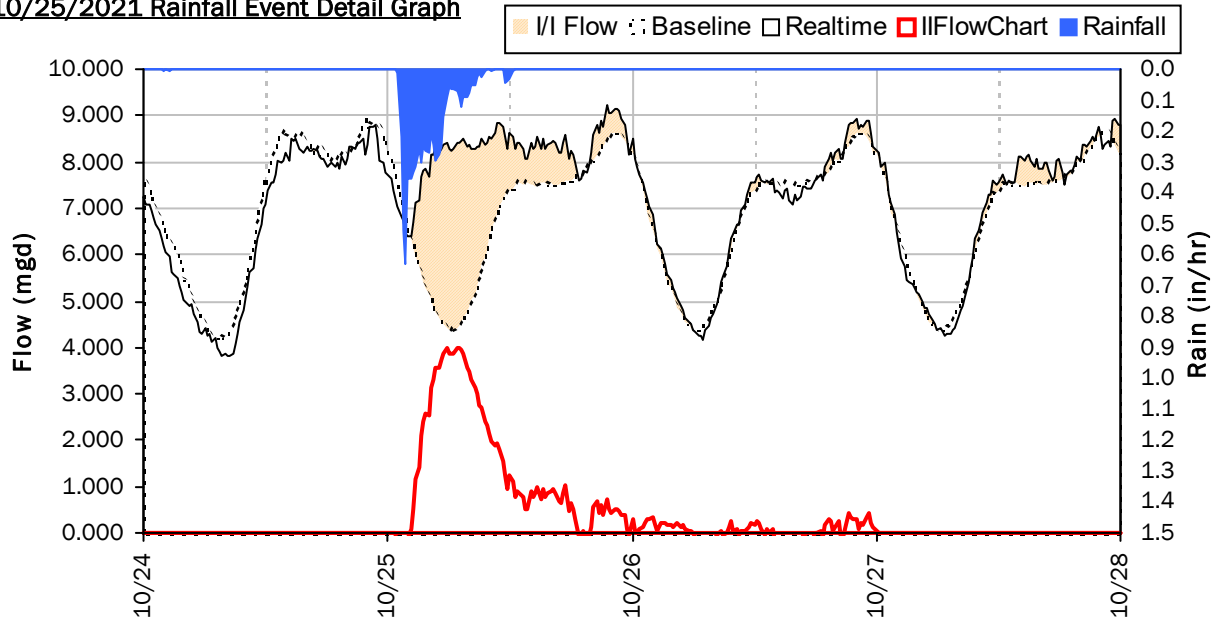
WWTP INFLUENT

I/I Summary: 10/25/2021 Rainfall Event

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



10/25/2021 Rainfall Event Detail Graph



Storm Event I/I Analysis (Rain = 1.65 inches)

