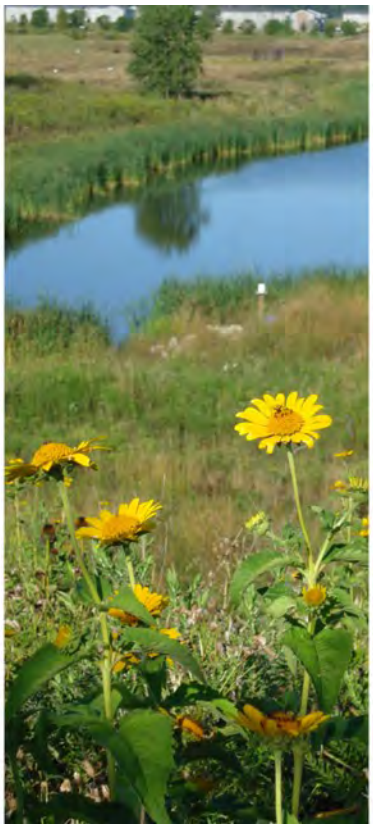
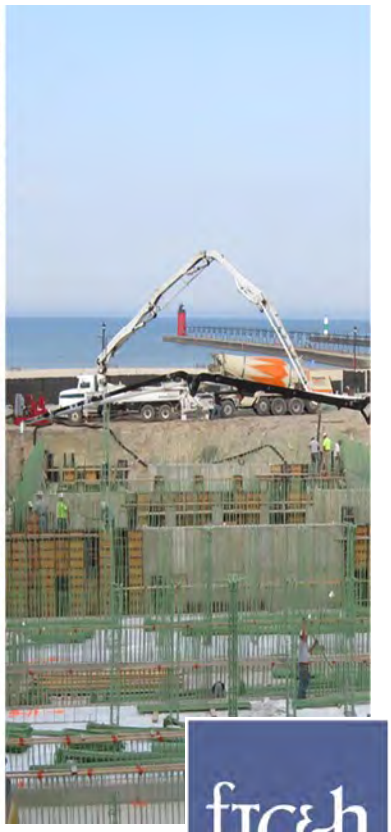
Preliminary Design Memorandum

Nine Mile Collection System Improvements

Project No. 171445
December 18, 2018





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PRELIMINARY DESIGN MEMORANDUM

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DATE: December 18, 2018 **PROJECT NO.:** 171445

RE: Nine Mile Collection System Improvements

Table of Contents

Table of Contents 1

Introduction 2

Background and Existing Data Review 2

Collection System Evaluation 3

- Flow Monitoring 3
- Rainfall Data 4
- Dry Weather Flow Summary 4
- Wet Weather Flow Summary 4
- I/I Analysis 5
- CCTV Review 6

Model and Capacity Analysis 7

- Model Calibration 7
- Design Storms 7
- Model Flow Projections 7

Alternatives Analysis 9

- Option 1: Reduce Peak Flows (I/I Removal) 9
- Option 2: Increase Interceptor Capacity (Phase 1) 10
- Option 3: Reduce Peak Flows and Increase Interceptor Capacity (Phase 1 and I/I Removal) 11
- Option 4: Increase Interceptor Capacity (Phase 1 and 2) 11
- Option 5: Increase Interceptor Capacity and Reduce Peak Flows (Phase 1, 2 and I/I Removal) 12
- Option 6: Underground Storage 12

Future Development 13

Recommendations 14

List of Tables

Table 1 – Rainfall Summary 4
Table 2 – Dry Weather Flow Summary 4
Table 3 – Wet Weather Flow Summary 5
Table 4 – Design Storms and Modeled Rainfall 7
Table 5 – Existing System Flow Projections 7
Table 6 – Actual Peak Flows (Upsizing Interceptor to 24-inch) 8
Table 7 – Reduce Peak Flows (I/I Removal) 9
Table 8 – Peak Flow at WWTP 12
Table 9 – Required Storage Volume 13
Table 10 – Population Forecast 13
Table 11 – Peak Flow to WWTP (2030 Flows) 13

List of Figures

Figure 1 – Flow Monitoring Locations
Figure 2 – Flow Monitoring Schematic
Figure 3 – I/I Contributions by Tributary Area
Figure 4 – PACP Defects (I/I)
Figure 5 – Interceptor Improvements

List of Appendices

Appendix 1 – Model Calibration Hydrographs
Appendix 2 – CCTV Review Summary Table

Introduction

The 2011 Clermont County (County) Wastewater Master Plan Update identified the potential for capacity issues in the sewer system upstream of the Nine Mile Wastewater Treatment Plant (WWTP). However, the Master Plan did not include flow monitoring and calibration of the sewer system hydraulic model. To better simulate actual conditions, FTCH installed six flow monitors in strategic locations to establish dry weather and wet weather flows in the sewer upstream of the Nine Mile WWTP. The flow monitoring data was used to identify areas in the system with significant responses to inflow and infiltration (I/I) and update the County's existing sanitary hydraulic model. The model was used to identify capacity issues for various design storm events. FTCH utilized the updated model to perform alternative analyses and identify different solutions for addressing capacity issue(s). The following preliminary design memorandum describes the findings, conclusions and recommendations with associated costs for implementing these improvements.

Background and Existing Data Review

The focus of this study was on the collection system upstream of the Nine Mile WWTP. The upstream collection system consists of an 18-inch trunk sewer flowing south and a 12-inch trunk sewer flowing from the east. The two trunk sewers converge at the confluence of Nine Mile Creek near the intersection of Nine Mile Road and Bradbury Road. Flows continue southwest to the Nine Mile WWTP through a single 18-inch interceptor located along the creek. The 18-inch sewer transitions to a 21-inch sewer roughly 2,500 feet upstream of the WWTP and enters the treatment plant via 275 lineal feet (lf) of 24-inch sewer. The entire length of the interceptor is approximately 8,500 lf.

FTCH reviewed up-to-date Geographical Information System (GIS) data provided by the County to verify the hydraulics of the existing uncalibrated model of the Nine Mile collection system. Within its GIS, the County provided shapefiles containing a summary of the Pipeline Assessment Certification Program (PACP) coded defects from available closed circuit television (CCTV) records of the existing sewer system which were used to identify concentrated areas of defects.

Collection System Evaluation

Flow Monitoring

Six area/velocity flow meters were installed in strategic locations within the collection system following site visits by FTCH staff and coordination with County staff. Flow data was downloaded bi-weekly from each monitor from March 13, 2018 to June 19, 2018. The flow monitoring program was designed for two purposes: to identify the areas within the collection system that are contributing significant I/I and to calibrate the existing hydraulic model. The locations of the six flow monitors are shown in Figure 1 and described below. Figure 2 is a flow schematic showing the upstream and downstream relationships between the flow monitors.

<u>Site 1 – MH 6650 – Springs Lane (12-inch)</u>

A flow monitor was installed in manhole 6650 on the 12-inch sanitary sewer running south near Springs Lane, just east of Nine Mile Road. The total tributary area is a combination of residential and commercial area and incorporates approximately 665 acres. The incremental tributary area to Site 1 is 355 acres.

<u>Site 2 – MH 9031 – Michael Drive (15-inch)</u>

A flow monitor was installed in manhole 9031 on the 15-inch sewer on Michael Drive, west of Nine Mile Road and South of I-275. The tributary area to the monitor is approximately 765 acres which services a combination of residential and commercial users.

<u>Site 3 – MH 6591 – Nine Mile Tobasco (18-inch)</u>

A flow monitor was installed in manhole 6591 on the 18-inch interceptor sewer on Nine Mile Tobasco Road. This monitor characterizes the majority of the incoming flow to the Nine Mile WWTP. The total tributary area to the monitor is approximately 5,030 acres.

<u>Site 4 – MH 6875 – Slaven Road (12-inch)</u>

A flow monitor was installed in manhole 6875 on the 12-inch sewer east of Slaven Road and north of Bradbury Road. The total tributary area is largely residential and incorporates approximately 2,140 acres. The incremental tributary area to Site 4, downstream of Site 5, is 1,940 acres. This monitor characterizes the flow entering the 18-inch interceptor from the 12-inch trunk on the northeast side of the study area.

<u>Site 5 – MH 766 – Still Meadow Drive (10-inch)</u>

A flow monitor was installed in manhole 766 on the 10-inch sewer running south between Still Meadow Drive and Country Club Drive. The monitor is located near the Royal Oaks Golf Course. The tributary area to the monitor is largely residential and incorporates approximately 200 acres.

<u>Site 6 – MH 6682 – Ohio Pike (12-inch)</u>

A flow monitor was installed in manhole 6682 on the 12-inch sewer running south through a commercial area near Ohio Pike SR-125. The monitor is located just east of I-275. The tributary area to the monitor services both commercial and residential users and incorporates approximately 310 acres.

Rainfall Data

Rainfall data was gathered from two rain gauges located near the project area during the study period. Data was retrieved from Weather Underground (www.weatherunderground.com) from the Amelia station (KOHAMEL18) located east of Bach Bruxton Road and north of the Ohio Pike (SR-125), and from the Nottingham Cove station (KOHCINCI270) between Eight Mile Road and Nordyke Road, just north of the Cincinnati By-pass (I-275). The Amelia station is located approximately 2.8 miles northeast of the project area, and the Nottingham station is located approximately 2.3 miles northwest of the project area. Rainfall data was compared to verify both stations reported similar daily rainfall volumes and distributions. The County received significant rainfall on the days listed below in Table 1.

Table 1 – Rainfall Summary

Date	Rainfall Amount (inches)	Rainfall Duration (hours)
March 28-30, 2018	1.95	62
April 3, 2018	1.67	24
April 15, 2018	1.63	22
June 1, 2018	0.52	16
June 12, 2018	0.39	5

Dry Weather Flow Summary

Table 2 below shows the average dry weather flow observed at each of the flow monitors. Dry weather flows are compared to wet weather flows in the subsequent sections of this memorandum.

Table 2 – Dry Weather Flow Summary

Monitor	Average Daily Dry Weather Flow (gpm)
Site 1 – MH 6650 – Springs Lane	242
Site 2 – MH 9031 – Michael Drive	212
Site 3 – MH 6591 – Nine Mile Tobasco	1,261
Site 4 – MH 6875 – Slaven Road	218
Site 5 – MH 766 – Still Meadow Drive	40
Site 6 – MH 6682 – Ohio Pike	31

Wet Weather Flow Summary

Table 3 below presents the observed wet weather flows and corresponding peaking factor for each of the flow monitors during the study period. The adjusted dry weather flow represents the instantaneous dry weather flow that would likely have occurred on a typical dry weather day at the time the peak wet weather flow is occurring.

Table 3 – Wet Weather Flow Summary

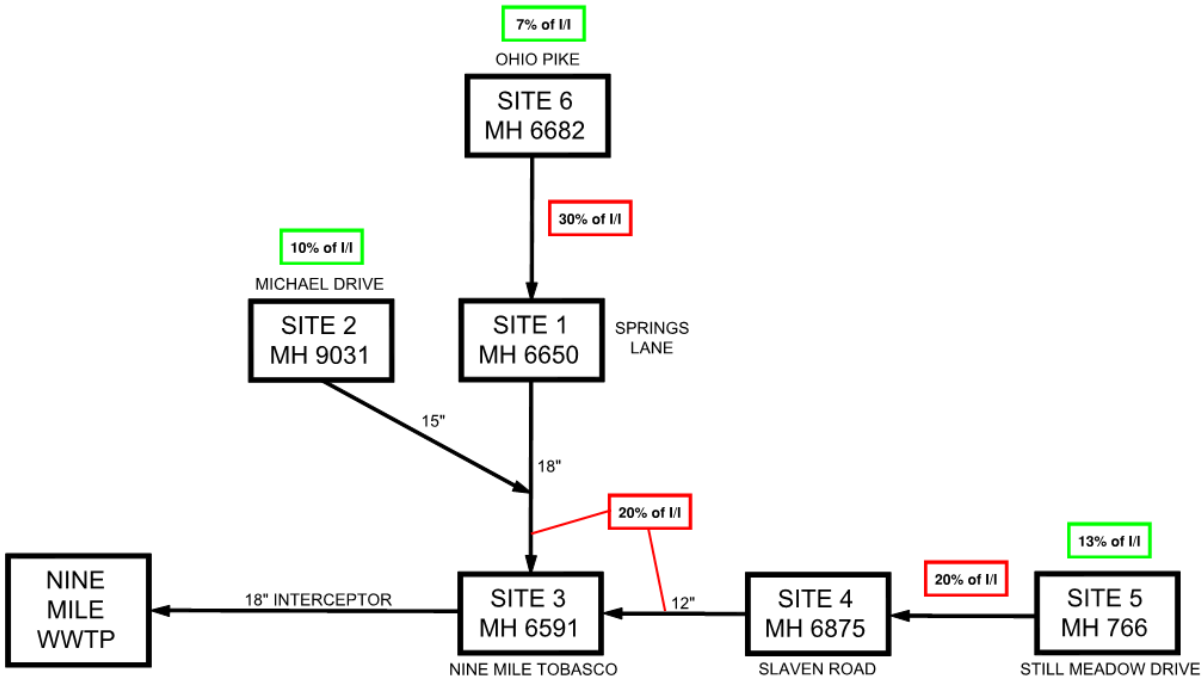
Monitor	Date and Time of Peak Wet Weather Flow	Adjusted Dry Weather Flow (gpm)	Largest Observed Peak Wet Weather Flow (gpm)	Maximum Peaking Factor Observed
Site 1 – MH 6650 – Springs Lane	4/3/2018 22:30	377	962	2.6
Site 2 – MH 9031 – Michael Drive	3/28/2018 6:25	158	722	4.6
Site 3 – MH 6591 – Nine Mile Tobasco	4/15/2018 14:10	1,275	3,877	3.0
Site 4 – MH 6875 – Slaven Road	4/3/2018 4:10	119	804	6.8
Site 5 – MH 766 – Still Meadow Drive	4/3/2018 3:30	71	346	4.9
Site 6 – MH 6682 – Ohio Pike	4/3/2018 22:40	59	259	4.4

I/I Analysis

Based on analysis of the flow monitoring data, significant I/I was observed within a few areas of the collection system and should be considered for improvements. Figure 3 shows a map of the tributary areas and the approximate percentages of I/I contribution from each incremental area to the total I/I seen at Site 3. I/I contributions were estimated from observed flow monitoring data during the April 15, 2018 rainfall event. Figure 4 shows the associated I/I related PACP defects within each tributary area.

The three priority areas were identified as follows:

- Between Site 6 and Site 1 (30% of total I/I)
- Upstream of Site 3 and downstream of Sites 1, 4, and 2 (20% of total I/I)
- Between Site 5 and Site 4 (20% of total I/I)



CCTV Review

The County provided FTCH with PACP summary reports of the defects found within the sewers during CCTV inspections. During inspection, the sanitary sewers are assessed from both a structural perspective and an O/M perspective. The structural assessment outlines where the pipe is physically damaged or defective. O/M assesses defects that may obstruct pipe flow or will affect the structural condition overtime, including defects such as deposits, debris, roots and I/I. The reports provided by the County were analyzed to identify areas within the collection system where significant I/I defect grades (4 or 5) were reported. The County also provided a selection of CCTV videos for review to confirm the presence of I/I within the public system. Appendix 2 contains a list of the sewer segments reviewed along with notes on the condition of the sewer.

The most common sources of I/I seen in the televising and reported on the PACP defect sheets include infiltration gushers (rated 5) and runners (rated 4) at pipe joints, at lateral connections to the mainline sewer, and at the first or second joint within the laterals. These issues can be addressed by grouting the area where the clear water is entering the sewer and installing a cured in place pipe, which can be installed in the entire pipe segment or in 4-foot long sections. Although the scope of the analysis did not include reviewing manholes for presence of I/I, the televising and PACP summary reports suggest that several manholes show evidence of I/I at the chimney, wall joints, and pipe connections.

Of the sewers provided by the County for review, a total of 25 pipe segments totaling slightly less than 7,000 lf received O/M scores of 4 or 5 due to infiltration. Approximately 70% of the instances of infiltration gushers and runners were found in the sewers located upstream of Site 5 and Site 4. Specifically, the sewers under Carol Drive, Dieckman Drive, Debby Carol Drive, and Jackie Drive should be targeted for I/I removal. Many infiltration sources were also found in the sewers under Gaskins Road, Conley Road, Crescent Drive and Terrydel Lane. Additional effort is required to determine the final limits of the project, but we would recommend the County initially budget $850,000 for this work which would include up to 7,000 lf of CIPP lining, lining up to 50 manholes, and completing up to 11 spot repairs.

Model and Capacity Analysis

Model Calibration

The County's existing hydraulic model was originally developed in 2011 by CH2M HILL using Infoworks ICM software. Manhole rim elevations, pipe inverts, and pipe lengths were provided in the existing model but were verified with the County's GIS database. The NML 2010 model network within the County's model database was calibrated using flow data from the rain events shown in Table 1. The model has two key components: hydrology, which simulates the rainfall runoff to the point where it enters the collection system; and hydraulics, which simulates the flow within the sewer system. Runoff was generated in the model using the RTK method for simulating rainfall derived I/I in the system. The runoff generated by the RTK method is routed through the hydraulic model and predicts the flow rate through the sanitary sewer. RTK parameters for each flow monitor were adjusted until the model predicted a similar response compared to the response observed in the flow monitoring data. Parameters were adjusted until a satisfactory calibration was achieved and the results matched reasonably with the overall hydrograph shape, peak flow, and total volume. Appendix 1 contains hydrographs of each monitor during select rainfall events.

Design Storms

The calibrated Infoworks ICM model was used to evaluate how the existing sewer system would respond to different design storm events. FTCH evaluated the 5-year, 6-hour event, the 10-year, 24-hour event and the 25-year, 24-hour event as a part of the study. The three events differ in rainfall volume and intensity and are represented in the table below. Rainfall intensities were based on Bulletin 71 and SCS Type II distributions were used.

