

**ENVIRONMENTAL CONSTRAINTS
ANALYSIS**

Summit District Development Project



August 15, 2023

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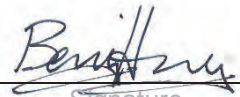
Project Number:
193806201

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Prepared by:


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Benjamin Harvey

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Signature

Jared Ward, Project Manager

Printed Name

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Executive Summary

On behalf of The Ridge Group Development, Stantec conducted an Environmental Constraints Analysis (ECA) of water resources, biological resources, and protected lands; and a review of regulatory and permitting considerations for the proposed Summit District Development Project in Monroe County, Indiana (Project). The total Project area encompasses approximately 138.51 acres. The Project area is primarily fallow cropland, scrub undeveloped land, and forested land. This ECA provides an overview of the key environmental resources identified during preliminary planning and site investigations. This ECA further provides recommendations and/or mitigation of potential risks to each resource before Project implementation.

The ECA results indicate that some environmental constraints exist for the Project and are of low to moderate significance (Table 1). The Project is a proposed private action occurring on private land with low risk of adversely affecting the natural environment. The primary federal requirements anticipated are compliance with the Clean Water Act. Further protected species and cultural resources reviews may be triggered through regulatory processes if the Project cannot avoid affecting water resources. The primary local requirements are the City of Bloomington Unified Development Ordinance and associated permitting and approvals. Steep slopes may also be a potential constraint on development of the site, however this will be considered under the engineering analysis instead of this report, and there will be coordination where overlapping environmental and steep slope areas exist.

Many of the environmental constraints identified during this study are similarly situated with other environmental constraints, as is the case with mature canopy cover and karst features. These areas should be prioritized for preservation during site design. Additional areas that have environmental constraints may be suitable for use as stormwater detention, development amenities, or as green space.

Table 1 – Environmental Constraints Summary

Constraint	Potential Constraint Severity	Comments	Recommendations
Streams and Wetlands <ul style="list-style-type: none"> USACE and IDEM Regulated 	Low	Streams and wetlands were identified on the property, but impacts should be small and permissible	Avoid and minimize impacts to these resources wherever practicable
Streams and Wetlands <ul style="list-style-type: none"> Buffer Zones 	Moderate	Buffers must be established on all streams on the site, with restrictions on what types of development may occur	Avoid where feasible Utilize for green space or site amenities, or where permitted, stormwater detention
Floodplains	Low	Floodplain exists at the western Project area limits	Avoid structures and fill Utilize as green space or detention where possible
Karst Geology	Moderate	Karst features spread throughout the site, concentrated in several forested areas	Avoid impacts where feasible Coordinate potential impacts with state and local requirements/agencies
Tree and Forest Canopy	Moderate	Large sections of mature woods were identified, as well as a few smaller stands of canopy	Limit impacts where feasible Focus preservation on the larger contiguous stands and overlapping constraint areas Utilize as green space or amenities



1 Introduction

The Ridge Group Development (Ridge Group) is evaluating an approximately 138.51-acre area in Monroe County, Indiana (Project area) for a proposed mixed use development project referred to as the Summit District Development Project (Project). The Project is on private lands approximately 2 miles southwest of Bloomington, Indiana (Figures 1 and 2). On behalf of the Ridge Group, Stantec conducted a field and desktop-level Environmental Constraints Analysis (ECA) of water resources, floodplain constraints, karst features, and forest canopy cover and a review of regulatory and permitting considerations. The purpose of this ECA is to 1) identify the regulatory requirements and environmental constraints that were evaluated and may impact development, 2) summarize the results of field and desktop reviews relating to these environmental constraints, and 3) provide recommendations for how to best address these constraints while completing the required development of the site.

There are additional constraints, some environmental, which may impact development of the site. A notable example for this site would include steep slopes, which will be addressed during the civil engineering design process and coordinated with other environmental constraints where appropriate. These additional constraints may also include existing comprehensive plans, transportation plans, and planning codes, among others. These are considered outside the scope of this report and will not be addressed. The primary objective of this report is to evaluate environmental constraints applicable to early phase development of this site, and also those which will need to be addressed for Planned Unit Development (PUD) approval.

2 Background

Several overlapping jurisdictions exist on the Project area. These may include federal, state, or local agencies; and some resources are also regulated by multiple agencies under different programs.

Federal

The primary federal agency applicable at this time includes the US Army Corps of Engineers (USACE) in their regulatory authority over streams and wetlands (waters). The USACE regulates discharges (placement of fill) within streams and wetlands under their jurisdiction. Once the USACE establishes that a permit is required for impacts to a stream or wetland on the project, they agency has additional requirements to ensure the project meets other federal environmental regulations, including the endangered species act (ESA), which is administered by the US Fish and Wildlife (USFWS). The level of involvement required by the USFWS varies by project, and is determined after initial contact with the USACE is made, often in the form of a request for a Jurisdictional Determination (JD) or permit application submission.



Environmental Constraints Analysis

2 Background

The Federal Emergency Management Agency (FEMA) may also be consulted during development of the site, as they regulate mapped FEMA-designated flood zones. In Indiana, flood zone development more often involves the jurisdiction of state and local authorities. FEMA involvement is only typically triggered by local or state request, or if a flood zone map amendment is requested.

State

Two primary state agencies may have jurisdiction on the site, including the Indiana Department of Environmental Management (IDEM) and Indiana Department of Natural Resources (IDNR). IDEM also regulates impacts to streams and wetlands (waters), and through the state isolated wetland program also regulates wetlands that may not fall under the USACE's jurisdiction. The requirements for IDEM waters permitting are distinct from USACE permitting, but permitting is similar and generally performed in tandem with the USACE process. The IDEM Construction Stormwater General Permit (CSGP) also regulates aspects of construction and development, primarily to prevent sedimentation within streams. While much of the CSGP focuses on construction activities it also specifies that a 50-foot buffer should remain on stream resources, with certain exceptions.

The IDNR regulates floodway development in Indiana, including on all streams with a drainage area greater than 1 square mile, and requires permitting for most construction activities proposed within a floodway. The IDNR has several general licenses for activity with a floodway, and do not require formal permit application submission. In conjunction with floodway permitting, a biological review of the project is required for any action the IDNR approves. This biological review is often limited to the specific area where a floodway impact is proposed, however.

Local

The project will require approval by the City of Bloomington, and therefore must comply with requirements of the City's Unified Development Ordinance (UDO). The UDO lays out many requirements for development approval but for this ECA the focus will be on riparian areas, karst geology features, and tree and forest canopy features.

Similar to both federal and state agencies, the UDO regulates streams and wetlands, but the primary constraint on site development is through riparian area setbacks to said development. Three zones are designated in the site's draft PUD, located at 60-feet, 40-feet, and 20-feet respectively from the stream; and with increasing limits on what development activities can occur and requirements for development.

Karst geology exists in areas that are underlain by soluble bedrock and that is characterized by the development of sinkholes, caves, and springs. Karst features are identified as important for preservation in the UDO, and there are specific requirements to buffer development around the area which drains to these karst features. The UDO restricts development activities within a 25-foot buffer around karst features.

The UDO has requirements for tree and forest canopy preservation, which are based on the existing site canopy cover. The baseline canopy cover of the site is evaluated, and then used to calculate an amount



of canopy cover that will be retained after the site is developed. The ordinance places a higher value on large, mature trees and also places a preference towards preserving stands of intact mature forest.

3 Methodology

Following a review of the relevant potential environmental constraints that may apply to development of this site, Stantec developed a methodology to survey and evaluate the conditions on the site relative to these constraints. A desktop review was conducted to identify potential features ahead of field work. This desktop review utilized multiple years of aerial imagery, publically available light detection and ranging (lidar) elevation data, USFWS national wetland inventory, FEMA and IDNR floodplain mapping, and national hydrography dataset information to identify potential features and direct follow-up field verification activities. Stantec conducted a site visit in spring of 2023, after the growing season had commenced but before full vegetation cover on the site. This allowed an evaluation of the plant communities and canopy cover, while at the same time allowing easier identification and verification of potential karst features. Site data was collected using sub-meter accuracy geographic positioning system devices and software. Following the site visit, data were rectified against desktop review features to produce final versions of the identified environmental constraints.

4 Results

4.1 Streams and Wetlands

For purposes of this report, streams and wetlands as defined by USACE/IDEM guidelines are considered the same as what is described and regulated by the City of Bloomington under the UDO. A total of four streams and three wetlands were identified within the Project area. These features are shown on Figure 3 in the appendix.

Two streams were identified along the western Project area limits, one running north-south along the western boundary at South Weimer Road, and one tributary to this stream running generally northeast to southwest at the parcel boundary. The stream along Weimer Road is the largest on the site, with a drainage area of approximately 1.48 square miles. Another stream was identified bisecting the parcel and running generally northwest to southeast. This stream was small as it entered the parcel at the upstream extents but was more substantial by the time it exited the parcel, with its width going from 2 feet to 8 feet while flowing through the site. The overall drainage area of this stream was approximately 0.34 square miles. The final stream on the site ran east to west along the far southern boundary of the site, with portions within the parcel and the downstream end nearby but outside the parcel boundary.



Environmental Constraints Analysis

4 Results

Each of the wetlands on the parcel were located immediately adjacent to stream features, which means they would be regulated by both the USACE and IDEM. One wetland is larger in size, totaling approximately 0.3 acre, while the other wetlands are smaller by comparison and less than 0.1 acre in size. The larger wetland and one of the smaller ones are located along the streams at the western Project area boundary, and one wetland totaling 0.07 acre in size is located along the stream bisecting the Project area.

4.2 Floodplains

A FEMA-mapped floodplain is shown for the stream running along the western Project area boundary, associated with the large stream at that location. This floodplain boundary extends approximately 300 feet to the east into the Project area. The IDNR floodway mapping also shows mapped flood zone in this location. No other floodplain areas are shown within the Project area. Also, no other streams were determined to have a drainage area greater than 1 square mile, so would not be regulated by the IDNR. Floodplain mapping is shown on Figure 4 in the appendix.

4.3 Karst Geology

Karst areas present in this region include caves, springs, and sinkholes, with sinkholes being the most commonly occurring feature in this area. Sinkholes can be generally identified as a concave basin within the landscape, sometimes with a limestone opening (eye) located near the bottom of the depression. Lidar surface elevations were used to identify areas of closed drainage within the Project area. These were checked during field visits to confirm if they would be considered karst features based on the UDO requirements. A total of 48 potential sink holes were identified within the Project area. No caves or springs were identified during field or desktop investigations. Karst features were scattered throughout the site, but generally occurred where there is existing tree cover, and are clustered in the northwest of the site south of Sudbury Road, and at the far eastern and southeastern limits of the Project area. Karst features are shown on Figure 5 in the appendix.

4.4 Tree and Forest Canopy

Tree and forest canopy was initially identified based upon desktop review of aerial photography, and then the relative cover of canopy and the boundaries were confirmed during field investigation. Portions of the site appear to have been farmed as recently as 2020, with the northeastern and southeastern limits of the project apparently left fallow for longer than that. The site contained isolated stands and strips of trees in several locations, but the largest contiguous stands of tree canopy in the eastern, southeastern and northwest corners of the Project area. A total of approximately 27.43 acres of canopy cover was identified within the Project area. Tree and forest canopy cover is shown on Figure 6 in the appendix.



5 Environmental Constraints Discussion

A number of environmental constraints were identified on the Project area, each with specific protection mechanisms or potential impacts to development of the entire parcel. Some of the constraints are relatively easy to incorporate into project design or are possible to impact and mitigate, while others would be a significant challenge to impact or are not able to be impacted at all. This discussion section will briefly describe the regulatory environment surrounding each environmental constraint, and go on to discuss the feature's potential impact to development and how site development may proceed alongside existing environmental constraints.

5.1 Streams and Wetlands

Streams and wetlands are requested to be preserved based on the UDO, however under the USACE and IDEM regulatory environment can be impacted or removed as long as the site developer can demonstrate that the impact is required for development, tries to minimize these impacts, and provides compensatory mitigation if impacts reach certain thresholds. Because of the location of some streams within the Project area, crossing these streams will be required to develop the site. The long stream bisecting the parcel and the stream along the southern property boundary will each need to be crossed to access the eastern portion of the site and provide connectivity from the south. Crossing lengths should be minimized to the maximum extent practicable, and any other disturbance to the riparian buffer should be minimized based on the stream buffer restrictions identified in the PUD.

Stream Buffer Zones

Stream buffers are important to maintain to preserve the chemical, physical, and biological integrity of streams. Any preserved buffer is better than no buffer, however a good rule of thumb is that a 50-foot buffer should be preserved wherever possible. A 50-foot buffer is also required based on Indiana's CSGP, with exceptions for certain circumstances. Buffer areas were set at 20-feet (Zone 1), 40-feet (Zone 2), and 60-feet (Zone 3) from each stream corridor as based on the site's draft PUD. Development is constrained in each of these zones, with restrictions decreasing at each respective zone leading from the stream itself. These buffer areas are shown on Figure 7 in the appendix. The acreage of each zone within the Project area parcel boundary was calculated, finding a total of 5.43 acres will be classified as Zone 1, 4.89 acres are classified as Zone 2, and 4.70 acres are classified as Zone 3. Site development options are limited in these areas, however outermost zones are permitted to be used for green space, some site amenities, and stormwater detention.

5.2 Floodplains

The large area of floodplain on the western project area boundary is recommended for avoidance as much as practicable. This is because of constraints on development imposed by both FEMA and the IDNR. An exception to this may be that site detention basins or non-structural amenities could be planned within this area. Generally, regulatory agencies are more concerned with the placement of fill or a restriction of flow area within floodplains. If detention basins, unpaved trails, or green space could be



Environmental Constraints Analysis

5 Environmental Constraints Discussion

located within this area it may satisfy site development objectives and make the floodplain areas usable space. Any potential development would need to be approved locally and by the state, and modifications would need to be coordinated through FEMA.

5.3 Karst Geology

The primary areas of concentration of karst geology are located in clusters in the northwest of the site south of Sudbury Road, and at the far eastern and southeastern limits of the Project area. Based on the UDO, features that are close together can be combined into compound karst features for preservation, which may be applicable to some of these features. In general these areas should be avoided where possible, as capping sinkholes is typically expensive and only allowable where development cannot occur otherwise.

5.4 Tree and Forest Canopy

Large sections of tree canopy are located in contiguous stands, with the most mature forested stands occurring at the northwest, eastern, and southeastern Project area limits. There are limited stands of canopy scattered throughout the site as well, but these are generally of lesser quality or concentrated in narrow strips. To the maximum extent possible, the larger sections of mature forest canopy should be preserved on the site and this should be designated as the retained canopy as final design is developed. Other sections of forest canopy should be preserved wherever practicable for development.

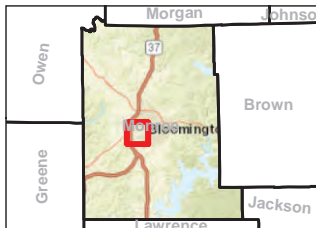
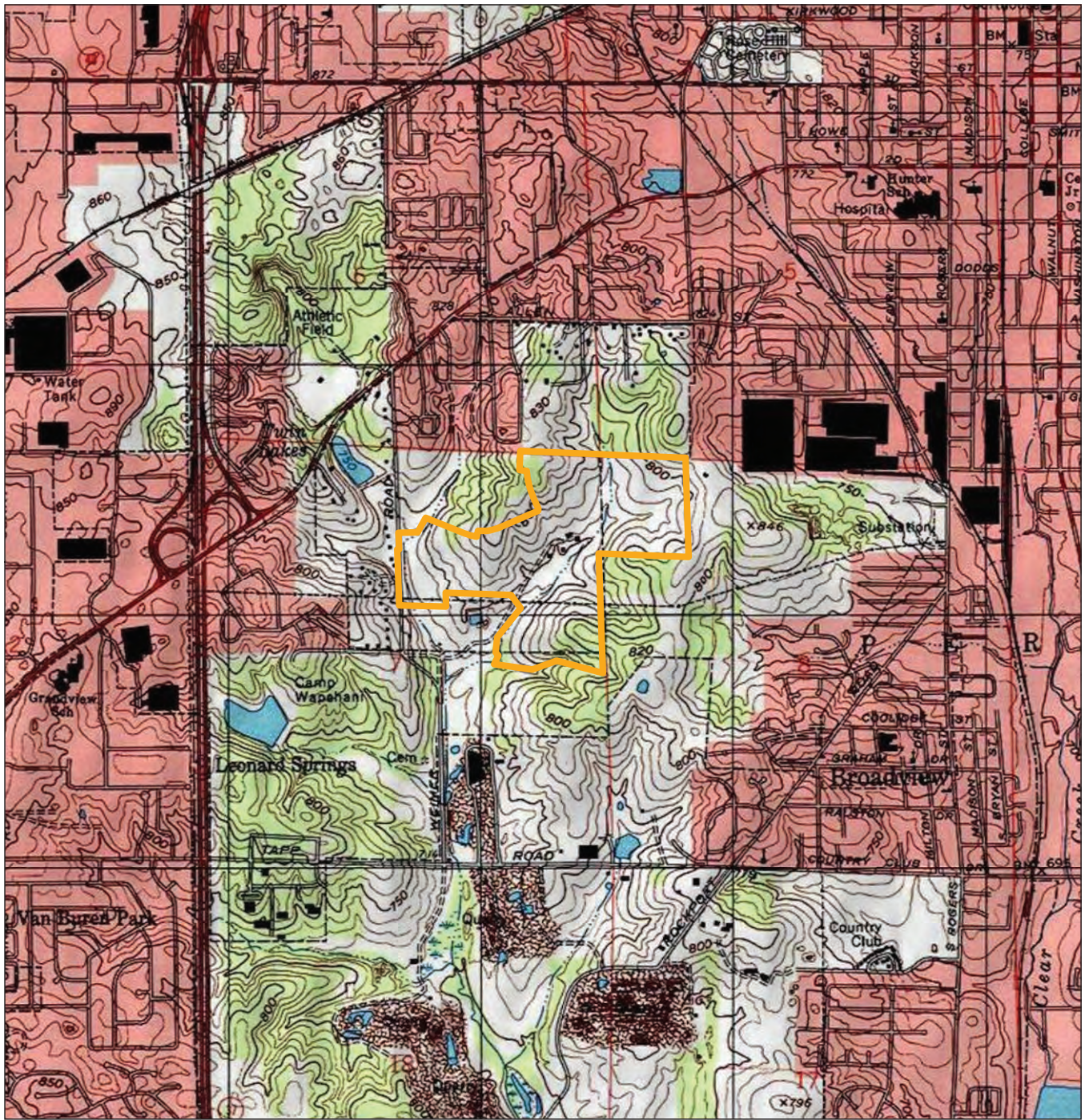
5.5 Overlapping Constraints and Jurisdictions

Because of how the environmental constraints are located on the site, there is a potential to maximize preserved areas on the Project area. As is typical in this region, many of the areas containing karst features were not developed in the past and were allowed to grow in as tree canopy. This provides a potential to preserve both of these features in one undeveloped area. Similar to this, large areas of the floodplain and some of the stream buffer areas are also mature forest or wetland, so would not diminish developable area as much as if the overlap were less pronounced. Generally, as site configuration is finalized, the development team should retain and preserve areas with multiple overlapping environmental constraints.

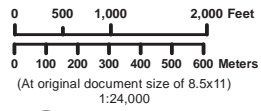


Appendix A - Figures





Legend
 Project Location



Project Location Prepared by SKL on 6/15/2023
T8N, R1W, S7-8 TR by LS on 6/15/2023
7.5' Quadrangle: Bloomington IR Review by DV on 6/15/2023
Monroe County, IN

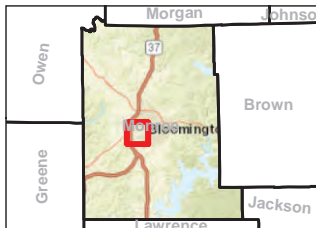
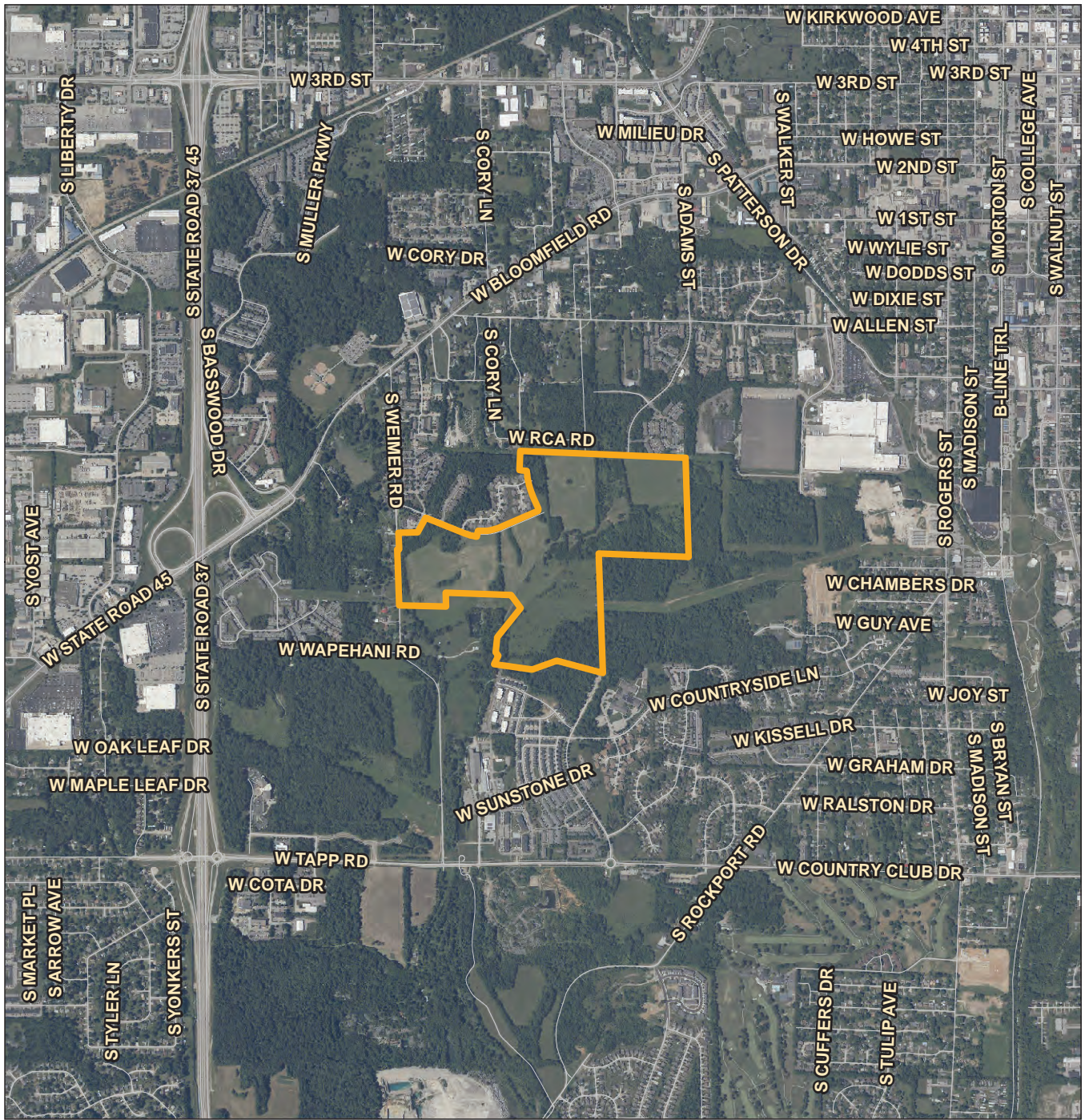
Client/Project The Ridge Group, Inc. Proj No. 193806201
Summit District - Bloomington

Environmental Constraints Analysis

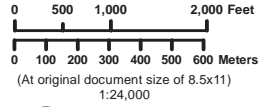
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Title Project Location