Capacity

Peak Flow: 9.238 mgd
PF: 1.34

Peak Level: 13.01 in
d/D Ratio: 0.22

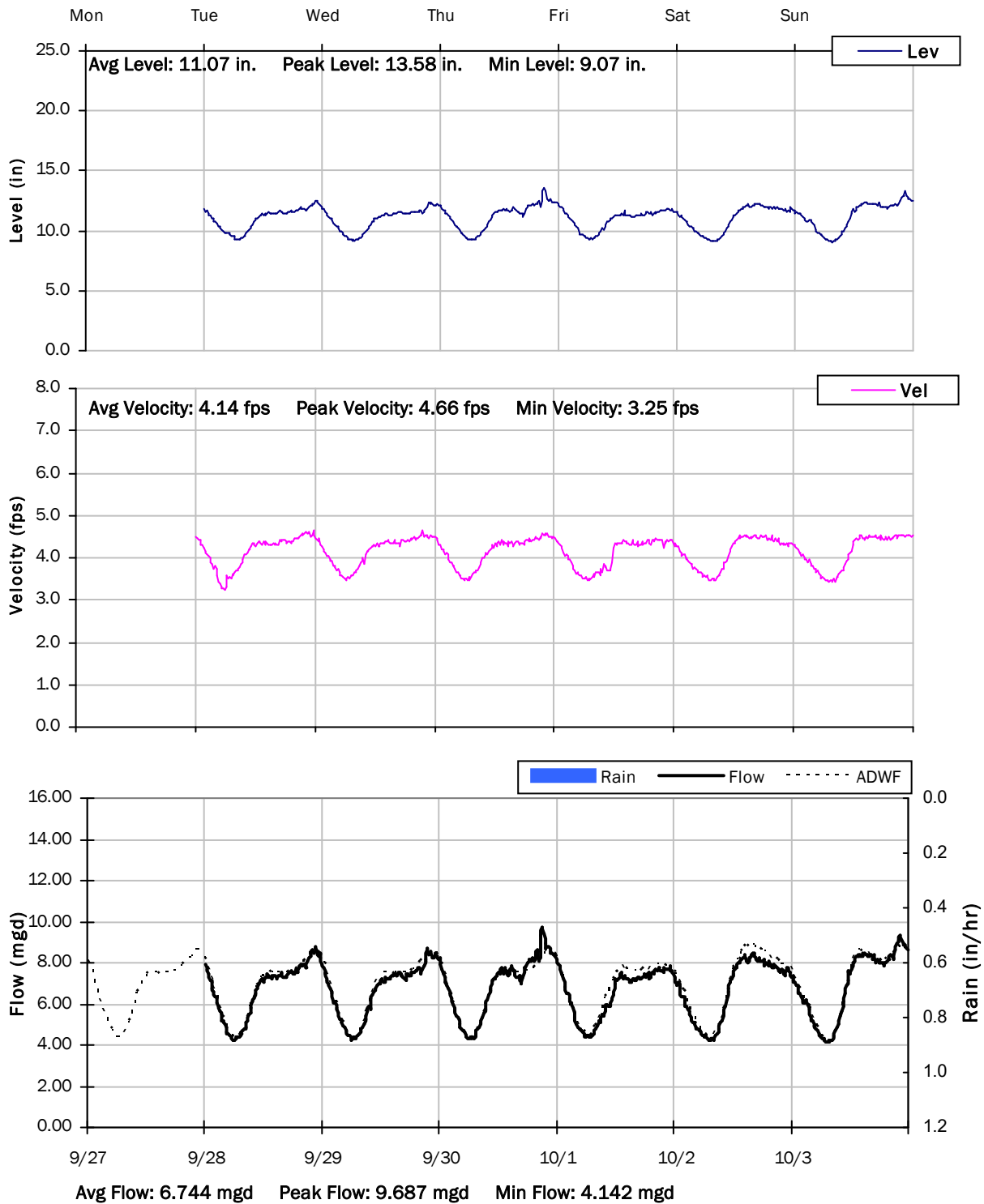
Inflow / Infiltration

Peak I/I Rate: 3.986 mgd
Total I/I: 1,428,000 gallons

WWTP INFLUENT

Weekly Level, Velocity and Flow Hydrographs

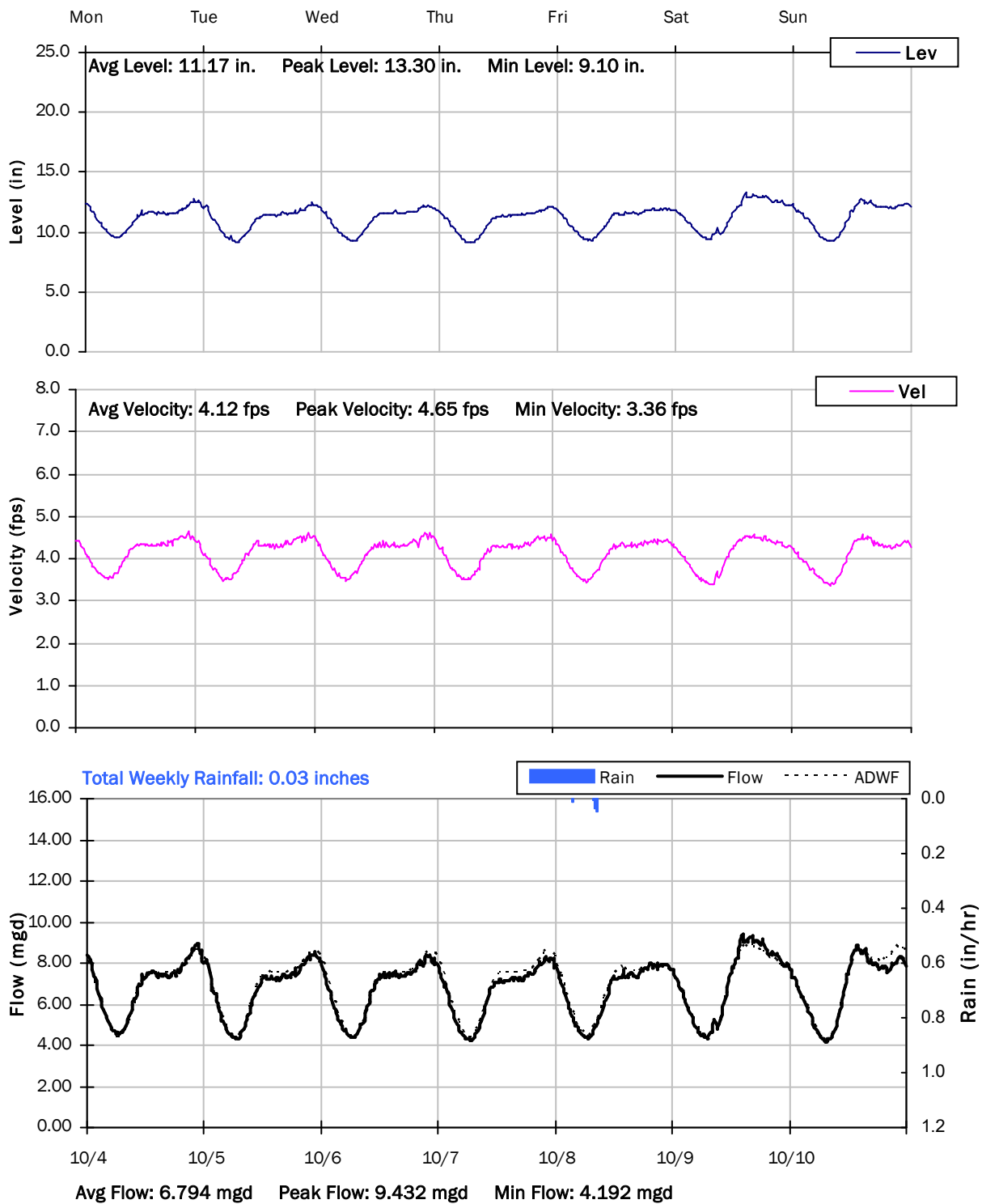
9/27/2021 to 10/4/2021



WWTP INFLUENT

Weekly Level, Velocity and Flow Hydrographs

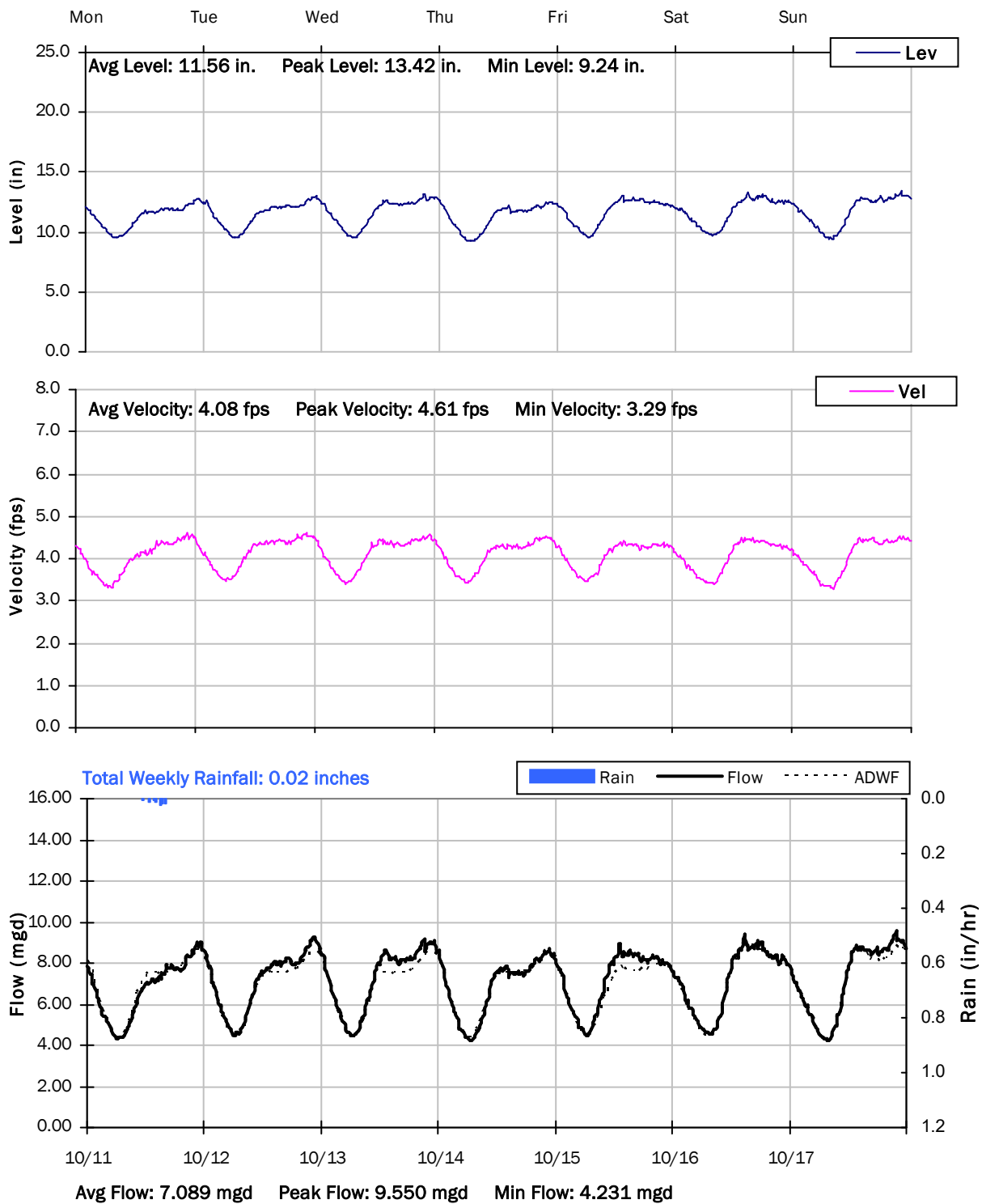
10/4/2021 to 10/11/2021



WWTP INFLUENT

Weekly Level, Velocity and Flow Hydrographs

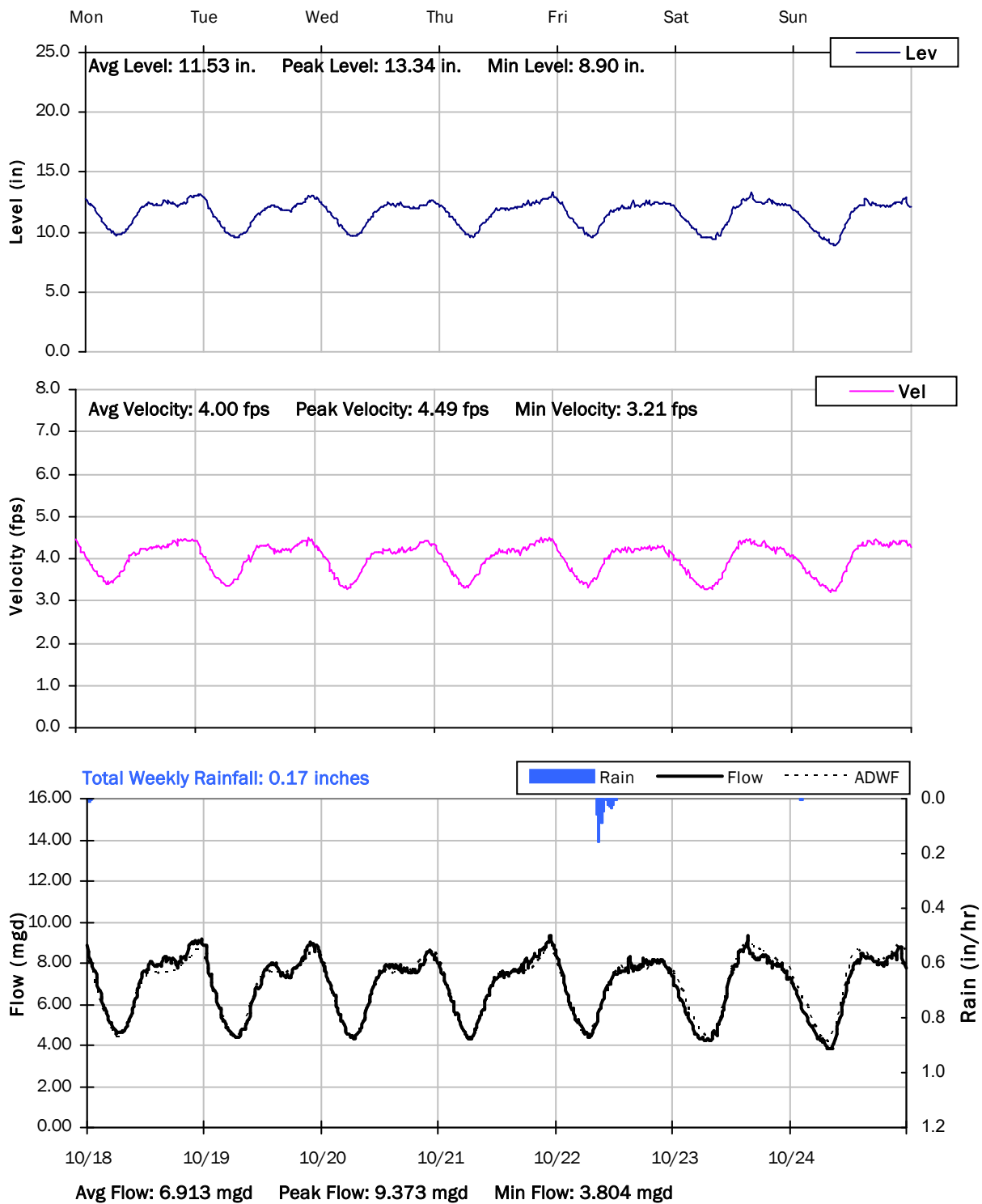