Table 4 – Design Storms and Modeled Rainfall

Storm	Total Rainfall Volume (in)
5-year, 6-hour	2.62
10-year, 24-hour	3.99
25-year, 24-hour	4.70

Model Flow Projections

The calibrated model was used to determine peak wet weather flows in the existing sewer system for the 5-year, 6-hour storm, 10-year, 24-hour storm, and 25-year, 24-hour storm. Peak flows are presented in the following table.

Table 5 – Existing System Flow Projections

Monitor	5-yr, 6-hr (gpm)	10-yr, 24-hr (gpm)	25-yr, 24-hr (gpm)
Site 1 – MH 6650 – Springs Lane	1,513	2,375	2,449
Site 2 – MH 9031 – Michael Drive	1,715	1,849	1,897
Site 3 – MH 6591 – Nine Mile Tobasco	4,940	5,403	5,414
Site 4 – MH 6875 – Slaven Road	1,759	2,220	2,348
Site 5 – MH 766 – Still Meadow Drive	660	960	1,068
Site 6 – MH 6682 – Ohio Pike	489	782	886

The upstream 18-inch trunk sewer from the north and 12-inch trunk sewer from the east are adequately sized to handle flows for the 5-year, 6-hour storm event. The model shows surcharging in the 18-inch interceptor for this design event and shows manholes overflowing or surcharging near the ground elevation. The interceptor is shallow and flat in many locations, particularly at creek crossings. These shallow, flat sewers act as a bottleneck in the system which results in surcharging upstream. The profile below shows the existing interceptor from the upstream end at Bradbury Road to the downstream end at the WWTP. Running the 10-year, 24-hour and 25-year, 24-hour storm events causes the surcharge from the 18-inch interceptor to extend back into both trunk sewers. The surcharge observed in both trunk sewers does not appear to be a capacity issue but rather the result of a backwater effect due to the downstream restriction on the 18-inch interceptor.

Profile 1 – Existing 18-inch interceptor (5-year, 6-hour storm)

To review the full projected flow to the WWTP, the 18-inch interceptor was upsized to a 24-inch sewer in the model to reduce the surcharging and accommodate the predicted flows for the three storm events. The unrestricted peak flows to the WWTP are shown in Table 6 below.

Table 6 – Actual Peak Flows (Upsizing Interceptor to 24-inch)

Pipe Size	Peak Flow to WWTP
5-year, 6-hour	5,330 gpm (7.68 MGD)
10-year, 24-hour	6,700 gpm (9.65 MGD)
25-year, 24-hour	7,000 gpm (10.08 MGD)

As seen in Table 6 above, if the interceptor is upsized to accommodate the flows predicted by the model, the peak flow to the WWTP exceeds the plant capacity for the 10-year, 24-hour storm and the 25-year, 24-hour storm. The existing system model was also run using smaller storm events to determine the peak flow to the WWTP without an overflow. The model shows the existing interceptor can convey a peak flow of 4,490 gpm (6.5 MGD) to the treatment plant before flows begin surcharging out of the ground.

Alternatives Analysis

Option 1: Reduce Peak Flows (I/I Removal)

The flow monitoring data and PACP defect information provided by the County revealed significant I/I entering the upstream collection system. This information was used to assess peak flow reduction potential by means of I/I removal in the identified priority areas. I/I removal can be accomplished by cured-in-place pipe lining, manhole lining and footing drain disconnection. The model was used to simulate the effect of various levels of I/I removal in the priority areas identified in the upstream collection system on peak flows in the existing Nine Mile interceptor.

Table 7 – Reduce Peak Flows (I/I Removal)

I/I Removal Level	Anticipated Peak Flow to WWTP (5-yr, 6-hr)
15% Reduction	4,660 gpm
30% Reduction	4,450 gpm
50% Reduction	4,020 gpm

These peak flows were compared with the existing capacity of the interceptor before flows begin surcharging out of the ground (4,490 gpm). The model estimates that if 30% of the I/I observed in the three priority areas is eliminated, the existing system has just enough capacity to handle peak flows to the WWTP during the 5-year, 6-hour storm event. I/I removal alone does not provide enough relief upstream to prevent the interceptor from overflowing for the 10-year and 25-year design storms.

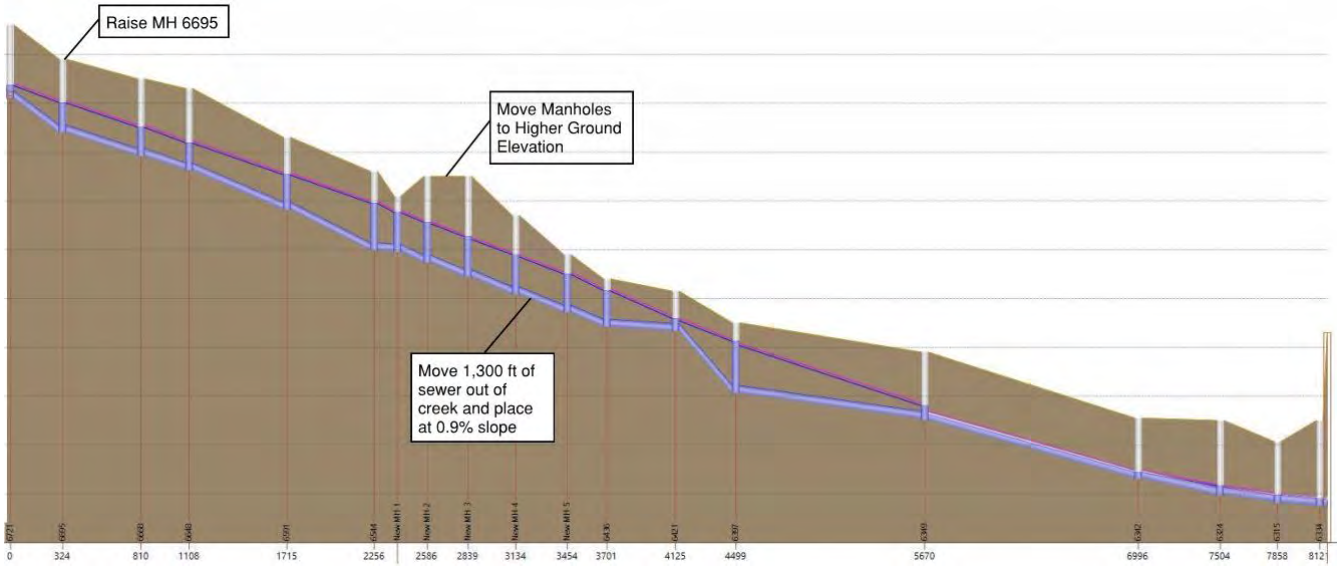
Profile 2 – Existing interceptor with 30% I/I Removal (5-year, 6-hour storm)

Option 2: Increase Interceptor Capacity (Phase 1)

In addition to investigating I/I removal potential, alternatives to increase the interceptor capacity were assessed. To provide capacity for the existing peak flows, the interceptor would need to be upsized from an 18-inch to a 24-inch sewer from MH 6721 to MH 6315. However, this would increase the capacity of the system past the capacity of the WWTP and would be relatively expensive. The slope of the interceptor varies along the route with some areas being relatively flat and shallow, and other areas being steeper with more cover. Generally, the flatter, shallower sewers are the primary cause of the capacity issues observed in the interceptor. Alternatives for smaller-scale improvements were reviewed to increase the capacity of the interceptor without complete replacement.

Phase 1 of the relocation would involve re-routing 1,300 lf of sewer out of the low spots near or within the creek and placing the sewer at a steeper (0.9%) slope. The areas of the interceptor which run within or near the creek present an operation and maintenance issue as well as a capacity issue. Relocating the sewer would provide an opportunity to make the sewer deeper as well as steeper to help overall capacity. The sewer of concern is located between MH 6544 and MH 6436 where the manholes are shallow and the sewer is flat. The property owner near the creek has reported overflows at MH 6433 which is in the affected area. Additionally, there is a shallow manhole located near the upstream end of the interceptor that should be raised. This manhole is in a low spot adjacent to the creek. Raising MH 6695 approximately 5 feet will help prevent overflows near this location of the collection system. The rerouting configuration seen in the profile below provides improvements for the 5-year, 6-hour design event. We are unaware of soil borings in the area to determine if option 1 would require rock excavation or special backfill. Our opinion of cost for the phase 1 improvements range from $1 Million for good soils and $2.2 Million if Rock excavation and/or special backfill is required.

Profile 3 – Phase 1 interceptor improvements (5-year, 6-hour storm)

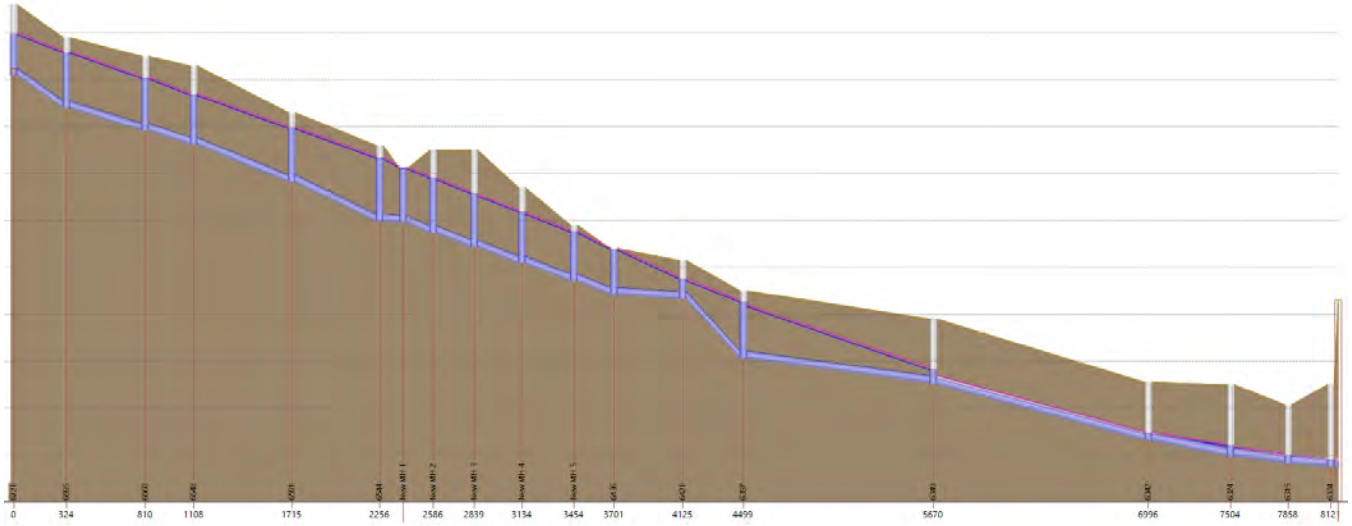


With Phase 1 interceptor improvements, the system still shows surcharging out of manholes for the 10-year, 24-hour and 25-year, 24-hour design events. Figure 5 shows Phase 1 of the interceptor improvements described above.

Option 3: Reduce Peak Flows and Increase Interceptor Capacity (Phase 1 and I/I Removal)

The model was utilized to assess the ability of the interceptor to handle the 10-year, 24-hour design storm by removing I/I and performing Phase 1 interceptor improvements. The model shows that in order to avoid overflowing for the 10-year, 24-hour design storm, a 50% reduction in I/I must be achieved in combination with performing Phase 1 interceptor improvements. As seen in Profile 4 below, the model predicts the combination of these improvements to provide capacity for the 10-year, 24-hour storm before flows begin overflowing manholes.

Profile 4 – Phase 1 interceptor improvements and 50% I/I removal (10-year, 24-hour storm)



Option 4: Increase Interceptor Capacity (Phase 1 and 2)

To further increase the capacity of the interceptor, additional improvements can be made. Phase 2 of interceptor improvements includes upsizing and modifying the slope of approximately 1,970 lf of existing 18-inch sewer to 21-inch sewer. This portion of sewer is located downstream of the Phase 1 improvements and includes the sewer between MH 6436 and MH 6349. By implementing Phase 2 in addition to Phase 1 improvements, the model predicts that the system can handle flows for the 25-year, 24-hour design event. This option does not require upstream I/I removal to prevent an overflow. However, I/ I removal would limit the surcharging during the event. Our opinion of cost for the phase 2 improvements range from $2.2 Million for good soils to $3.5 Million if Rock excavation and/or special backfill is required.

Profile 5 – Phase 1 and 2 interceptor improvements (25-year, 24-hour event)

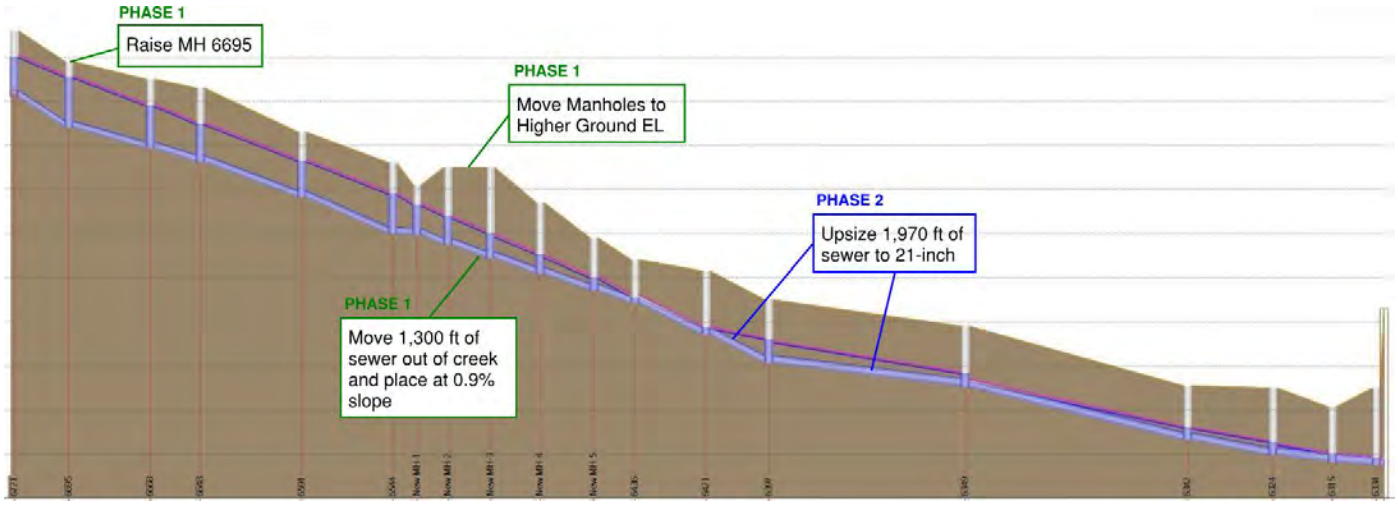


Figure 5 shows Phase 2 of the interceptor improvements detailed above. With this proposed alternative, the model predicts a peak flow to the WWTP during the 25-year, 24-hour storm of 5,520 gpm (8 MGD).

Option 5: Increase Interceptor Capacity and Reduce Peak Flows (Phase 1, 2 and I/I Removal)

Although I/I removal is not required to prevent an overflow along the interceptor for the 25-year, 24-hour storm, I/I removal would help decrease peak flows upstream and create capacity within the sewer for future development. The following table outlines peak flows seen at the WWTP for various design storms under proposed Option 4 and proposed Option 5.

Table 8 – Peak Flow at WWTP

Design Event	Option 4 (gpm)	Option 5 (gpm)
5-year, 6-hour	5,050	4,430
10-year, 24-hour	5,515	5,500
25-year, 24-hour	5,520	5,510

A significant drop in peak flow is observed during the 5-year, 6-hour event. The peak flows at the plant for the 10-year and 25-year storms do not vary significantly from those observed under Option 4; however, the surcharging in the upstream sewer branches increases without I/I removal.

Option 6: Underground Storage

Building underground storage as an alternative was also assessed. The storage model scenarios were performed independently of any other improvements discussed in the sections above. The model was used to evaluate the feasibility of installing an underground storage tank to act as an overflow during wet weather events. The model was used to evaluate the location and volume required to reduce peak flows to the WWTP for the three design storms. The storage volumes listed in the table are the volumes required to reduce the peak flow to the current capacity of the interceptor (4,490 gpm). The best location for storage hydraulically was determined to be near the upstream end of the interceptor because of where the restriction is located. However, construction of storage would be difficult and expensive due to the topography of the area.

Table 9 – Required Storage Volume

Design Event	Required Volume (gallons)
5-year, 6-hour	100,000
10-year, 24-hour	585,000
25-year, 24-hour	795,000

Future Development

Population growth forecasts were developed for decades 2020 and 2030 as a part of the 2010 Wastewater Master Plan by CH2MHILL. These population estimates were used to estimate the additional baseflow tributary to the interceptor if this level of population growth is met. Table 10 shows the additional population projections developed in the 2010 Master Plan.

Table 10 – Population Forecast

Year	Additional Population	Additional Baseflow (gpm)	Est. Additional Peak Flow (gpm)*
2020	2,200	200	355
2030	3,070	280	500

*Using a max peaking factor of 1.77

Flow projections were estimated by assuming the following:

- A general residential wastewater profile was used to simulate the diurnal pattern of residential flows. The profile was based on 100 gal/capita/day with a max peaking factor of 1.77.
- Groundwater infiltration was accounted for using 30 gal/capita/day.
- Small RDII factors were used to account for some infiltration and inflow into the system. Contribution of RDII into the system should be small for new construction.

The Phase 1 and 2 interceptor improvements without I/I removal (Option 4) and Phase 1, Phase 2, and I/I Removal (Option 5) models were run using the additional 2030 flow projections developed by CH2MHILL as a part of the Master Plan. The models predict significant surcharging in the upstream collection system when future flows are added. I/I removal in the upstream areas will help offset the surcharging caused by the addition of future flows. However, since the amount of I/I removed and the location and type of future development will be variable, the focus of this analysis was on the overall effect on the interceptor.