Notes
1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources: Stantec, NAIP
3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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Legend
 Project Location



Project Location Prepared by SKL on 6/15/2023
 T8N, R1W, S7-8 TR by LS on 6/15/2023
 7.5' Quadrangle: Bloomington IR Review by DV on 6/15/2023
 Monroe County, IN

Client/Project The Ridge Group, Inc. Proj No. 193806201
 Summit District - Bloomington

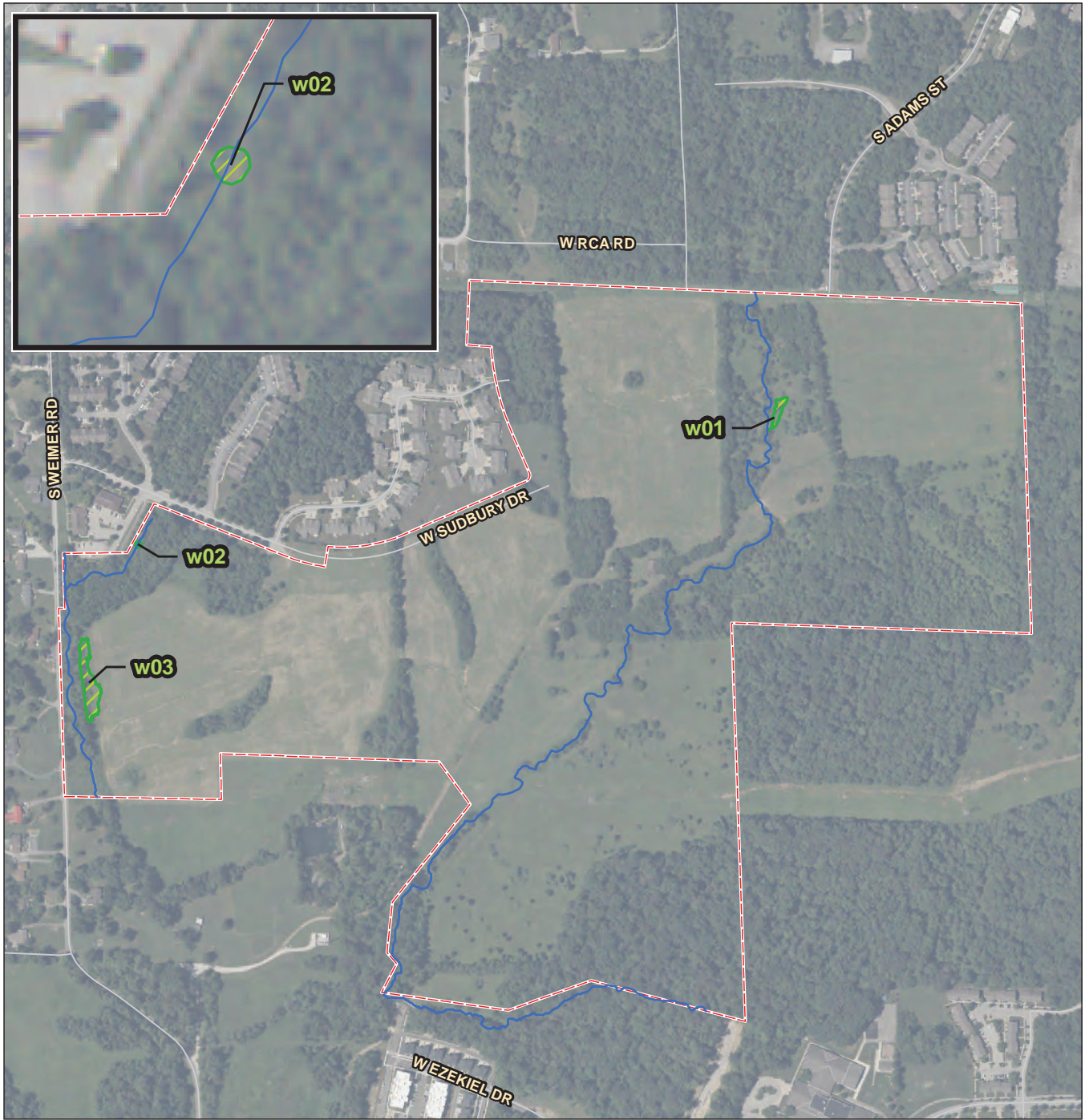
Environmental Constraints Analysis




Figure No.
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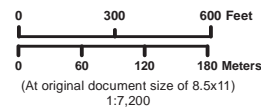
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 3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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- Legend**
-  Delineated Stream
 -  Delineated Wetland
 -  Project Location



Project Location: T8N, R1W, S7-8
 7.5' Quadrangle: Bloomington
 Monroe County, IN

Prepared by SKL on 6/19/2023
 TR by LS on 6/19/2023
 IR Review by DV on 6/19/2023

Client/Project: The Ridge Group, Inc. Proj No. 193806201

Summit District - Bloomington
 Environmental Constraints Analysis

Figure No.
3

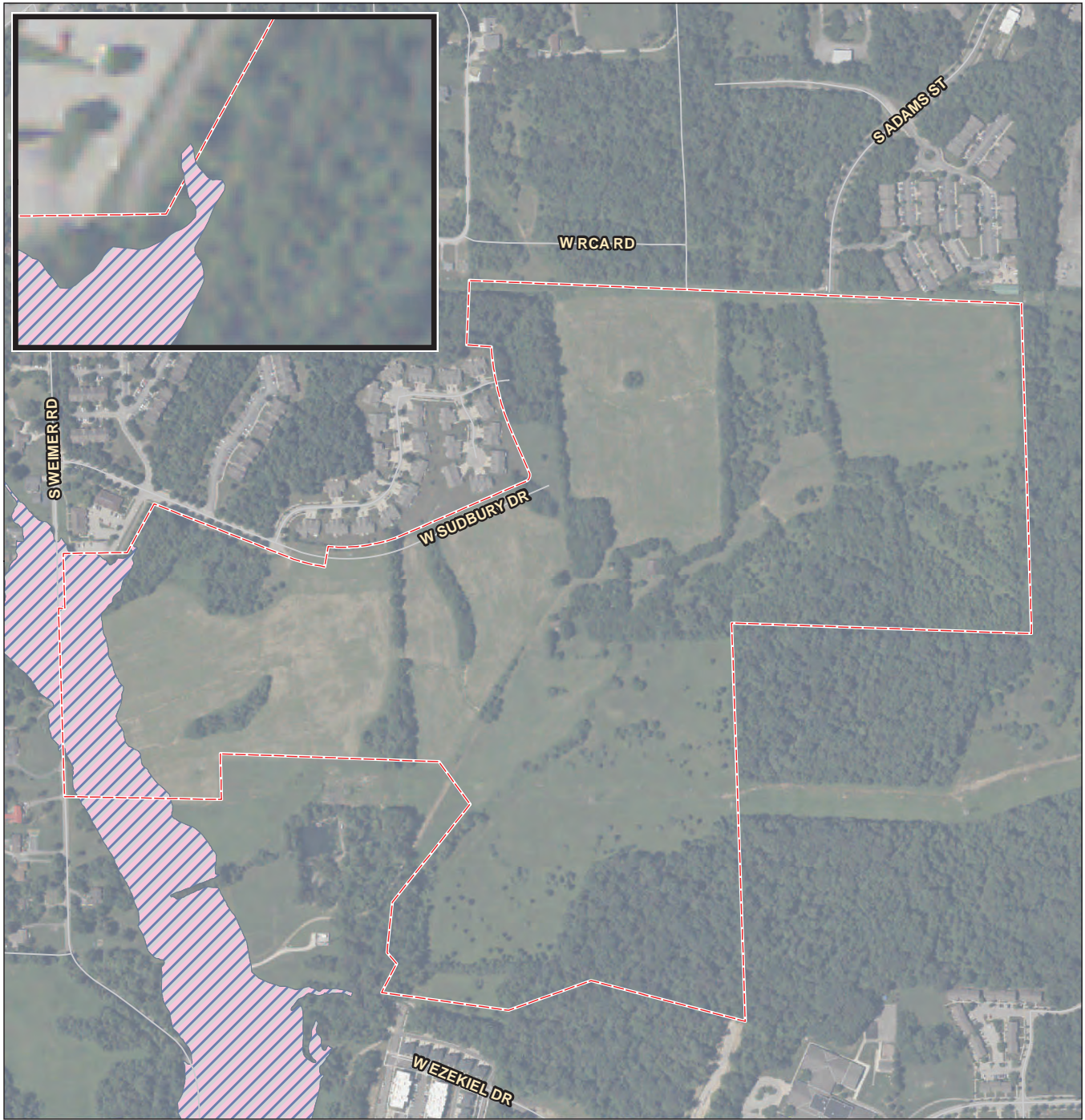
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Streams and Wetlands

Notes

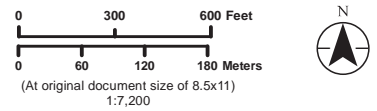
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3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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- Legend**
- Project Location
 - FEMA Flood Zone**
 - Floodway
 - IDNR Best Available Flood Mapping**
 - Zone**
 - Floodway



Project Location
T8N, R1W, S7-8
7.5' Quadrangle: Bloomington
Monroe County, IN

Prepared by SKL on 6/16/2023
TR by LS on 6/16/2023
IR Review by DV on 6/16/2023

Client/Project
The Ridge Group, Inc.
Summit District - Bloomington
Environmental Constraints Analysis

Proj No. 193806201

Figure No.
4

Title
Mapped Floodplain

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources: Stantec, 2022 NAIP
3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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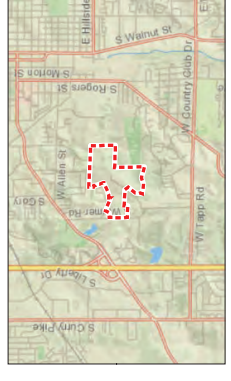


Figure No. **5**
 Title **Karst Data**
 Client: The Ridge Group
 Project: Summit District

Client/Project
 Karst Data REV A
 Prepared by ABC on 2/18/21-01
 IR Reviewed by ABC on 2/18/21-01

Project Location
 Bloomington, IN
 Scale: 1:14,200
 0 75 150 feet

Legend
 Karst Point (yellow dot)
 AOI (red dashed line)



Notes
 1. Coordinate System: NAD 1983 UTM Zone 18N
 2. Data Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WGCAC, USGS, NASA, ESA, METI, INRCAN, GEBCO, NOAA, increment P Corp.



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Figure No. 6

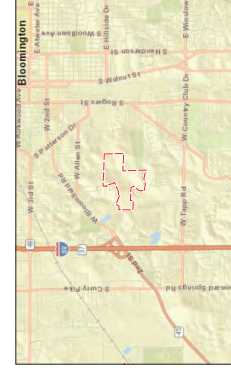
Canopy Estimate

Client/Project
 The Ridge Group, Inc.
 Summit District - Bloomington
 Environmental Constraints Analysis
 Prepared by: S&B on 04/20/23
 Project No.: 133002019
 IR Review by: DV on 04/14/2023
 7.5 Quads: Bloomington, Monroe County, IN

Proj. No. 13300201



- Legend
- Project Location
 - Canopy Estimate = 27.43 acres



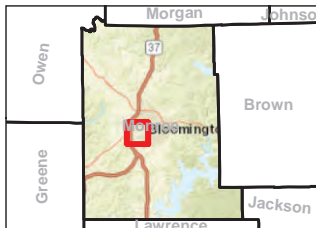
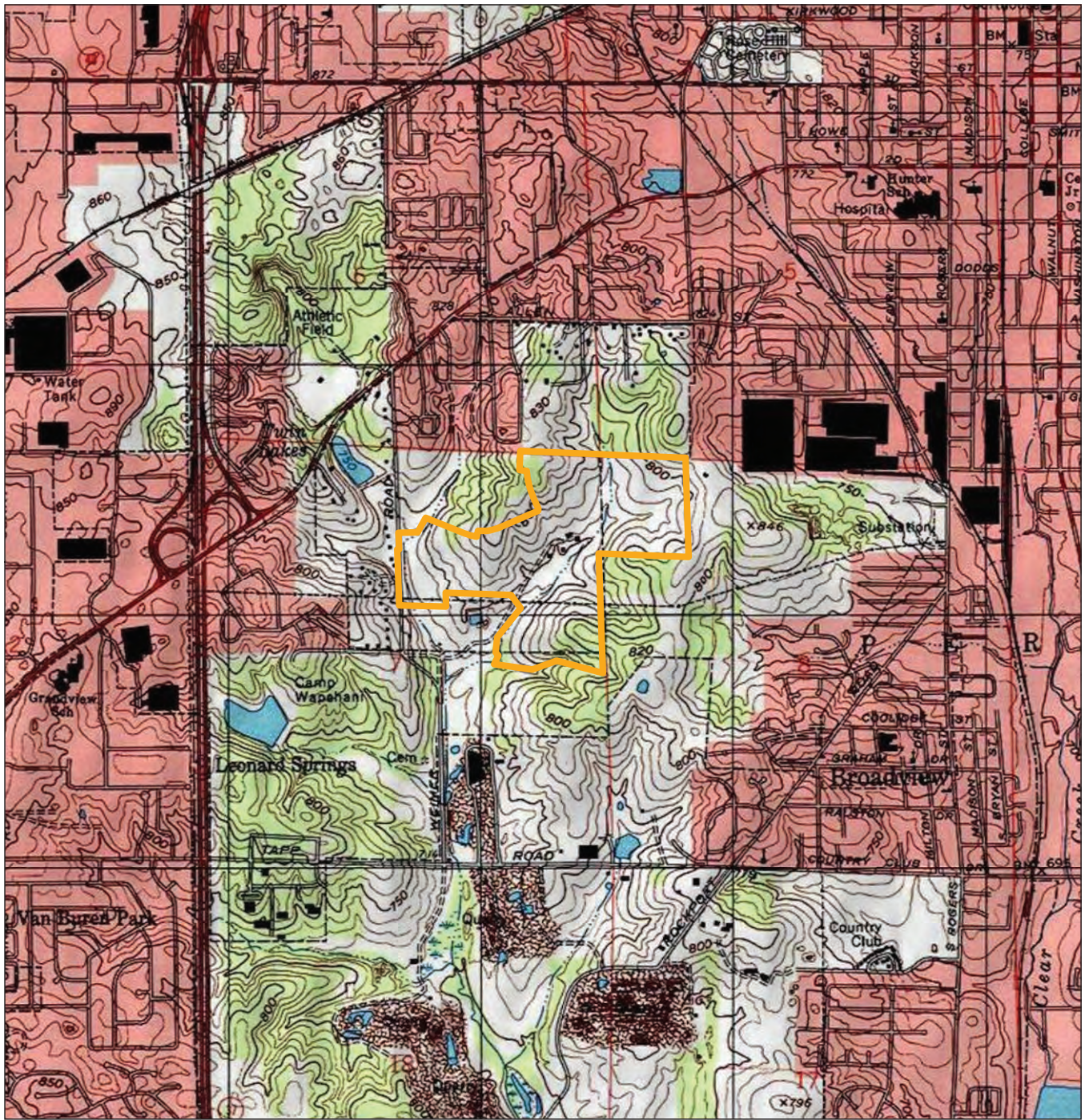
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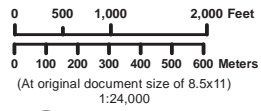
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Appendix A - Figures





Legend
 Project Location



Project Location Prepared by SKL on 6/15/2023
T8N, R1W, S7-8 TR by LS on 6/15/2023
7.5' Quadrangle: Bloomington IR Review by DV on 6/15/2023
Monroe County, IN

Client/Project The Ridge Group, Inc. Proj No. 193806201
Summit District - Bloomington

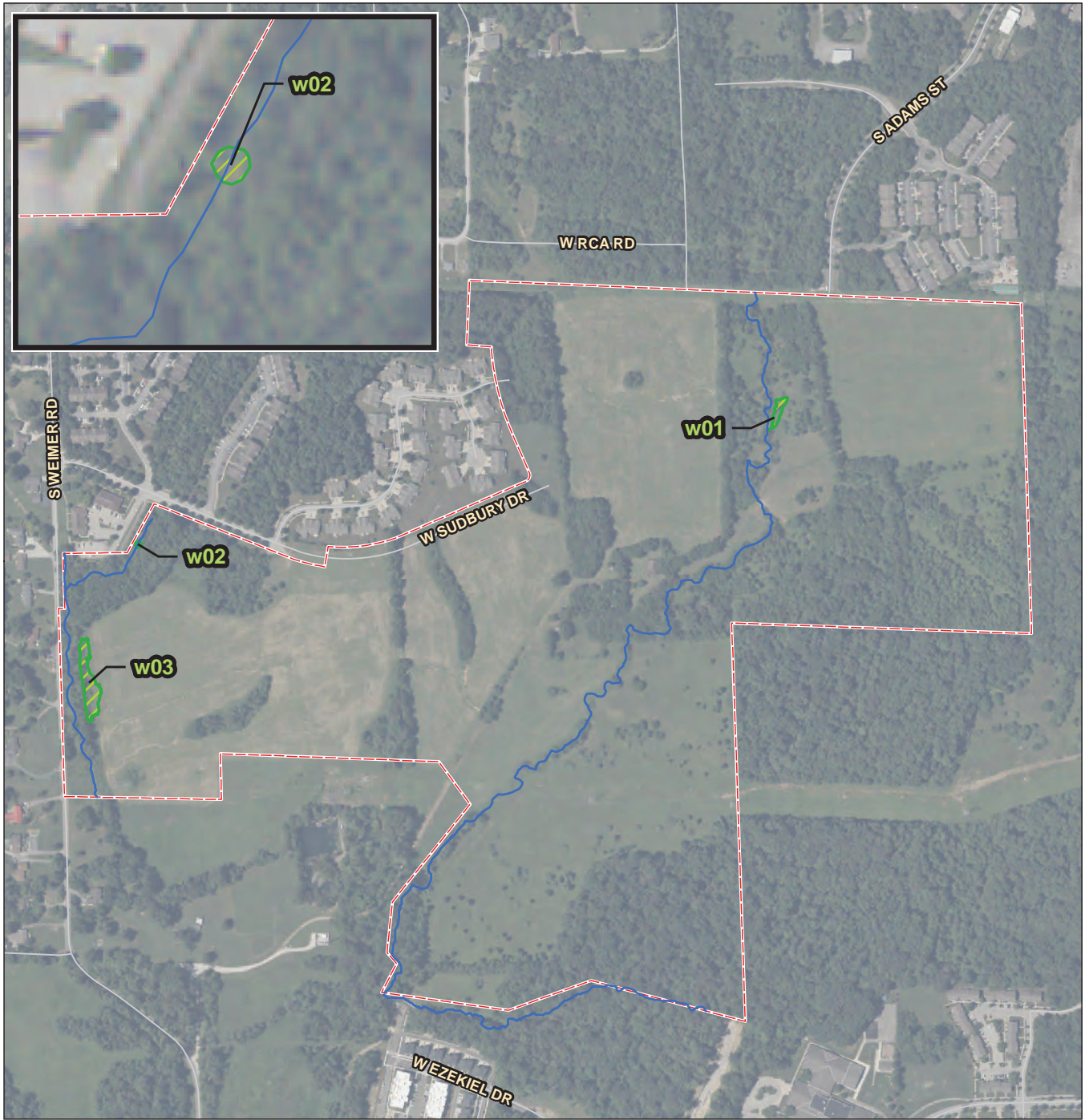
Environmental Constraints Analysis




Figure No. 1

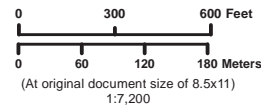
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1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources: Stantec, NAIP
3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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- Legend**
-  Delineated Stream
 -  Delineated Wetland
 -  Project Location



Project Location Prepared by SKL on 6/19/2023
 T8N, R1W, S7-8 TR by LS on 6/19/2023
 7.5' Quadrangle: Bloomington IR Review by DV on 6/19/2023
 Monroe County, IN

Client/Project Proj No. 193806201
 The Ridge Group, Inc.

Summit District - Bloomington
 Environmental Constraints Analysis

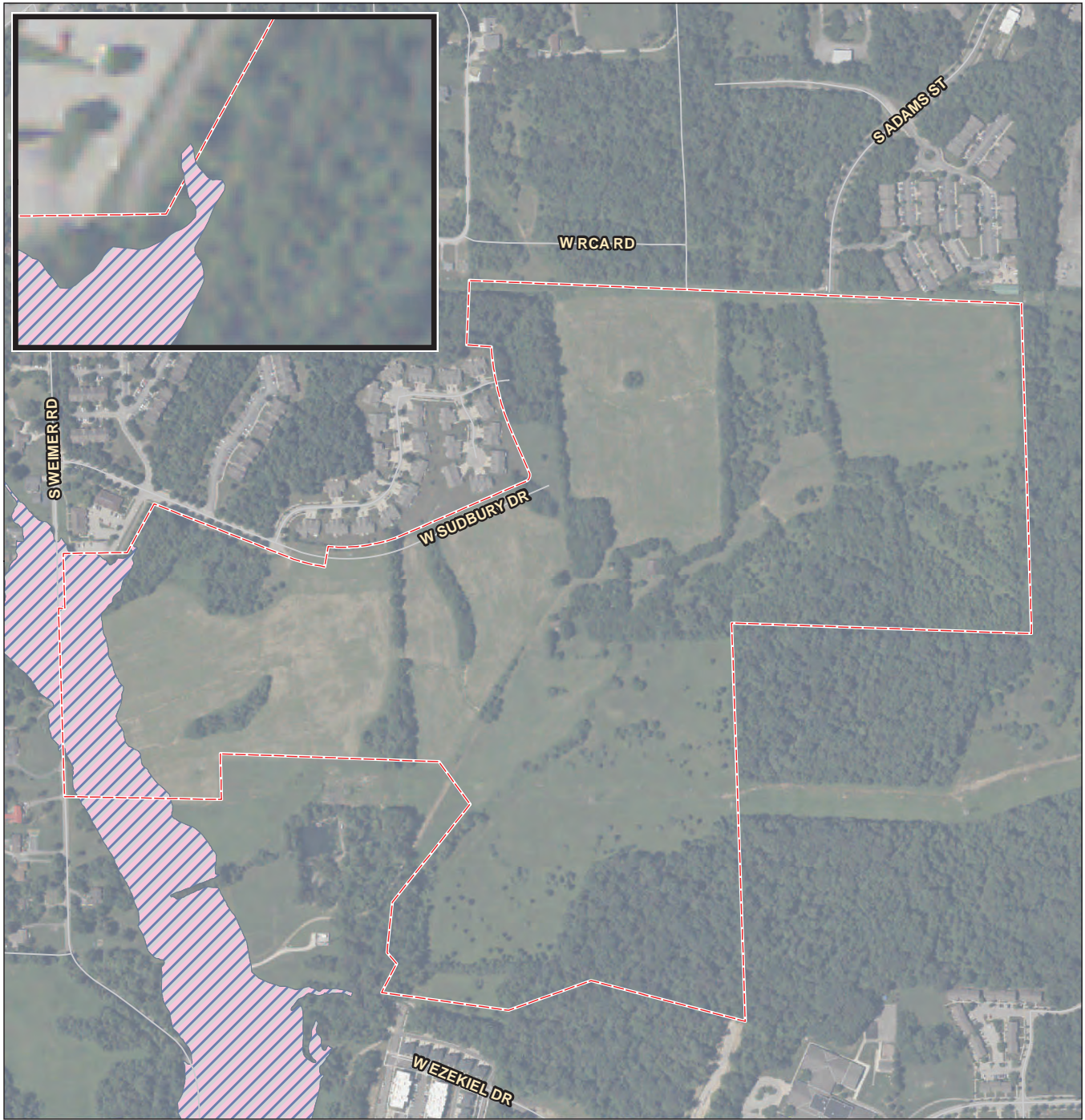
Figure No.
 3

Title
 Streams and Wetlands

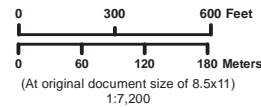
- Notes**
1. Coordinate System: NAD 1983 UTM Zone 16N
 2. Data Sources: Stantec, 2022 NAIP
 3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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\\us0707-ppl\ss01\shared_projects\gis_projects\193806201\03_data\gis_cadd\gis_cadd\mxd\03a\03a\FloodZones.mxd Revised: 2023-06-16 By: bwharvey



- Legend**
- Project Location
 - FEMA Flood Zone**
 - Floodway
 - IDNR Best Available Flood Mapping**
 - Zone**
 - Floodway



Project Location
T8N, R1W, S7-8
7.5' Quadrangle: Bloomington
Monroe County, IN

Prepared by SKL on 6/16/2023
TR by LS on 6/16/2023
IR Review by DV on 6/16/2023

Client/Project
The Ridge Group, Inc. Proj No. 193806201

Summit District - Bloomington
Environmental Constraints Analysis

Figure No.
4

Title
Mapped Floodplain

Notes

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Data Sources: Stantec, 2022 NAIP
3. Background: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

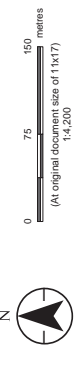
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Figure No.
5

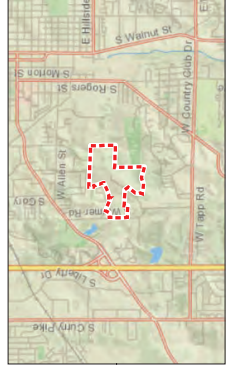
Karst Data

Client: The Ridge Group
Project: Summit District

Project Location:
Bloomington, IN



- Legend**
- Karst Point
 - AOI



Notes:
1. Coordinate System: NAD 1983 UTM Zone 18N
2. Data Sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, INRCAN, GEBCO, NOAA, increment P Corp.