10/11/2021 to 10/18/2021



WWTP INFLUENT

Weekly Level, Velocity and Flow Hydrographs

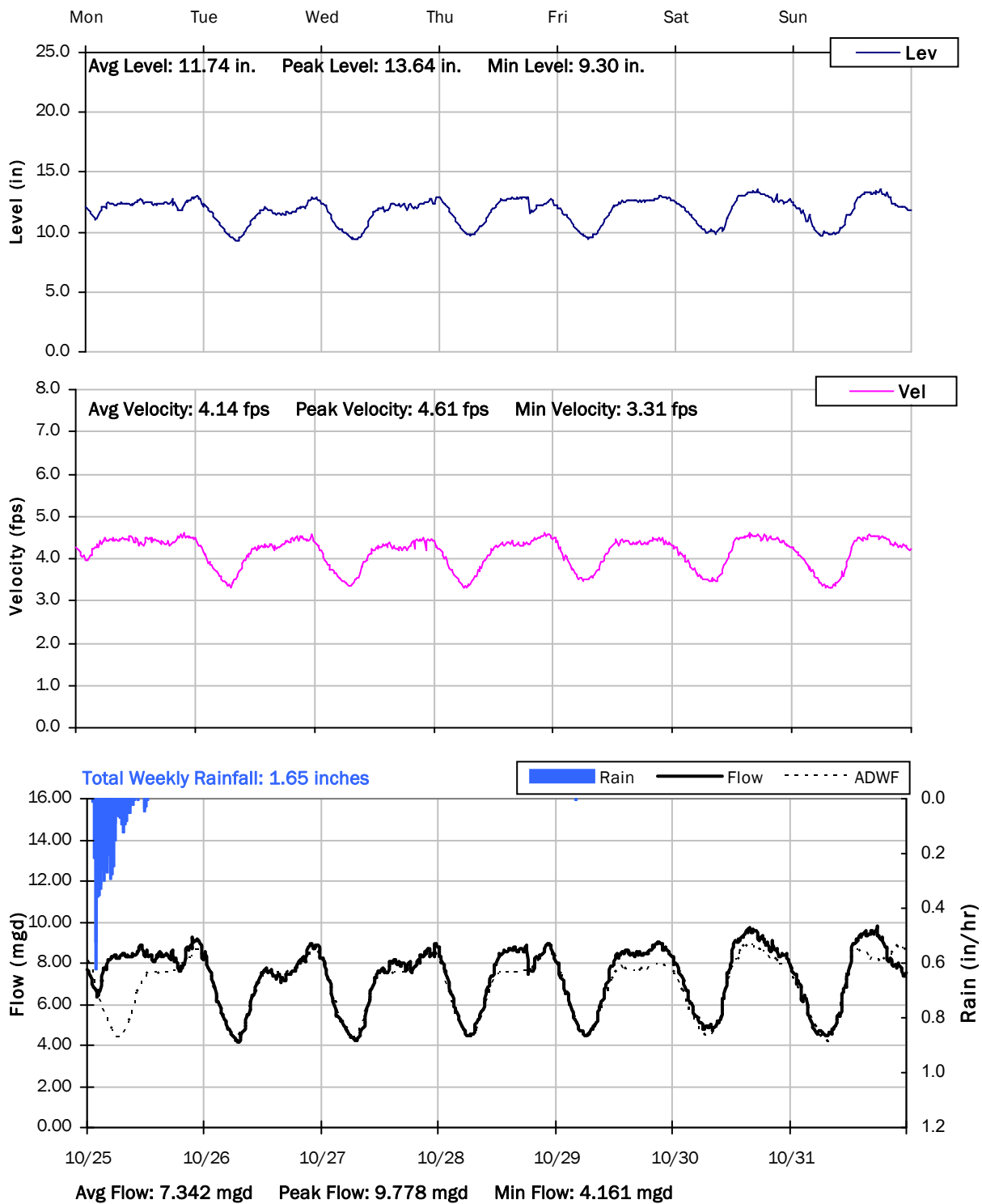
10/18/2021 to 10/25/2021



WWTP INFLUENT

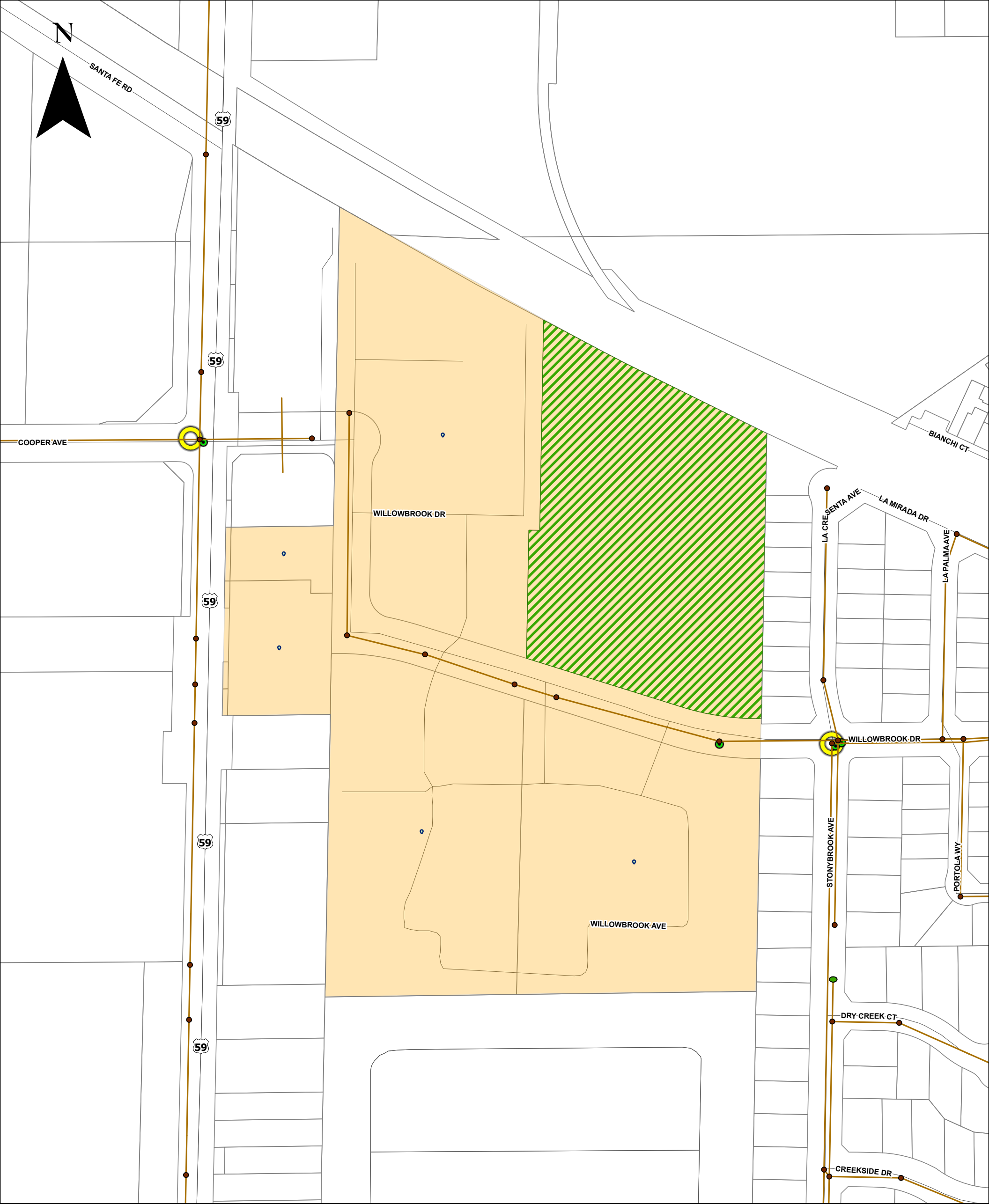
Weekly Level, Velocity and Flow Hydrographs

10/25/2021 to 11/1/2021



Appendix B

Land Use Basin Maps



Legend

 Pump Stations



 2

 High-Medium Density

 Sewer Manholes

 Sewer Clean-Outs

 Sewer Line Network

 City Parks

 Road CenterLines

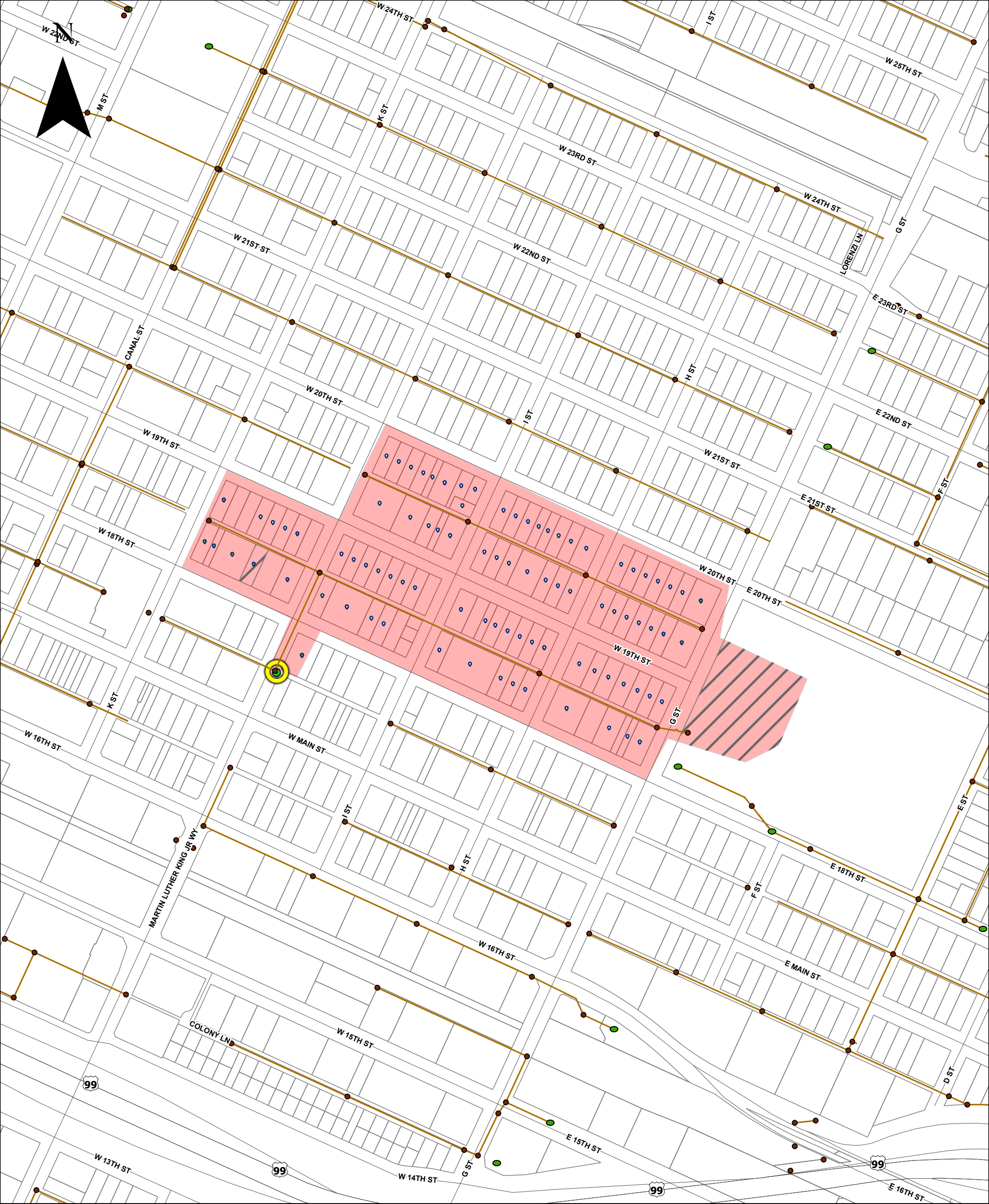
 Properties Within City of Merced Limits