The model shows that with these improvements in place, the interceptor does not overflow for the 25-year, 24-hour event with 2030 future development flows. The peak flows to the WWTP for this scenario are presented in the following table.

Table 11 – Peak Flow to WWTP (2030 Flows)

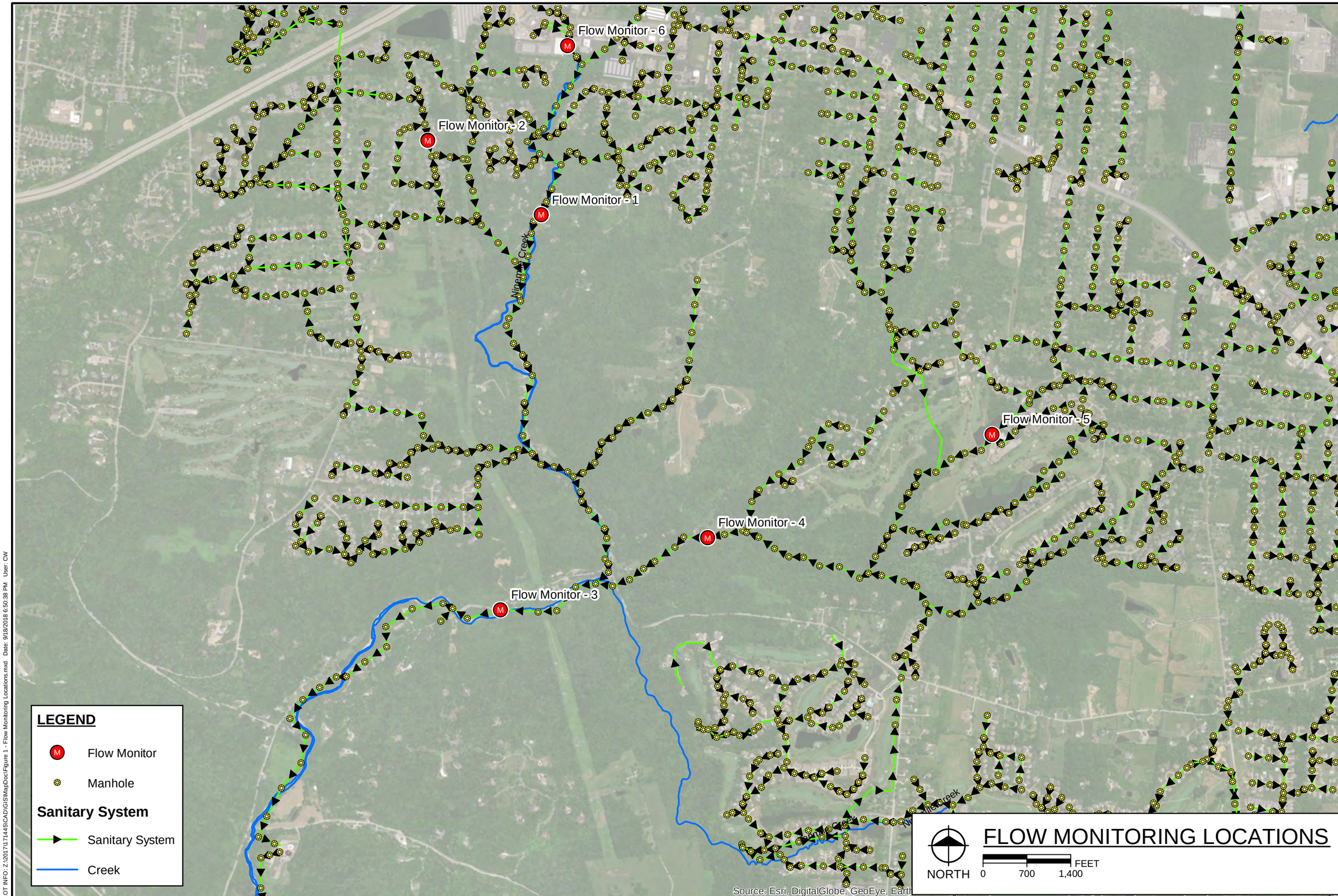
Design Event	Peak Flow (gpm)
5-year, 6-hour	6,010
10-year, 24-hour	6,255
25-year, 24-hour	6,370

The peak flows for the 10-year and 25-year storms are at, or just above, the 9 MGD capacity of the WWTP (6,250 gpm). Considering this is based on an assumed I/I removal rate and assumed future development flow rates, FTCH recommends the County perform additional flow monitoring after the I/I improvements are completed to confirm the actual flow removed.

Recommendations

Option 4 will provide capacity in the interceptor for the existing system but does not provide capacity for future development. Therefore, the County has decided to pursue Option 5, which includes Phase 1 and Phase 2 interceptor improvements and I/I removal in the targeted areas. The estimated project cost for Phase 1 and 2 interceptor improvements ranges from $3 Million to $5.3 Million ($2.2 Million for Phase 1 and $3.1 Million for Phase 2) depending on the soils in the area. Based on a preliminary review of the television tapes provided, an initial budget of $850,000 is recommended. The final cost for the I/I removal will be dependent on the size and type of project(s) chosen. The County should consider additional flow monitoring after I/I improvements are completed to confirm the amount removed and the availability of the system to handle future flow.

Figures



FLOW MONITORING LOCATIONS

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architects
constructors

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Clermont County Water Resources Department
Clermont County, Ohio

Nine Mile Collection System Improvements

PROJECT NO.
171445

FIGURE NO.
1

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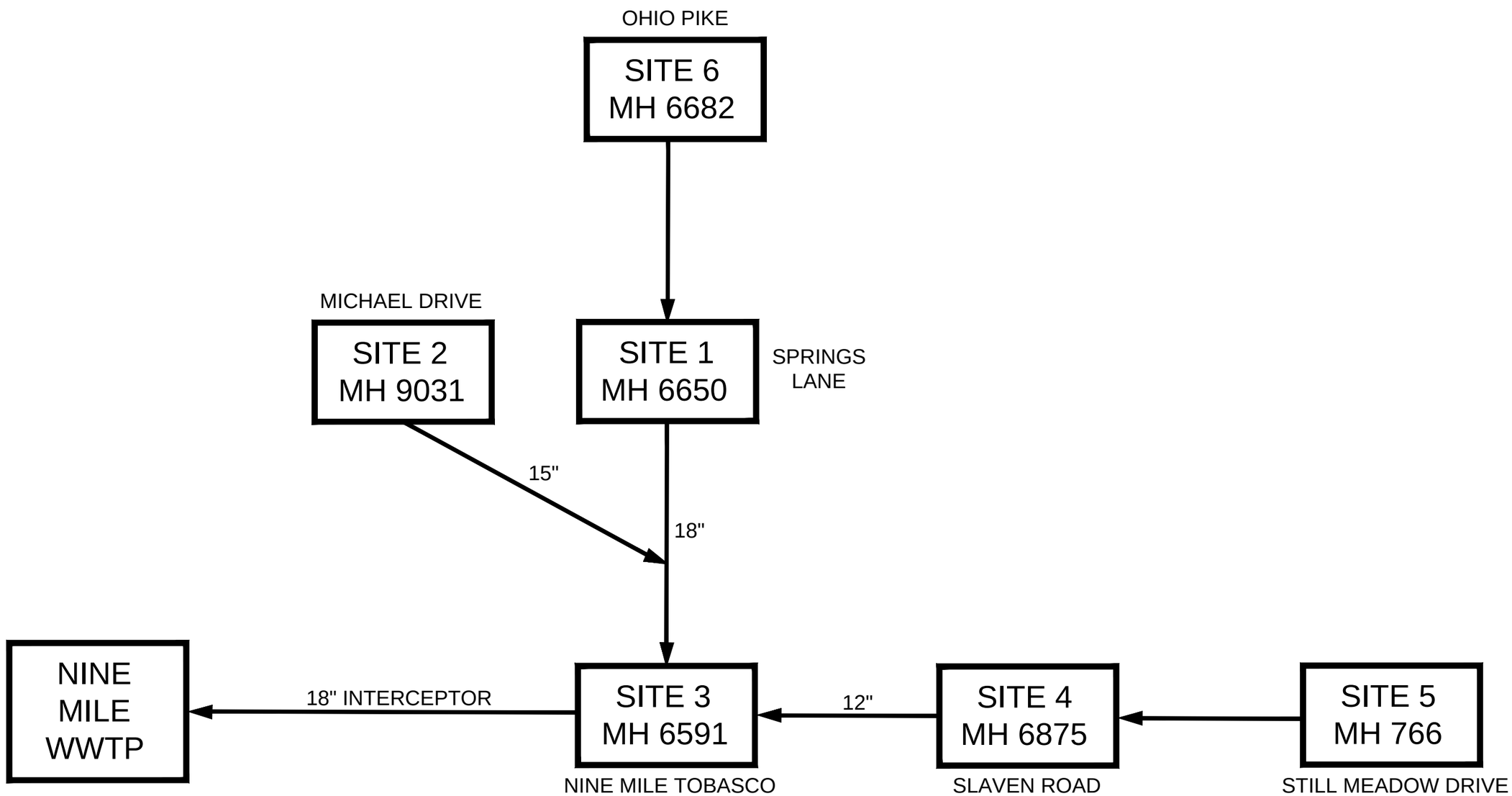
PLOT INFO: Z:\2017\171445\CAD\GIS\MapDoc\Figure 1 - Flow Monitoring Locations.mxd Date: 9/18/2018 6:50:38 PM User: CW



FLOW MONITORING SCHEMATIC

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engineers
scientists
architects
constructors

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Clermont County Water Resources Dept.
Clermont County, Ohio

Nine Mile Collection System Improvements

PROJECT NO.
171445

FIGURE NO.
2

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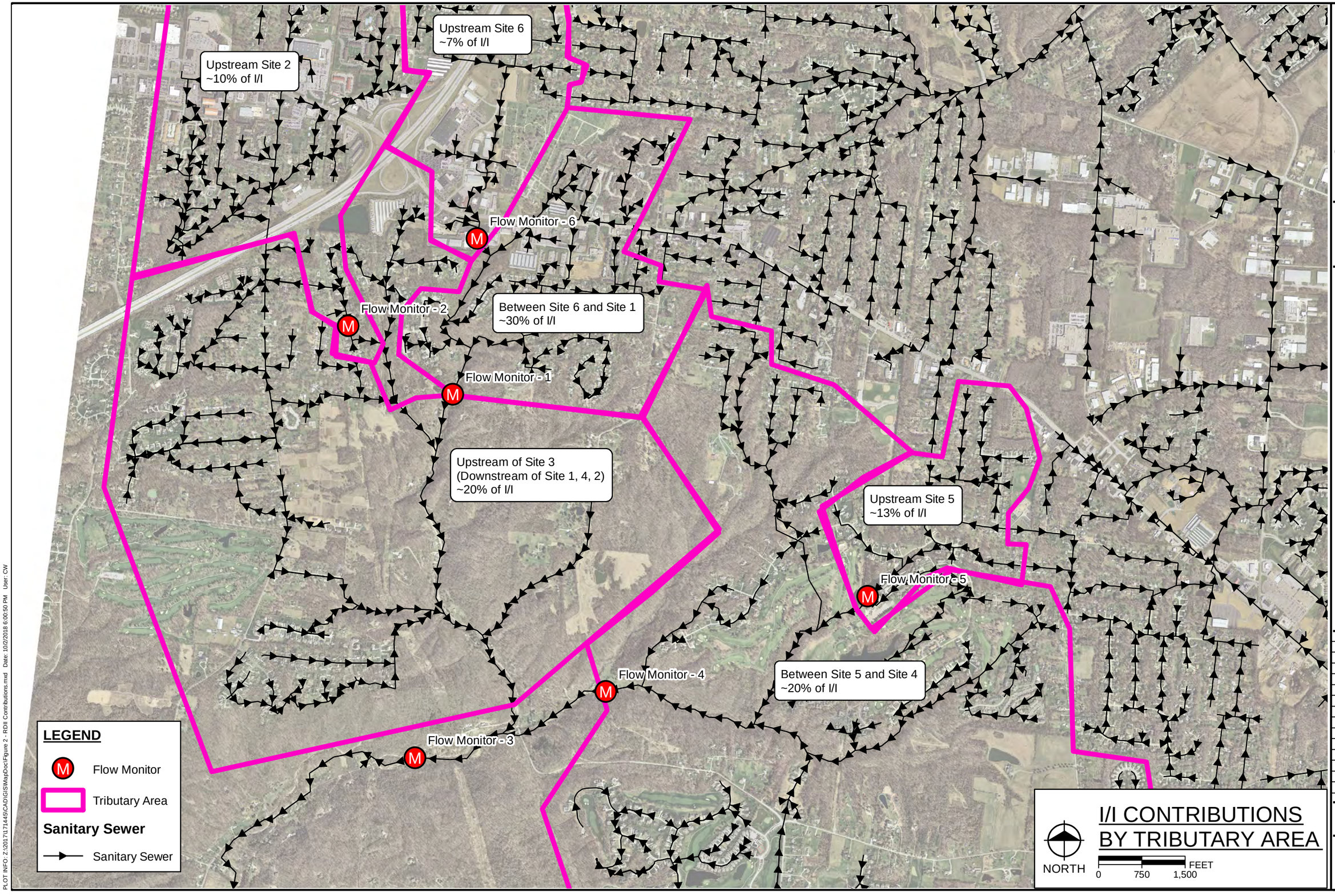

I/I CONTRIBUTIONS BY TRIBUTARY AREA

fitch

engineers
scientists
architects
constructors

fishbeck, thompson, carr & huber, inc.

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Clermont County, Ohio

Nine Mile Collection System Improvements

PROJECT NO.
171445

FIGURE NO.
3

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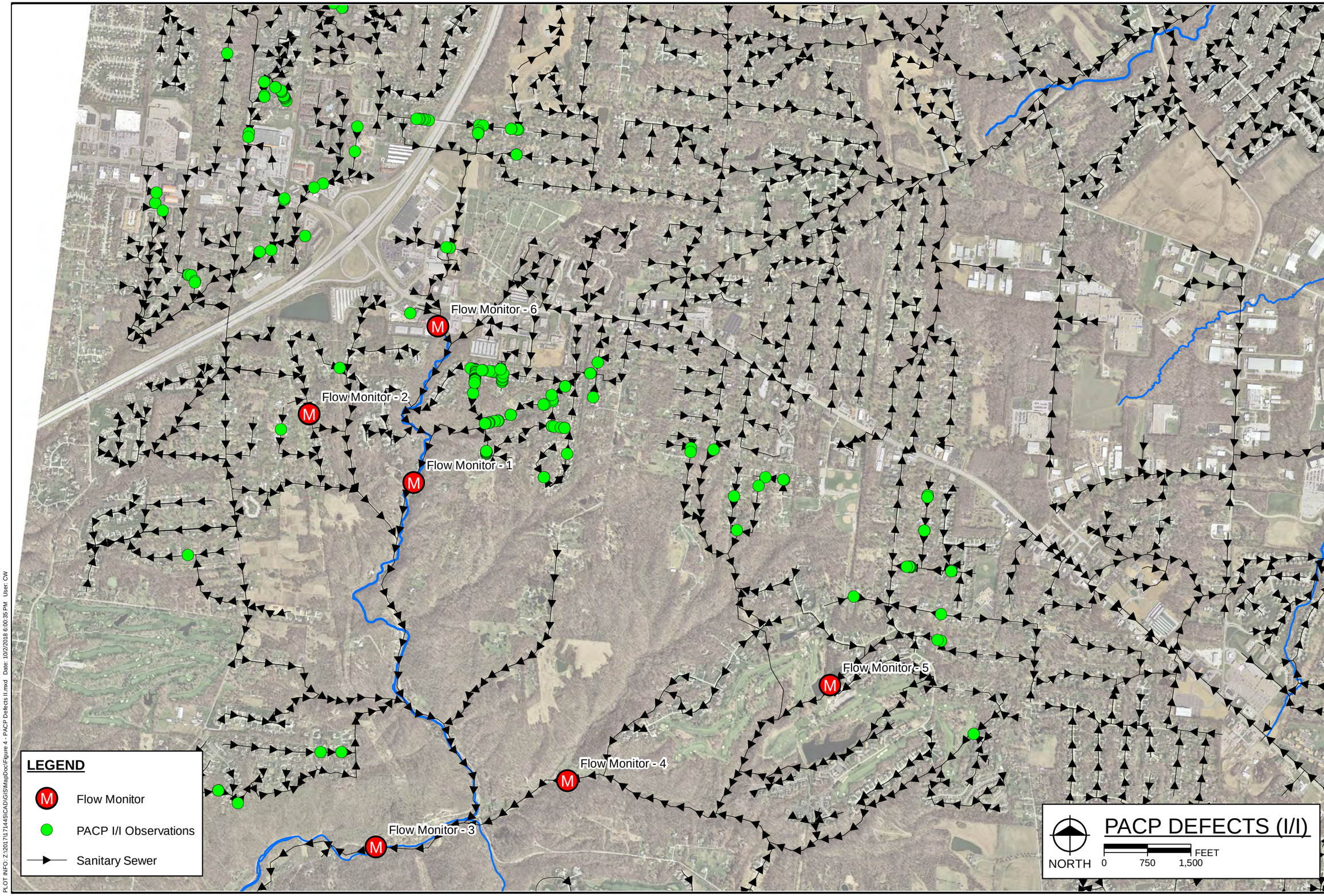