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Figure No. 6

Canopy Estimate

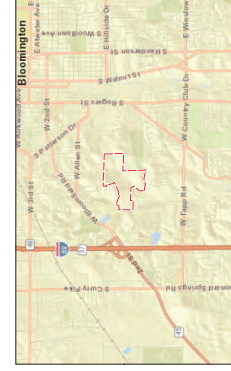
Client/Project
 The Ridge Group, Inc.
 Summit District - Bloomington
 Environmental Constraints Analysis

Prepared by: SDC on 04/20/23
 Project No.: 13000209
 IR Review by: DV on 04/14/2023
 7.5 Quadsig: Bloomington, Monroe County, IN

Plan No.: 130002021



- Legend
- Project Location
 - Canopy Estimate = 27.43 acres



Notes

1. Coordinate System: WGS 1984 UTM Zone 18N
2. Data Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCA, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Esri (Thailand), NCCO, (c) OpenStreetMap contributors, and the GIS User Community



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Proposed Phasing Plan by neighborhood	Start Year	End Year	Total Years	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	Total	%
Shasta meadows	2025	2028	4	137.5	137.5	137.5	137.5	137.5							550	13%
Denali Woods	2025	2029	5	100	100	100	100	100							500	12%
Everest Center	2027	2034	8		212.5	212.5	212.5	212.5	212.5	212.5	212.5	212.5	212.5	212.5	1700	40%
Sandila Place	2028	2032	5				220	220	220	220	220	220	220	220	1100	26%
Whitney Glen	2033	2034	2									432.5	432.5	432.5	400	9%
Total				0	237.5	237.5	450	670	532.5	432.5	432.5	432.5	412.5	200	4250	100%
			%	0%	6%	6%	11%	16%	13%	10%	10%	10%	10%	10%	4250	100%

Proposed Units	Acres	Units
Shasta meadows	23.4	550
Denali Woods	33.3	500
Everest Center	37.2	1700
Sandila Place	33.1	1100
Whitney Glen	11.6	400
Total	138.6	4250

Indiana Administrative Code
 327 IAC 3-6-11 Design flow rate requirements for collection systems and water pollution treatment/control facilities

Type	gpd/unit
1 Bedroom Apartment	200
2 Bedroom Apartment	300
Single-Family Home	310
MF - 3 Bedroom	350
1 & 2 Family Dwelling per Bedroom	150

*City Memo Uses 310 for all units

3.0 Summit District's Impact to Sewer Near Connection Point
 Under full buildout conditions, the development will be composed of residential units, retail and commercial units. The design flow rate for the sewer system is based on the design flow rate for the daily and peak daily flows were completed using the unit matrix provided by the developer and Section 327 Indiana Administrative Code 3-6-11.

Total Equivalent Dwelling Units (EDU) = 4,250
Flow per EDU = 310 gallons per day
Average Daily Flow (ADF) = 1,317,500 gpd
Peak Factor (PF) = 4
Peak Daily Flow (PDF) = 5,270,000 gpd

The development is proposed to connect to the existing collection system at **Manly 2557**, which is located on the **Manly 2557** north-south sewer along **Manly 2557** as shown in Figure 3-1. Approximately 215 LF of sewer is proposed to be installed from the sewer connection point, the sewer connects to the Manly 2557 North-South West Interceptor.

Overall Development (Total)	General Average	Proposed # of Residential Service Connections	ADF	Peak Factor	1 CFS = 448.8 GPM			Peak Flow Rate (Q peak)	Peak Flow Rate (Q peak)	% Total
					PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)			
ADF (Avg Daily Flow) = GA x PRSC	GA (gpd)	PRSC (Units)	gpd/unit	PF	PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)	Peak Flow Rate (Q peak)	Peak Flow Rate (Q peak)	% Total
Shasta meadows	310	550	170,500	4	682,000	0.682	MGD	473.6	1.06	CFS
Denali Woods	310	500	155,000	4	620,000	0.620	MGD	430.6	0.96	CFS
Everest Center	310	1,700	527,000	4	2,108,000	2.108	MGD	1,463.9	3.26	CFS
Sandila Place	310	1,100	341,000	4	1,364,000	1.364	MGD	947.2	2.11	CFS
Whitney Glen	310	400	124,000	4	496,000	0.496	MGD	344.4	0.77	CFS
Total	310	4,250	1,317,500	4	5,270,000	5.270	MGD	3,659.7	8.15	CFS

Units per Year	General Average	Proposed # of Residential Service Connections	ADF	Peak Factor	Cumulative PFR (Q peak)			Peak Flow Rate (Q peak)	Peak Flow Rate (Q peak)	% Total
					PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)			
ADF (Avg Daily Flow) = GA x PRSC	GA (gpd)	PRSC (Units)	gpd/unit	PF	PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)	PDF (Peak Daily Flow Rate)	Peak Flow Rate (Q peak)	Peak Flow Rate (Q peak)	% Total
2025	310	237.5	73,625	4	294,500	0.295	MGD	204.5	0.46	CFS
2026	310	237.5	73,625	4	294,500	0.295	MGD	204.5	0.46	CFS
2027	310	450	139,500	4	555,000	0.555	MGD	387.5	0.86	CFS
2028	310	670	207,700	4	830,800	0.831	MGD	576.9	1.29	CFS
2029	310	532.5	165,075	4	660,300	0.660	MGD	458.5	1.02	CFS
2030	310	432.5	134,075	4	536,300	0.536	MGD	372.4	0.83	CFS
2031	310	432.5	134,075	4	536,300	0.536	MGD	372.4	0.83	CFS
2032	310	412.5	127,875	4	511,500	0.512	MGD	355.2	0.79	CFS
2033	310	412.5	127,875	4	511,500	0.512	MGD	355.2	0.79	CFS
2034	310	200	62,000	4	248,000	0.248	MGD	174.4	0.39	CFS
Total	310	4,250	1,317,500	4	5,270,000	5.270	MGD	3,659.7	8.15	CFS

ESTIMATED SCHEDULE:

The Project will be completed under the tentative milestones shown below. This tentative schedule is based on receiving a Notice to Proceed in January 2024 and receiving prompt review and approvals from the OWNER.

<u>ITEM</u>	<u>TENTATIVE DATE</u>
Kickoff Workshop	January 2024
Surveying and Geotechnical Field Work	January – April 2024
50% Design Services	January – June 2024
50% Review Workshop	July 2024
95% Design Services & Easement Descriptions	July – November 2024
95% Design Review Workshop	December 2024
Final Detailed Design Services and Permitting	January – June 2025
Bidding Phase	July – August 2025
Contract Award	September 2025
Construction Engineering Phase	October 2025 – March 2027



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9604 Coldwater Road, Suite 203
Ft. Wayne, IN 46825*

PH :-(260) 494-3223

FAX :-(260) 494-3224

DILLMAN WWTP WEST INTERCEPTOR - SUMMIT DISTRICT IMPACT MEMORANDUM

TO: City of Bloomington Utilities
FROM: Commonwealth Engineers, Inc.
DATE: September 5, 2023
SUBJECT: Dillman WWTP West Interceptor – Summit District Impact

1.0 Introduction

The Dillman Wastewater Treatment Plant (WWTP) Basin consists of three (3) main interceptors that convey sanitary flow south to the WWTP. The thirty-six (36) inch west interceptor generally follows Clear Creek Trail, the forty-two (42) inch central interceptor generally follows Clear Creek, and the forty-two (42) inch east interceptor generally follows Jackson Creek. The west and central interceptors converge near 5825 S Rogers Street. The interceptor then converges with the east interceptor near the confluence of Clear Creek and Jackson Creek. The forty-eight (48) inch interceptor then travels southwest to the treatment plant.

The WWTP has a permitted design capacity of 15 MGD with a peak capacity of 30 MGD. City of Bloomington Utilities (CBU) has made improvements to the WWTP to achieve a future capacity of 20 MGD and peak flow of 40 MGD. The influent pump station has a firm pumping capacity of 75 MGD with the largest unit out of service. The equalization (EQ) basin has a total capacity of 43 million gallons.

A development named Summit District is proposed to connect to the sanitary sewer collection system. The development is located on a 140 acre property located east of Weimer Road and west of the RCA Community Park as shown in **Figure 1-1**. The development will include a distribution of residential units, retail and commercial buildings, hotels, and a fire department. Full buildout of the property is estimated to occur by 2038. Under full buildout conditions, the sanitary sewer for the development will connect to Manhole 7597 in the Dillman WWTP West Interceptor Basin.

As a part of this study, the Dillman WWTP West Interceptor within the CBU's hydraulic collection system model was calibrated to dry weather and wet weather conditions. The hydraulic model is well calibrated and accurately represents the existing conditions of the collection system. The hydraulic model was utilized to evaluate planning-level alternative solutions to eliminate potential SSOs up to a defined level of control. **Figure 1-1** illustrates the extents of the Dillman WWTP West Interceptor model. The hydraulic model was developed and calibrated using the United States Environmental Protection Agency's (USEPA) hydraulic modeling program SWMM5 computational engine. The model is well calibrated and suitable for preliminary engineering alternative analyses.



Figure 1-1: Dillman WWTP West Interceptor SWMM Hydraulic Model

2.0 Existing Conditions

To analyze the existing Dillman WWTP West Interceptor capacity during a large wet weather event, a fifty (50) year, one (1) hour storm was loaded into the model. The fifty (50) year, one (1) hour design storm equates to 2.89 inches of rain falling in one (1) hour. This design storm has been utilized for other similar SSO communities in the state. As shown in **Figure 2-1**, the downstream portion of the interceptor does not have the capacity to convey the peak flow. The majority of the flow reaching the WWTP comes from the Central Interceptor and East Interceptor.

Over the past five (5) years, MH 4749 near S. Rogers St. and Charlie Ave. has experienced several sanitary sewer overflows (SSOs). SSOs are prohibited in Indiana. The reality though is that sanitary sewer collection systems experience significant impacts due to infiltration and inflow. In older sanitary collection systems, infiltration and inflow can approach hydraulic behavior and wet weather response similar to a combined collection system. Growth within the Dillman WWTP sewershed is expected to occur further taxing the system and increasing the occurrence of SSOs. Specifically, the Summit District development adds additional flow to the collection system, further increasing the occurrence and volume of SSOs.

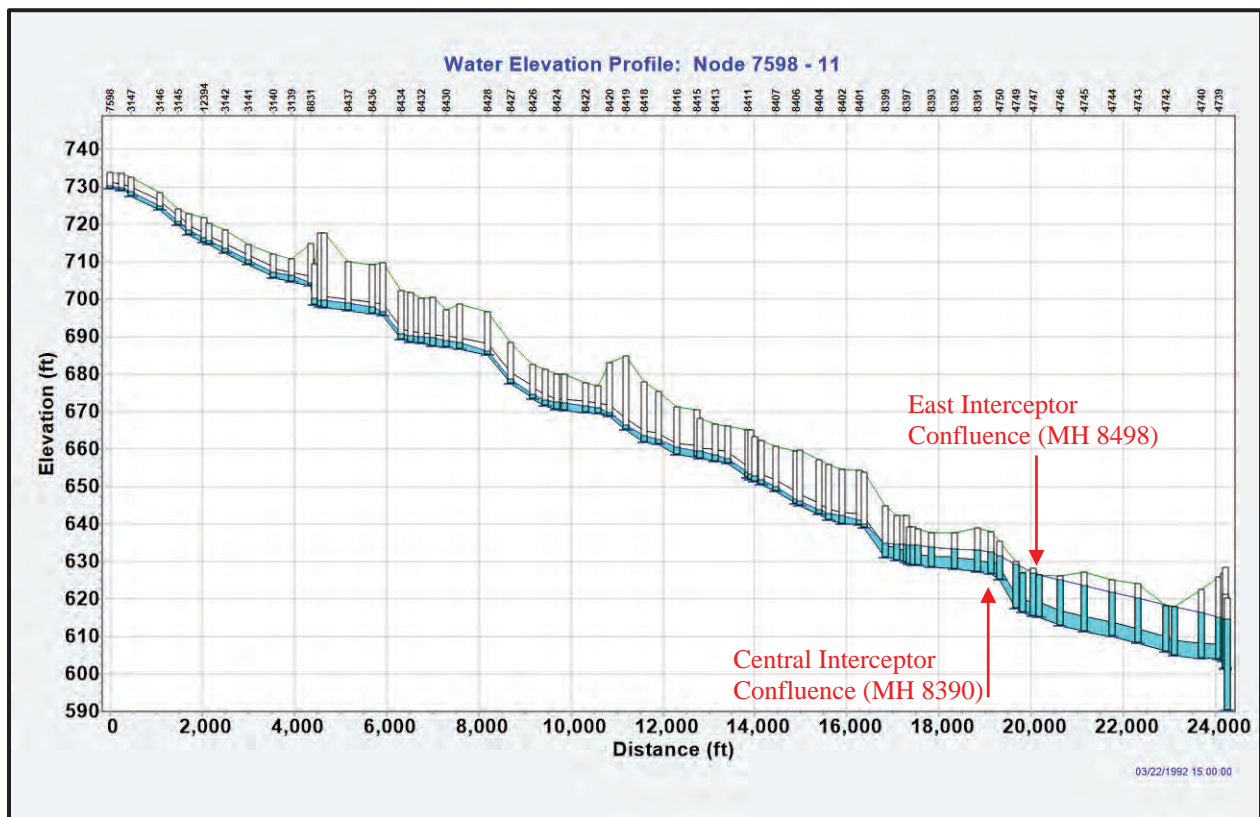


Figure 2-1: Dillman WWTP West Interceptor Hydraulic Grade Line 50-Year, 1-Hour Design Storm

3.0 Summit District's Impact to Sewer Near Connection Point

Under full buildout conditions, the development will be composed of residential units, retail and commercial buildings, hotels, and a fire department. The following calculations to determine average daily and peak daily flows were completed using the unit matrix provided by the developer and Section 327 Indiana Administrative Code 3-6-11.

Total Equivalent Dwelling Units (EDU) = 4,966

Flow per EDU = 310 gallons per day

Average Daily Flow (ADF) = 4,966 units X 310 gpd / unit = 1.54 MGD

Peaking Factor (PF) = 4

Peak Daily Flow (PDF) = 1.54 MGD X 4 = 6.16 MGD

The development is proposed to connect to the existing collection system at MH 7597, which is located on the twenty (20) inch sanitary sewer along Weimer Rd, as shown in **Figure 3-1**. Approximately 215 LF downstream of the proposed connection point, the sewer connects to the thirty (30) inch Dillman WWTP West Interceptor.

Table 3-1 includes a comparison of the full-flow capacity to the existing conditions flow and flow with Summit District. As shown in the table, the 20 (twenty) inch sewer is undersized for the peak design flow with Summit District. As shown in **Figure 3-2**, the hydraulic grade line (HGL) exceeds the crown of the pipe by less than one (1) foot during peak flow. It is recommended to monitor flows along the twenty (20) inch sewer as the development is built out to ensure there is adequate capacity during wet weather. Alternatively, if Summit District connects to MH 3147 or further downstream on the thirty (30) inch interceptor, no surcharging occurs for the peak wet weather flow.

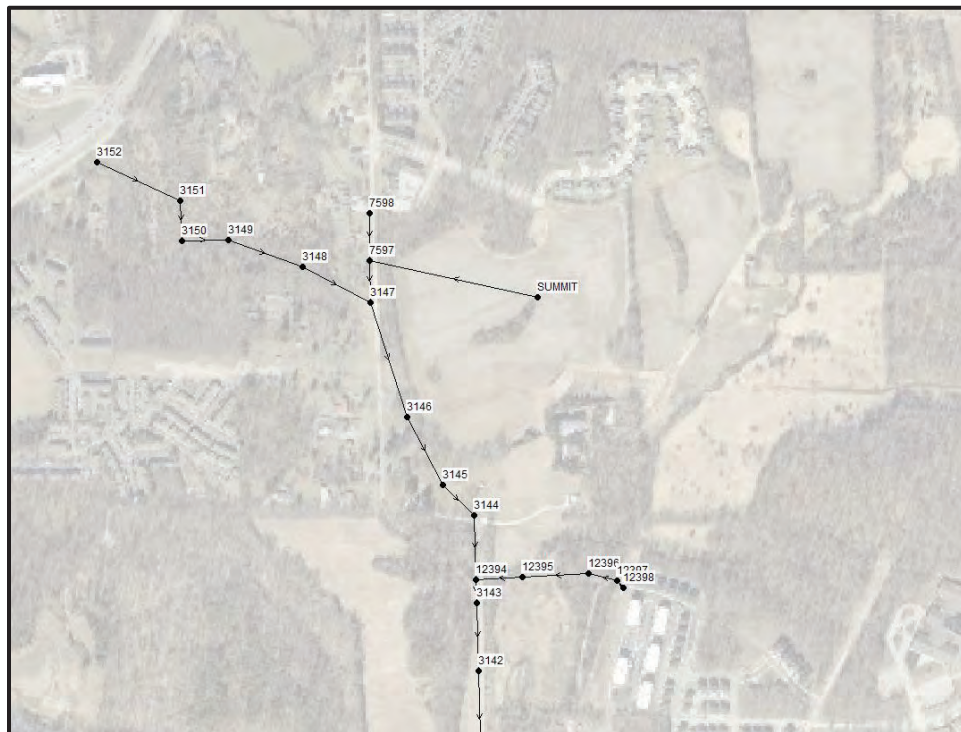


Figure 3-1: Summit District Connection to Existing Collection System

Table 3-1: 50-Year, 1-Hour Design Storm Flows Near the Connection Point with Summit District

	20-Inch Sewer Flow (MGD)	30-Inch Sewer Flow (MGD)
Full-Flow Capacity	4.3	20.6
Existing Conditions	1.9	11.0
Future Growth Conditions	8.0	17.5

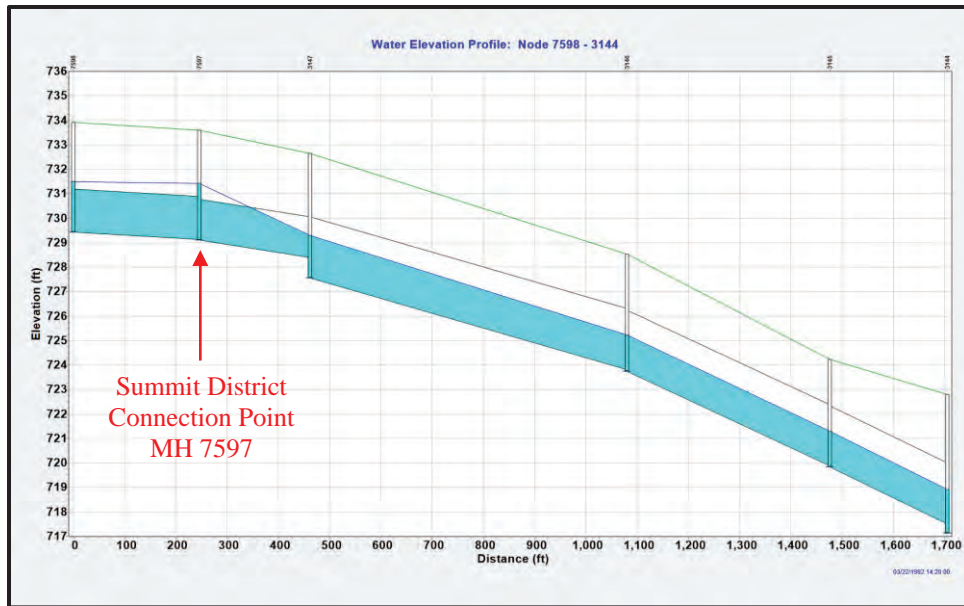


Figure 3-2: Connection Point of Summit District HGL 50-Year, 1-Hour Design Storm

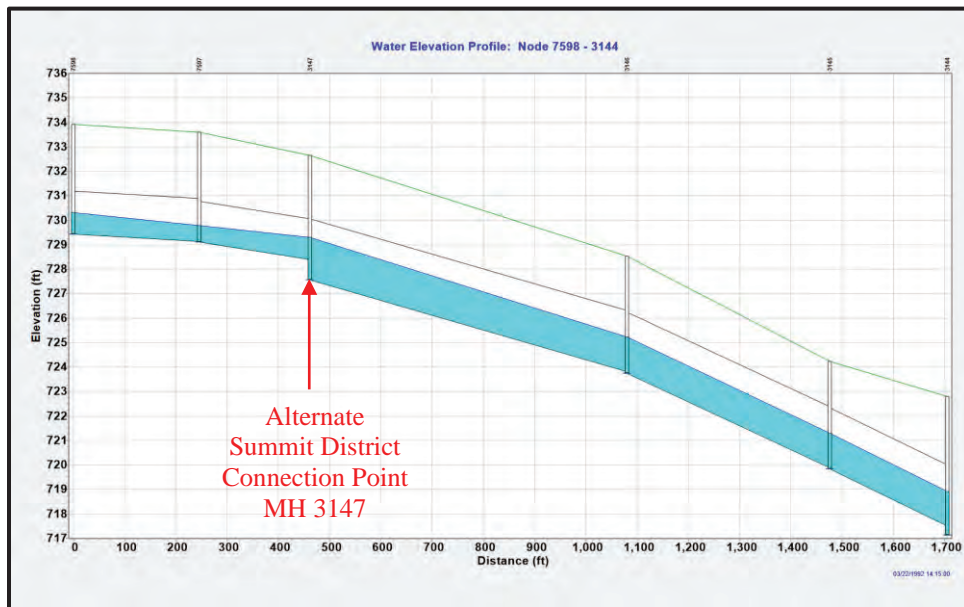


Figure 3-3: Alternate Connection Point of Summit District HGL 50-Year, 1-Hour Design Storm

4.0 Increase in Flow Reaching WWTP

During the metering period of May 2023 through August 2023, the existing conditions average dry weather flow was approximately 7.0 MGD. However, Monthly Report of Operation (MRO) data from May 2022 through July 2023 were reviewed to assess the average dry weather flow throughout year. It was determined that the yearly average dry weather flow is approximately 10.0 MGD. Assuming the interceptor was sized to receive these flows without surcharging, **Table 4-1** compares the dry weather and wet weather flow reaching the WWTP for the existing conditions and full buildout future flow conditions.