 City Limits Boundary



 Sewer Accounts as of Nov 2021 (5)

High-Medium Density-2



Legend

 Pump Stations

 2

 High Density

 Sewer Manholes

 Sewer Clean-Outs

 Sewer Line Network

 Schools

 Road CenterLines

 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Accounts as of Nov 2021 (85)

 Sewer Metered Accounts as of Nov 2021 (16)

High Density-1



Legend

Pump Stations

2

Industrial

Sewer Manholes

Sewer Clean-Outs

Sewer Line Network

Road CenterLines

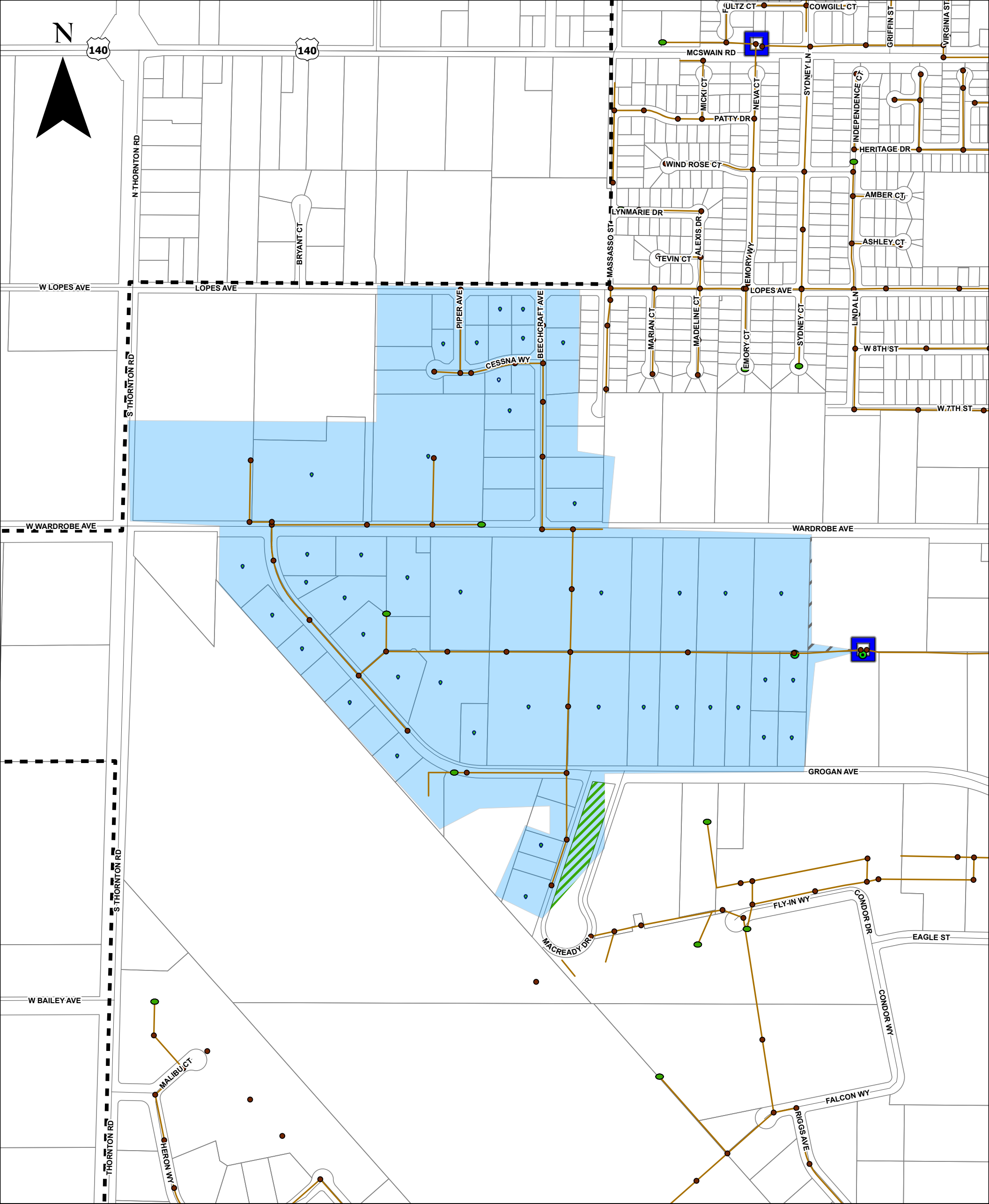
Properties Within City of Merced Limits

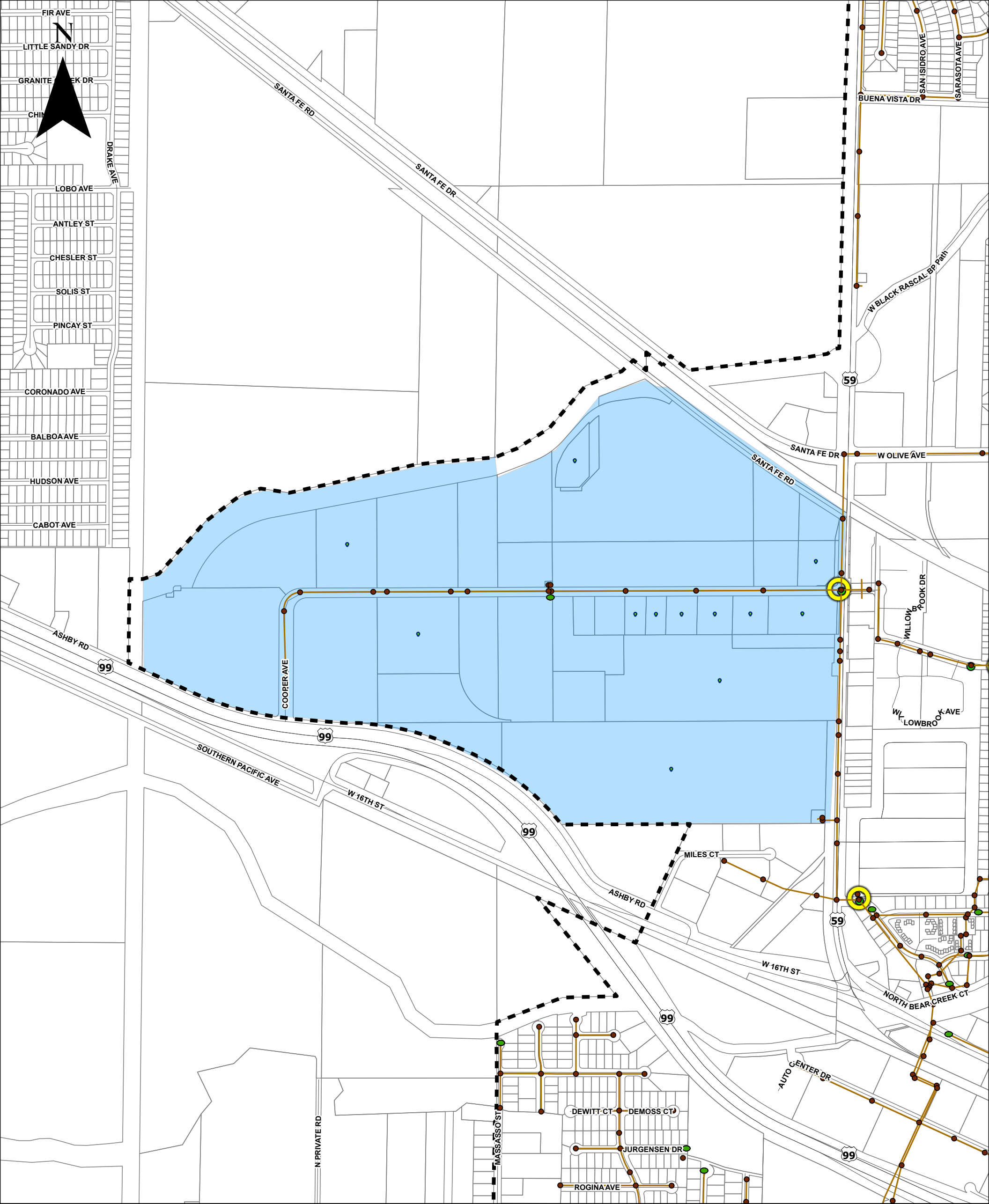
City Limits Boundary

Sewer Accounts as of Nov 2021 (59)

Sewer Metered Accounts as of Nov 2021 (7)