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Clermont County, Ohio

Nine Mile Collection System Improvements

PROJECT NO.
171445

FIGURE NO.
4

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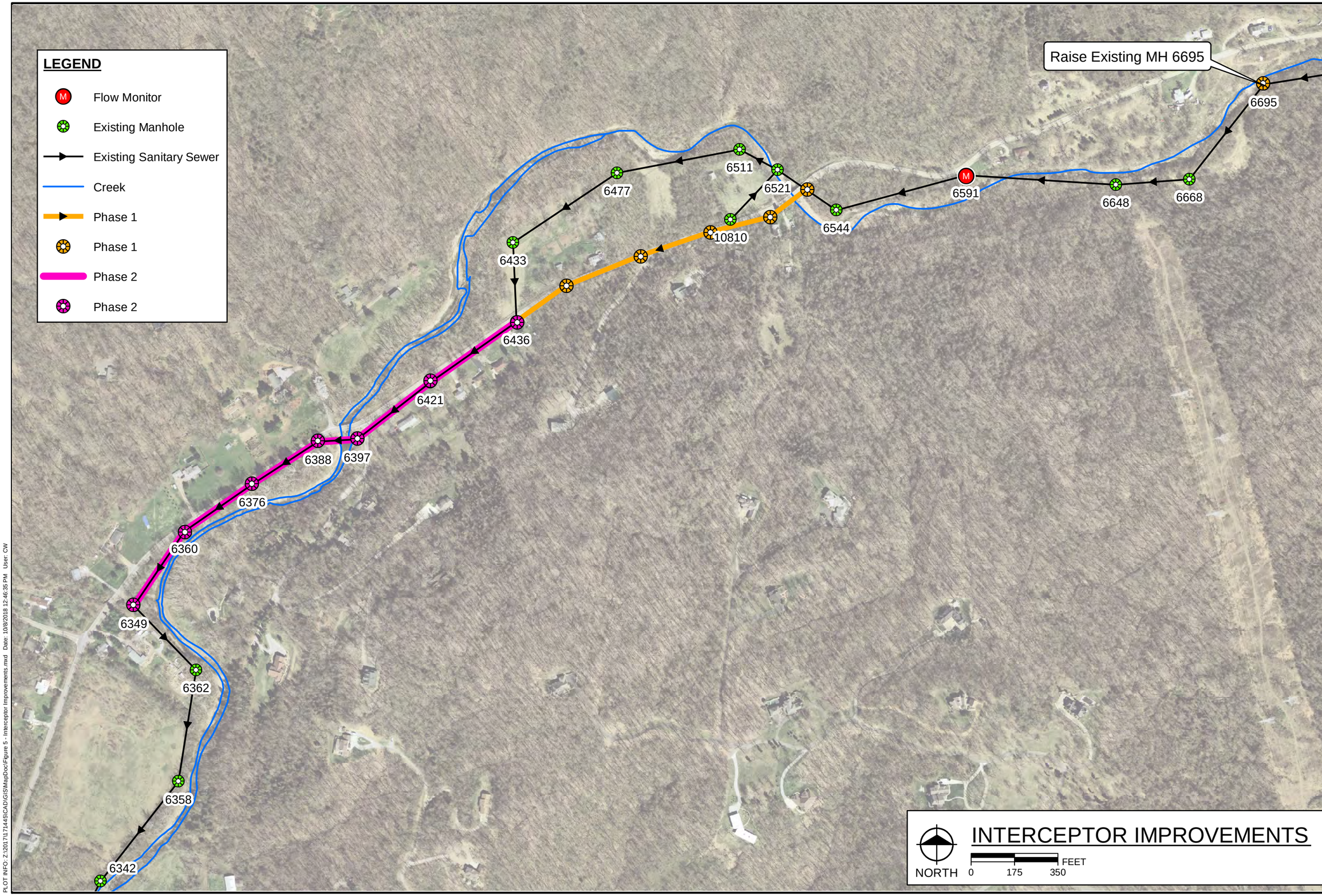

INTERCEPTOR IMPROVEMENTS

fr c&h

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Clermont County Water Resources Department
Clermont County, Ohio

Nine Mile Collection System Improvements

PROJECT NO.
171445

FIGURE NO.
5

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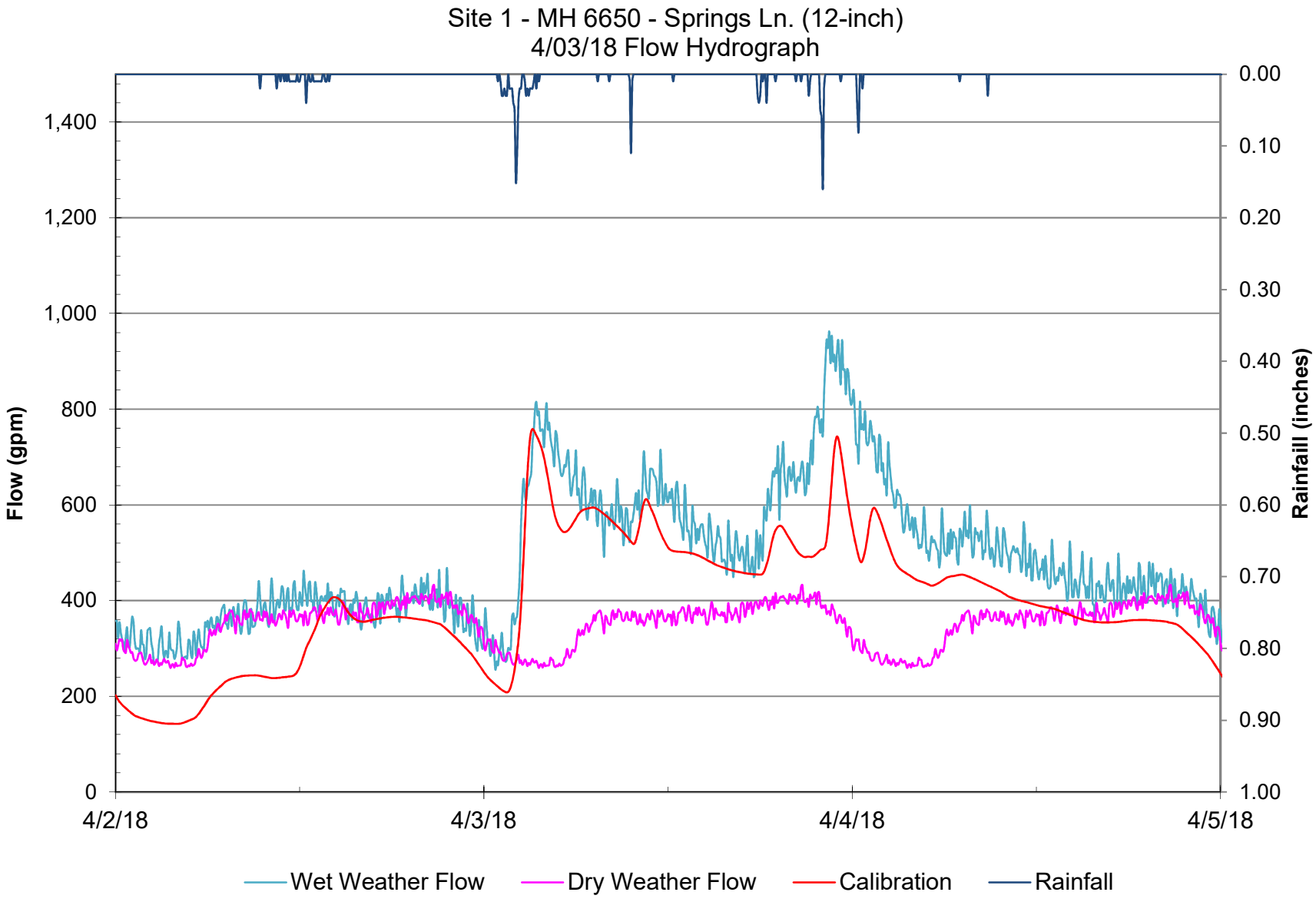
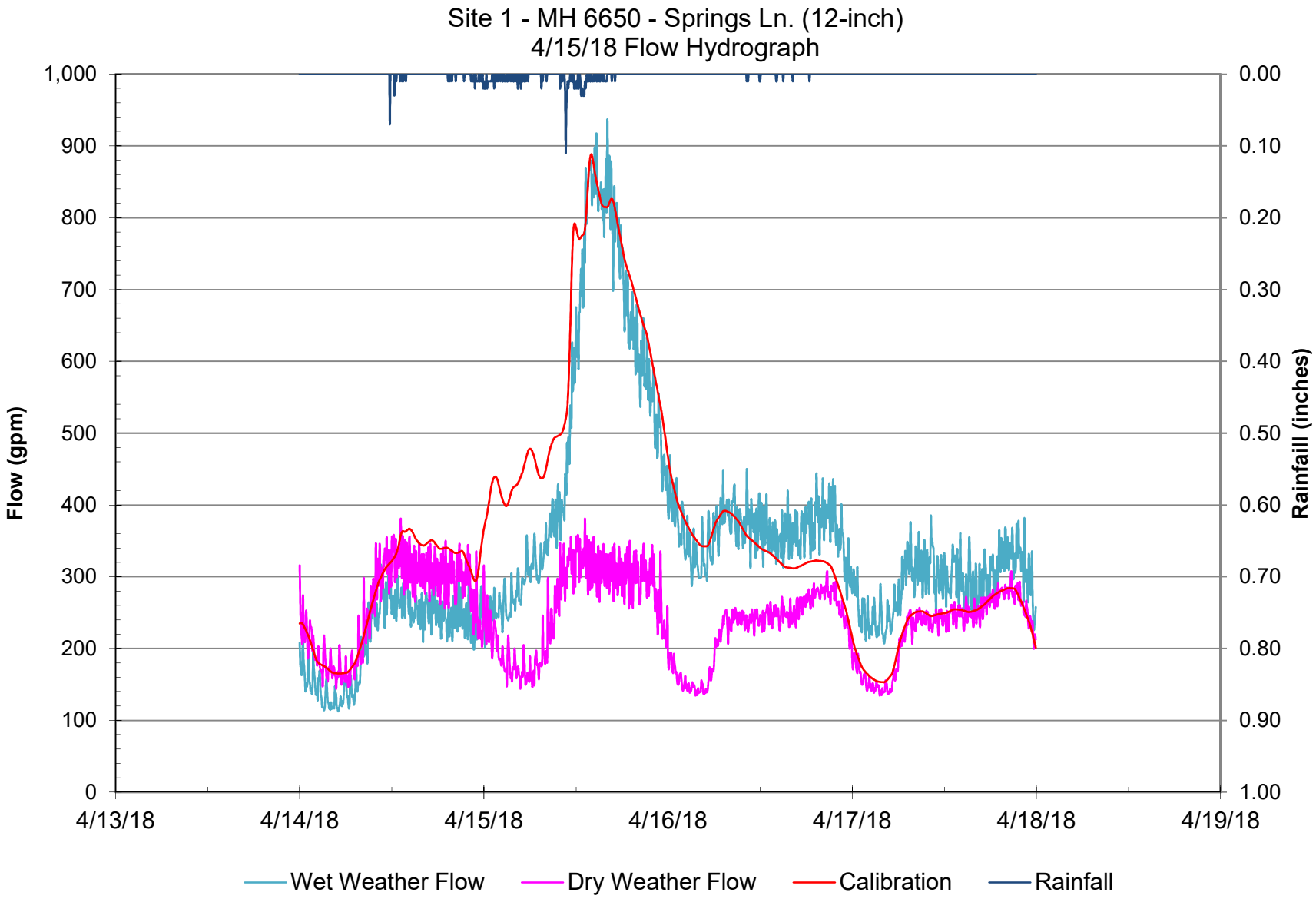
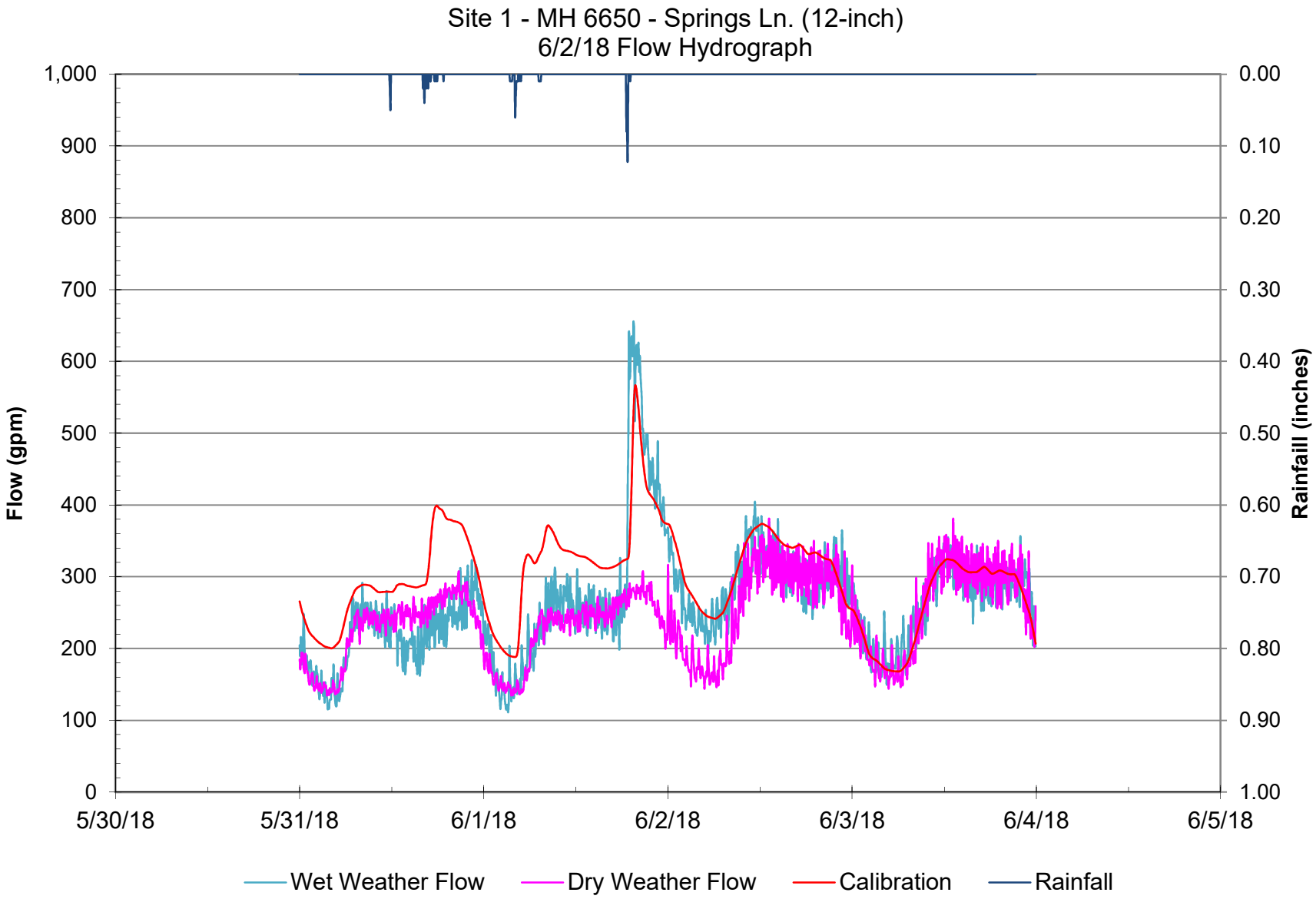
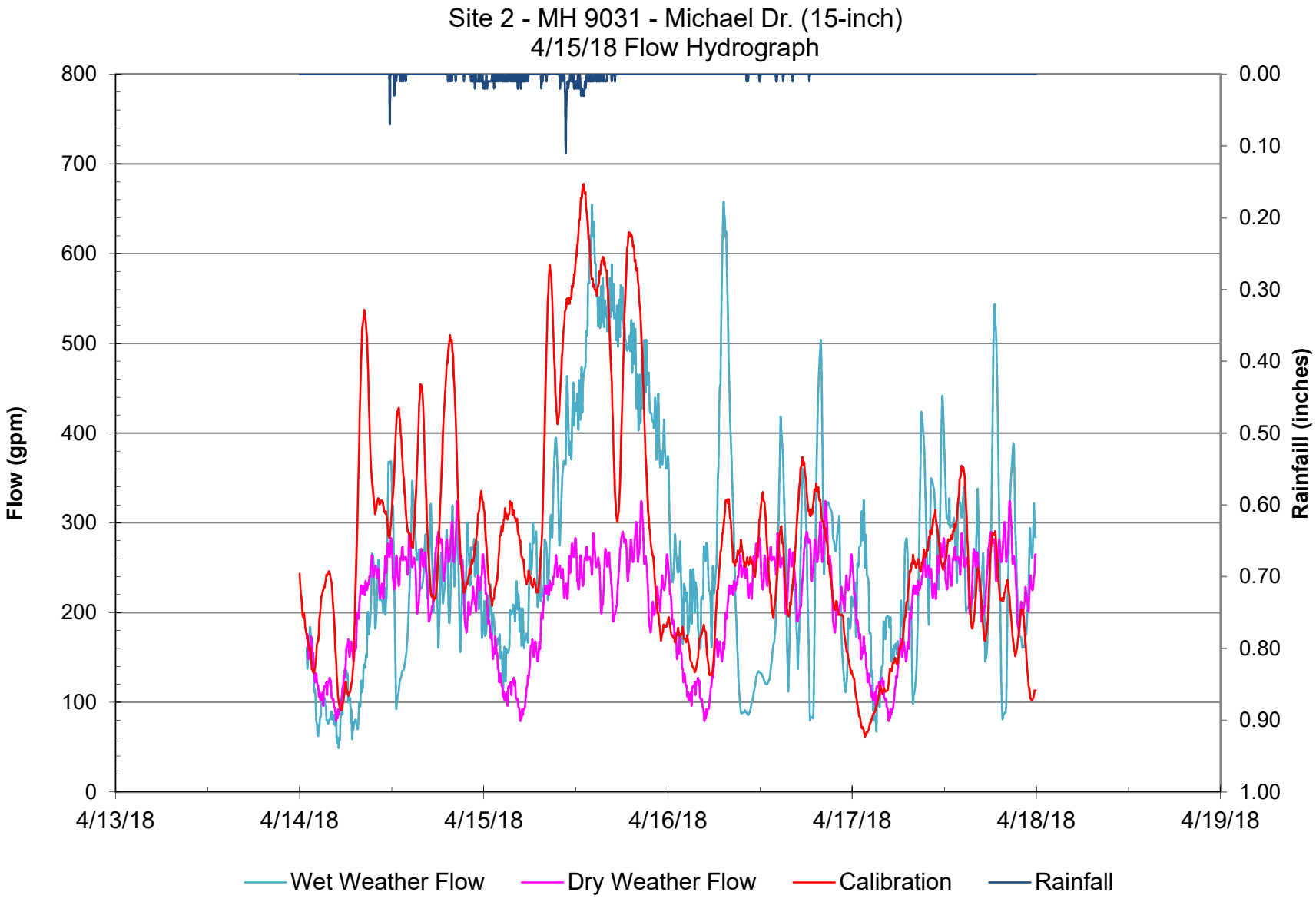
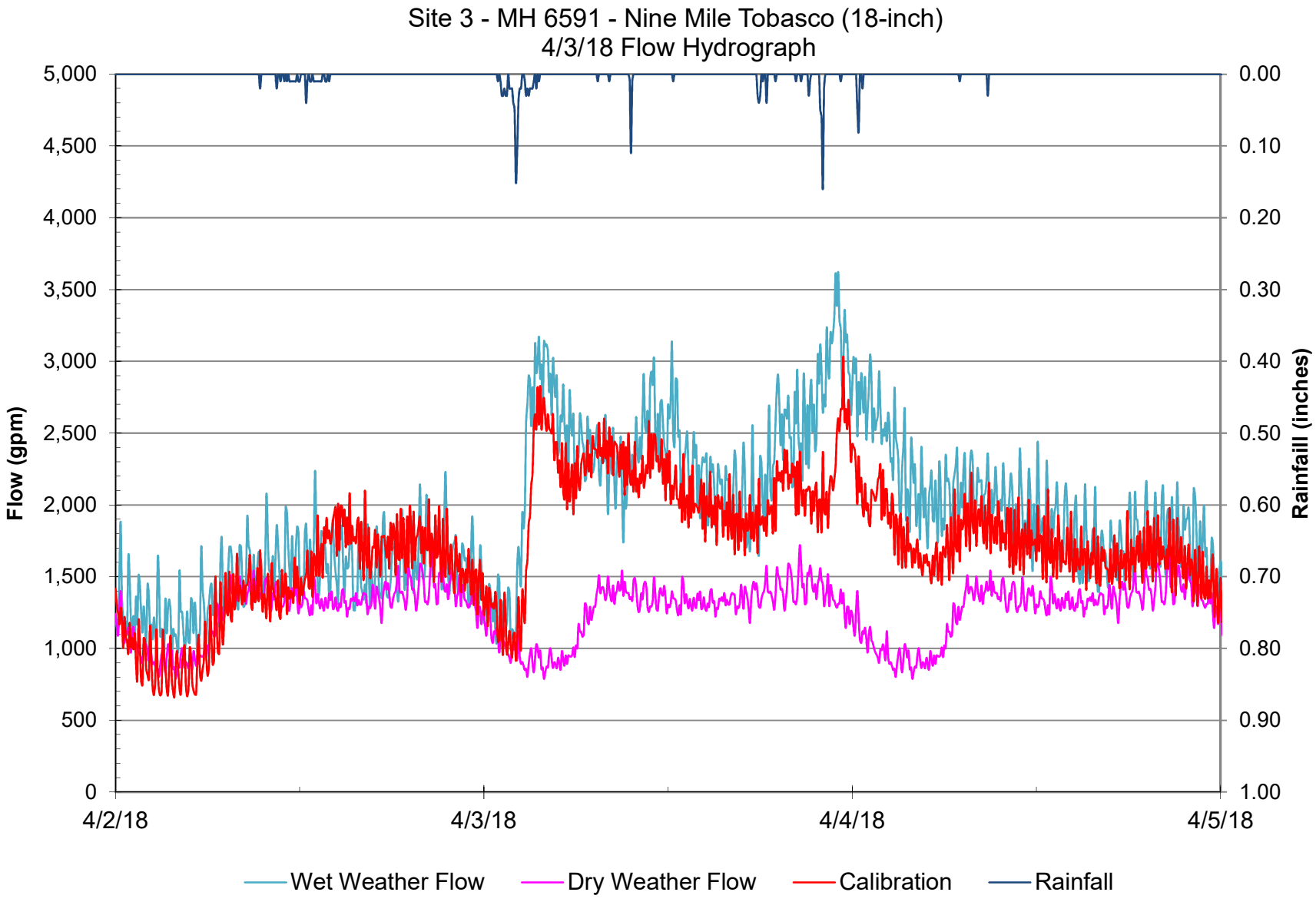
Appendix 1