Table 4-1: Flow Reaching WWTP

	Existing Conditions (MGD)	Full Buildout Future Flow (MGD)	Increase in Flow (%)
Dry Weather	10.0	13.7	36.6
50 Year, 1 Hour	73.9	88.5	19.8

In addition to the Summit District development, several developments within the West Interceptor Basin are planned to connect to the collection system. Multiple developments in the Central and East Interceptor Basins are either currently under construction or recently completed. These Central and East Interceptor flows were not recorded during the metering period, so they are included in the future flow in **Table 4-1**.

The Summit District accounts for 46.5% of the future growth flow in the West Interceptor Basin. Additionally, the Summit District development increases the existing dry weather and wet weather flows by 15.4% and 8.3%, respectively. Calculations are shown below.

Future Growth in West Interceptor Basin = Full Buildout – Existing – Central and East Future Growth

$$= 13.7 \text{ MGD} - 10.0 \text{ MGD} - 0.4 \text{ MGD} = 3.3 \text{ MGD}$$

Summit District Share of Future Growth = Summit District Flow / Future Growth in West Interceptor

$$= 1.54 \text{ MGD} / 3.3 \text{ MGD} = 46.5\%$$

Summit District Increase of Existing Dry Weather = Summit District Dry Weather / Existing Dry Weather

$$= 1.54 \text{ MGD} / 10.0 \text{ MGD} = 15.4\%$$

Summit District Increase of Existing Wet Weather = Summit District Peak Flow / Existing Wet Weather

$$= 6.16 \text{ MGD} / 73.9 \text{ MGD} = 8.3\%$$

5.0 Alternatives

Alternative solutions to eliminate potential sanitary sewer overflows occurring within Dillman WWTP West Interceptor Basin were developed for the fifty (50) year design storms. The following performance criteria were used when identifying and assessing alternative solutions for the collection system:

- Eliminate potential sanitary sewer overflows for the 50-year design storm.
- Achieve eight (8) feet of freeboard between the ground elevation and the maximum HGL in the collection system. If eight (8) feet of freeboard was not available, the HGL must be lower than the crown of the pipe.
- Firm (design) lift station pumping rate shall meet or exceed the peak inflow to each lift station.

Table 5-1 provides the total (construction and non-construction) cost of the three (3) alternatives presented below for the future growth conditions in the Dillman WWTP Basin.

Table 5-1: Alternative Total Cost Estimate

Alternative	Total Cost (\$)
1	59,924,450
2	45,501,790
3	44,198,460

Alternative 1 – Wet Weather Overflow at MH 8397 and MH 4756 with Flow Control

Diversion structures at MH 8397 and MH 4756 will divert wet weather to a lift station located near W Church Lane. Both structures will include plates to control flow in the existing downstream interceptors and divert more toward the lift station. The lift station will pump to the existing EQ basin. The force main alignment is proposed to follow the Limestone Greenway, which was constructed in 2019.

Improvements considered in this alternative include:

- 36 MGD Lift Station*
- New Diversion Structures with Flow Control*
- 30" Diameter Gravity Sewer from MH 8397 and MH 4756 to new manhole (600 feet)*
- 36" Diameter Gravity Sewer from new manhole to new lift station (200 feet)*
- 36" Diameter Force Main from New Lift Station to EQ Basin (3,450 feet)*
- 36" Diameter Gravity Sewer from MH 3139 to MH 8831 (415 feet)
- 42" Diameter Gravity Sewer from MH 8399 to MH 8397 (460 feet)

Improvements required to address the existing issues include the items with asterisks above. Costs associated with these current improvements are estimated at \$58,133,300. This value could be potentially reduced by designing a firm capacity station for current flows readily expandable to the future growth flow. The other items included above would be constructed as developments are connected to the system.

Alternative 2 – Wet Weather Relief Sewer

During wet weather, wastewater overflows a weir in a diversion structure at MH 8397. The wet weather sewer travels parallel to the existing West Interceptor. At two additional locations, diversion structures divert flow from the main interceptor to the wet weather sewer. A new wet weather lift station will accept flows in excess of the capacity of the influent pump station. The lift station will pump to the EQ basin. Challenges of this alternative include fitting the new gravity sewer on WWTP property dealing with other pipes and utilities. Additionally, this alternative requires a large diameter gravity sewer underneath I-69.

Improvements considered in this alternative include:

- 14 MGD Lift Station*
- 3 New Diversion Structures*
- 30" Diameter Gravity Relief Sewer from MH 8397 (1,800 feet)
- 42" Diameter Gravity Relief Sewer (1,150 feet)
- 48" Diameter Gravity Relief Sewer to Influent Pump Station (3,890 feet)*
- 24" Diameter Force Main from New Lift Station to EQ Basin (2,100 feet)*
- 36" Diameter Gravity Sewer Replacement from MH 3139 to MH 8831 (415 feet)

Improvements required to address the existing issues include the items with asterisks above. Note only two (2) diversion structures are required. Costs associated with these current improvements are estimated at \$38,418,640. The other items included above would be constructed as developments are connected to the system.

Alternative 3 – New Dry Weather Flow Sewer

A diversion structure at MH 8498 diverts all dry weather flow through a new gravity sewer. When the depth in the diversion structure exceeds the maximum dry weather depth, flow overtops a weir into the existing gravity sewer. A new wet weather lift station will accept flows in excess of the capacity of the influent pump station. The lift station will pump to the EQ basin. Challenges of this alternative include fitting the new gravity sewer on WWTP property dealing with other pipes and utilities. Additionally, this alternative requires a large diameter gravity sewer underneath I-69. The pipe replacement instead of a parallel sewer also requires significant bypass pumping.

Improvements considered in this alternative include:

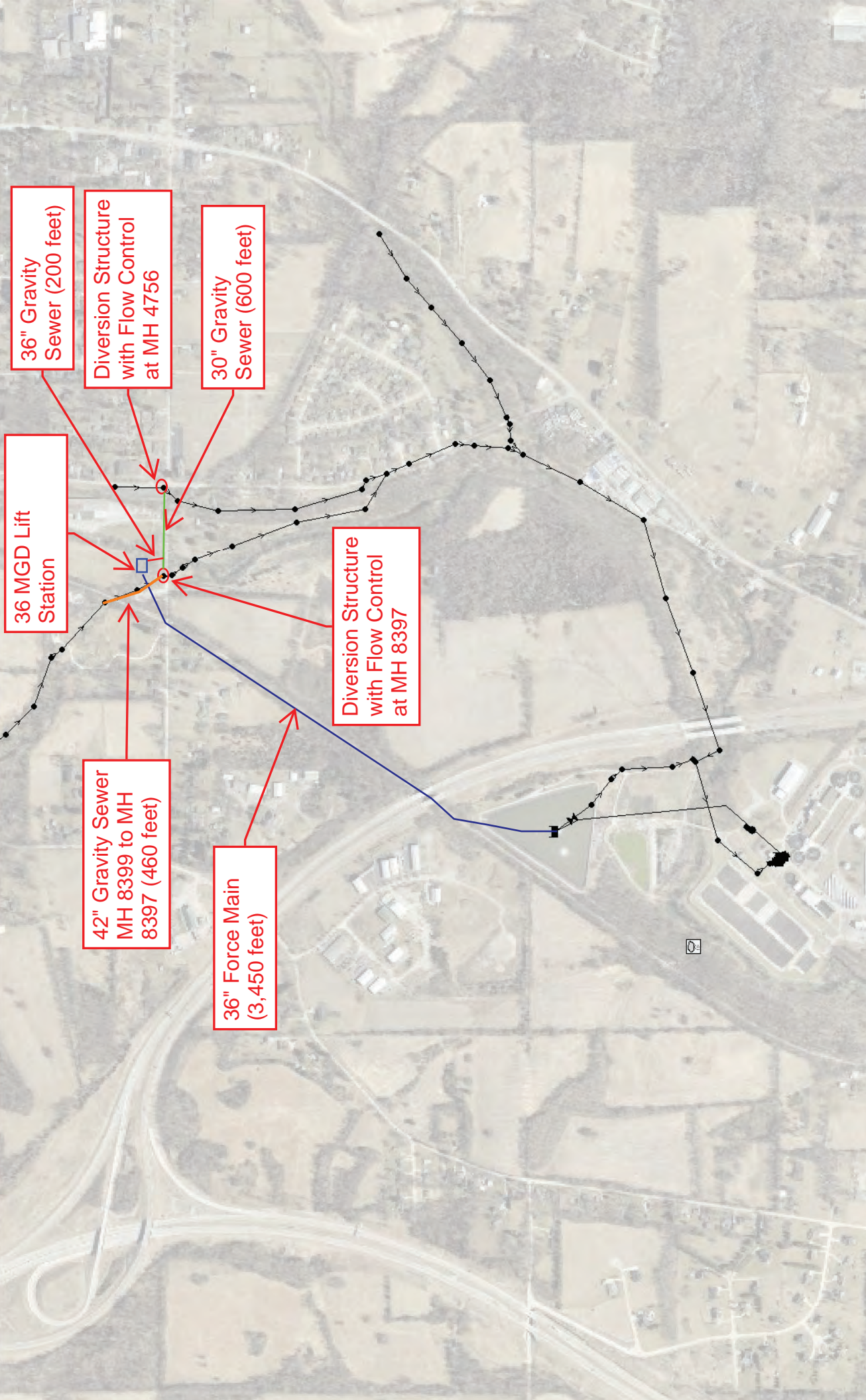
- 14 MGD Lift Station*
- New Diversion Structure*
- 48" Diameter Gravity Relief Sewer from MH 8498 (2,300 feet)*
- 54" Diameter Gravity Relief Sewer to Influent Pump Station (1,750 feet)*
- 24" Diameter Force Main from New Lift Station to EQ Basin (2,100 feet)*
- 36" Diameter Gravity Sewer Replacement from MH 3139 to MH 8831 (415 feet)
- 42" Diameter Gravity Sewer Replacement from MH 8396 to MH 8390 (1,790 feet)
- 48" Diameter Gravity Sewer Replacement from MH 8390 to MH 4747 (920 feet)

Improvements required to address the existing issues include the items with asterisks above. Costs associated with these current improvements are estimated at \$38,300,230. The other items included above would be constructed as developments are connected to the system.



36" Gravity Sewer
from MH 3139 to MH
8831 (415 feet)

Required for all 3
alternatives



36" Gravity Sewer (200 feet)

Diversion Structure with Flow Control at MH 4756

30" Gravity Sewer (600 feet)

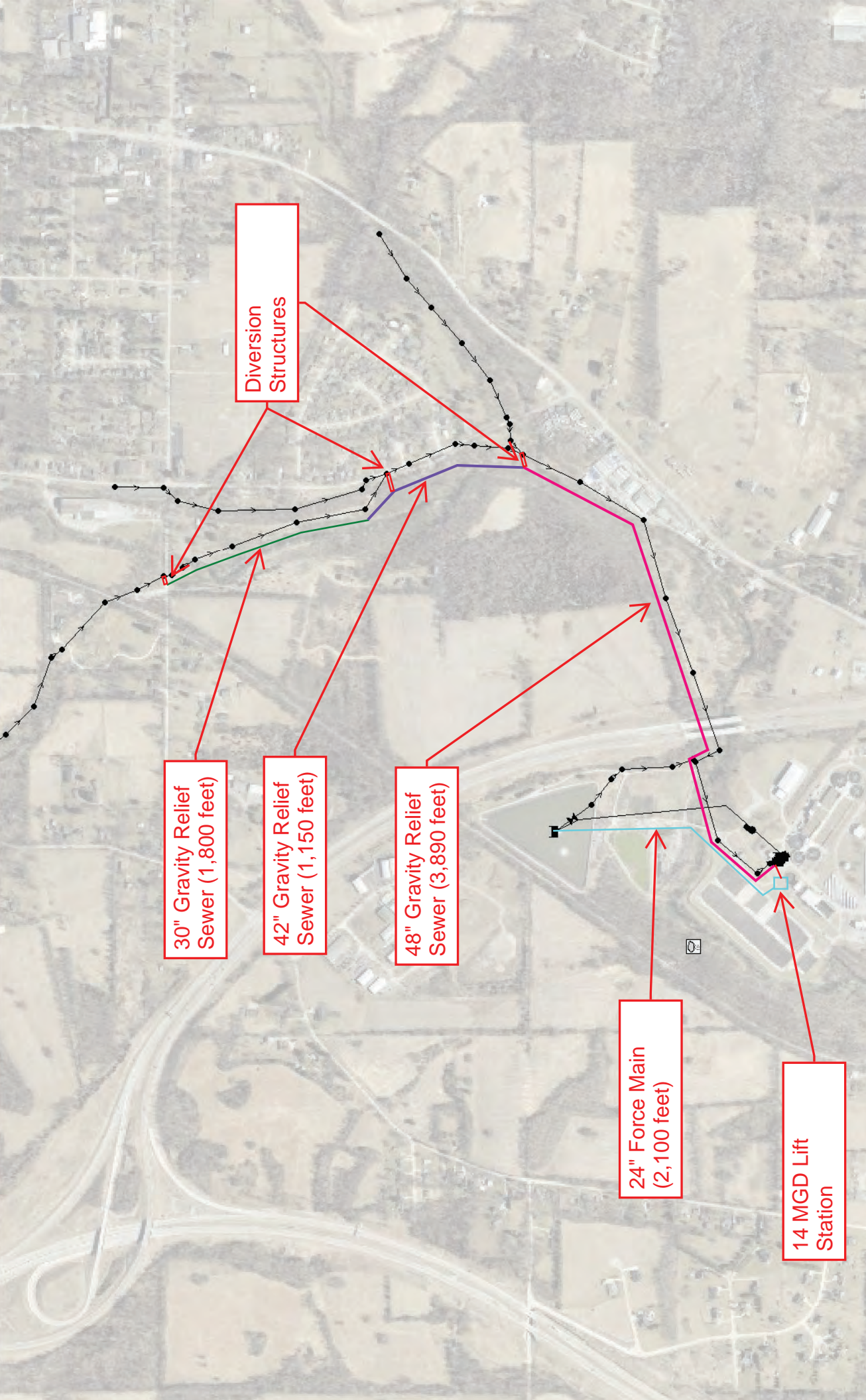
36 MGD Lift Station

Diversion Structure with Flow Control at MH 8397

42" Gravity Sewer MH 8399 to MH 8397 (460 feet)

36" Force Main (3,450 feet)

ALTERNATIVE 1



30" Gravity Relief
Sewer (1,800 feet)

42" Gravity Relief
Sewer (1,150 feet)

48" Gravity Relief
Sewer (3,890 feet)

Diversion
Structures

24" Force Main
(2,100 feet)

14 MGD Lift
Station

ALTERNATIVE 2

ALTERNATIVE 3												
Item	Description	QNTY	UNIT	UNIT COST (\$)	TOTAL COST (\$)	WWTP (A)	DS Gravity (A)	mid gravity (B)	US gravity (C)			
1	MOBILIZATION/DEMOLITION (5%)	1	LS	1,563,000	1,563,000	804,000	516,000	86,000	157,000			
2	CONTRACTOR CONSTRUCTION ENGINEERING (2%)	1	LS	613,000	613,000	315,000	202,000	34,000	62,000			
3	MISC. UTILITY RELOCATION ALLOWANCE	1	LS	100,000	100,000	50,000	25,000	12,500	12,500			
4	MAINTENANCE AND PROTECTION OF TRAFFIC	1	LS	100,000	100,000	20,000	50,000	20,000	10,000			
5	TEMPORARY EROSION CONTROL	1	LS	100,000	100,000	20,000	40,000	15,000	25,000			
6	BYPASS PUMPING	1	LS	500,000	500,000	25,000	40,000	220,000	215,000			
7	14 MGD LIFT STATION	1	LS	13,946,500	13,946,500	13,946,500						
8	24-INCH DIAMETER FORCE MAIN	2,100	LF	370	777,000	777,000						
9	EQ BASIN DISCHARGE	1	LS	185,000	185,000	185,000						
10	CONNECTION FROM LIFT STATION	1	LS	500,000	500,000	500,000						
11	54-INCH DIAMETER GRAVITY RELIEF SEWER	1,400	LF	1,430	2,002,000		2,002,000					
12	54-INCH DIAMETER GRAVITY RELIEF SEWER - UNDER I-69	400	LF	8,080	3,232,000		3,232,000					
13	48-INCH DIAMETER GRAVITY RELIEF SEWER	2,250	LF	1,280	2,880,000		2,880,000					
14	48-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 8390 TO MH 4747)	920	LF	1,280	1,177,600			1,177,600				
15	42-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 8396 TO MH 8390)	1,790	LF	1,130	2,022,700				2,022,700			
16	DIVERSION STRUCTURE	1	LS	185,000	185,000		185,000					
17	BEDROCK EXCAVATION	9,865	CY	250	2,466,200	251,000	1,654,000	187,100	374,100			
18	LATERAL CONNECTIONS	2	EA	25,000	50,000			50,000				
19	36-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 3139 TO MH 8831)	415	LF	1,000	415,000				415,000			
				CONSTRUCTION COST SUBTOTAL (\$)=	32,815,000	16,893,500	10,826,000	1,802,200	3,293,300			
				10% CONSTRUCTION CONTINGENCY (ROUNDED) =	3,282,000	1,689,500	1,082,700	180,300	329,500			
				TOTAL CONSTRUCTION COST =	36,097,000	18,583,000	11,908,700	1,982,500	3,622,800			
				25% NON-CONSTRUCTION COSTS (ROUNDED) =	9,025,000	4,646,000	2,977,300	495,800	905,900			
				TOTAL COST =	45,122,000	23,229,000	14,886,000	2,478,300	4,528,700			

9.70% \$ 2,253,213.00 \$ 9.70% \$ 1,443,942.00 \$ 11.50% \$ 285,004.50 \$ 22% \$ 996,314.00
 TOTAL = \$ 4,978,473.50



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**DILLMAN WWTP WEST
INTERCEPTOR SWMM
MODEL CALIBRATION,
FUTURE GROWTH, &
ALTERNATIVE TECHNICAL
MEMORANDUM
ADDENDUM NO. 1**

TO: City of Bloomington Utilities

FROM: Commonwealth Engineers, Inc.

DATE: November 9, 2023 – Revised December 26, 2023

SUBJECT: SWMM Model Calibration, Future Growth, and Alternative Analysis

ATTACHMENTS: Attachment 1 – Rainfall Classification
Attachment 2 – Dry Weather Calibration and Validation Figures
Attachment 3 – Wet Weather Calibration and Validation Figures
Attachment 4 – Peak Hydraulic Grade Lines
Attachment 5 – Cost Estimate
Attachment 6 – Alternatives Hydraulic Grade Lines

1.0 Introduction

The project area includes the City of Bloomington Utilities (CBU) Dillman WWTP Basin, which is depicted in **Figure 1-1**. As shown, the Dillman WWTP Basin is defined as a separate sanitary basin and approximately consists of the area south of Vernal Pike. Specifically, this study is focused on the West Interceptor Basin within the Dillman WWTP Basin.

During dry weather, sanitary flow is conveyed by the Dillman WWTP West Interceptor south towards the WWTP. Two (2) other interceptors convey flow from the central and eastern portions of the Dillman WWTP Basin. The three (3) interceptors converge near S Old Indiana 37 and S Roger Street. From there, sanitary flow is conveyed through a forty-eight (48) inch interceptor to the WWTP.

During wet weather, the Dillman WWTP West Interceptor Basin experiences significant wet weather flows and sanitary sewer overflows (SSOs) are potentially occurring throughout the system. Within the study area, MH 4749 near S. Rogers St. and Charlie Ave. has experienced several SSOs over the past five (5) years. SSOs are prohibited in Indiana. The reality though is that sanitary sewer collection systems experience significant impacts due to infiltration and inflow. In older sanitary collection systems, infiltration and inflow can approach hydraulic behavior and wet weather response similar to a combined collection system. Growth in the Dillman WWTP sewershed is expected to further tax the system and increase the occurrence of SSOs.

The Dillman WWTP has a permitted design capacity of fifteen (15) MGD with a peak capacity of thirty (30) MGD. CBU has made improvements to the WWTP to achieve a future capacity of twenty (20) MGD and peak capacity of forty (40) MGD. The influent pump station has a firm pumping capacity of seventy-five (75) MGD with the largest unit out of service. The equalization (EQ) basin has a total capacity of forty-three (43) million gallons.

As a part of this study, extensive surveying and field data were collected in order to develop a hydraulic model that accurately represents the existing conditions of the collection system. From there, the model was calibrated to dry and wet weather conditions. The hydraulic model is well calibrated and accurately represents the existing conditions of the collection system. The hydraulic model was utilized to evaluate planning-level alternative solutions to eliminate potential SSOs up to a defined level of service. **Figure 1-2** illustrates the extents of the Dillman WWTP West Interceptor model. The hydraulic model was developed and calibrated using the United States Environmental Protection Agency's (USEPA) hydraulic modeling program SWMM5 computational engine. The model is well calibrated to dry and wet weather events and is suitable for preliminary engineering alternative analyses.