Industrial-1





Legend

 Pump Stations

 2

 Industrial

 Sewer Manholes

 Sewer Clean-Outs

 Sewer Line Network

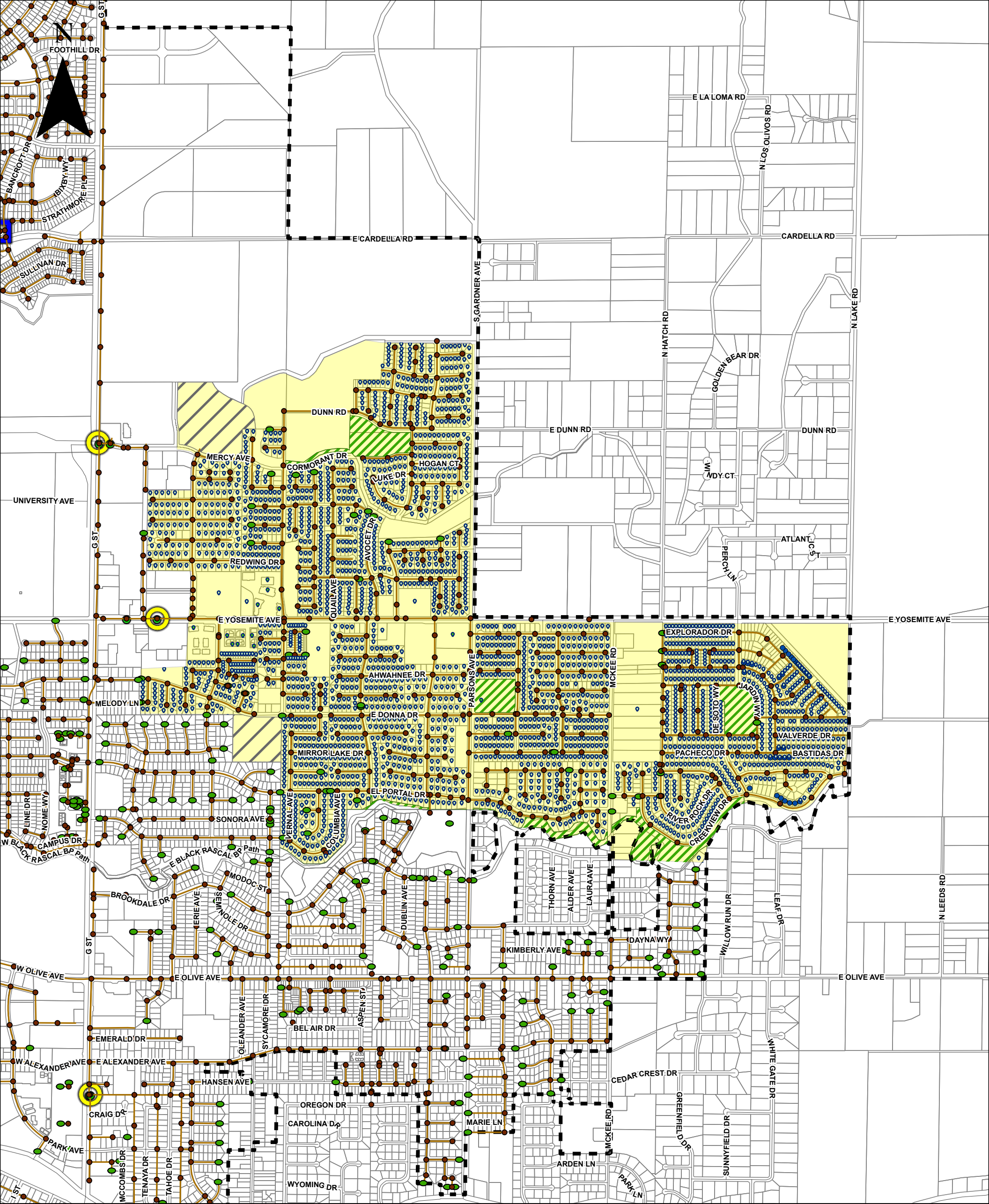
 Road CenterLines

 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Metered Accounts as of Nov 2021 (12)

Industrial-3



Legend

0

Pump Stations

2

Office Commercial

Low Density

Sewer Manholes

Sewer Clean-Outs

Sewer Line Network

Final Permits (Sept 27 to Nov 1) (33)

City Parks

Schools

Road CenterLines

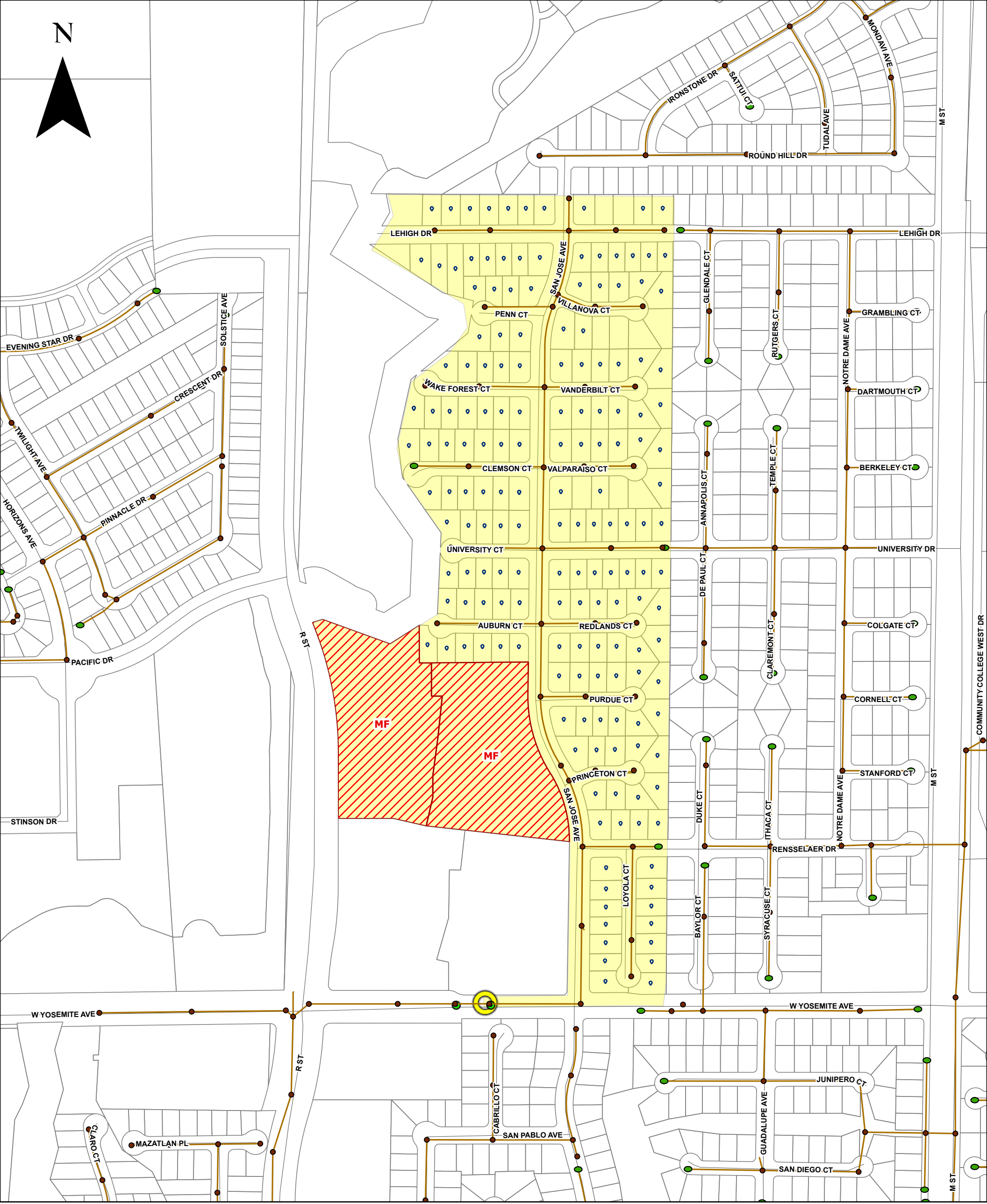
Properties Within City of Merced Limits

City Limits Boundary

Sewer Accounts as of Nov 2021 (2,799)

Sewer Metered Accounts as of Nov 2021 (13)

Low Density-1



Legend

 Pump Stations

 2

 Low Density

 Sewer Manholes

 Sewer Clean-Outs

 Sewer Line Network

 MultiFamily

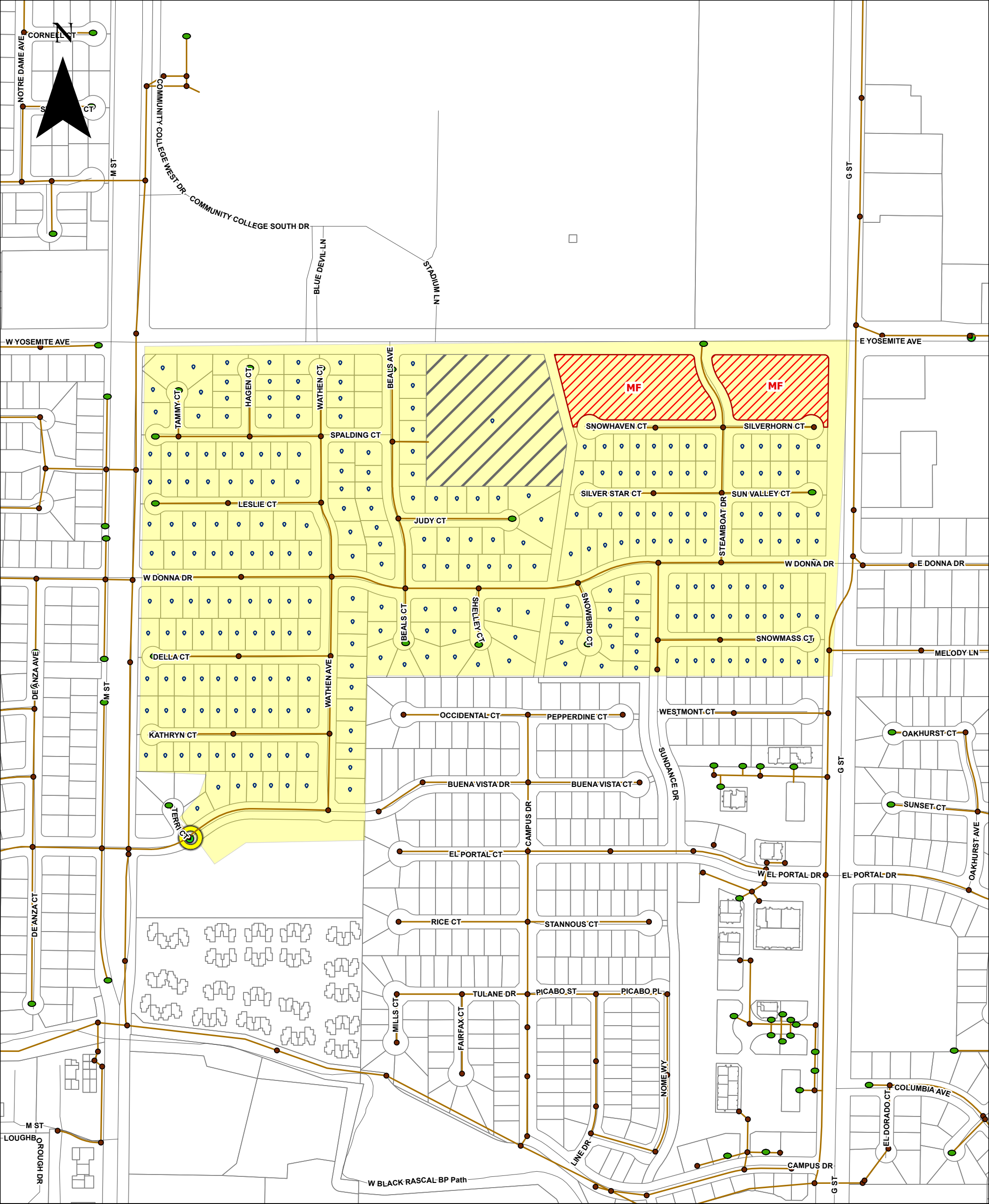
 Road CenterLines

 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Accounts as of Nov 2021 (181)