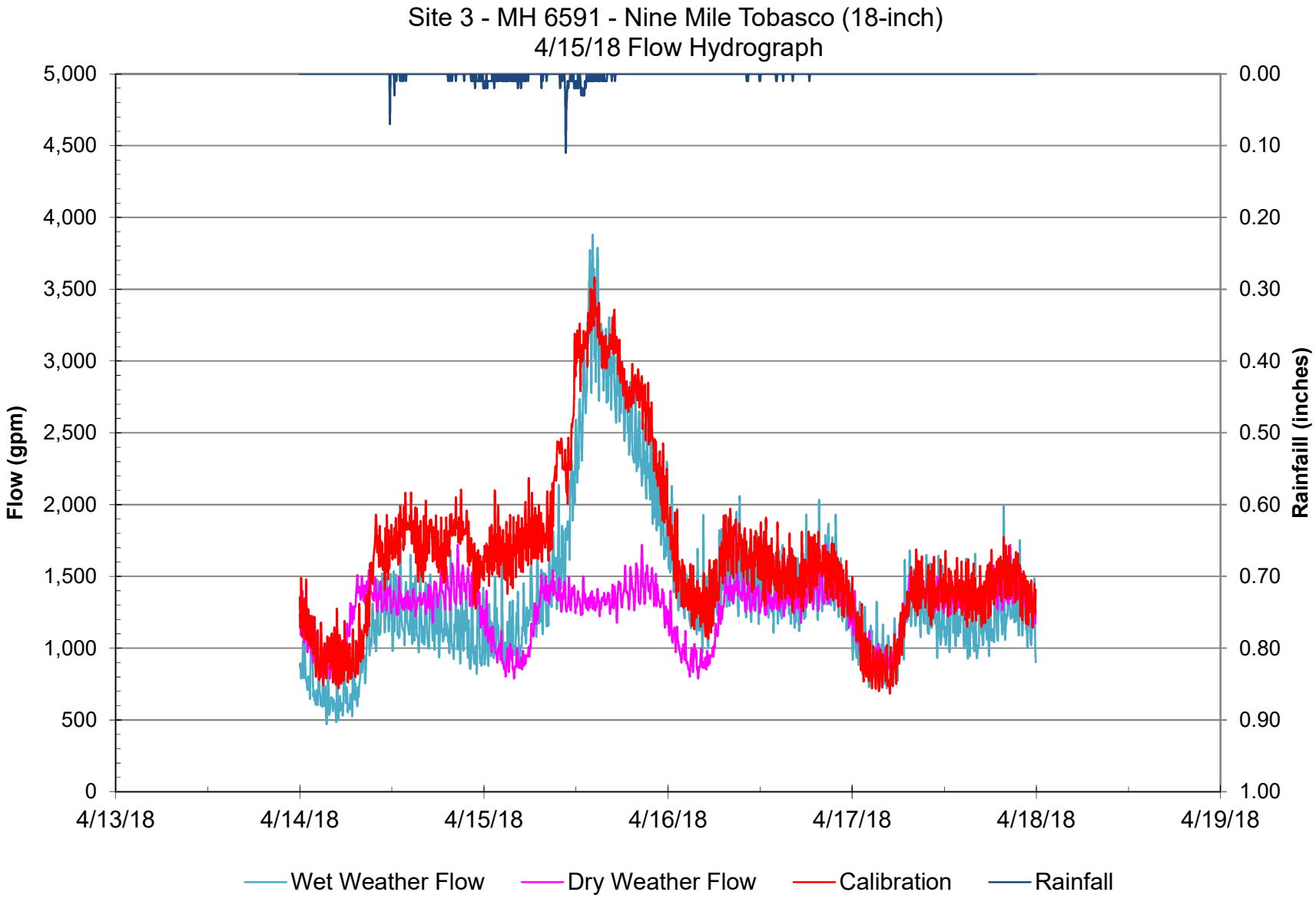

Site 1 - MH 6650 - Springs Ln. (12-inch)
4/03/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
0
200
400
600
800
1,000
1,200
1,400
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/2/18
4/3/18
4/4/18
4/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

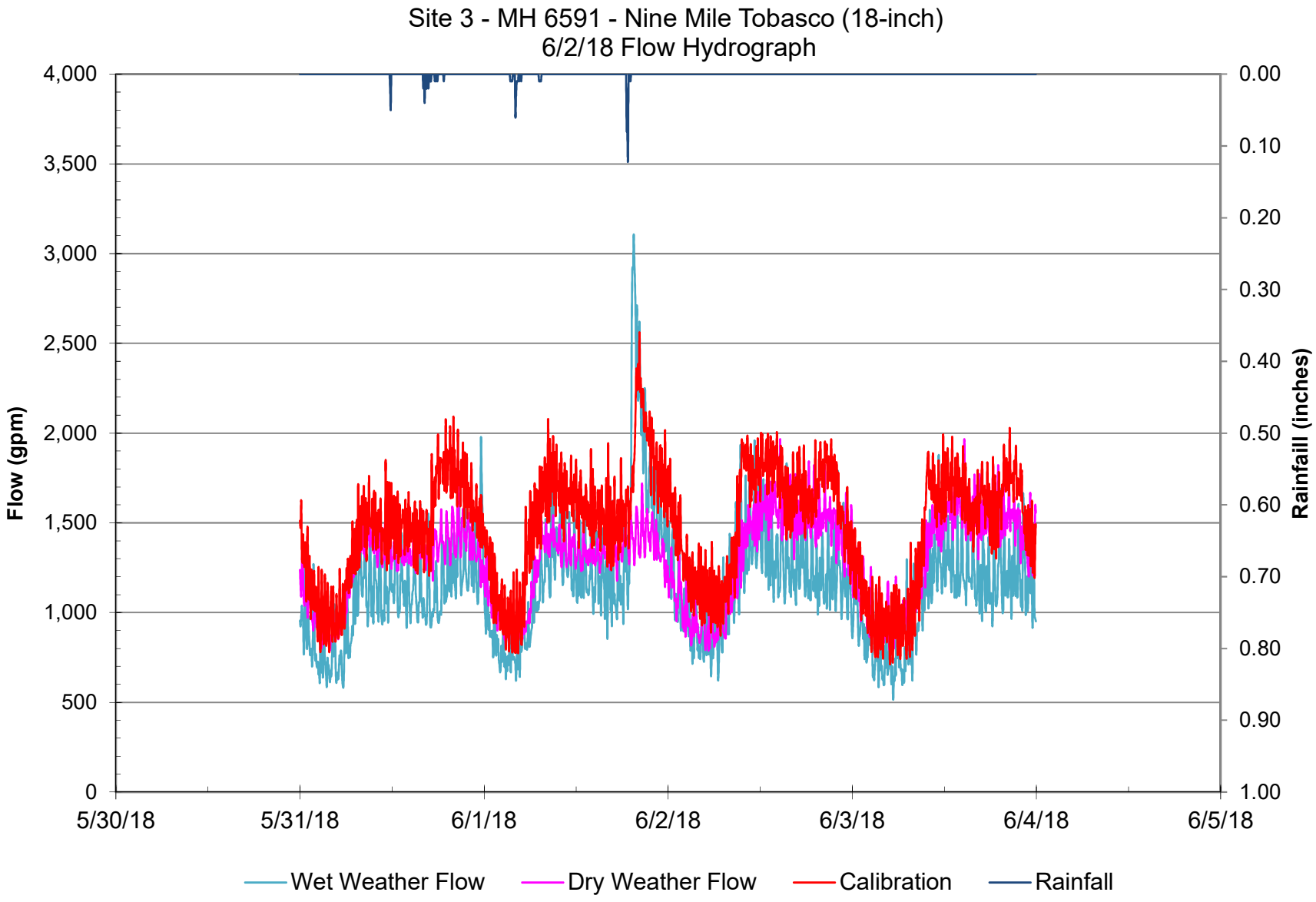

Site 1 - MH 6650 - Springs Ln. (12-inch)
4/15/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
1,000
900
800
700
600
500
400
300
200
100
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/13/18
4/14/18
4/15/18
4/16/18
4/17/18
4/18/18
4/19/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

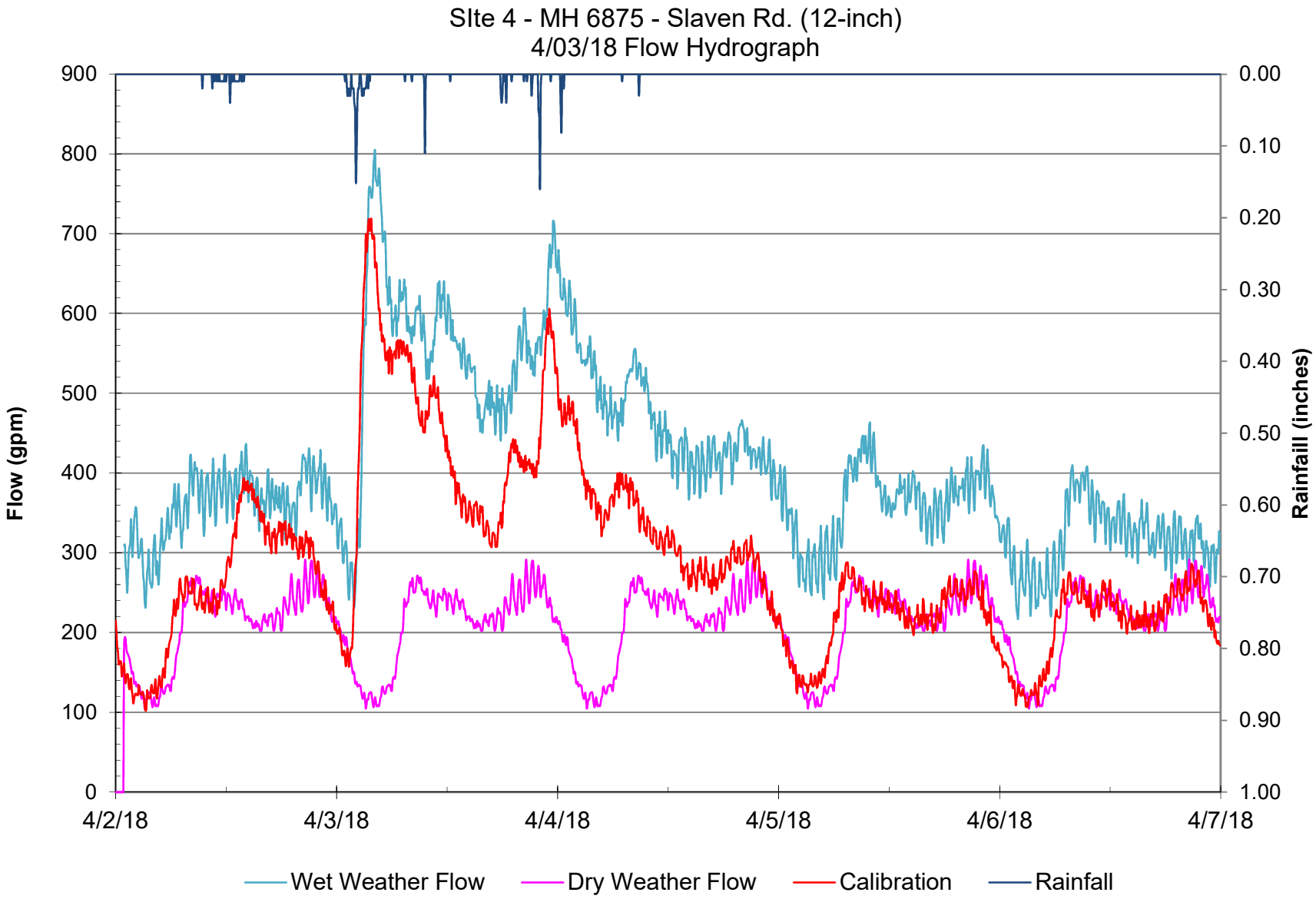

Site 1 - MH 6650 - Springs Ln. (12-inch)
6/2/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
1,000
900
800
700
600
500
400
300
200
100
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
5/30/18
5/31/18
6/1/18
6/2/18
6/3/18
6/4/18
6/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