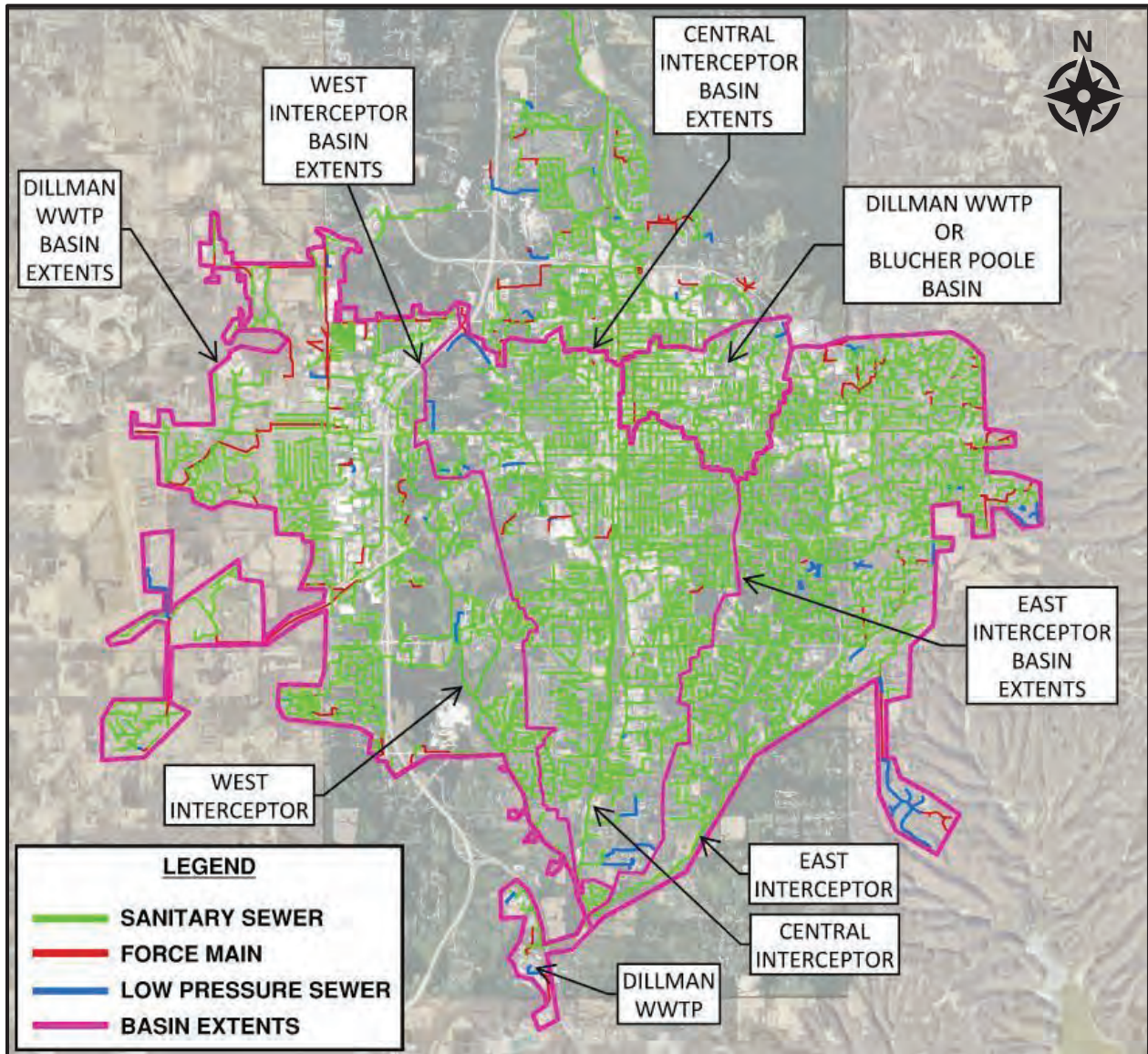


Figure 1-1: Dillman WWTP Basin

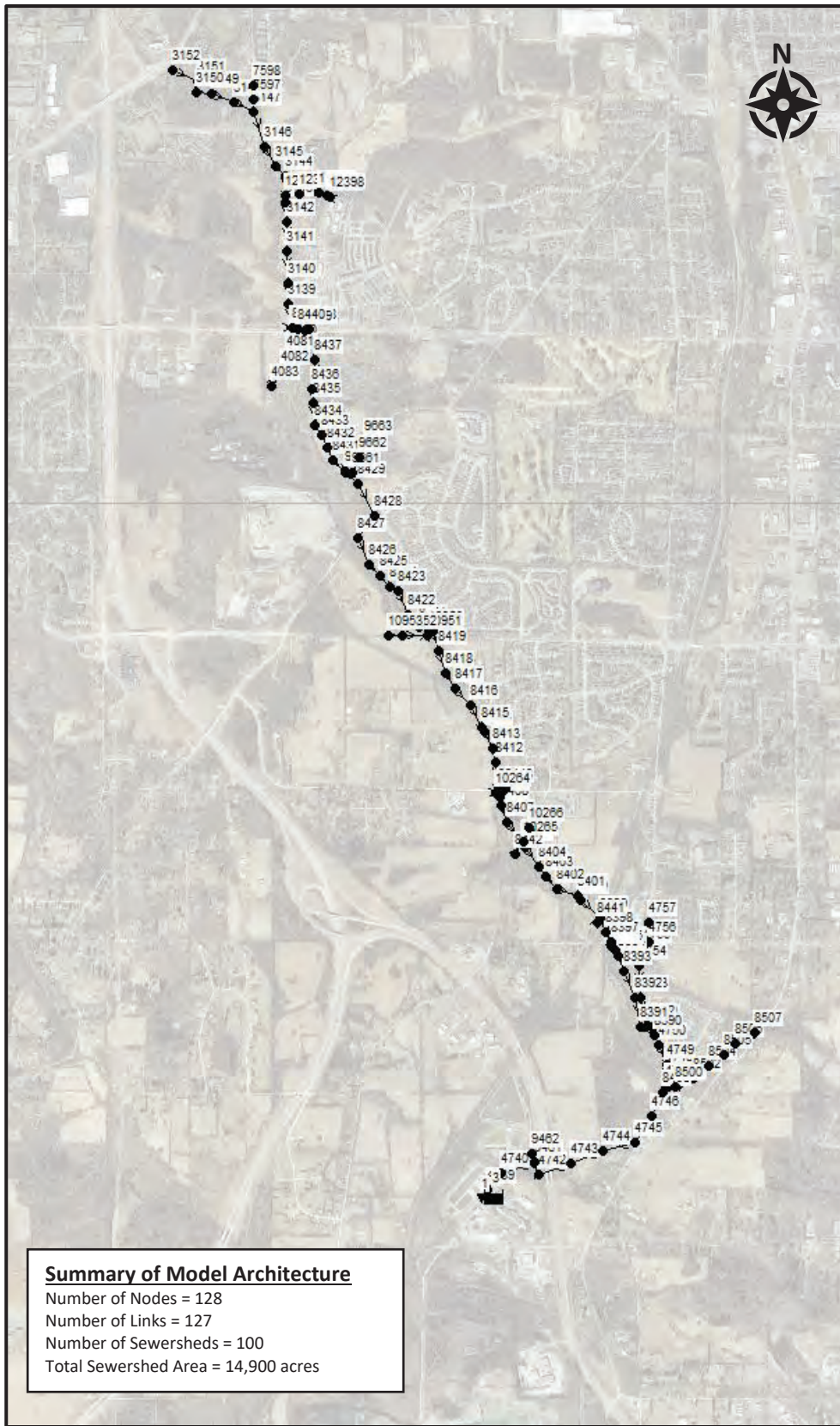


Figure 1-2: SWMM5 Model Architecture

2.0 Rainfall and Flow Meter Data

An accurate source of rainfall and flow meter data is necessary to develop a calibrated hydraulic model for the Dillman WWTP Basin. A temporary rain gauge and flow meters were installed as a part of this modeling effort. The following is a summary of the rainfall and flow meter data that was used for the model calibration.

2.1 Rainfall Data

One (1) temporary rainfall gauge was deployed at the Dillman WWTP and recorded data in five (5) minute intervals. **Figure 2-1** illustrates the location of the gauge in relation to the Dillman WWTP West Interceptor Basin. Rainfall data was downloaded and analyzed for the duration of the flow monitoring period from May 2023 through August 2023. Several wet weather events occurred during the flow monitoring period and are classified in **Table 2-1**. **Attachment 1** contains the detailed categorization of all wet weather events occurring during the flow monitoring period.

Table 2-1
Classification of Rainfall Events at Dillman WWTP

Date	Depth (in)	Duration (hr)	Recurrence Interval *
6/11/2023	0.93	1	4-6 Months
7/1/2023	0.66	1	< 2 Months
7/2/2023	0.99	1	4-6 Months
7/2/2023	2.67	48	6-9 Months
7/8/2023	0.74	1	2-3 Months
7/17/2023	1.10	1	6-9 Months
8/5/2023	1.66	1	2-5 Years

* Classification approximated using **Rainfall Frequency Atlas of the Midwest - Bulletin 71**.

2.2 Flow Meter Data

Flow metering was performed from May 2023 through August 2023. Six (6) temporary area-velocity (AV) flow meters were placed throughout the Dillman WWTP Basin. One (1) permanent flow meter is located on the Dillman WWTP West Interceptor. **Table 2-2** provides a summary of the flow meters, corresponding structure locations, and corresponding pipe diameters. **Figure 2-1** depicts the location of each flow meter used during dry and wet weather calibration and the contributory area to each meter, which represents the modeled SWMM5 subbasins.

**Table 2-2
Summary of Flow Meters**

Location in the Collection System (Manhole #)	Temporary/Permanent	Pipe Diameter (in)	Meter Location (Influent/Effluent)
3148	Temporary	30	Influent
3144	Permanent	30	Influent
4080	Temporary	15	Influent
8391	Temporary	36	Influent
4752	Temporary	42	Influent
8501	Temporary	42	Influent
4740	Temporary	48	Influent

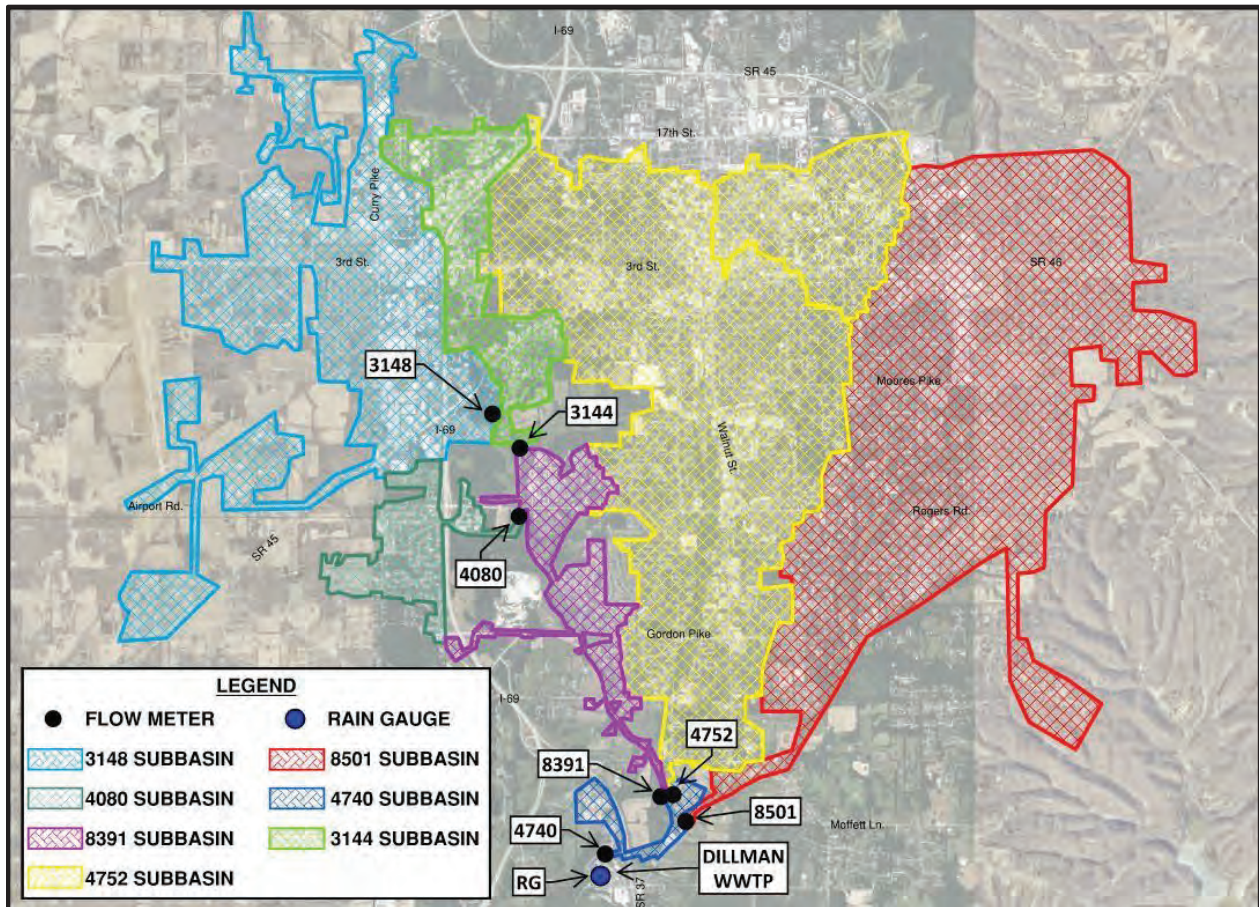


Figure 2-1: SWMM5 Flow Meter Subbasins

3.0 Model Calibration

Model calibration for both dry and wet weather conditions are critical components of collection system modeling. Proper dry weather calibration and validation ensure an accurate depiction of base sanitary flows and levels in the collection system. Likewise, proper wet weather calibration and validation ensure accurate predictions of the wet weather volumes and rates entering the collection system during various wet weather events along with corresponding effects to the hydraulic grade lines in the sanitary collection system. Dry and wet weather conditions were calibrated and validated separately, as summarized below.

3.1 Dry Weather Calibration and Validation

The flow metering data and rainfall data were reviewed to find an optimal seven (7) to fourteen (14) day span in which no significant rainfall had fallen during that span and no significant wet weather events had occurred in at least the two (2) preceding days. The dry weather span that occurred between May 26, 2023 and June 7, 2023 met these criteria (see **Figure 3-5**). During this period, the flow metering data was analyzed, and dry weather flow characteristics were calculated for each meter installed within the dry weather flow path. Dry weather calibration was performed by distributing the average dry weather flow metered at the monitoring locations to upstream nodes based on residential/business counts and approximate flow rates from industries and institutions. Diurnal patterns were also calculated based upon hourly and daily variation in the flow. These patterns allowed the average dry weather flow to accurately match the hydrographs collected by the flow meters.

Attachment 2 contains the graphical comparison of the modeled flow and depth data with the metered flow and depth data for the selected dry weather calibration period. As shown in **Attachment 2**, the model is adequately calibrated to dry weather conditions due to the consistent agreement between the metered data and model output.

The selected dry weather validation span to independently assess the dry weather calibration was July 23, 2023 to August 6, 2023 (see **Figure 3-5**). For the dry weather validation model run, the established dry weather flow patterns from the preceding calibration were not altered in the model, thus providing a secondary period in which the model output can be compared to the gauged metering data during dry weather. **Attachment 2** contains the graphical comparison of the modeled flow and depth data with the gauged metering data for the selected dry weather validation period. As shown, the model is adequately validated for planning-level purposes due to the consistent agreement between the metered data and model output.

3.2 Wet Weather Calibration & Validation

Generally, there are two (2) common methodologies in EPA SWMM5 utilized to calibrate collection system models to wet weather conditions. The first method is the Rainfall Derived Infiltration and Inflow (RDII) unit hydrograph method, which is commonly used to calibrate separate sewer areas. The second is the subcatchment method, which is used to calibrate combined sewer areas. The Dillman WWTP West Interceptor Basin is defined as a separate sanitary system; therefore, only the RDII unit hydrograph method was utilized during the wet weather calibration process. A summary of the RDII Unit Hydrograph Method, wet weather calibration, and wet weather validation is provided hereafter.

RDII Unit Hydrograph Method

Sanitary sewers are designed to collect and convey sanitary flows; however, collection systems are susceptible to collecting additional flows due to infiltration and inflow (I&I). Inflow is runoff that enters the system directly from manhole lids and frames, improperly connected downspouts, sump pumps, and cross-connections with storm sewers. Inflow usually occurs shortly after rainfall begins and quickly

recedes once it stops. It is typically the major component of the Rainfall Derived Infiltration and Inflow (RDII) peak flow. During dry weather, groundwater can infiltrate into the system through leaks in pipes and manholes. During wet weather, an increase in infiltration can be expected. Infiltration processes typically extend beyond the end of the wet weather event and take longer to recede. Systems are usually designed to accommodate I&I, though these flows often exceed design allowances with system age and growth. An RDII hydrograph represents the total flow that enters the collection system in the form of I&I.

The RDII unit hydrograph method is based on fitting up to three (3) triangular hydrographs to an observed RDII hydrograph: (a) short-term I&I response, (b) intermediate-term I&I response, and (c) long-term I&I response. Each unit hydrograph is defined by three (3) parameters:

- R = fraction of rainfall volume that enters the sewer system.
- T = time from the onset of rainfall to the peak of the unit hydrograph.
- K = ratio of time to recession of the unit hydrograph to the time to peak.

An RTK unit hydrograph was developed for each of the seven (7) flow metering locations, which represents the Rainfall Derived Infiltration and Inflow entering the Dillman WWTP Basin.

Wet Weather Calibration and Validation

The wet weather calibration process began by examining the rainfall and flow metering data in order to select a wet weather calibration event. Calibration proceeded by developing model unit hydrographs, which were systematically adjusted and revised by adjusting the RTK calibration parameters until the modeled data matched the observed data for the primary calibration event. As shown in **Table 2-1**, the storm events on July 17, 2023 and August 5, 2023 were the largest storm events. Each of these events were initially selected for calibration. Calibrating to these events resulted in the model not being well calibrated to any other event in the metering period. Therefore, the next largest storm event on July 2, 2023 was selected for model calibration (See **Figure 3-5**).

When the model was calibrated to the July 2, 2023 event, it was observed that the wet weather event that occurred on July 17, 2023 resulted in observed responses from the flow meters that were much greater than the predicted responses from the hydraulic model as shown in **Figure 3-1**. Inversely, it was observed that the wet weather event that occurred on August 5, 2023 resulted in observed responses from the flow meters that were much lower than the predicted responses from the hydraulic model as shown in **Figure 3-1**.

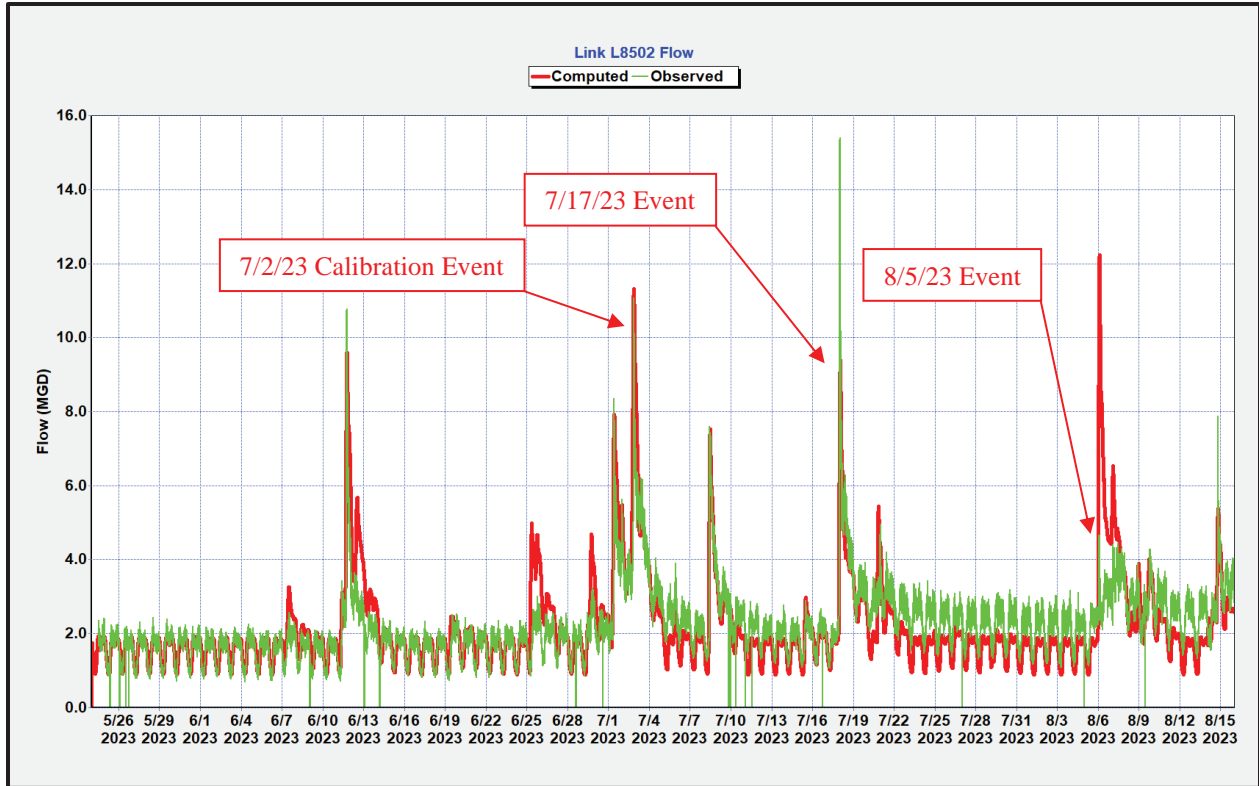


Figure 3-1: Wet Weather Calibration Spatial Variation

It is assumed that spatial variation of the storm caused these observed differences. Daily rainfall totals for three (3) rain gauges located in the City were gathered from the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) site as shown in **Table 3-1**. **Figure 3-2** shows the location of the NOAA sites and the rain gauge deployed as part of this study. As detailed in **Table 3-1**, the study’s rain gauge at Dillman WWTP recorded significantly less rain for the July 17, 2023 event and significantly more rain for the August 5, 2023 event compared to the NOAA gauges. This data suggests that more rain fell in the Dillman WWTP Basin than was recorded by the Dillman WWTP rain gauge for the July 17, 2023 event. Similarly, the data suggests a significant portion of the August 5, 2023 event missed the Dillman WWTP Basin.

**Table 3-1
Study and NOAA Rain Gauge Storm Comparison**

Station Name	7/17/23 Wet Weather Event	8/5/23 Wet Weather Event
Dillman WWTP RG	1.29	2.59
1.3 SE	2.42	1.57
2.7 E	2.65	1.41
Indiana University	2.06	Data Not Recorded

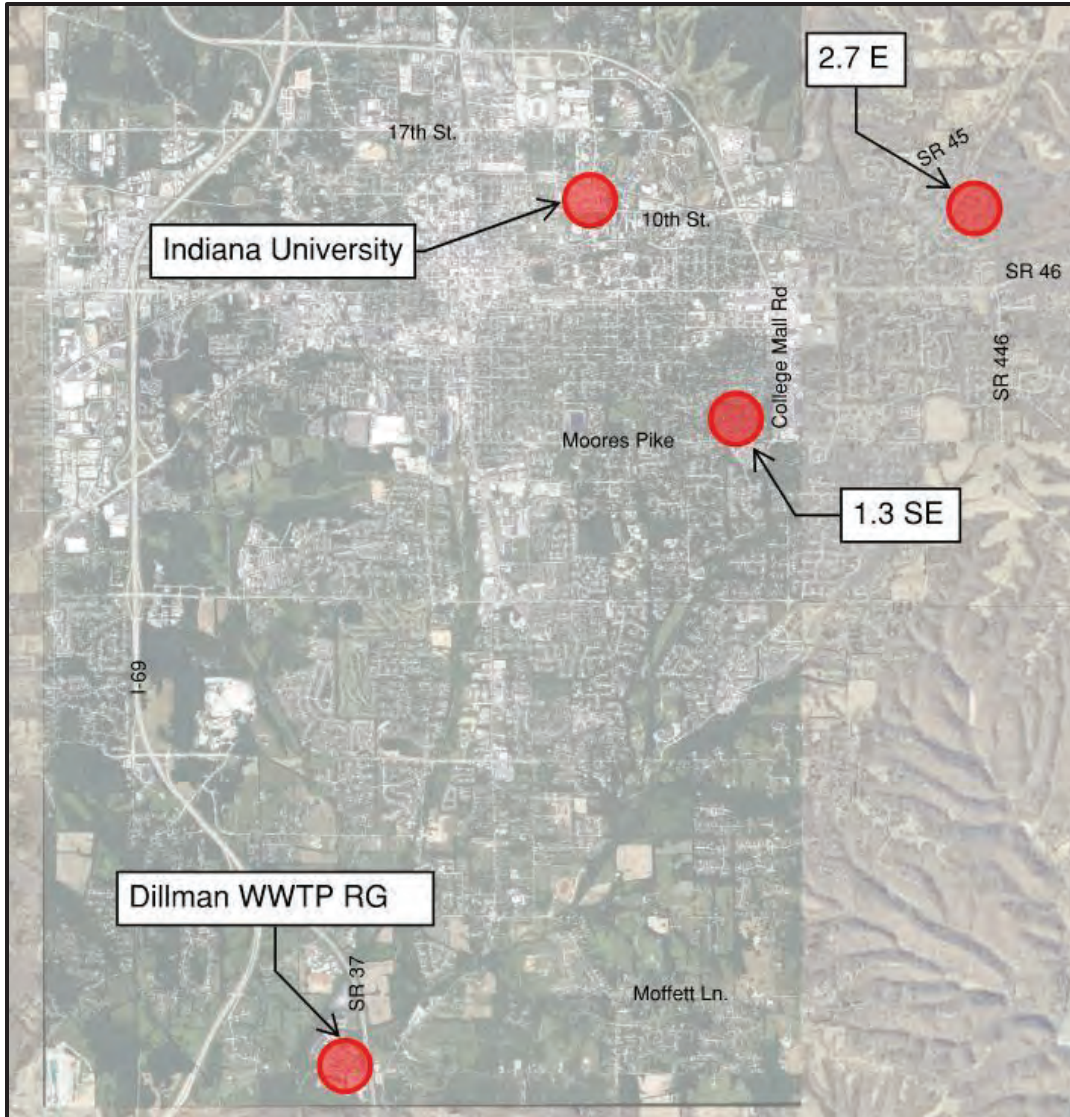


Figure 3-2: Study and NOAA Rain Gauge Locations

During the calibration, it was determined that restrictions are likely present downstream of MH 8391. This determination is based on observed depths in MH 8391 during the metering period. As shown in **Figure 3-3**, the depth generated in the model in MH 8391 was lower than the metered data. Since the flow at the structure is well calibrated, this suggests that potential downstream restrictions may have existed during the flow monitoring period.