Low Density-2



Legend

 Pump Stations

 2

 Low Density

 Sewer Manholes

 Sewer Clean-Outs

 Sewer Line Network

 MultiFamily

 Schools

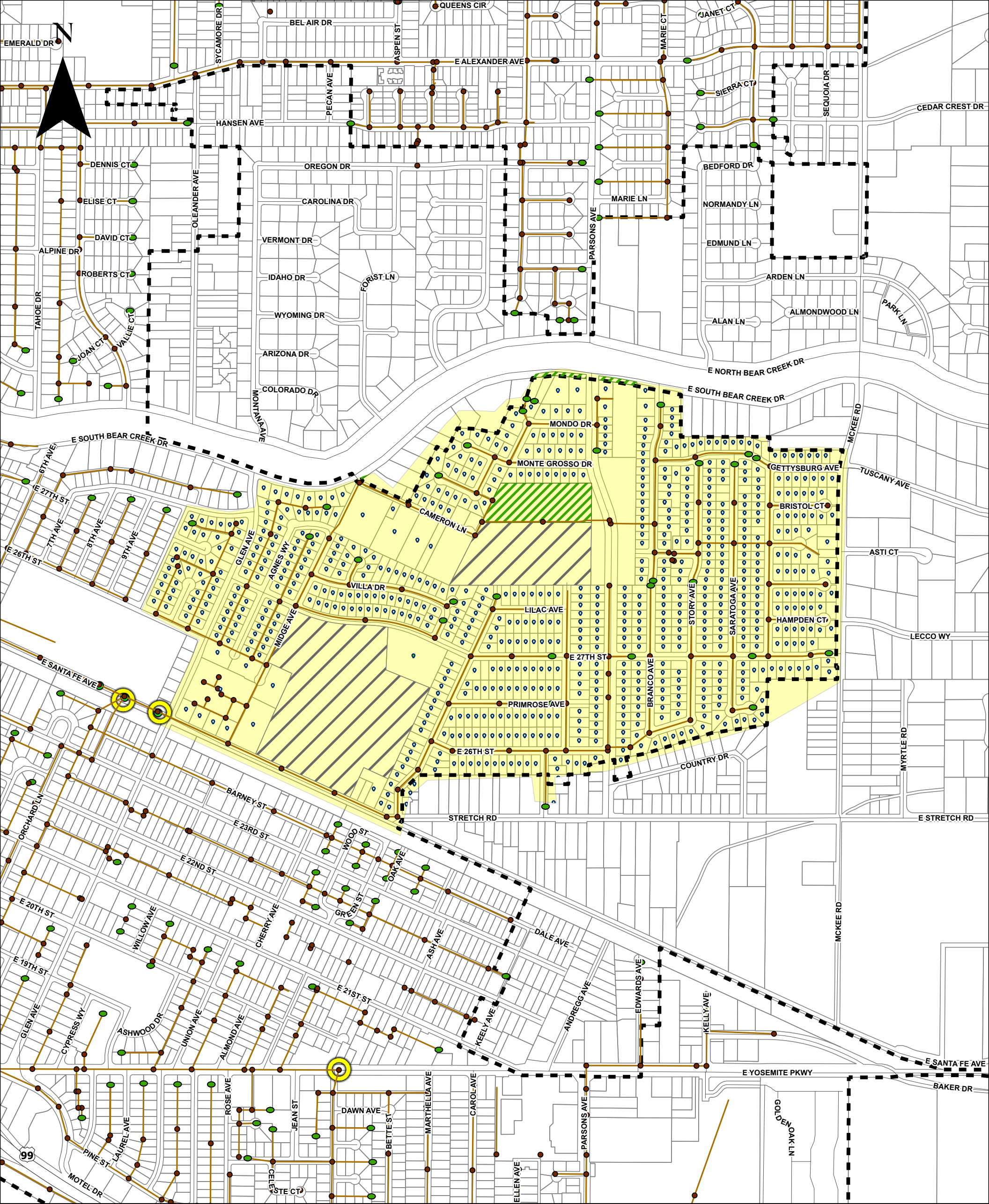
 Road CenterLines

 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Accounts as of Nov 2021 (277)

Low Density-3



Legend

Pump Stations

2

Low Density

Sewer Manholes

Sewer Clean-Outs

Sewer Line Network

City Parks

Schools

Road CenterLines

Properties Within City of Merced Limits

City Limits Boundary

Sewer Accounts as of Nov 2021 (781)

Sewer Metered Accounts as of Nov 2021 (1)

Low Density-4



Legend

 Pump Stations



 2



 Low Density



 Sewer Manholes



 Sewer Clean-Outs



 Sewer Line Network



 Final Premits (Sept 27 to Nov 1) (5)



 Road CenterLines



 Properties Within City of Merced Limits



 City Limits Boundary



 Sewer Accounts as of Nov 2021 (357)

Low Density 5 - Gerard



Legend

 Pump Stations

 2

 Low Density

 Sewer Manholes

 Sewer Clean-Outs

 Sewer Line Network

 Road CenterLines

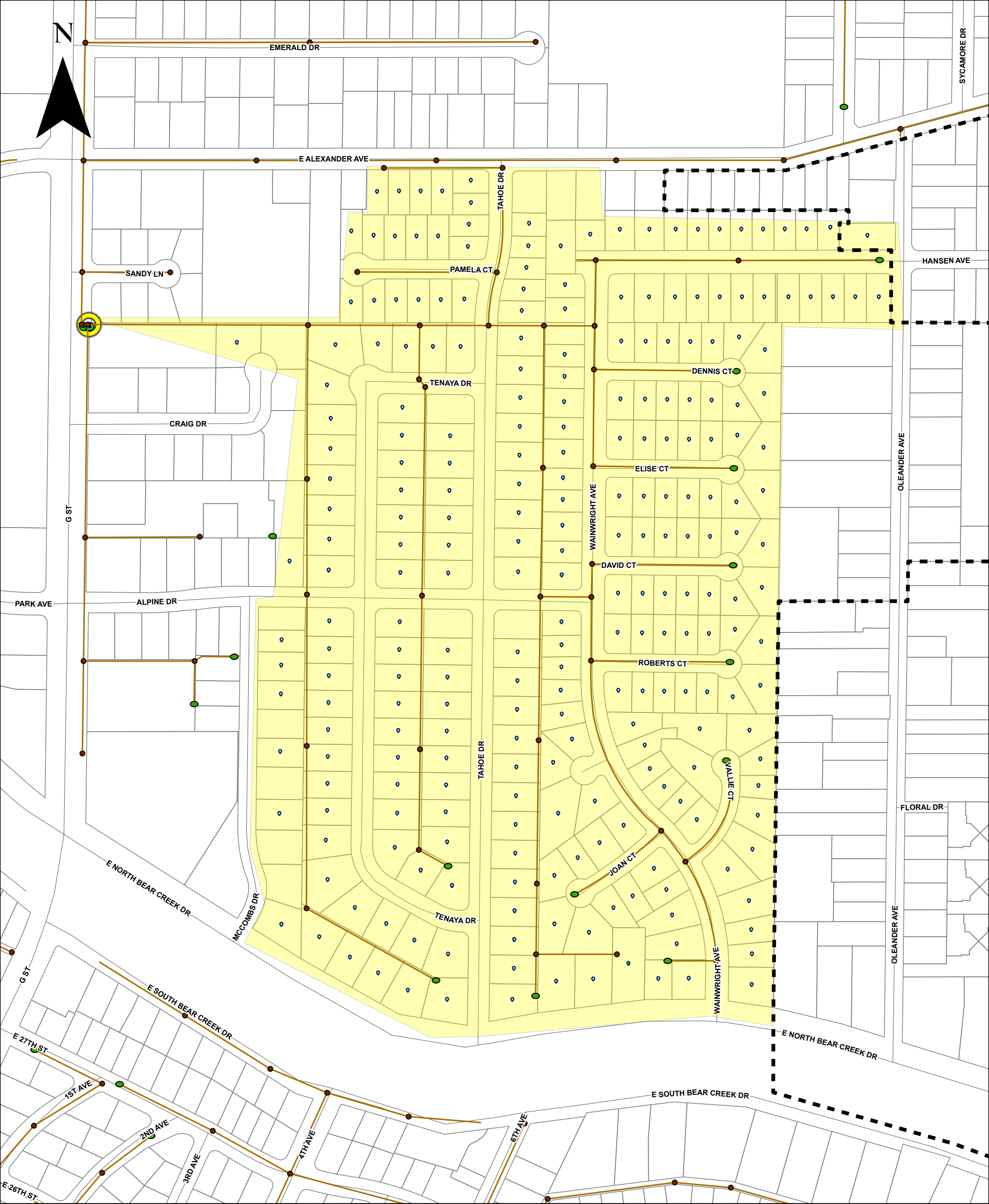
 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Accounts as of Nov 2021 (420)

 Sewer Metered Accounts as of Nov 2021 (2)

Low Density 6 - 21st/Cedar



Legend

Pump Stations

2

Low Density

Sewer Manholes

Sewer Clean-Outs

Sewer Line Network

Road CenterLines

Properties Within City of Merced Limits

City Limits Boundary

Sewer Accounts as of Nov 2021 (261)

Sewer Metered Accounts as of Nov 2021 (1)

Low Density 7 - Tahoe Dr.