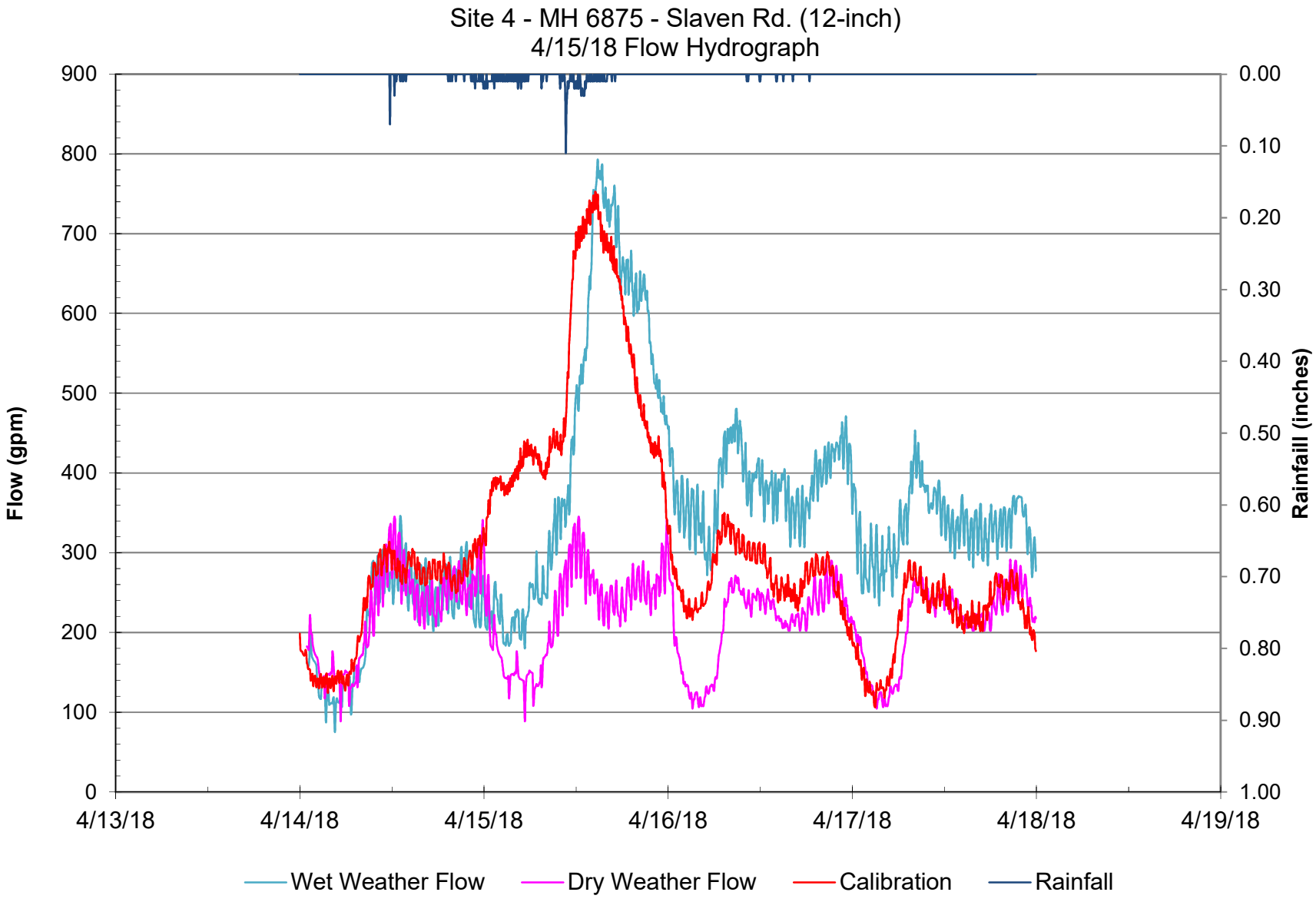

Site 2 - MH 9031 - Michael Dr. (15-inch)
4/15/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
800
700
600
500
400
300
200
100
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/13/18
4/14/18
4/15/18
4/16/18
4/17/18
4/18/18
4/19/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

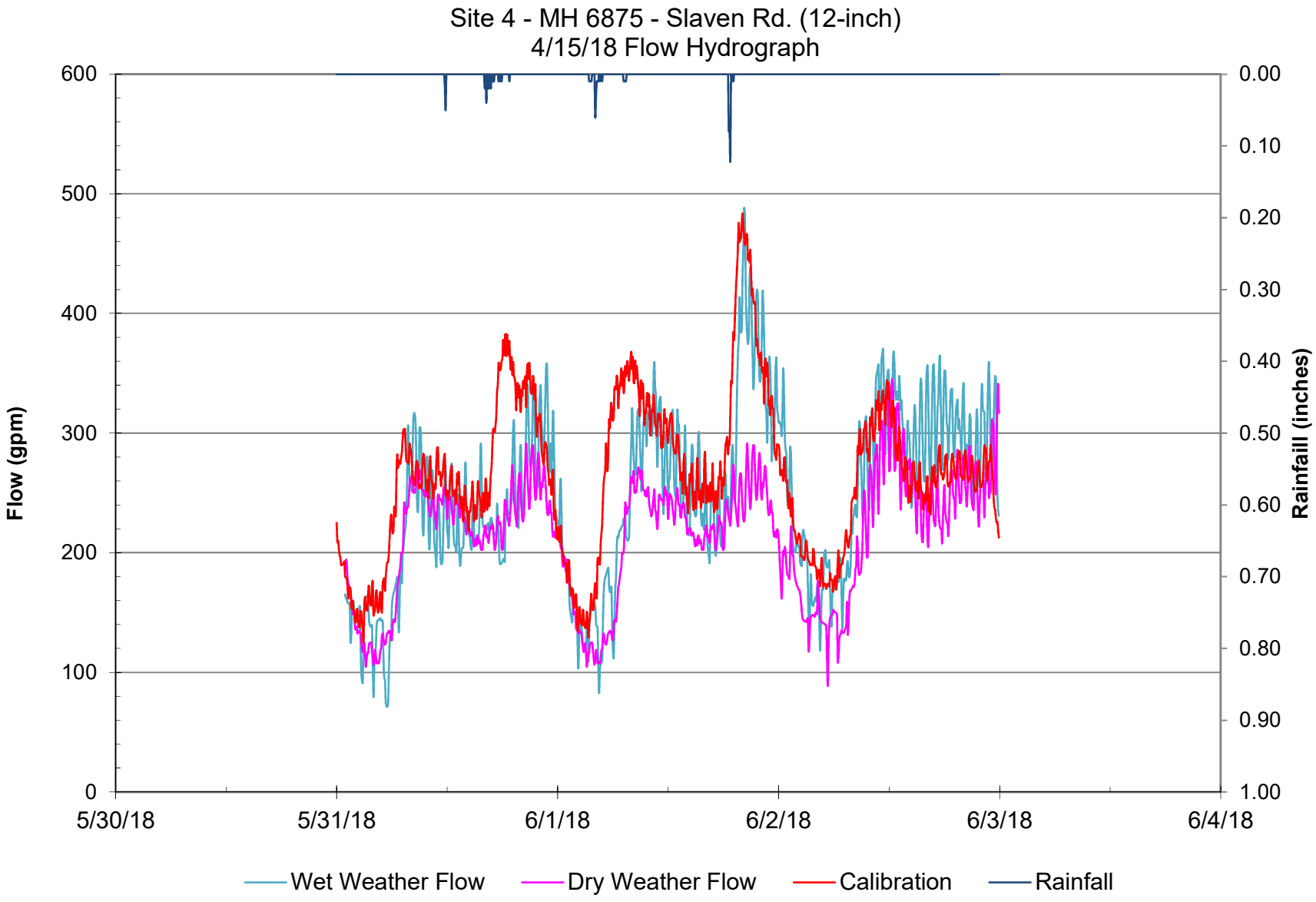

Site 3 - MH 6591 - Nine Mile Tobasco (18-inch)
4/3/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/2/18
4/3/18
4/4/18
4/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

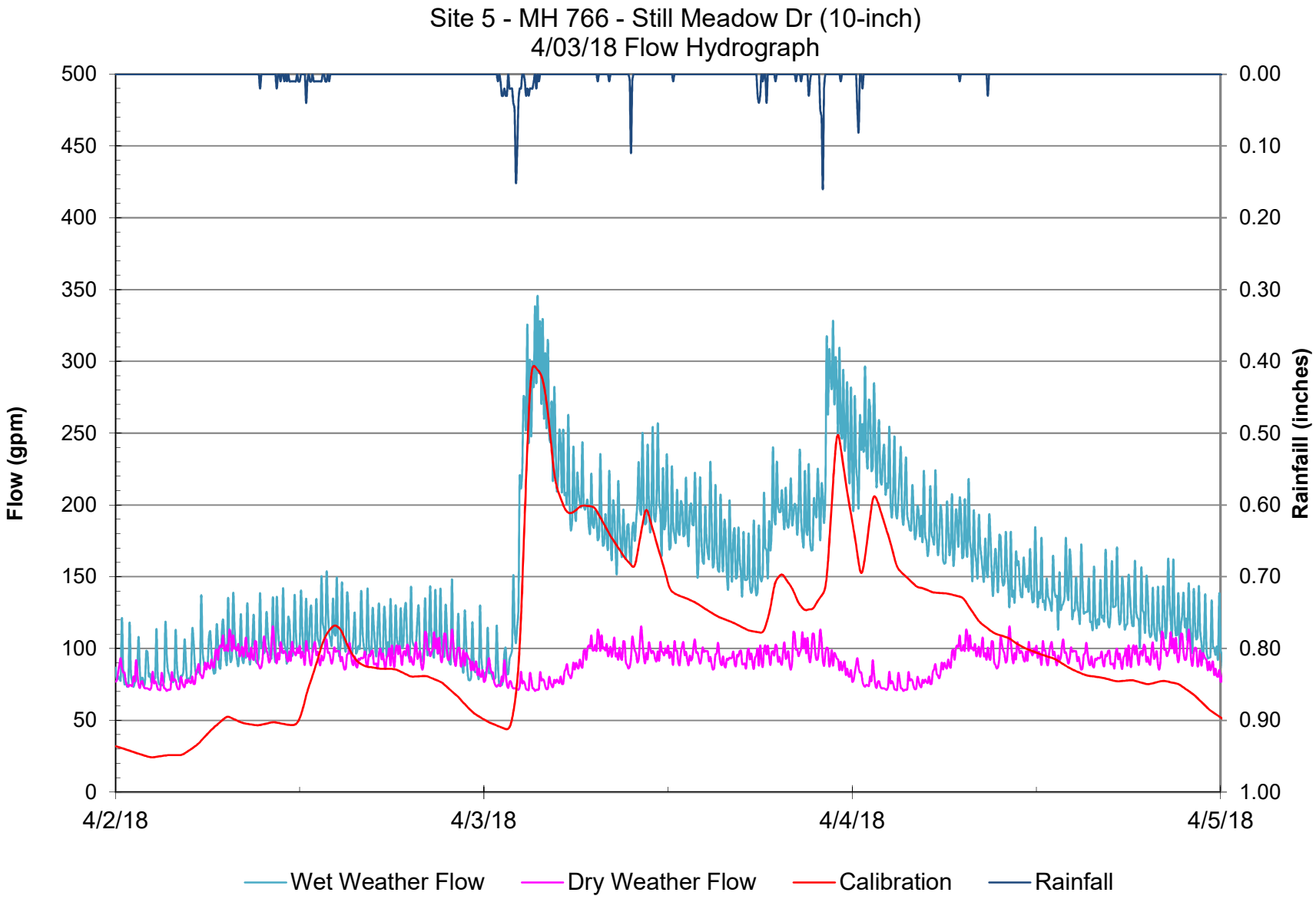

Site 3 - MH 6591 - Nine Mile Tobasco (18-inch)
4/15/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/13/18
4/14/18
4/15/18
4/16/18
4/17/18
4/18/18
4/19/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

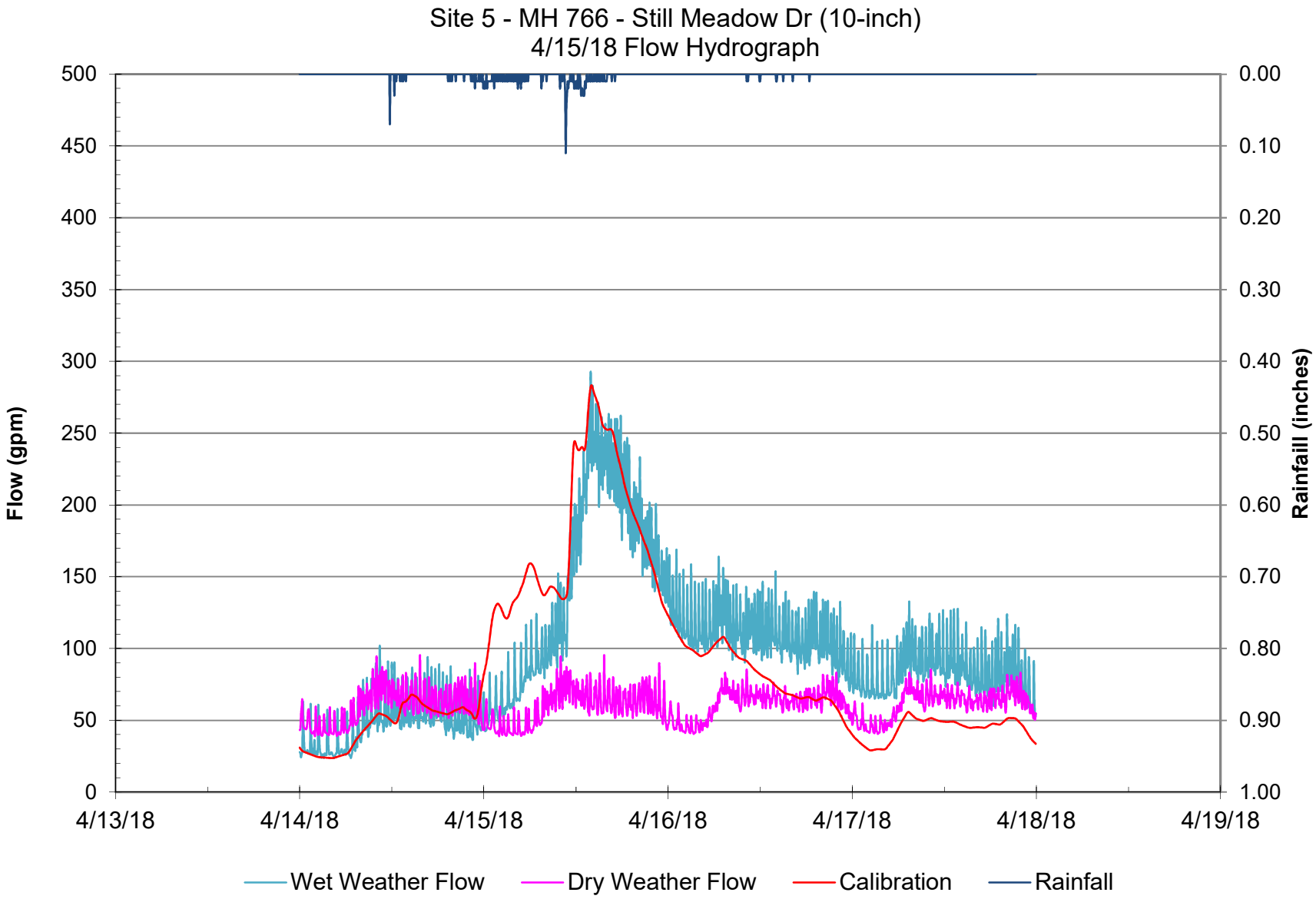

Site 3 - MH 6591 - Nine Mile Tobasco (18-inch)
6/2/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
5/30/18
5/31/18
6/1/18
6/2/18
6/3/18
6/4/18
6/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

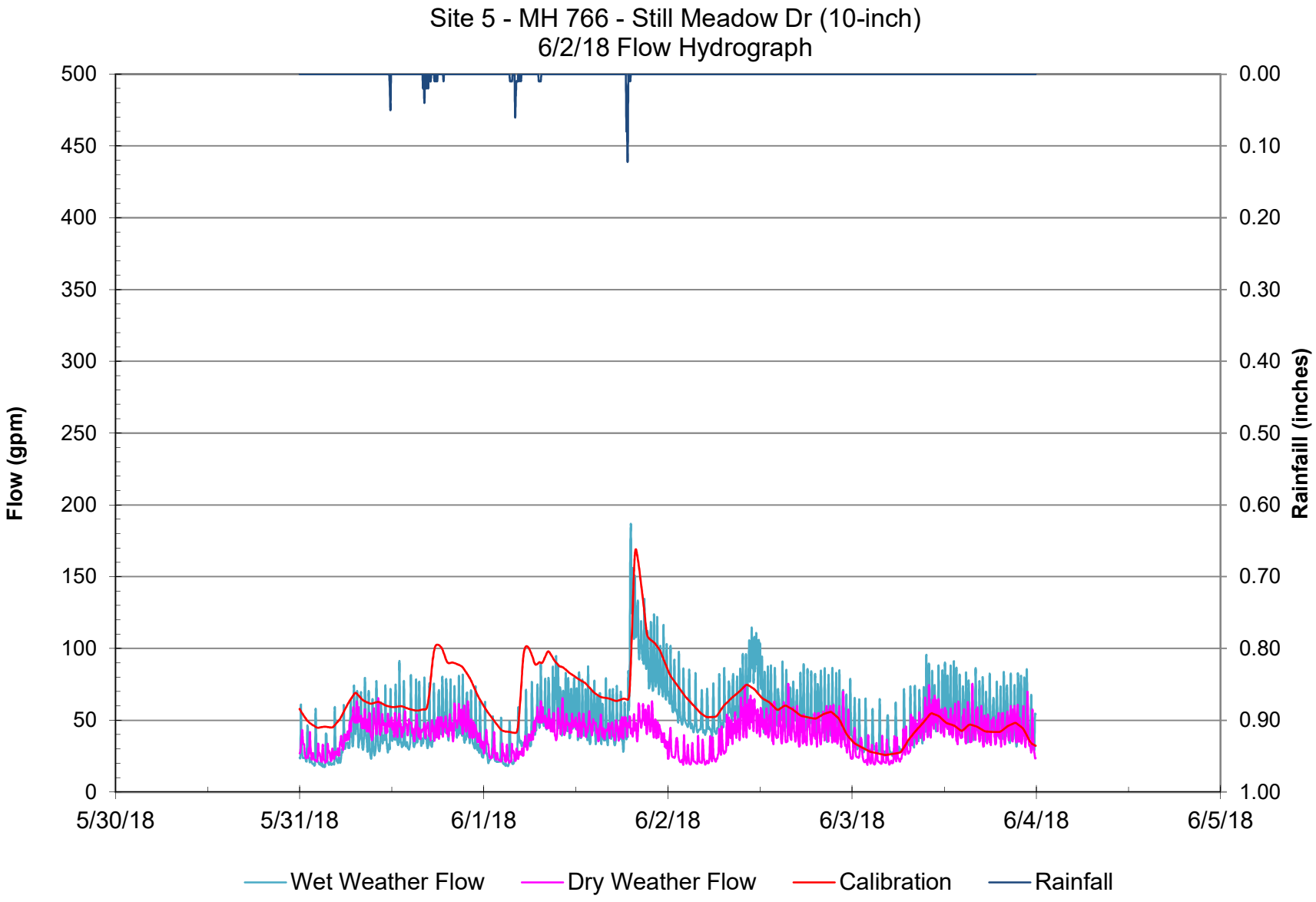

SIte 4 - MH 6875 - Slaven Rd. (12-inch)
4/03/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
900
800
700
600
500
400
300
200
100
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/2/18
4/3/18
4/4/18
4/5/18
4/6/18
4/7/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