Restrictions were systematically introduced via reducing the cross-sectional area of the sewer between MH 8390 and MH 8391 by sixty-six (66) percent. As shown in **Figure 3-4**, the depth generated in the model with added restrictions matched the metered data. It is advised that the City confirm this restriction and clean or repair this section of pipe.

The entire metering period was selected as the wet weather validation span. For the wet weather validation model run, the established RTK unit hydrographs from the preceding calibration were not altered in the model. **Attachment 3** contains the graphical comparison of the modeled flow and depth data with the gauged metering for the selected calibration and validation spans. As shown in **Attachment 3**, the model is adequately calibrated and validated and is suitable for preliminary engineering purposes.

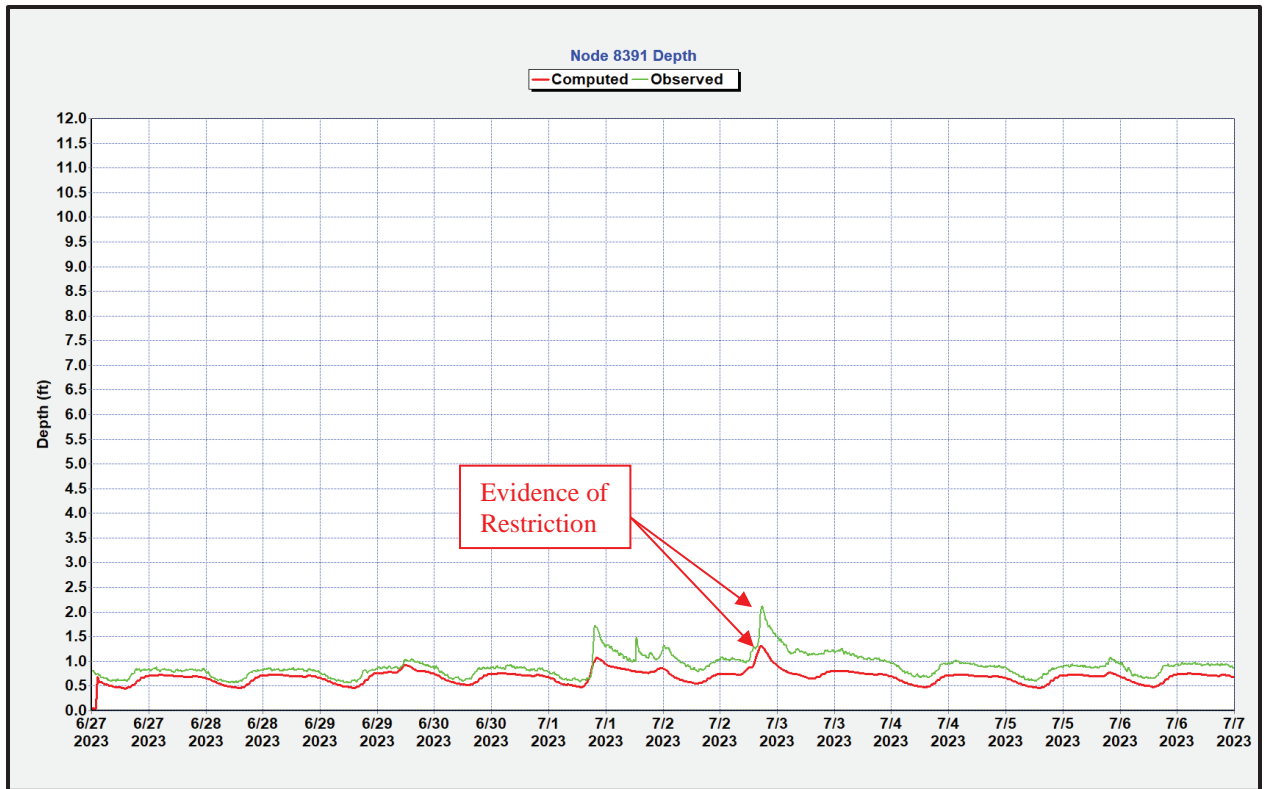


Figure 3-3: Meter MH 8391 Depth Without Restrictions Added

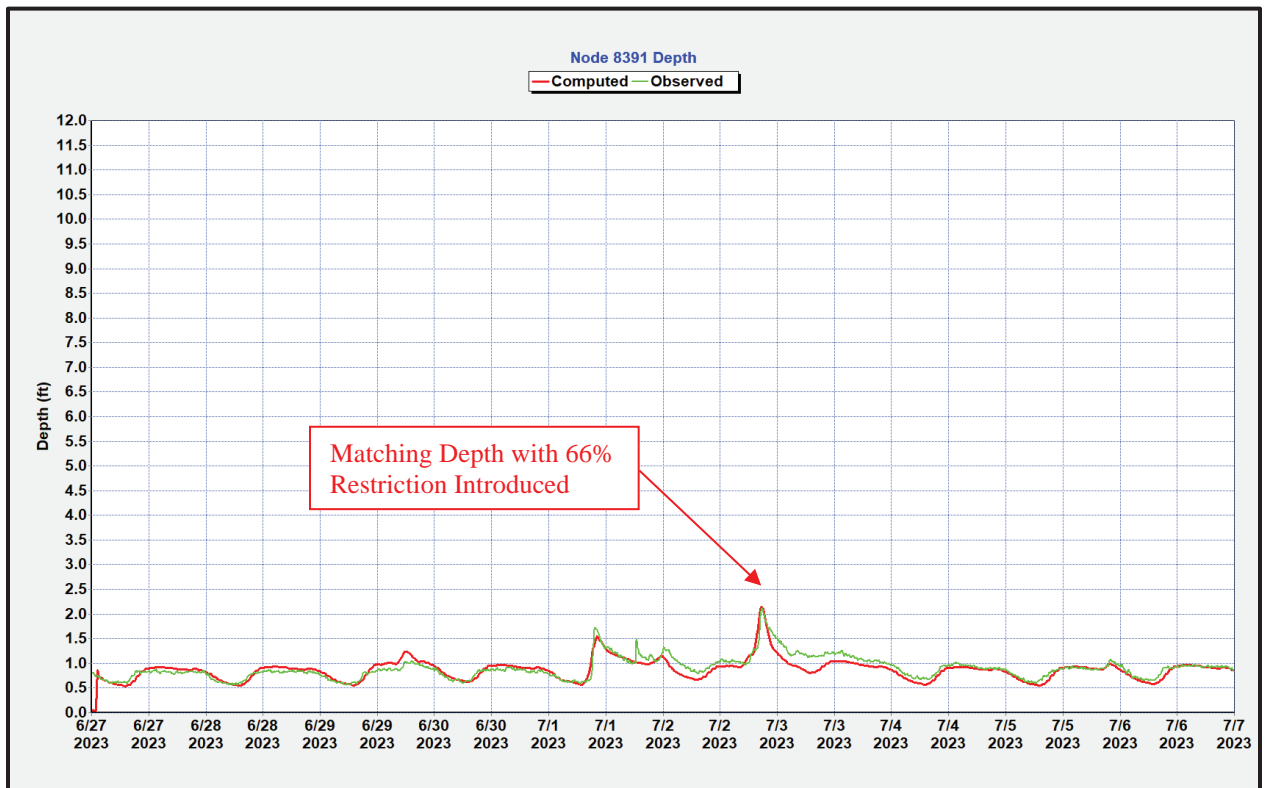


Figure 3-4: Meter MH 8391 Depth With Restrictions Added

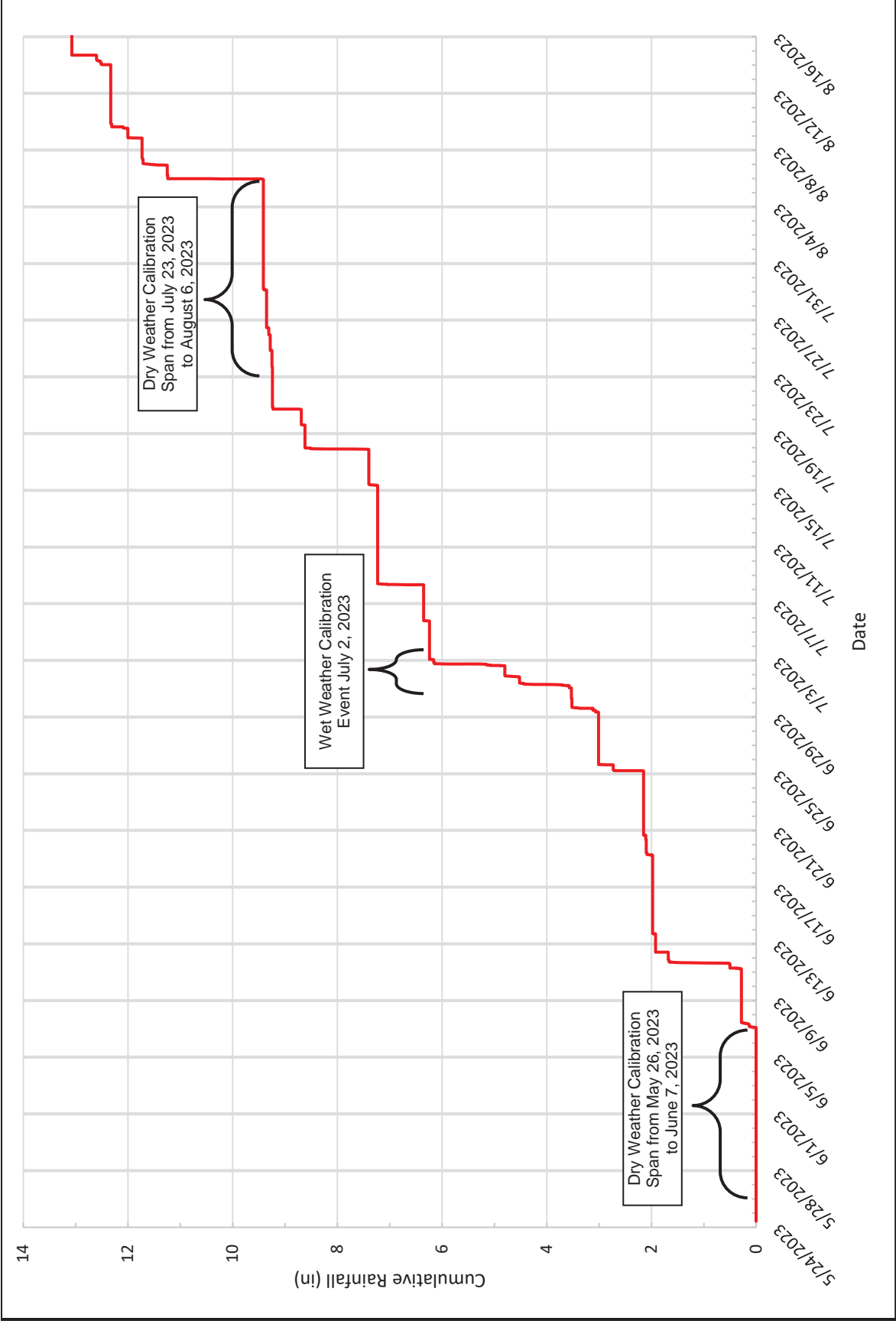


Figure 3-5: Cumulative Rainfall at Dillman WWTP

3.3 Dry Weather Flow Adjustment

Upon completion of dry weather and wet weather calibration and validation, it was observed that the dry weather flow for the metering period was lower than the yearly average dry weather flow into the Dillman WWTP. Monthly Operating Reports (MRO) from January 2021 through July 2023 were reviewed. Wet weather was omitted from the monthly average data as presented in **Figure 3-6**. It appears that beginning in April 2022, the dry weather flow is lower historic averages. The average dry weather flow from April 2022 through July 2023 was approximately ten (10) MGD. Based on discussions with CBU, it was determined that the modeled dry weather be artificially increased to match the average yearly dry weather flow into the WWTP. The dry weather flow reaching the WWTP in the model was increased to ten (10) MGD by equally distributing the additional flow across the model nodes.

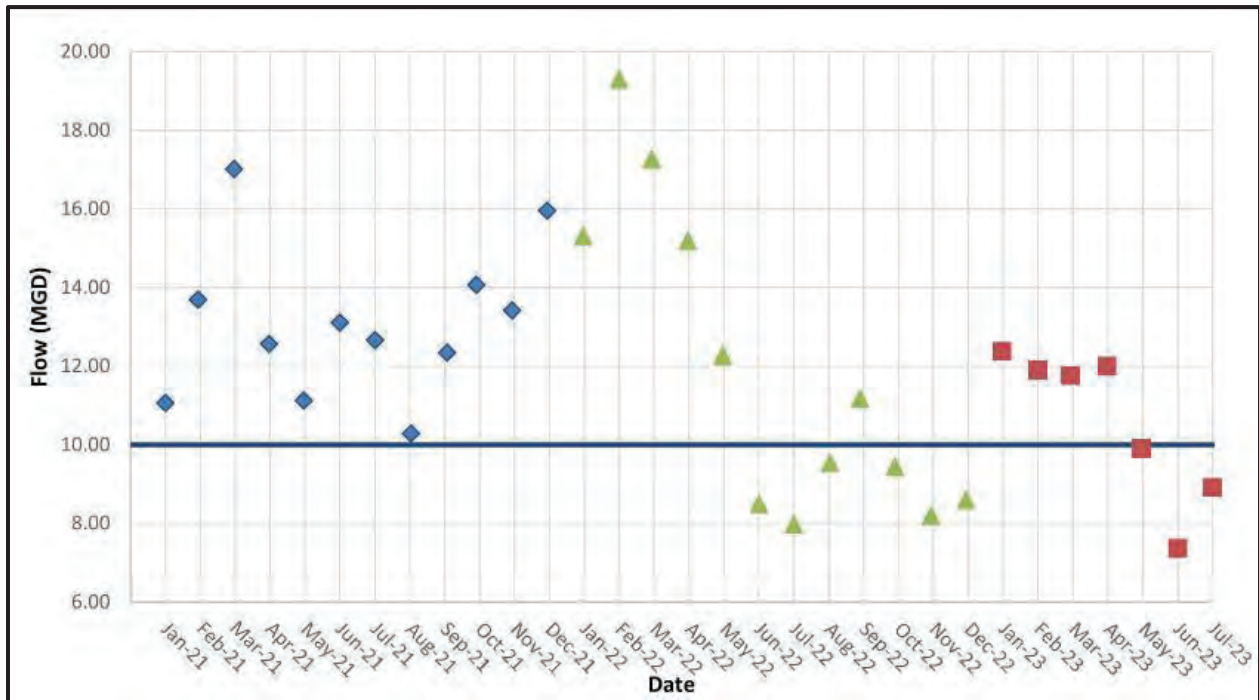


Figure 3-6: Average Monthly DWF into Dillman WWTP

4.0 Baseline Hydraulic Assessment

Upon completing the dry and wet weather calibration and validation of the West Interceptor, the existing system collection system model was analyzed using the ten (10) year, twenty-five (25) year, and fifty (50) year design storms (i.e. one (1) hour and twenty-four (24) hour storms) with the goal of identifying trouble spots in the collection system. **Table 4-1** contains a summary of design storms used during the baseline assessment; these design storms were created using the *Rainfall Frequency Atlas of the Midwest - Bulletin 71*. It is assumed the restrictions described in **Section 3.2** will be corrected and were therefore removed from the baseline assessment. **Figures 4-1 and 4-2** depict the hydraulic grade line (HGL) in the Dillman WWTP West Interceptor for the fifty (50) year, one (1) hour design storm. The HGL for the ten (10) year, and twenty-five (25) year, one (1) hour design storms are shown in **Attachment 4**.

As shown in **Figure 4-2**, the peak flow into the Dillman WWTP results in the sewer backing up. However, it should be noted that the interceptor is unable to convey the flow regardless of the WWTP capacity. **Figure 4-3** depicts the HGL in the downstream West Interceptor for the design storm with a free outfall replacing the WWTP. The portion of the West Interceptor downstream of the confluence with the Central Interceptor and East Interceptor is unable to convey the total flow from all three (3) interceptors.

Figure 4-4 illustrates the peak depth of flow and potential flooding locations for the fifty (50) year, one (1) hour design storm. It should be noted that the manholes on the WWTP property are bolted down and do not flood.

Table 4-1
Baseline Assessment Design Storms

Design Storm Recurrence Interval	Duration	Rainfall Depth (in)	Peak Flow at WWTP* (MGD)
10-Year	1-Hour	2.11	57.0
10-Year	24-Hour	4.49	54.1
25-Year	1-Hour	2.54	66.3
25-Year	24-Hour	5.40	63.7
50-Year	1-Hour	2.89	73.8
50-Year	24-Hour	6.15	71.8

* Assuming the collection system has the capacity to convey all flow without surcharging or SSOs occurring.

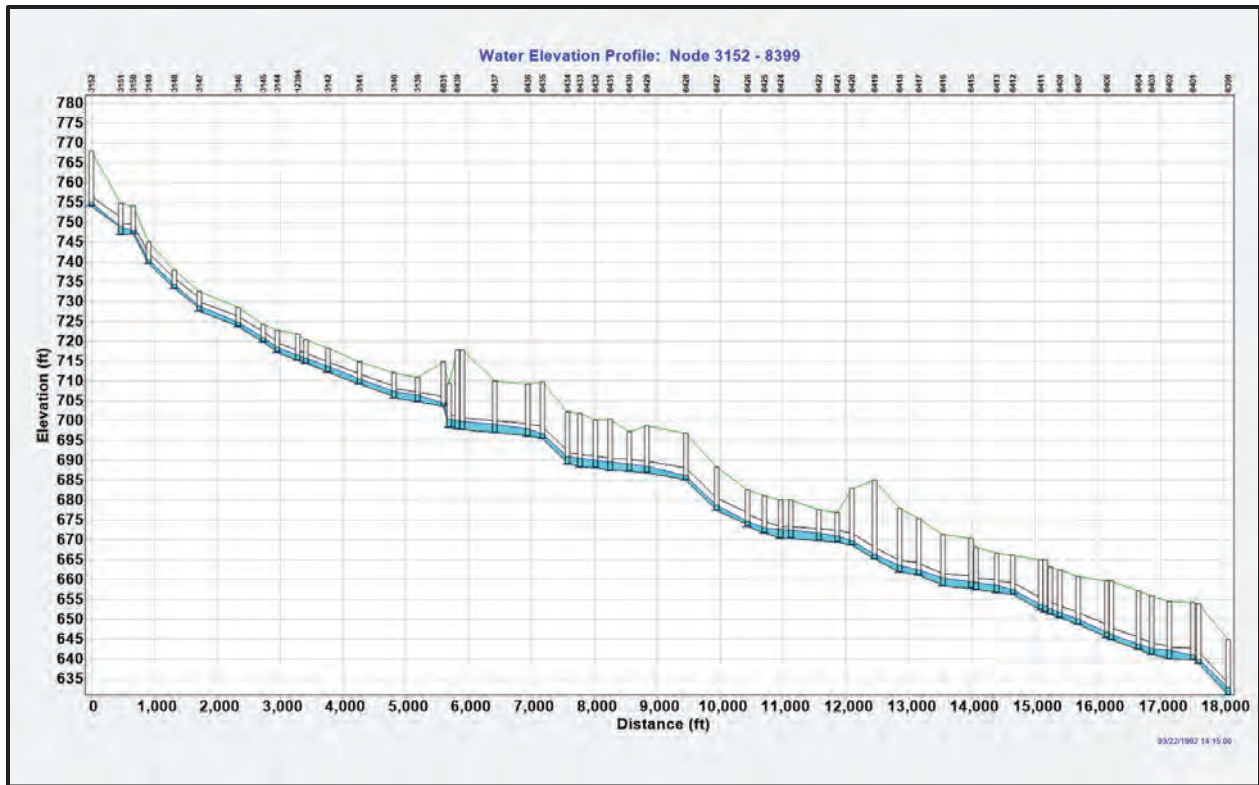


Figure 4-1: Upstream West Interceptor Hydraulic Grade Line 50-Year, 1-Hour Design Storm

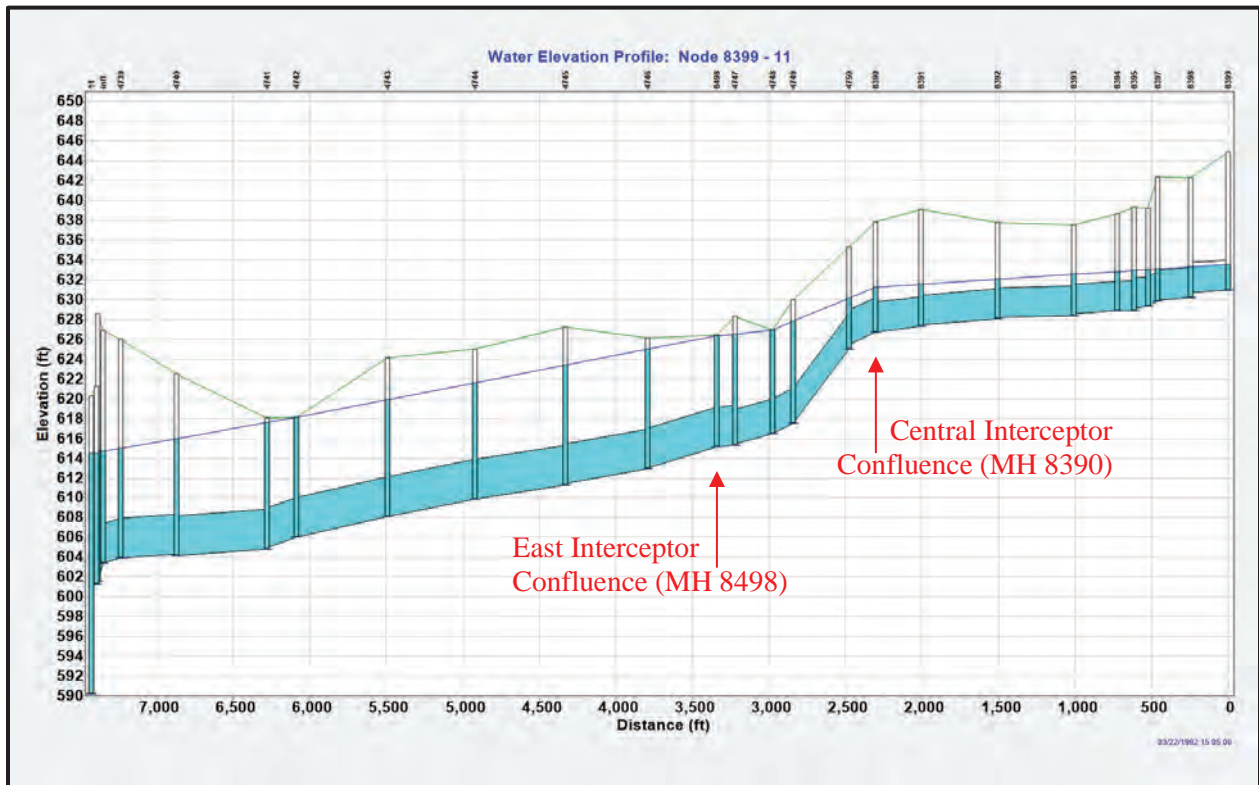


Figure 4-2: Downstream West Interceptor Hydraulic Grade Line 50-Year, 1-Hour Design Storm