Legend

 0

 Pump Stations

 2

 Low Density

 Sewer Manholes

 Sewer Clean-Outs

 Sewer Line Network

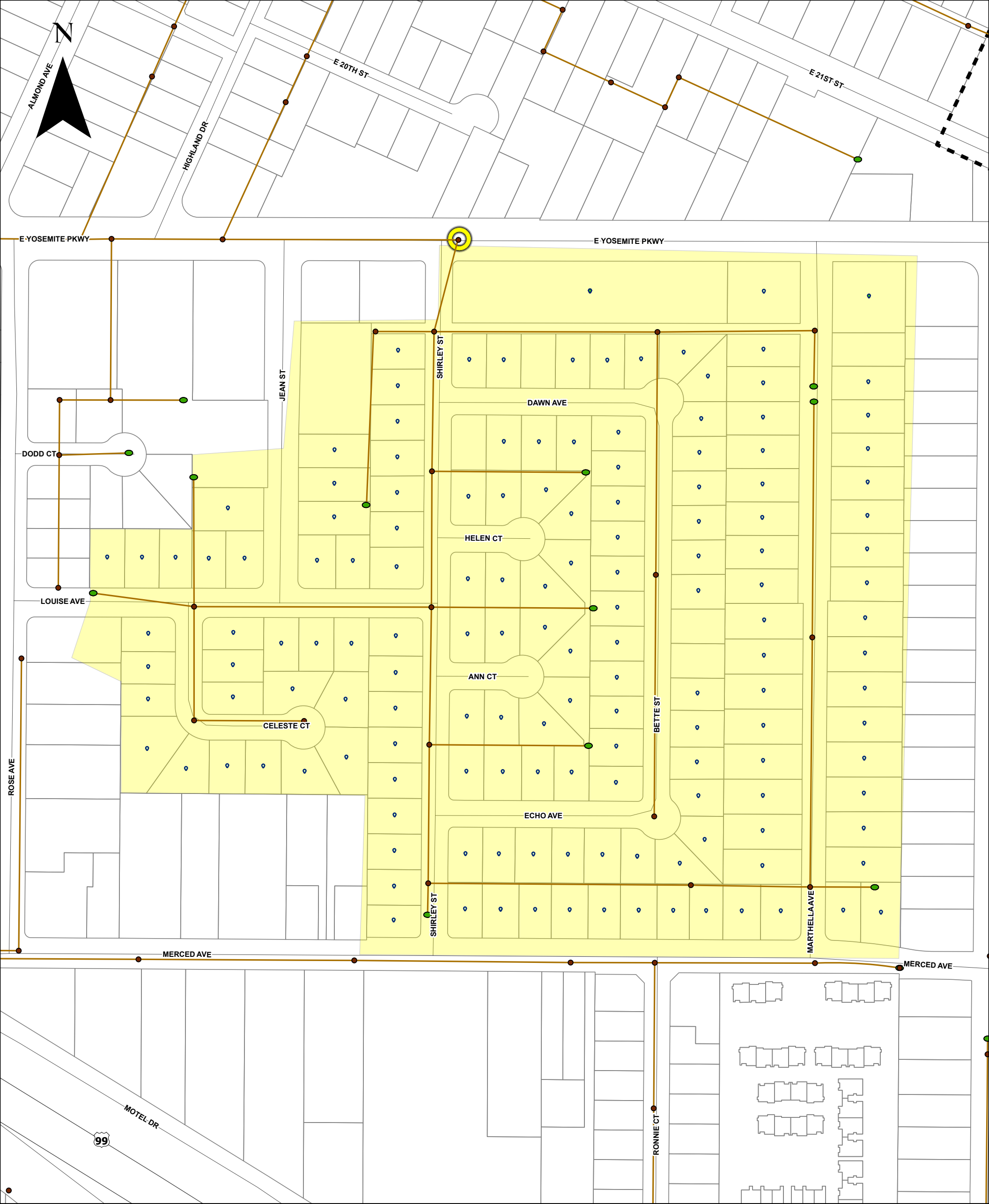
 Road CenterLines

 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Accounts as of Nov 2021 (346)

Low Density 8 - Sydney



Legend

Pump Stations

Low Density

Sewer Manholes

Sewer Clean-Outs

Sewer Line Network

Road CenterLines

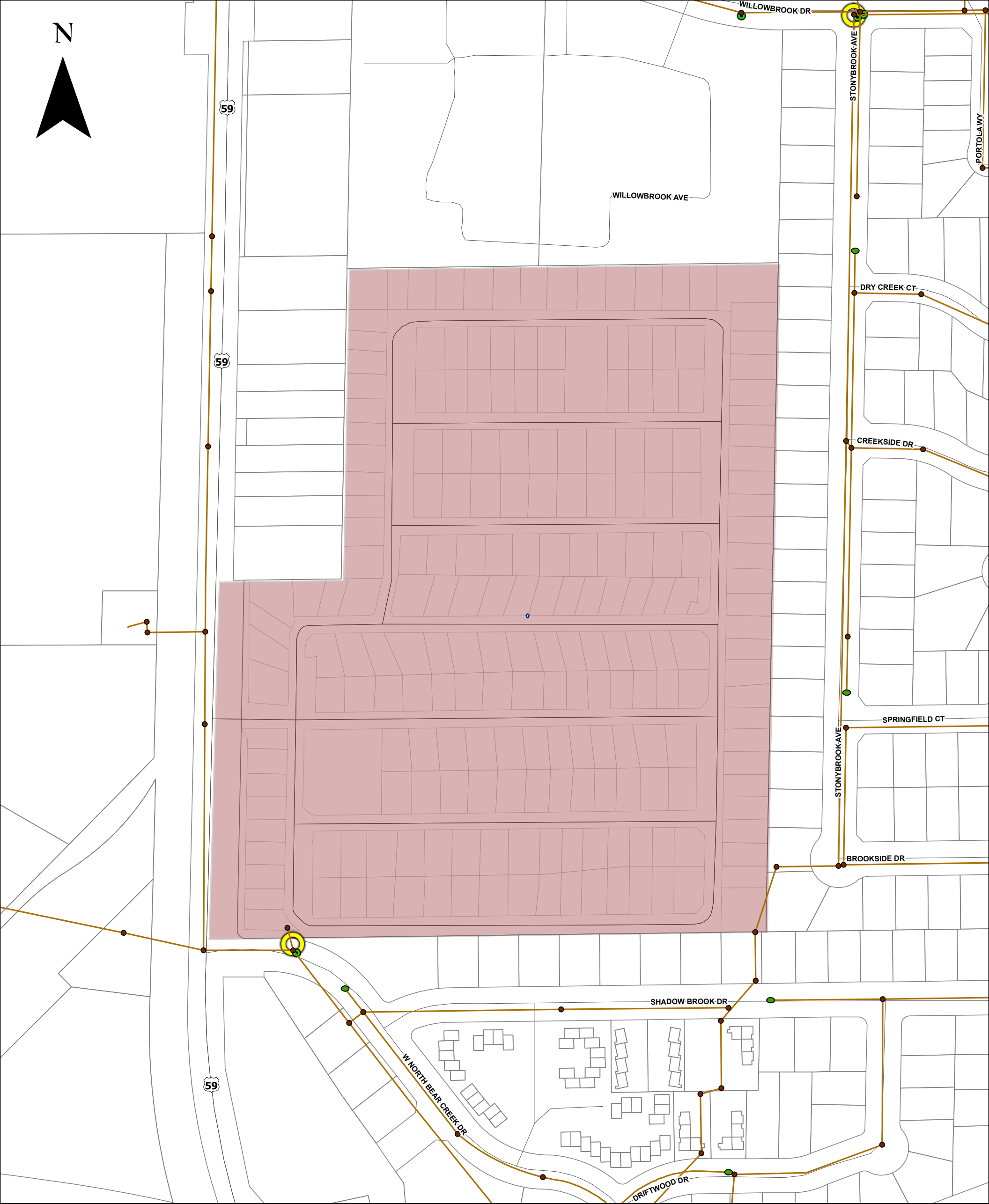
Properties Within City of Merced Limits

City Limits Boundary

Sewer Accounts as of Nov 2021 (150)

Sewer Metered Accounts as of Nov 2021 (8)

Low Density 9 - Hwy140



Legend

 Pump Stations



 2

 Mobile



 Sewer Manholes



 Sewer Clean-Outs



 Sewer Line Network



 Mobile Park Units (217)