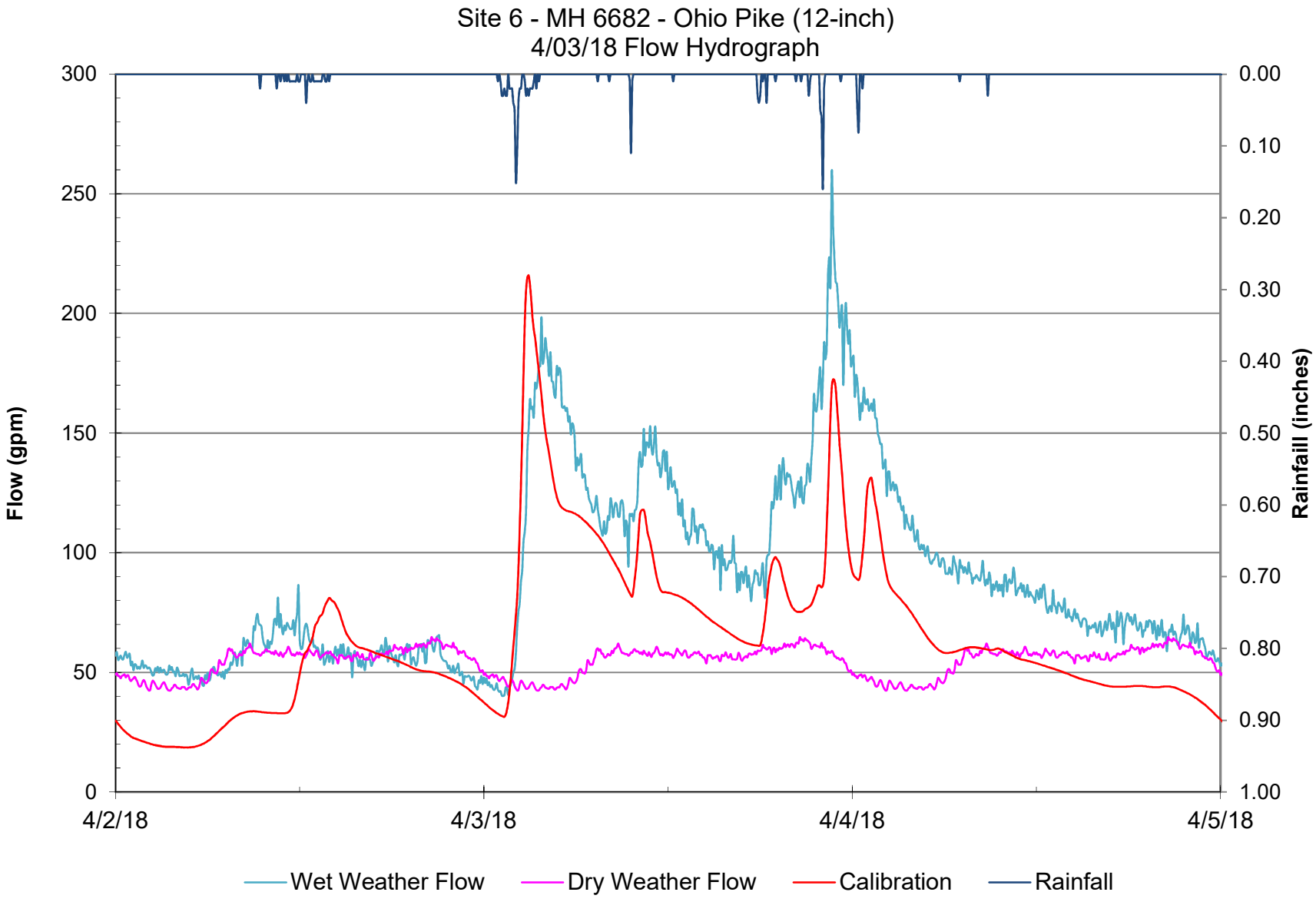

Site 4 - MH 6875 - Slaven Rd. (12-inch)
4/15/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
900
800
700
600
500
400
300
200
100
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/13/18
4/14/18
4/15/18
4/16/18
4/17/18
4/18/18
4/19/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

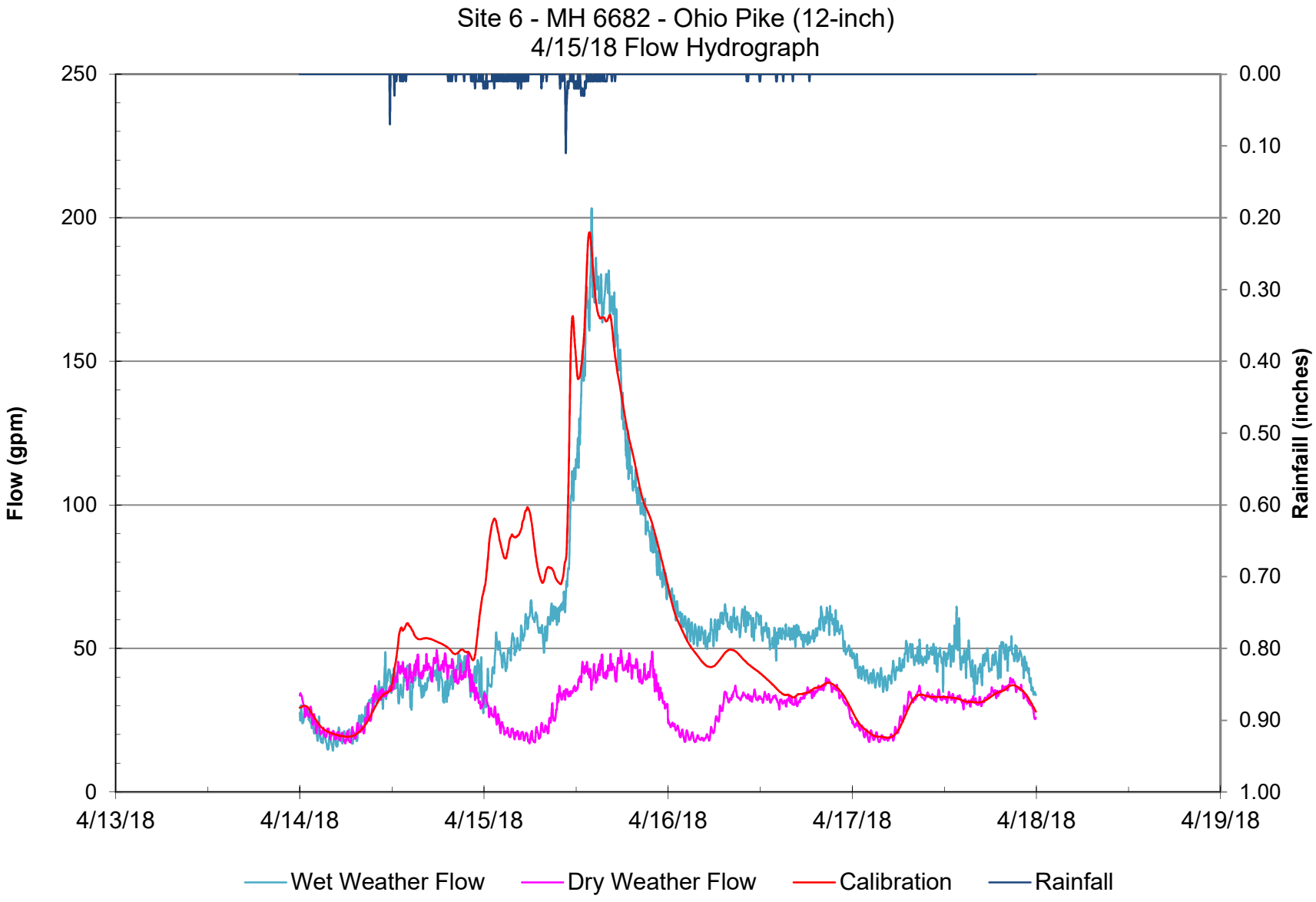

Site 4 - MH 6875 - Slaven Rd. (12-inch)
4/15/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
600
500
400
300
200
100
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
5/30/18
5/31/18
6/1/18
6/2/18
6/3/18
6/4/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

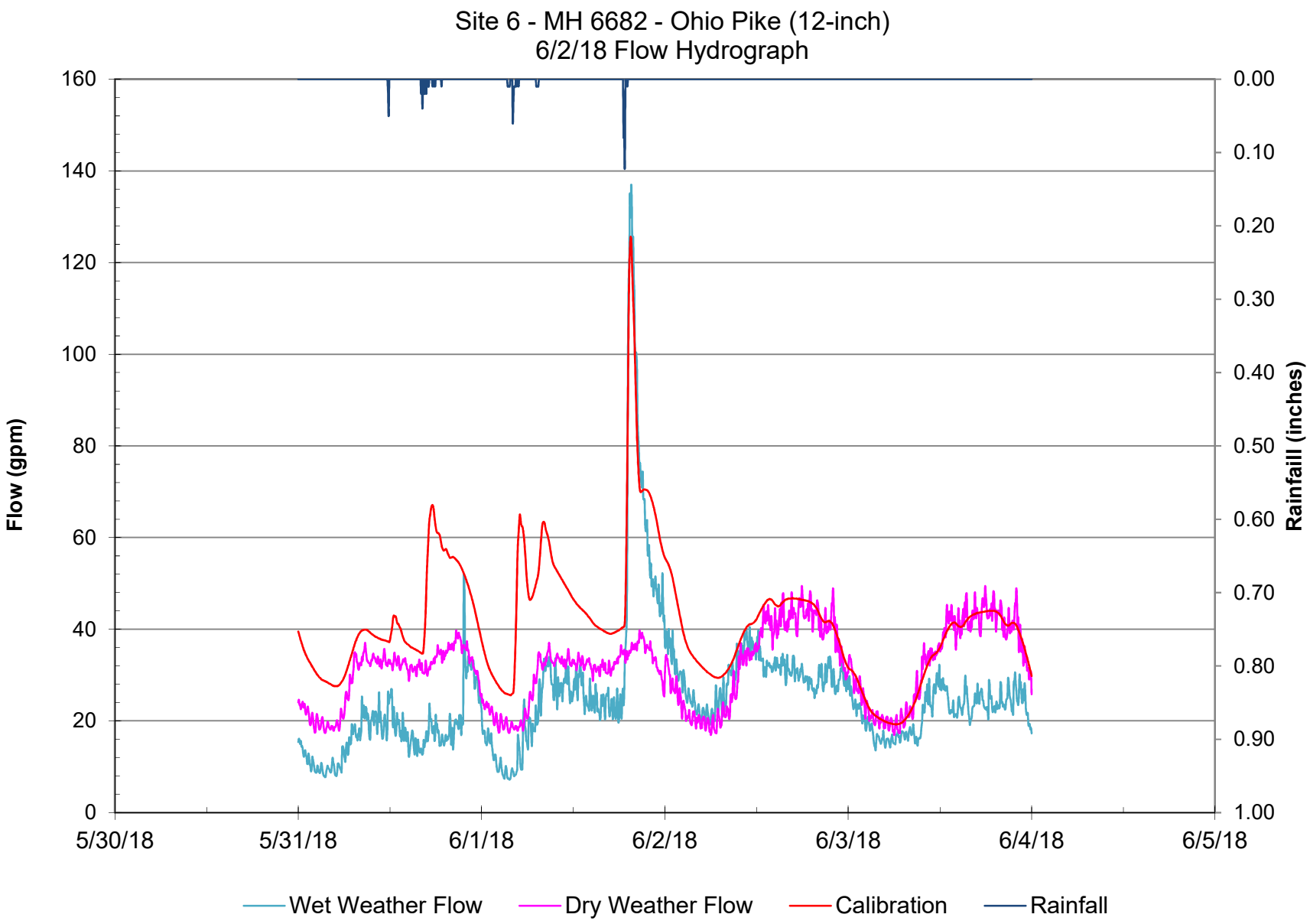

Site 5 - MH 766 - Still Meadow Dr (10-inch)
4/03/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
500
450
400
350
300
250
200
150
100
50
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/2/18
4/3/18
4/4/18
4/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall


Site 5 - MH 766 - Still Meadow Dr (10-inch)
4/15/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
500
450
400
350
300
250
200
150
100
50
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/13/18
4/14/18
4/15/18
4/16/18
4/17/18
4/18/18
4/19/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall


Site 5 - MH 766 - Still Meadow Dr (10-inch)
6/2/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
500
450
400
350
300
250
200
150
100
50
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
5/30/18
5/31/18
6/1/18
6/2/18
6/3/18
6/4/18
6/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall


Site 6 - MH 6682 - Ohio Pike (12-inch)
4/03/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
300
250
200
150
100
50
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/2/18
4/3/18
4/4/18
4/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall


Site 6 - MH 6682 - Ohio Pike (12-inch)
4/15/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
250
200
150
100
50
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
4/13/18
4/14/18
4/15/18
4/16/18
4/17/18
4/18/18
4/19/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall


Site 6 - MH 6682 - Ohio Pike (12-inch)
6/2/18 Flow Hydrograph
Flow (gpm)
Rainfaill (inches)
160
140
120
100
80
60
40
20
0
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
5/30/18
5/31/18
6/1/18
6/2/18
6/3/18
6/4/18
6/5/18
Wet Weather Flow
Dry Weather Flow
Calibration
Rainfall