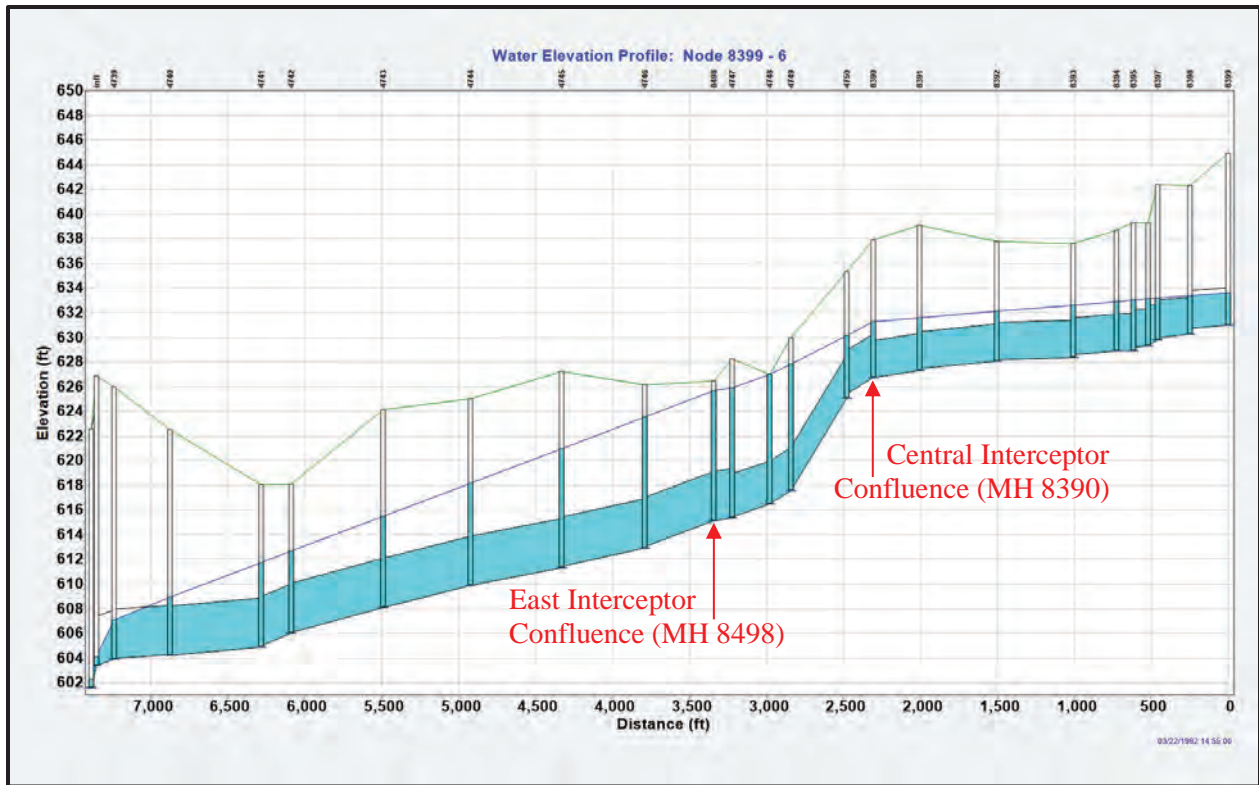


Figure 4-3: Downstream West Interceptor Hydraulic Grade Line 50-Year, 1-Hour Design Storm Without WWTP Capacity Limitations

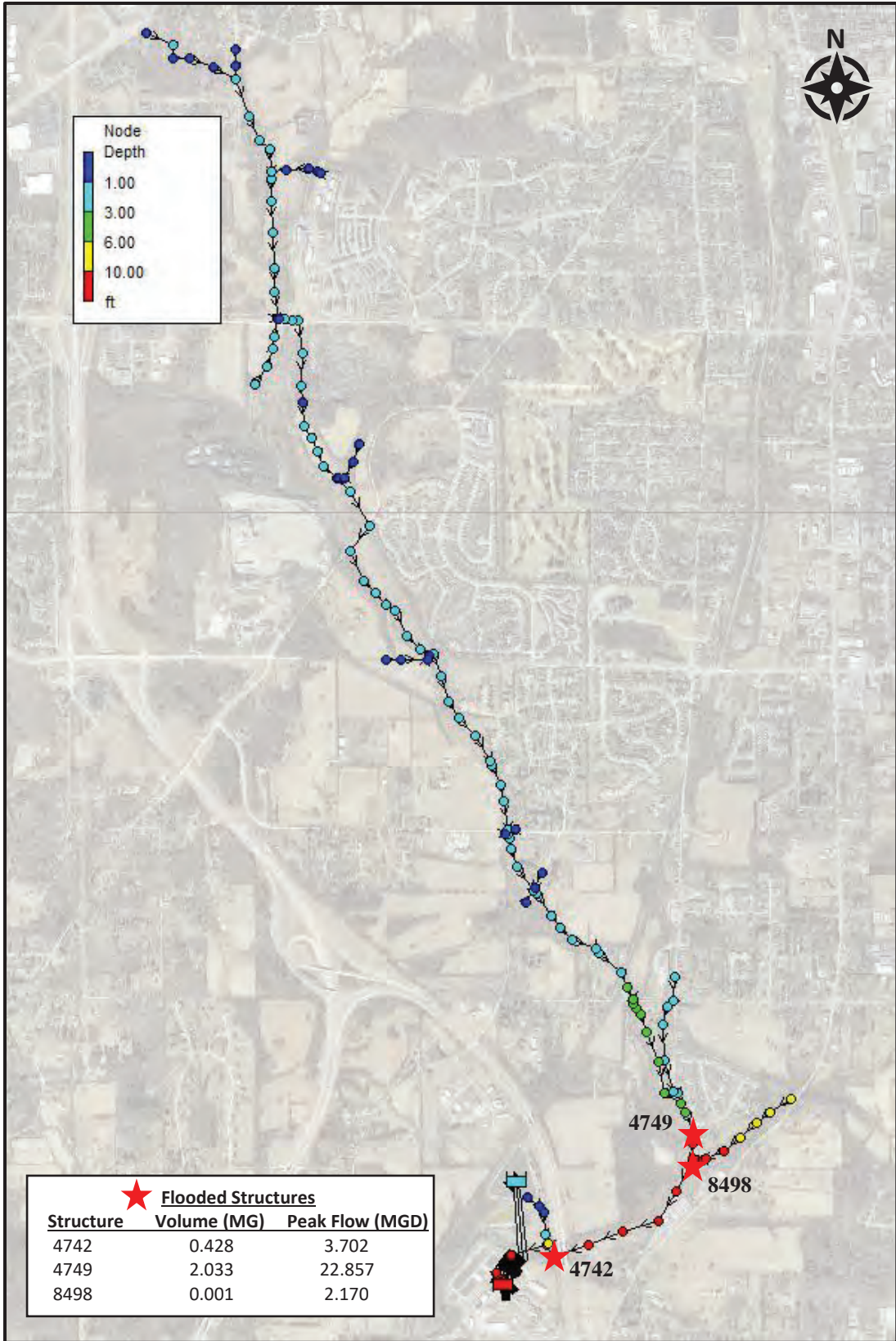


Figure 4-4: Existing System Peak Depth of Flow and Potential Flooding Locations for 50-Year 1-Hour Design Storm

5.0 Future Growth

After completing the baseline hydraulic assessment of the existing collection system, the calibrated model was adjusted to account for future growth conditions. Growth at four (4) locations is expected in the West Interceptor Basin based on discussions with CBU. These anticipated areas of growth for the future build-out conditions are shown in **Figure 5-1**. Approved wastewater flows within the central and eastern interceptor basins were also identified by CBU. **Table 5-1** displays the future flows associated with each growth area. Wet weather response for typical new sanitary construction was estimated using a peaking factor of four (4), and the RDII unit hydrograph values are summarized in **Table 5-2**. Following the addition of future growth, the model can be utilized as a planning-level tool to assess alternative solutions.

Table 5-1
Future Growth Design Flows

Area	Dry Weather Flow (MGD)
Summit District	1.32
NE Fullerton/I-69	1.66
4691 S Victor Pike	0.22
Westgate on 3rd	0.08
Central Interceptor Basin	0.15
East Interceptor Basin	0.23

Table 5-2
Future Growth Weather RDII Characteristics

Response	R ¹	T ²	K ³
Short Term	0.005	2	2
Medium-Term	0.009	4	5
Long-Term	0.03	10	10

¹R = fraction of rainfall that becomes I&I.
²T = time of hydrograph peak (hr).
³K = falling limb duration / rising limb duration. (dimensionless).

The Summit District development is of key interest. The percentage of Summit District's dry weather flow to total future dry weather flow at several locations was calculated and is detailed in **Table 5-3**. The locations of measurement are shown on **Figure 5-1**. An example calculation for location A is shown below.

$$\begin{aligned} \text{Summit District Percentage} &= \text{Summit District Dry Weather} / \text{Total Future Dry Weather} \\ &= 1.32 \text{ MGD} / 13.7 \text{ MGD} = 9.6\% \end{aligned}$$

**Table 5-3
Summit District's Dry Weather Flow Percentage**

Location	Basins Serviced	Dry Weather Flow (MGD)	Summit District's Percentage
A	West + Central + East	13.7	9.7%
B	West + Central	11.5	11.5%
C	West	6.0	22.0%

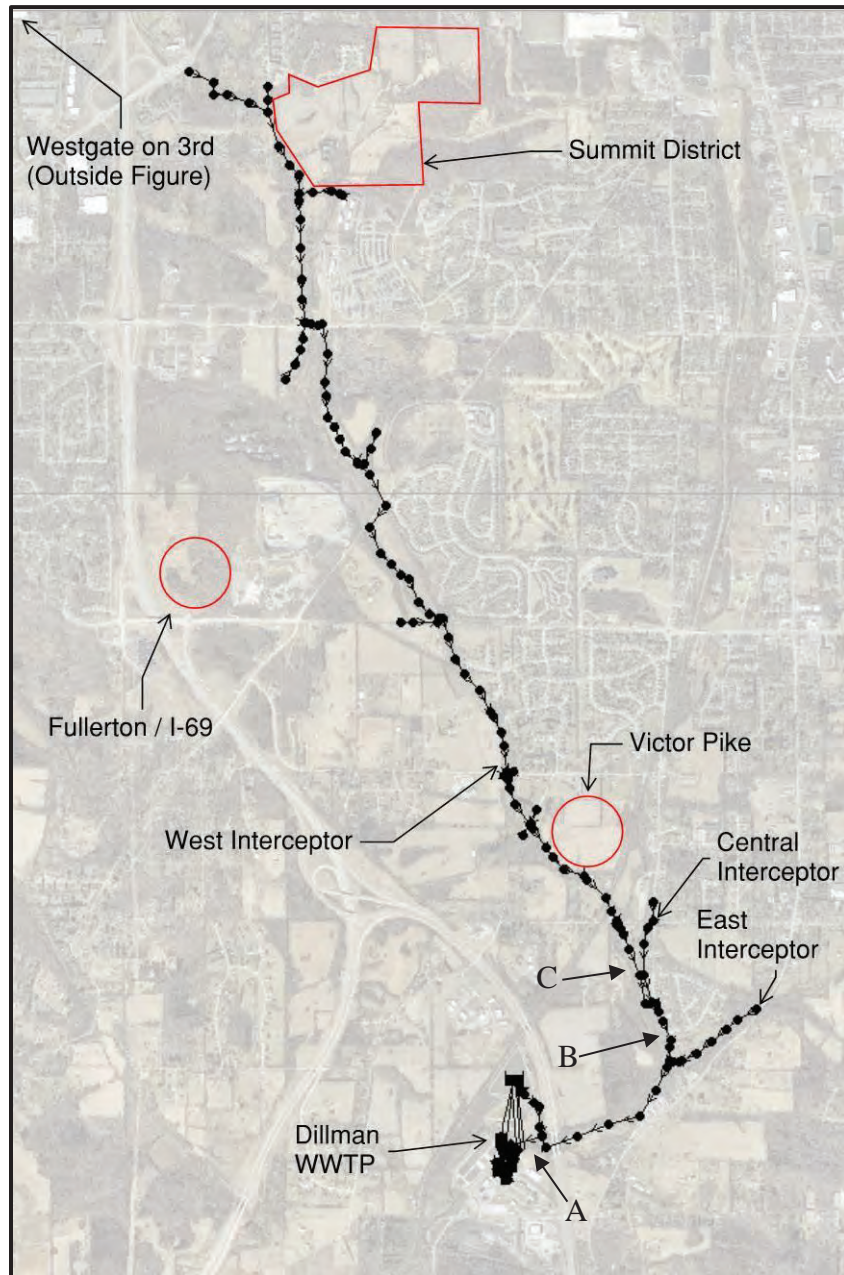


Figure 5-1: Potential Growth Areas

6.0 Alternative Analysis

Alternative solutions to eliminate potential sanitary sewer overflows occurring within the collection system under future growth conditions were developed for the fifty (50) year design storm. The following performance criteria were used when identifying and assessing alternative solutions for the Dillman WWTP West Interceptor:

- Eliminate potential sanitary sewer overflows for the 50-year design storm.
- Achieve eight (8) feet of freeboard between the ground elevation and the maximum hydraulic grade line (HGL) in the collection system. If eight (8) feet of freeboard was not available, the HGL must be lower than the crown of the pipe.
- Firm (design) lift station pumping rate shall meet or exceed the peak inflow to each lift station.

The eight (8) feet of freeboard requirement is set to protect homes from wastewater backing up into basements. However, the downstream portion of the interceptor is on the WWTP property and does not have any lateral connections to homes or businesses. Solutions with a relief sewer at the downstream portion of the system were allowed to have a minimum freeboard of six (6) feet in the existing pipe on the WWTP property.

Three (3) alternatives were developed to eliminate the potential sanitary sewer overflows and maximize the performance of the collection system. It should be noted that the alternatives do not account for future growth outside of what is stated in **Section 5.0**.

Under future growth conditions assuming no conveyance limitations, eighty-nine (89) MGD reaches the WWTP for the design storm. This exceeds the pumping capacity at the WWTP influent pump station by fourteen (14) MGD resulting in the collection system backing up. As described in **Section 4.0** and illustrated in **Figure 4-2**, the downstream interceptor is unable to convey the existing or future design storm flows regardless of the pumping capacity at the WWTP. The alternative solutions must address both of these issues.

Additionally, a section of interceptor north of Tapp Rd. is unable to convey the flow for the future growth conditions design storm and results in a freeboard of less than three (3) feet. This requires a section of pipe to be upsized. This solution is included in all alternatives and shown in **Figure 6-1**. The three (3) alternative figures for the downstream improvements are shown in **Figures 6-2, 6-3, and 6-4**. Cost estimates for each alternative are included in **Attachment 5**. Peak hydraulic grade lines for the fifty (50) year, one (1) hour design storm through each alternative are provided in **Attachment 6**.

The following describes each alternative solution to the fifty (50) year design storm. The gravity alternatives are separated into sections based on location in the system. These sections correspond to the flows in **Table 5-3**. Costs for each section and total cost are provided below.

- **Alternative 1** includes diversion structures at MH 8397 and MH 4756 to divert wet weather to a lift station located near W Church Lane. Both structures include plates to control flow in the existing downstream interceptors and divert more toward the lift station. The lift station will pump to the existing EQ basin. The force main alignment is proposed to follow the Limestone Greenway, which was constructed in 2019.

Improvements considered in this alternative include:

Lift Station Improvements

- 36 MGD Lift Station
- 2 Diversion Structures with Flow Control
- 3,450-FT of 36-inch Dia. Force Main

- 460-FT of 42-inch Dia. Sanitary Sewer Replacement
- 200-FT of 36-inch Dia. Sanitary Sewer
- 600-FT of 30-inch Dia. Sanitary Sewer
- 415-FT of 36-inch Dia. Sanitary Sewer Replacement

Total: \$59,937,000

- **Alternative 2** includes a diversion structure at MH 8397 to overflow wet weather into a relief sewer. The relief sewer travels parallel to the existing West Interceptor. At two additional locations, diversion structures divert flow from the main interceptor to the wet weather relief sewer. A new wet weather lift station on the WWTP property will accept flows in excess of the capacity of the influent pump station. The lift station will pump to the EQ basin. Challenges of this alternative include fitting the new gravity sewer on WWTP property dealing with other pipes and utilities. Additionally, this alternative requires a large diameter gravity sewer underneath I-69.

Improvements considered in this alternative include:

WWTP Improvements: \$23,229,000

- 14 MGD Lift Station
- 2,100-FT of 24-inch Dia. Force Main

(A) Downstream of Confluence with East Interceptor: \$14,886,000

- 1,800-FT of 54-inch Dia. Sanitary Relief Sewer
- 2,250-FT of 48-inch Dia. Sanitary Relief Sewer
- 1 Diversion Structure

(B) Between Confluences with East Interceptor and Central Interceptor: \$3,161,000

- 970-FT of 42-inch Dia. Sanitary Relief Sewer
- 1 Diversion Structure

(C) Upstream of Confluence with Central Interceptor: \$5,038,000

- 1,830-FT of 30-inch Dia. Sanitary Relief Sewer
- 415-FT of 36-inch Dia. Sanitary Sewer Replacement
- 1 Diversion Structure

Total: \$46,314,000

- **Alternative 3** includes a diversion structure at MH 8498 diverts all dry weather flow through a new gravity sewer. When the depth in the diversion structure exceeds the maximum dry weather depth, flow overtops a weir into the existing gravity sewer. A new wet weather lift station on the WWTP property will accept flows in excess of the capacity of the influent pump station. The lift station will pump to the EQ basin. Challenges of this alternative include fitting the new gravity sewer on WWTP property dealing with other pipes and utilities. Additionally, this alternative requires a large diameter gravity sewer underneath I-69. The pipe replacement instead of a parallel sewer also requires significant bypass pumping.

Improvements considered in this alternative include:

WWTP Improvements: \$23,229,000

- 14 MGD Lift Station
- 2,100-FT of 24-inch Dia. Force Main

(A) Downstream of Confluence with East Interceptor: \$14,886,000

- 1,800-FT of 54-inch Dia. Sanitary Relief Sewer
- 2,250-FT of 48-inch Dia. Sanitary Relief Sewer
- 1 Diversion Structure

(B) Between Confluences with East Interceptor and Central Interceptor: \$2,478,000

- 920-FT of 48-inch Dia. Sanitary Sewer Replacement

(C) Upstream of Confluence with Central Interceptor: \$4,529,000

- 1,790-FT of 42-inch Dia. Sanitary Sewer Replacement
- 415-FT of 36-inch Dia. Sanitary Sewer Replacement