 Road CenterLines



 Properties Within City of Merced Limits

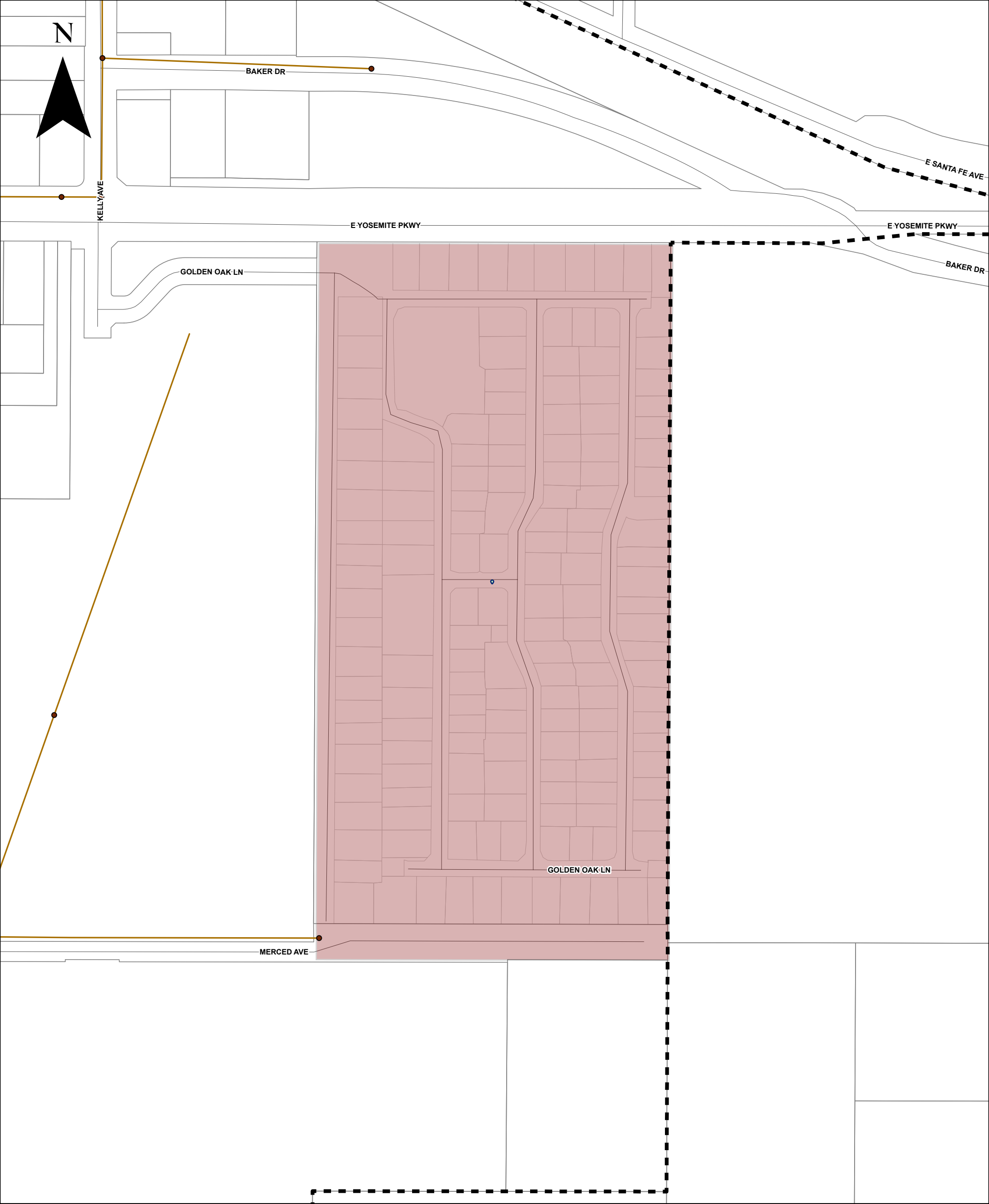


 City Limits Boundary



 Sewer Accounts as of Nov 2021 (1)

Mobile-2



Legend

Mobile

Sewer Manholes

Sewer Line Network

Mobile Park Units (159)

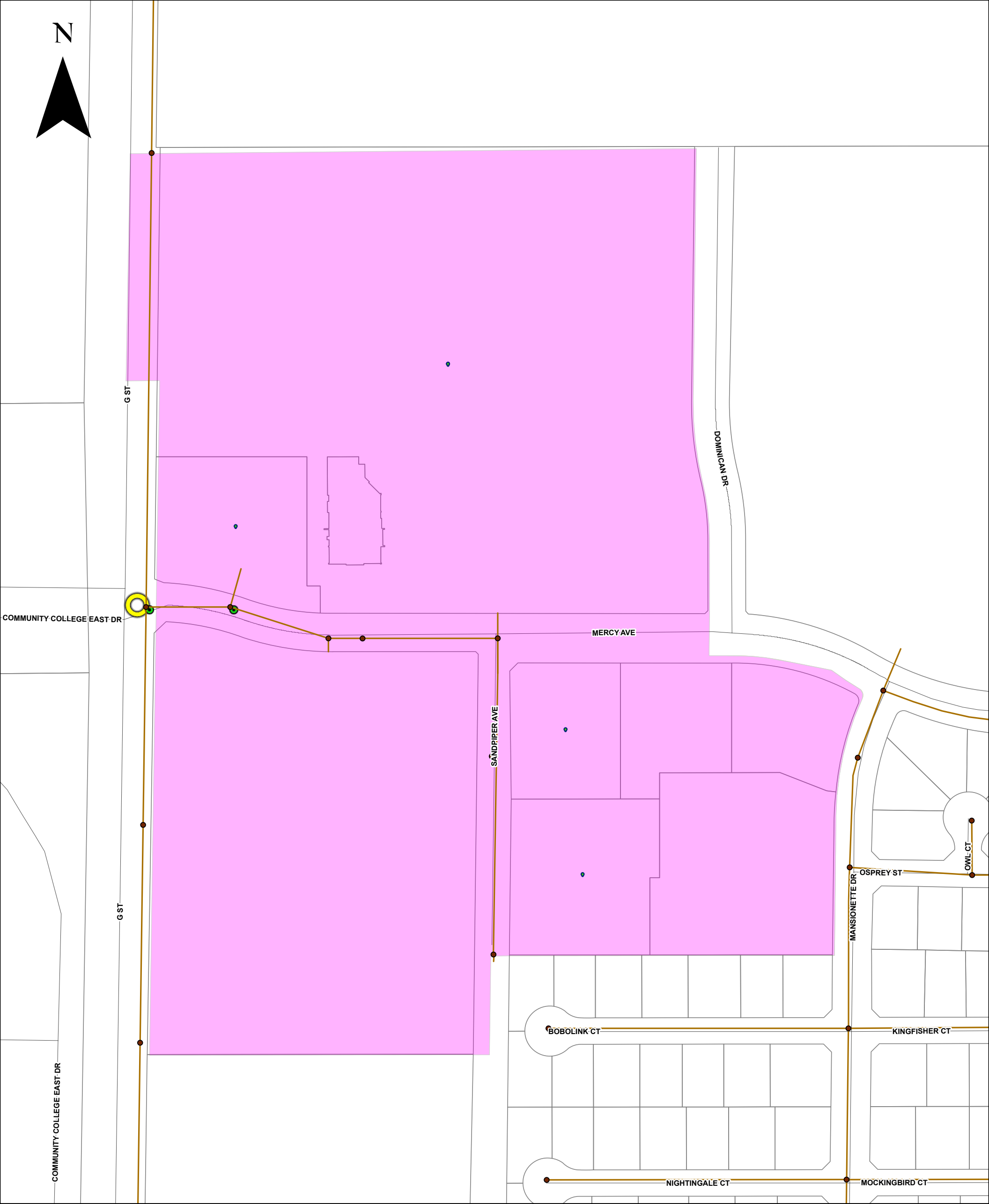
Road CenterLines

Properties Within City of Merced Limits

City Limits Boundary

Sewer Accounts as of Nov 2021 (1)

Mobile-2



Legend

 Pump Stations

 2

 Office Commercial

 Low Density

 Sewer Manholes

 Sewer Line Network

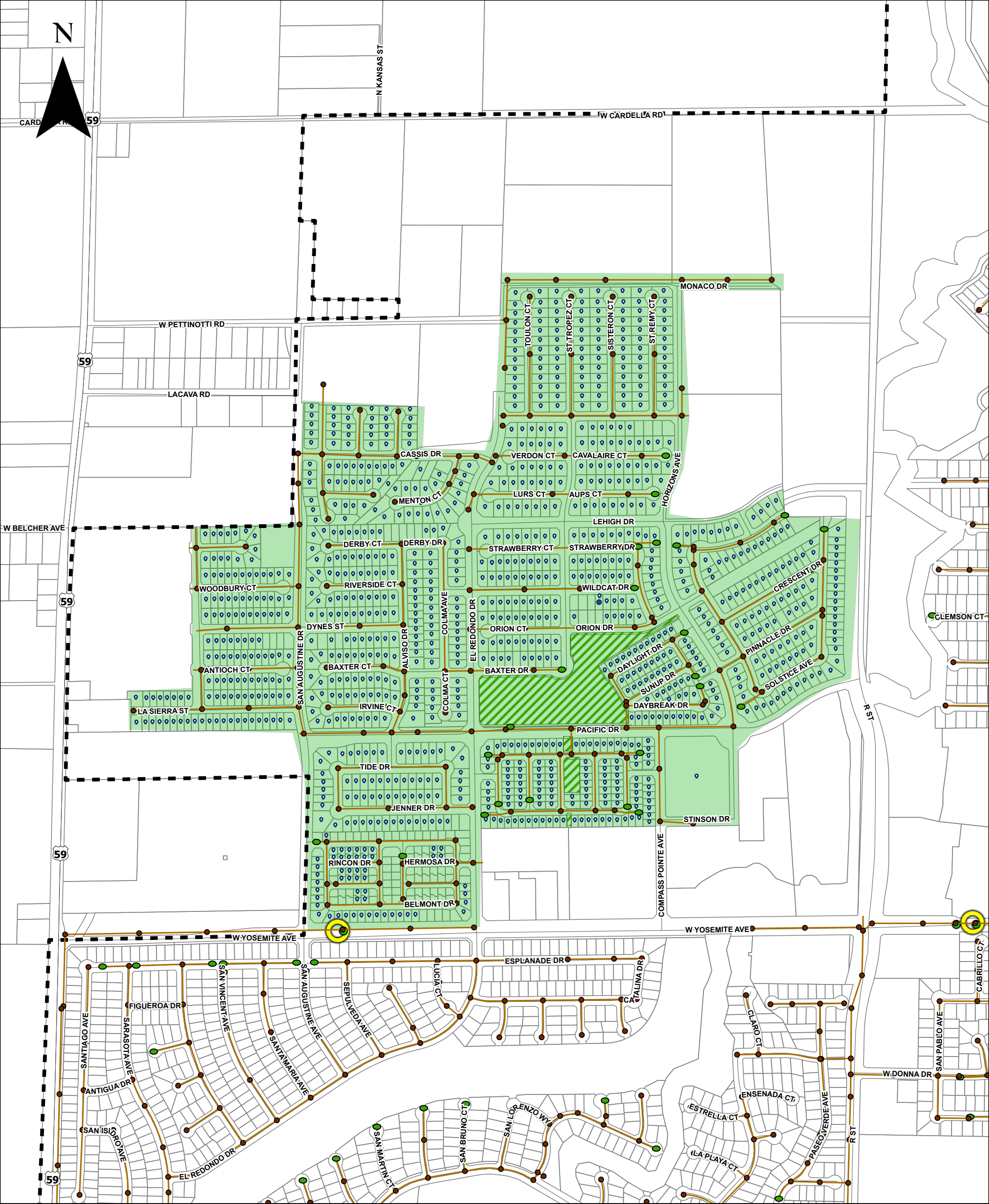
 Road CenterLines

 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Metered Accounts as of Nov 2021 (6)

Office Commercial-2 (hosp/med)



Legend

 Pump Stations

 2

 Planned Development

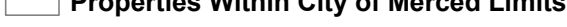
 Sewer Clean-Outs

 Sewer Line Network

 Final Permits (Sept 27 to Nov 1) (1)

 City Parks

 Road CenterLines

 Properties Within City of Merced Limits

 City Limits Boundary

 Sewer Accounts as of Nov 2021 (1,123)

Planned Development-1