Appendix 2

Nine Mile Collection System Improvements
CCTV Review Summary Table

Video #	PDF Log	GIS	Trib to Meter	Street	Dia.	CCTV Foot.	Pipe Rating (Struct.)	Pipe Rating (I/I)	Pipe Rating O/M	Pipe Material	Sewer Notes
5_1_1_05012017_102715	PDF_S5	6749-6733	1	SR 125 @ Shell	10	252.1	1	4	4	Truss Pipe	Infiltration from manhole 6733 chimney.
3_1_1_12092014_132718	6778-6785	6778-6775	1	Carriage Station	8	192.4	1	2	2	Clay Tile	Deposit attached at joints 127.7 ft and 137.7 ft downstream of 6778. Weeper at 137.7 joint (small amount of water).
4_1_1_11062012_095517	PDF_S4	6795-6787	1	Winding Way	10	181.0	1	2	2	VCP	Infil stain and weeper at 74.3 ft and 79.7 ft DS 6795.
1_1_1_12092014_120558	6803-6788	6788_6803	1	Carriage Station	8	236.7	1	1	1	Clay Tile	Medium roots in joints at 52.2 ft and 62.40 ft US of 6788.
2_1_1_12092014_123244	6788-6785	6788-6785	1	Carriage Station	8	171.0	1	1	1	Clay Tile	Medium roots in joints throughout. Settled debris in the pipe prevents finishing run. Line may need to be cleaned.
2_1_1_11062012_082644	PDF_S2	6823-6808	1	Winding Way	10	123.4	5	1	4	VCP	Broken pipe with soil visible at 22.5 ft DS of 6823. Pipe quite full - survey abandoned.
3_1_1_11062012_093449	PDF_S3	6808-6795	1	Winding Way	10	217.5	1	1	1	VCP	None.
3_1_1_07032016_122223	PDF_S3	6301-6321	2	Yarabee	8	193.9	1	1	5	Truss Pipe	Encrustations blocking 50% cross sectional at 193.6 ft DS 6301 (at 6321).
2_1_1_07032016_135154	6354-6353	6353-6354	2	Hamblen	8	10.9	1	1	4	Truss Pipe	Obstacles - 25% of cross sectional area. Line may need to be cleaned.
2_1_1_17032016_124725	8987-8985	8987-8985	2	Hamblen	8	332.2	4	3	3	Truss Pipe	Defective tap with signs of I/I and infil dripper at 203.5 ft DS of 8987. Collapsed/deformed pipe with infiltration dripper at 205.3 ft. Lateral connection looks bad at 252 ft.
5_1_1_22062016_100533	N/A	6420-6418	2	Independence	12	296.3	1	3	3	Truss Pipe	Attached grease throughout at flow line. Deposits settled 10% throughout. Encrustation at manhole 6418 (296.3 ft DS 6420) connection w/ infil dripper.
2_1_1_22062016_084240	6412-6409	6412-6409	2	Independence	12	195.3	1	2	2	Truss Pipe	Pipe running quite full, settled deposits ~10%.
10_1_1_22062016_141921	6454-6443	6454-6443	2	Independence	8	107.6	1	2	3	Truss Pipe	Encrustation with infil weeper at joint 103.5 ft DS of 6454.
2_1_1_24032016_140132	6369-6357	6369-6357	2	Ashteade Ln	8	197.7	1	1	1	PVC	None.
2_1_1_24032016_141811	6357-6361	6357-6361	2	Ashteade Ln	8	240.5	1	1	2	PVC	Line may need cleaning soon.
3_1_1_28032016_094759	6369-6357	6369-6357	2	Ashteade Ln	8	197.7	1	1	1	PVC	None.
1_1_1_07032016_133623	N/A	6353_8991	2	Hamblen	8	318.1	1	1	1	Truss Pipe	None.
1_1_1_10032016_142319	N/A	8989_8988	2	Hamblen	8	396.7	1	1	1	Truss Pipe	None.
3_1_1_07032016_141133	8991-8990	8991-8990	2	Hamblen	8	211.6	1	1	1	Truss Pipe	None.
3_1_1_17032016_131324	8988-8987	8988-8987	2	Hamblen	8	441.0	2	1	3	Truss Pipe	Issues with grease buildup and surface spalling but not necessarily I/I.
4_1_1_10032016_133311	8990-8989	8990-8989	2	Hamblen	8	8.5	1	1	1	Truss Pipe	None.
3_1_1_22062016_090657	N/A	6426-6414	2	Independence	12	184.9	1	1	1	Truss Pipe	Some settled debris throughout.
4_1_1_22062016_092005	6418-6416	6418-6416	2	Independence	12	109.7	1	1	1	Truss Pipe	None.
7_1_1_22062016_130043	6431-6428	6431-6428	2	Independence	12	196.5	1	1	3	Truss Pipe	Attached encrustation at joint 44.1 ft US of 6428 but no active infiltration. Some settled debris throughout.
9_1_1_22062016_135540	6463-6454	6463-6454	2	Independence	8	208.8	3	1	3	Truss Pipe	Fractured pipe at 11 ft DS 6463. Deposts attached at joints throughout but no active I/I.
2_1_1_03032016_140559	PDF_S2	6320-6327	2	Yarabee	8	143.2	1	1	1	Truss Pipe	Cracked truss pipe near 140 ft DS 6320.
4_1_1_07032016_124842	PDF_S4	6306-6301	2	Yarabee	8	431.1	1	1	1	Truss Pipe	None
2_1_1_02122016_102823	PDF_S2	6585-6557	3	Ellen Dr.	8	32.2	1	1	5	Truss Pipe	Settled gravel deposits throughout. Line may need cleaning soon.
5_1_1_22072016_090301	8646-8647	8646-8647	3	Marilyn Ln	8	164.2	1	5	5	Truss Pipe	Roots from tap connection entering main at 40 ft DS 8646. Major encrustation at manhole 8647 connection (163.6 ft DS 8646).
2_1_1_20072016_135510	8645-6844	8645-4644	3	Marilyn Ln	8	193.8	1	1	1	Truss Pipe	None.
3_1_1_22072016_081329	8644-8643	8644-8643	3	Marilyn Ln	8	384.6	1	1	1	Truss Pipe	None.
4_1_1_22072016_085520	8643-8646	8643-8646	3	Marilyn Ln	8	120.2	1	1	1	Truss Pipe	None.
1_1_1_01082016_100413	N/A	8993_8994	3	Massey Ct.	8	390.3	1	1	1	Truss Pipe	None.
3_1_1_01082016_124110	8995-8996	8995-8996	3	Massey Ct.	8	241.7	5	1	1	Truss Pipe	Broken pipe 241 ft upstream of 8996. Pipe material falling into main. Potential hole in the pipe below lateral at 239 ft US 8996.
2_1_1_26092016_104434	N/A	6799-416	4	Carol Dr.	8	344.4	1	5	5	Truss Pipe	Infiltration gusher at lateral joint (small but definitely pressurized) at 106.9 ft DS of 6799.
1_1_1_07042014_103723	PDF_S1	642_647	4	Debby Carol	8	258.4	1	5	5	Concrete	Infiltration gusher at lateral connection at 2 ft DS of 642.
1_1_1_08042014_102442	PDF_S1	514_512	4	Dieckkman	8	298.5	1	5	5	Concrete	Crack with infiltration gusher at 1 ft US of 512.
2_1_1_08042014_104832	PDF_S2	512-509	4	Dieckkman	8	279.2	1	5	5	Concrete	Infiltration gusher at joint within lateral at 114 ft DS of 512.
3_1_1_08042014_093111	PDF_S3	577-573	4	Jackie	8	299.7	1	5	5	Concrete	Infiltration gusher just downstream of 577 at crack/joint.
4_1_1_08042014_124559	PDF_S4	509-504	4	Dieckkman	8	136.9	3	4	4	Concrete	Infiltration runner at lateral connection 34 ft US 504. Infiltration runners at longitudinal crack and defective tap at 68 ft. Break in tap intruding at 142.9 ft.
5_1_1_08042014_130344	PDF_S5	504-525	4	Dieckkman	8	163.9	1	4	4	Concrete	Infiltration runner at joint at 125 ft DS of 504.
1_1_1_07042014_130658	PDF_S1	591_581	4	Jackie	8	374.7	2	4	4	Concrete	Large encrustation with dripper at 162.7 ft DS of 591. Crack with infiltration runner at 377.4 ft DS of 591. MH 581 with running infiltration down wall.
7_1_1_16022016_133146	1148-1131	1148-1131	4	Parfore	8	213.1	1	4	4	PVC	Infiltration runner at first joint in lateral at 168.4 ft DS 1148.
1_1_1_26092016_102447	6977-416 (1)	6977-416	4	Carol Dr.	8	33.8	1	3	3	Truss Pipe	Large encrustation with dripper at 32.5 ft DS 6977.
2_1_1_21022017_124607	505-461	505-461	4	Country Club Dr.	8	326.5	2	3	3	Truss Pipe	Infiltratoin dripper at 79.1 ft DS 505. Pipe greasy.
1_1_1_19032014_135041	538-551	538-551	4	Dieckkman	8	349.0	1	3	3	Concrete	Encrustation with infiltration weeper at 11 ft and 19.6 ft DS 538. Lateral with infiltration at 341 ft.
2_1_1_08042014_090512	PDF_S2	581-577	4	Jackie	8	283.1	1	3	3	Concrete	Major debris in main line blocking the lateral at 289.10 ft US 577
5_1_1_16022016_123714	1111-1134	1111-1134	4	Parfore	8	227.8	1	3	3	PVC	Major encrustation from tap located 227 ft DS of 1111 coming into the mainline - camera cannot make it passed.
2_1_1_07042014_123404	PDF_S2	647-591	4	Debby Carol	8	409.1	1	2	2	Concrete	Some joints with attached encrustations but no active I/I observed.
1_1_1_15022018_082450	6946-6939	6946_6939	4	Country Club Dr.	8	193.2	1	1	1	Truss Pipe	None.
5_1_1_24022017_134753	414-6998	414-6998	4	Country Club Dr.	8	224.2	4	1	1	Truss Pipe	Broken pipe at 62 ft US 6998 but no soil visible and no evidence of I/I.

Nine Mile Collection System Improvements
CCTV Review Summary Table

Video #	PDF Log	GIS	Trib to Meter	Street	Dia.	CCTV Foot.	Pipe Rating (Struct.)	Pipe Rating (I/I)	Pipe Rating O/M	Pipe Material	Sewer Notes
6_1_1_24022017_141330	6998-6993	6998-6993	4	Country Club Dr.	8	270.3	1	1	1	Truss Pipe	None.
1_1_1_31032010_104030	N/A	520-514	4	Dieckkman	8	295.0	1	1	1	Asbestos Cemen	None.
3_1_1_08042014_105957	PDF_S3	509-504	4	Dieckkman	8	126.3	1	1	2	Concrete	Tap intruding into mainline at 126.8 ft downstream of 509.
1_1_1_25082014_134842	N/A	113-116	4	Jackie	8	123.0	1	1	1	Concrete	None.
2_1_1_23052011_140744	N/A	116-138	4	Jackie	8	373.4	1	1	1	Concrete	Some grease attached throughout.
2_1_1_25082014_140013	N/A	119-116	4	Jackie	8	129.8	1	1	1	Concrete	Line should be cleaned eventually. Some settled debris near MH 116.
1_1_1_23052011_140102	N/A	113-116	4	Jackie	8	123.0	1	1	1	Concrete	None.
2_1_1_16022016_101100	1025-1019	1025-1019	4	Parfore	8	105.4	1	1	1	PVC	None.
3_1_1_16022016_102920	1000-1019	1000-1019	4	Parfore	8	72.5	1	1	1	PVC	None.
4_1_1_16022016_110919	1134-1139	1134-1139	4	Parfore	8	323.8	1	1	1	PVC	None.
6_1_1_16022016_131452	1139-1148	1139-1148	4	Parfore	8	237.0	1	1	1	PVC	None.
8_1_1_16022016_140917	1167-1148	1167-1148	4	Parfore	8	217.6	1	1	2	PVC	None.
8_1_1_21012015_131348	PDF_S8	1055-992	5	Gaskins Rd.	8	384.9	1	5	5	Truss Pipe	Infiltration gusher at joint in lateral at 76.3 ft DS 1055.
1_1_1_14012015_134155	1039-1043	1039_1043	5	Conley	8	139.6	1	4	4	Truss Pipe	Infiltration at deposit 70.8 ft US 1043. Large encrustation at 131 ft.
5_1_1_21042014_105624	PDF_S5	1005-999	5	Crescent St.	8	288.8	2	4	4	Concrete	Infiltration runner at joint 3 ft DS of 1005. Infil stain/signs of previous runner at 27 ft.
7_1_1_12101205_122918	PDF_S7	1118-1055	5	Gaskins Rd.	8	392.6	1	4	4	Truss Pipe	Infiltration runner at break in lateral at 308.1 DS of 1118.
4_1_1_21012015_094402	PDF_S4	832-868	5	Gaskins Rd.	8	317.0	1	3	3	Truss Pipe	Large attached encrustation with infiltration dripper at 19.5 ft DS 832.
2_1_1_14012015_140109	1043-1020	1043-1020	5	Conley	8	188.7	1	2	2	Truss Pipe	Encrustations with infiltration weepers at 78.2 ft and 80.70 ft DS of 1043.
1_1_1_02052014_124930	985 -944	985_944	5	Crescent St.	8	247.6	1	2	2	Concrete	Attached encrustation/grease on the bottom channel. Infiltration weepers at joints: 168.9 ft, 185.1 ft, 189 ft, 193.6 ft, 197 ft DS 985. Pipe ~30% full. Deposits more significant near manhole 944.
2_1_1_21042014_094904	1001-985	1001-985	5	Crescent St.	8	98.8	1	1	1	Concrete	Some grease along the flow line of the pipe.
3_1_1_21042014_095737	PDF_S3	1050-1001	5	Crescent St.	8	293.6	1	1	1	Concrete	No real I/I issues but major concrete agg exposed and major settled debris. May need to be cleaned.
4_1_1_21042014_103931	PDF_S4	1016-1005	5	Crescent St.	8	324.7	2	1	1	Concrete	None.
6_1_1_22042014_122454	N/A	1005-999	5	Crescent St.	8	7.5	2	1	1	Concrete	Crack just downstream of 1005.
7_1_1_22042014_123247	999-995	999-995	5	Crescent St.	8	319.2	5	1	2	Concrete	Roots in laterals at 56.2 ft DS 99 and 267.2 ft. Hole which has been patched at 295.30 - no soil visible and no evidence of I/I.
3_1_1_21012015_091232	PDF_S3	868-897	5	Gaskins Rd.	8	313.9	1	1	1	Truss Pipe	None.
4_1_7_21012015_100914	PDF_S4	832-868	5	Gaskins Rd.	8	323.0	1	1	1	Truss Pipe	None.
6_1_1_21012015_105821	PDF_S6	11-767	5	Gaskins Rd.	8	107.3	1	1	1	Truss Pipe	None.
2_1_1_15032010_084628	N/A	6798-6780	6	Hillview Dr.	8	277.5	3	5	5	Concrete	Infiltration gusher at lateral connection at 25.7 ft DS of 6798. Entire pipe not in GREAT condition but okay. Lots of exposed aggregate.
2_1_1_23062014_081101	PDF_S2	6673-6637	6	Wilfert	8	435.3	1	4	4	Concrete	Infiltration dripppers, weepers, runners all throughout sewer run.
1_1_1_23062014_091221	6637-6634	6637-6634	6	Clover Dr.	8	2.0	1	1	1	Concrete	Blockage in main which needs cleaning.
2_1_1_23062014_091706	6634-6640	6634-6640	6	Clover Dr.	8	3.0	1	1	1	Concrete	Survey abandoned immediately due to needing to be cleaned.
1_1_1_14052014_133713	PDF_S1	6776_6780	6	Hillview Dr.	8	218.1	1	1	1	Concrete	None.
1_1_1_15032010_082627	N/A	6835-6798	6	Hillview Dr.	8	4.2	1	1	1	Clay Tile	None.
1_1_3_15032010_083031	N/A	6835-6798	6	Hillview Dr.	8	347.0	1	1	1	Concrete	None.
4_1_1_15032010_094404	N/A	6868-6887	6	Hillview Dr.	8	301.2	5	1	1	Concrete	Surface spalling throughout. Pipe looks pretty bad but no evidence of I/I.
1_1_1_23062014_080304	PDF_S1	12543-6673	6	Wilfert	8	40.4	2	1	1	Concrete	Longitudinal crack at 21.2 - 24.0 ft DS 12543.
8_1_1_16032010_112628	N/A	6718-6746	6	Wilfert	8	295.0	1	1	1	Concrete	None.
Video not provided	PDF_S3	6872-6870	1	McCormick	8	128.1	5	3	4	Concrete	Hole in pipe, fractures, roots, infiltration weeper/stains, cracks throughout.
Video not provided	PDF_S8	6775-6762	1	McCormick	8	187.0	4	3	3	VCP	Infiltration weeper, stains, drippers throughout. Multiple fractures.
Video not provided	PDF_S3	6741-6736	1	McGary	8	247.2	1	3	3	VCP	Infiltration dripper, weeper, stains, attached encrustations throughout.
Video not provided	PDF_S1	6736-6731	1	McGary	8	249.3	1	3	3	PVC	Infiltration dripper at 164.4 ft DS 6736 w/ intruding sealing ring hanging.
Video not provided	PDF_S4	6756-6757	1	Levitt	8	232.3	1	2	5	VCP	Infiltration stains and weepers throughout, 35% encrustations at 51.5 ft DS 6756.
Video not provided	PDF_S1	6728-6741	1	McCormick	8	106.9	1	2	4	VCP	Infilration weeper, stains, throughout Obstacles in pipe.
Video not provided	PDF_S2	6877-6856	1	Miles	8	339.4	3	2	2	VCP	Infiltration weeper, stains, fractures, cracks and deposits throughout.
Video not provided	PDF_S1	6870-6857	1	Kerr	8	193.2	4	1	3	VCP	Attached encrustations throughout.
Video not provided	PDF_S2	6856-6860	1	Kerr	8	172.0	1	1	3	VCP	Attached encrustations throughout.
Video not provided	PDF_S1	6886-6885	1	Rue Center	8	33.0	5	1	1	Clay Tile	Broken pipe at 1 ft DS 6886. Pipe material in main.
Video not provided	PDF_S5	6787-6752	1	Winding Way	10	376.4	4	1	2	VCP	Broken pipe at 47.8 ft DS 6787. Attached encrustations, infiltration weeper, stains, and fractures throughout.
Video not provided	PDF_S3	6499-6496	2	McIntosh	8	34.6	1	4	4	Truss Pipe	Infiltration in MH 6496.
Video not provided	PDF_S3	6330-6329	2	Stone Creek Way	10	198.3	1	4	4	PVC	Infiltration in MH 6330.
Video not provided	6455-6431	6455-6431	2	Independence	12	194.3	1	3	5	Truss Pipe	Infiltration dripper at 192.7 ft DS 6455. 25% and 35% cross section attached encrustations.

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Video not provided	PDF_S1	6522-6499	2	McIntosh	8	82.9	1	1	4	Clay Tile	25% attached encrustation 80 ft DS 6522.
Video not provided	PDF_S2	6311-6307	2	Picadilly	8	5.0	5	1	1	Truss Pipe	Broken pipe at 5 ft downstream 6311 (soil visible).
Video not provided	PDF_S1	6344-6313	2	Southern Trl	8	407.2	1	1	5	PVC	40% attached encrustation just upstream of MH 6313.
Video not provided	PDF_S1	6321-6320	2	Yarabee	8	188.3	1	1	5	Truss Pipe	40% attached encrustations just DS of 6321.
Video not provided	PDF_S2	9111-9107	3	Hopper Hill	8	254.0	1	5	5	Truss Pipe	Infiltration runner and gusher just DS of MH 9111.
Video not provided	PDF_S3	9107-9112	3	Hopper Hill	8	175.9	1	2	2	Truss Pipe	Infiltration weeper just upstream of MH 9112.
Video not provided	PDF_S4	577-525	4	Jackie	8	203.0	1	5	5	Concrete	Infiltration gusher near crack at 206.5 ft DS 573 (near MH 525).
Video not provided	PDF_S3	468-450	4	Stanlyn	8	205.9	1	1	4	Truss Pipe	30% attached encrustation just US of MH 450.
Video not provided	PDF_S1	988-985	5	Crescent St.	8	343.2	1	4	4	Concrete	Infiltration in or at lateral 302.7 ft US 985.
Video not provided	PDF_S2	1175-1222	5	Gaskins Rd.	8	374.3	1	4	4	Concrete	Infiltration in or at lateral 258.10 DS 1175.
Video not provided	PDF_S2	1098-1039	5	Terrydel	8	274.6	1	4	4	Truss Pipe	Infiltration in or at lateral 143.9 ft DS 1098.
Video not provided	944-911	944-911	5	Crescent St.	8	25.4	2	1	3	Crescent	Rocks in main, line should be cleaned.
Video not provided	995-988	995-988	5	Crescent St.	8	292.1	2	1	5	Crescent	Rootball in joint, should be cut.
Video not provided	PDF_S1	1095-1050	5	Tracy	8	295.2	1	1	5	Concrete	35% attached encrustation just DS of MH 1095.
Video not provided	6644-6653	6644-6653	6	SR 125 @ Tender Town	8	231.6	1	5	5	Truss Pipe	Infiltration gusher at lateral connection.
Video not provided	6684-6682	6684-6682	6	SR 125 @ Recker Boeger	12	173.8	5	1	5	Truss Pipe	Major grease blockage and collapsed pipe.
Video not provided	PDF_3	6770-6750	6	Hillview	8	206.7	1	1	4	Concrete	Large encrustations and roots throughout, attached grease.