Total: \$45,122,000

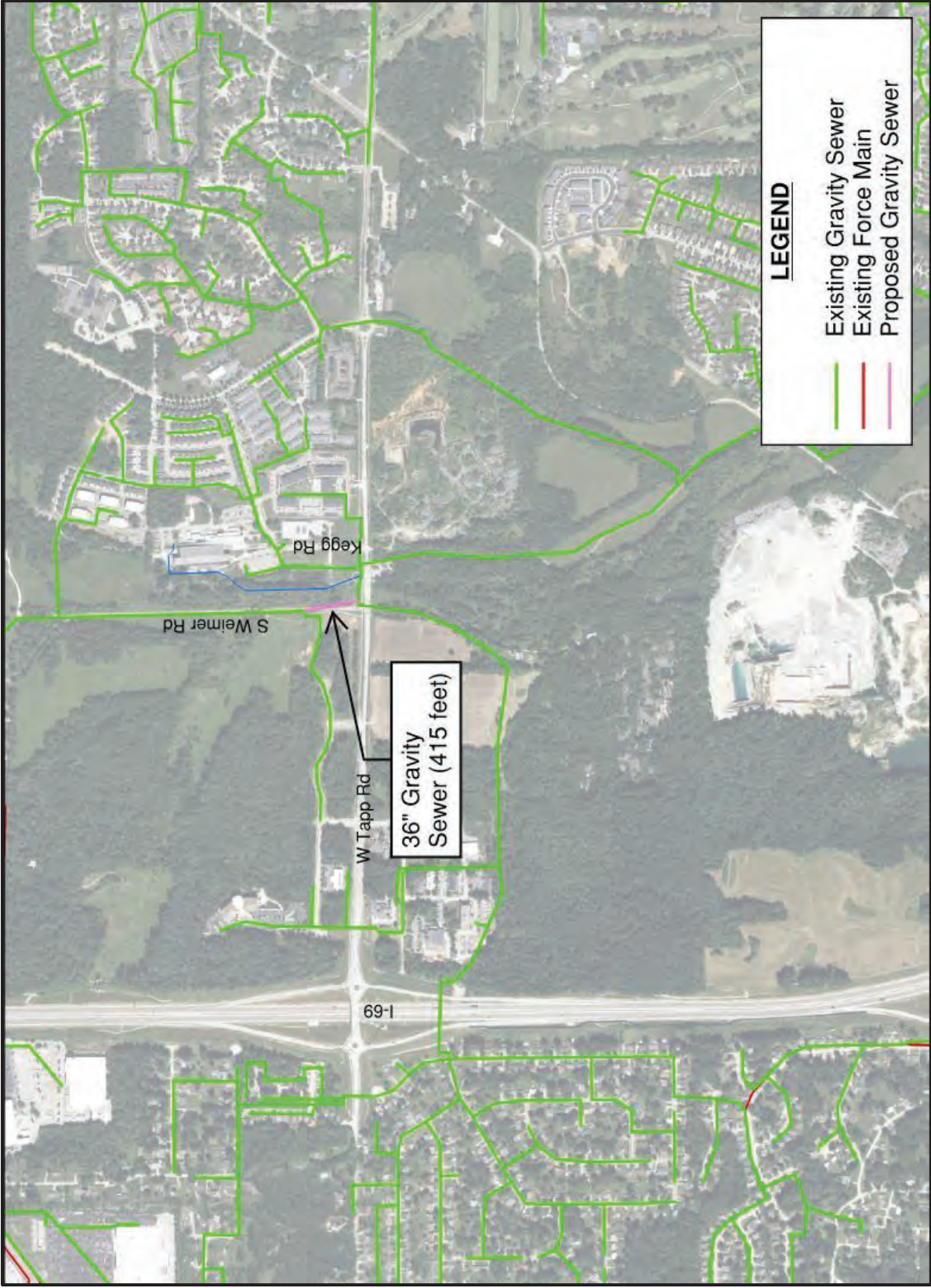


Figure 6-1: Upstream Solution for Alternatives 1, 2, and 3

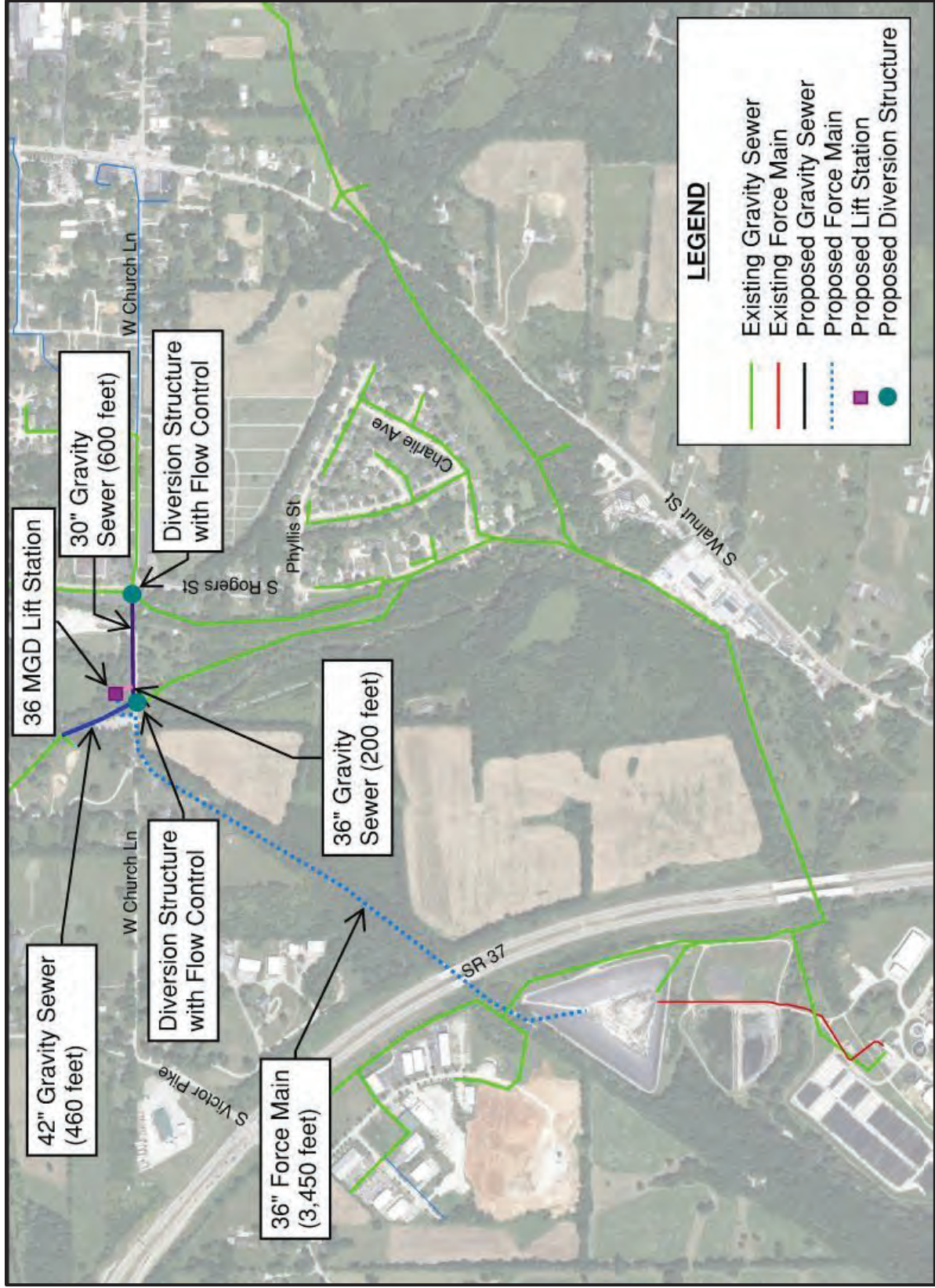


Figure 6-2: Alternative 1

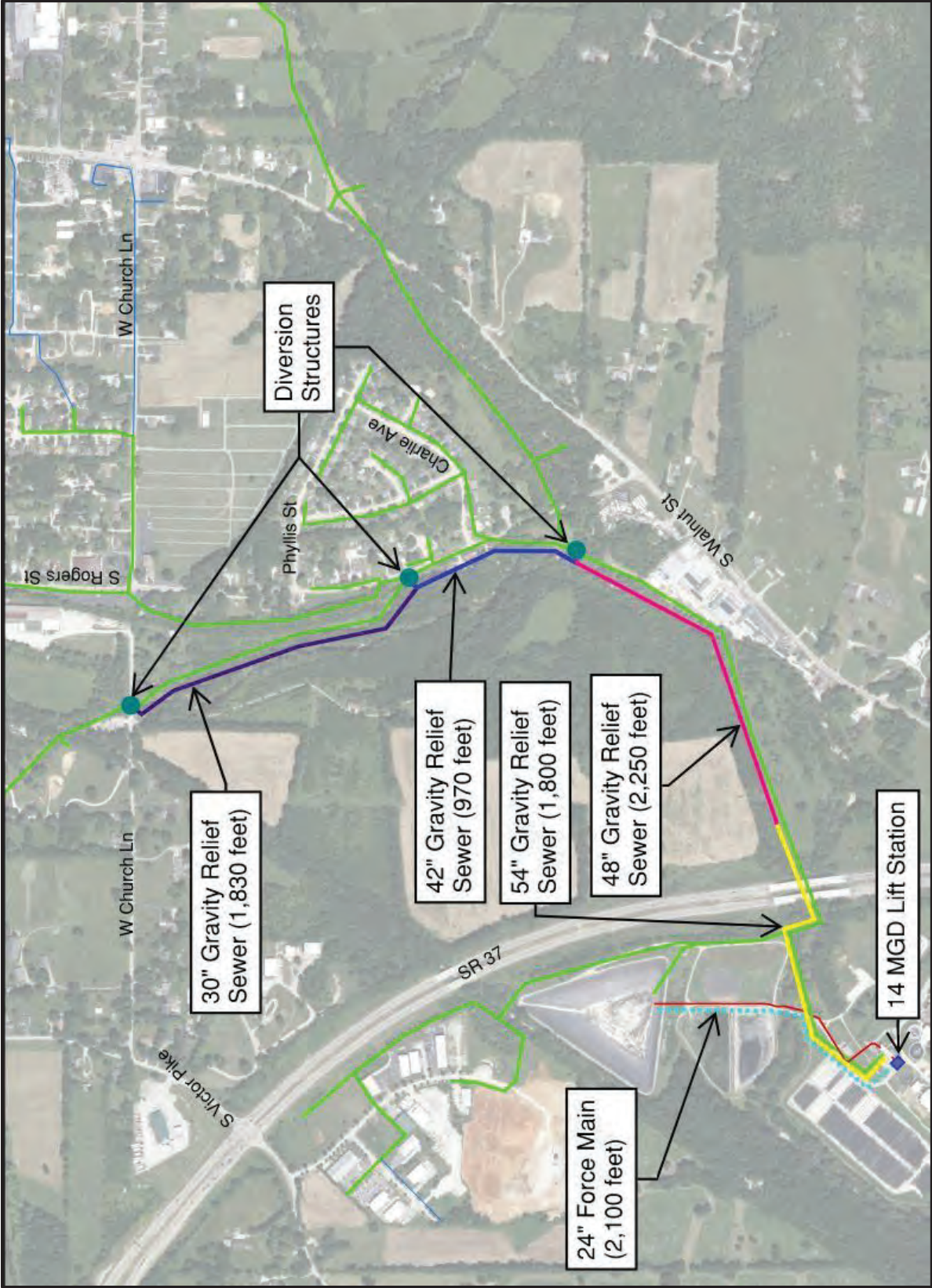


Figure 6-3: Alternative 2

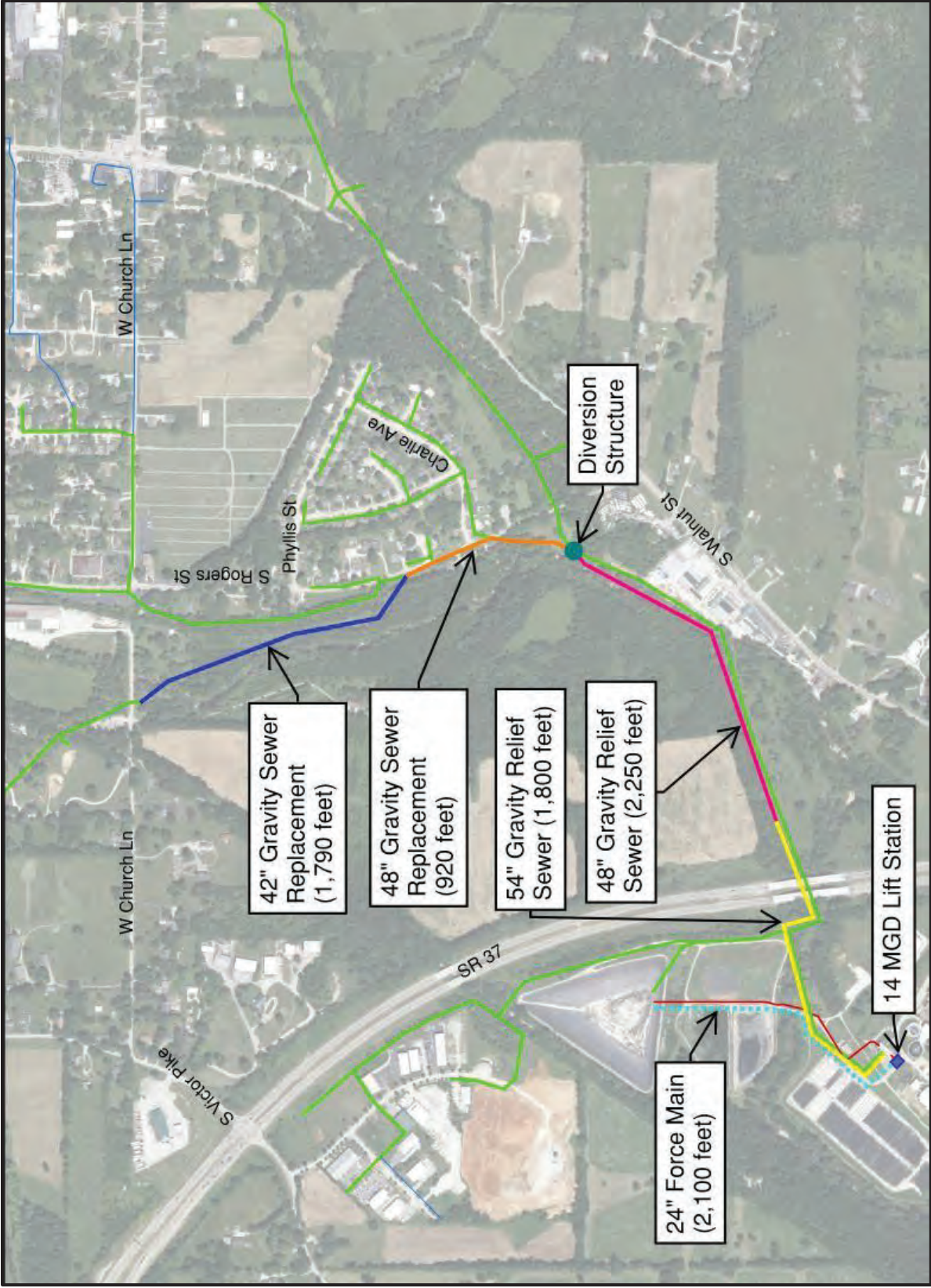


Figure 6-4: Alternative 3

Attachment 1
Rainfall Classification

Event #1: 6/11/2023

Duration	Rainfall (in)	Recurrence Interval
1 hr.	0.93	4 - 6 Months
2 hr.	1.13	4 - 6 Months
3 hr.	1.14	3 - 4 Months
6 hr.	1.17	2 - 3 Months
12 hr.	1.38	2 - 3 Months
18 hr.	1.40	2 - 3 Months
24 hr.	1.42	< 2 Months
48 hr.	1.64	2 - 3 Months

Event #2: 7/1/2023

Duration	Rainfall (in)	Recurrence Interval
1 hr.	0.66	< 2 Months
2 hr.	0.75	< 2 Months
3 hr.	0.87	< 2 Months
6 hr.	0.95	< 2 Months
12 hr.	0.99	< 2 Months
18 hr.	1.23	< 2 Months
24 hr.	1.27	< 2 Months
48 hr.	1.27	< 2 Months

Event #3: 7/2/2023

Duration	Rainfall (in)	Recurrence Interval
1 hr.	0.99	4 - 6 Months
2 hr.	1.04	3 - 4 Months
3 hr.	1.26	4 - 6 Months
6 hr.	1.36	3 - 4 Months
12 hr.	1.44	2 - 3 Months
18 hr.	1.44	2 - 3 Months
24 hr.	1.63	2 - 3 Months
48 hr.	2.67	6 - 9 Months

Event #4: 7/8/2023

Duration	Rainfall (in)	Recurrence Interval
1 hr.	0.74	2 - 3 Months
2 hr.	0.88	2 - 3 Months
3 hr.	0.88	< 2 Months
6 hr.	0.88	< 2 Months
12 hr.	0.88	< 2 Months
18 hr.	0.88	< 2 Months
24 hr.	0.88	< 2 Months
48 hr.	0.88	< 2 Months

Event #5: 7/17/2023

Duration	Rainfall (in)	Recurrence Interval
1 hr.	1.10	6 - 9 Months
2 hr.	1.11	4 - 6 Months
3 hr.	1.21	4 - 6 Months
6 hr.	1.22	2 - 3 Months
12 hr.	1.22	< 2 Months
18 hr.	1.22	< 2 Months
24 hr.	1.22	< 2 Months
48 hr.	1.29	< 2 Months

Event #6: 8/5/2023

Duration	Rainfall (in)	Recurrence Interval
1 hr.	1.66	2 - 5 Years
2 hr.	1.66	1 - 2 Years
3 hr.	1.66	9 Months - 1 Year
6 hr.	1.67	6 - 9 Months
12 hr.	1.67	4 - 6 Months
18 hr.	1.67	3 - 4 Months
24 hr.	2.00	4 - 6 Months
48 hr.	2.15	4 - 6 Months

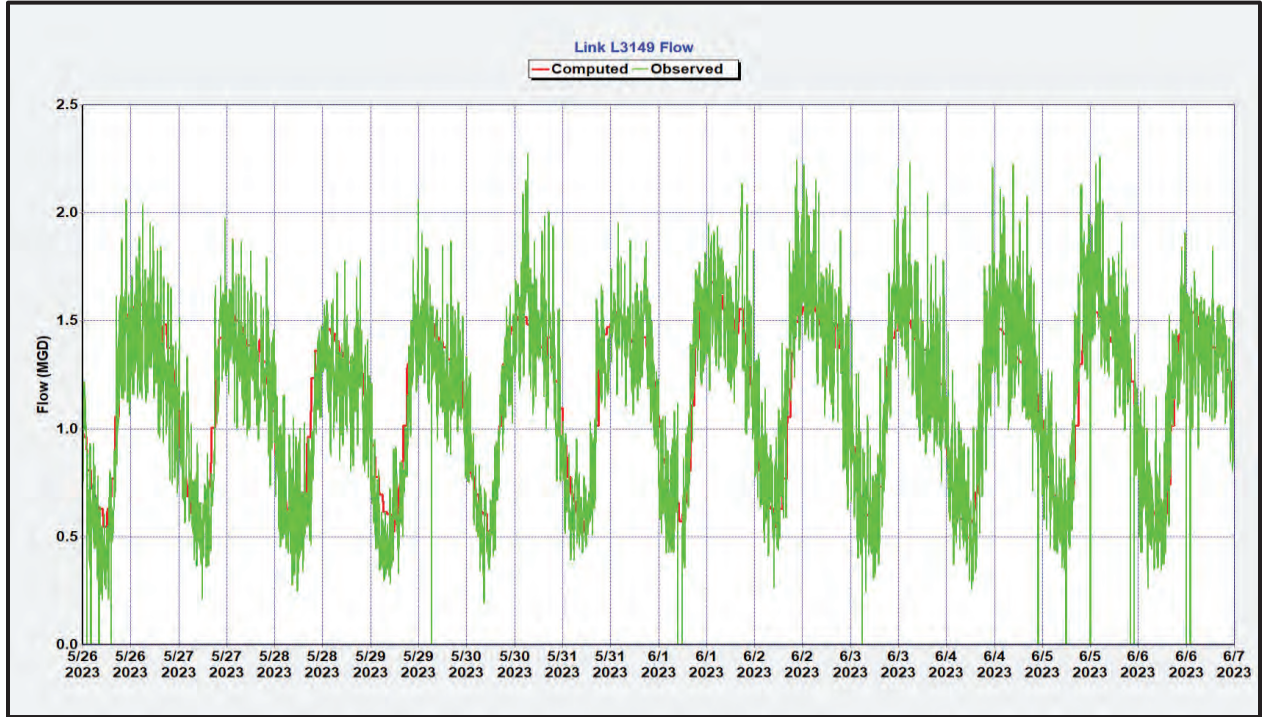
Attachment 2

Dry Weather Calibration & Validation Figures

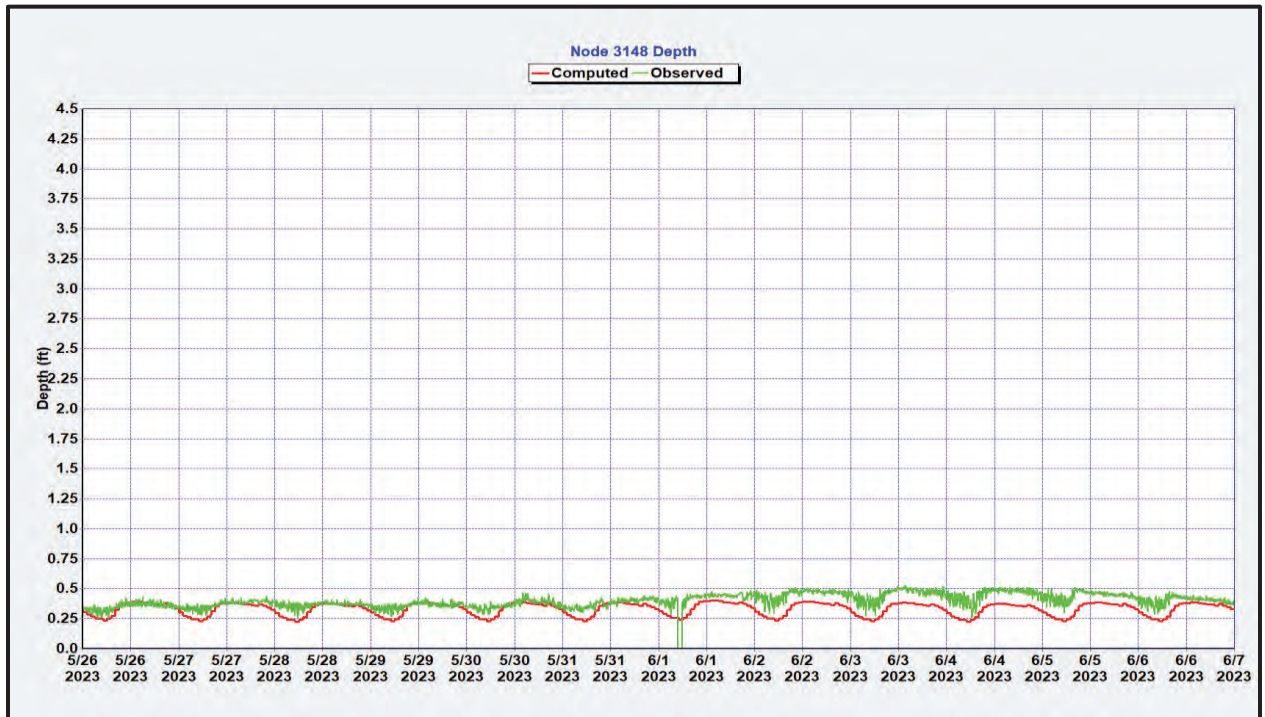
Dry Weather Calibration Period

May 26, 2023 – June 7, 2023

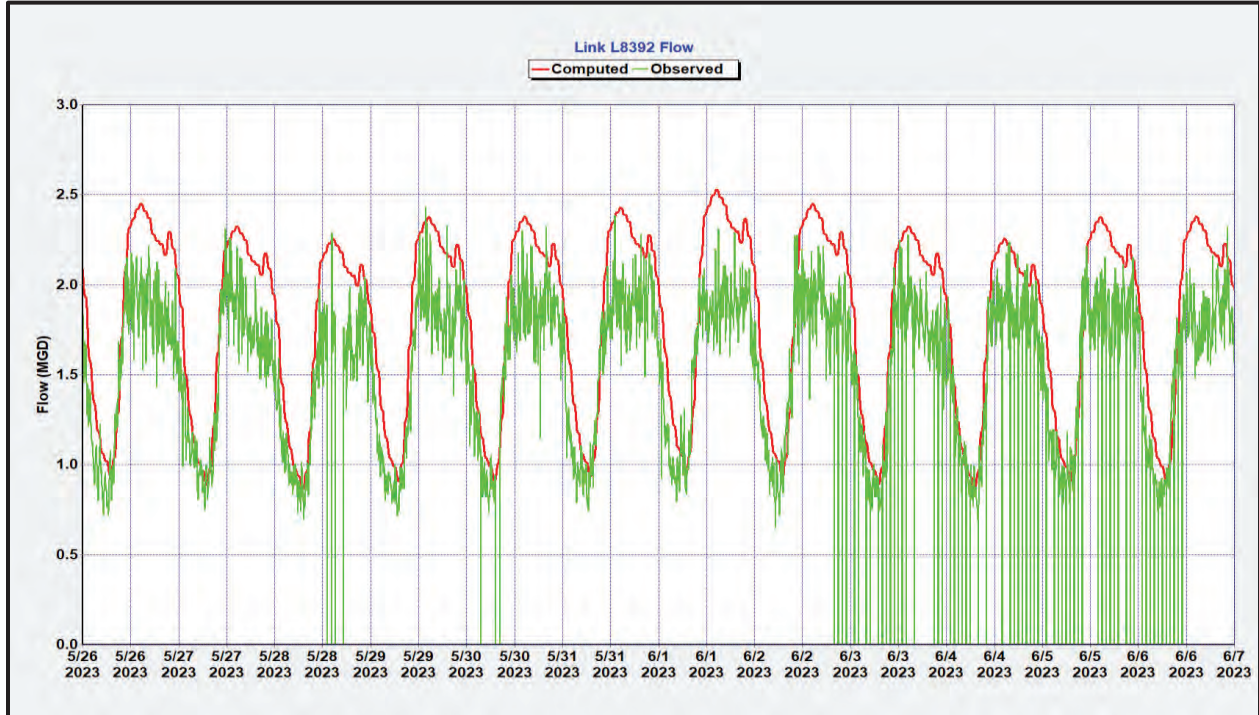
MH 3148 - 30-inch Influent: Flow (MGD)



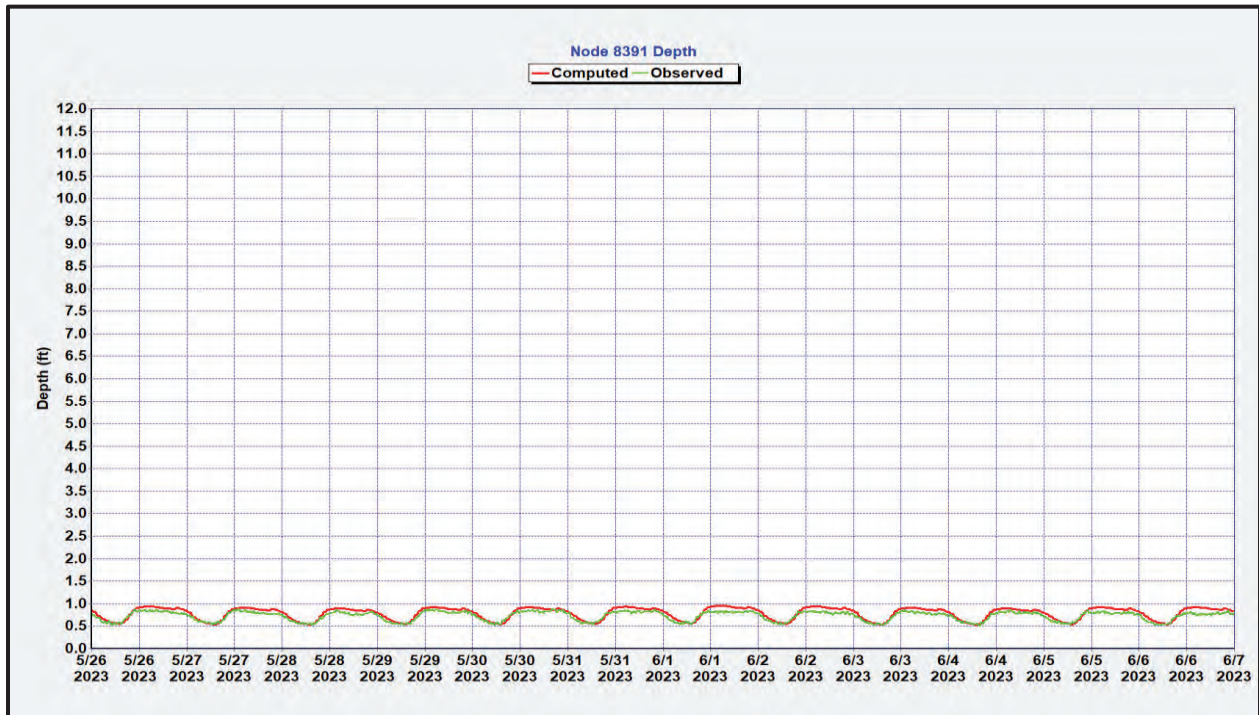
MH 3148 - 30-inch Influent: Depth (ft)



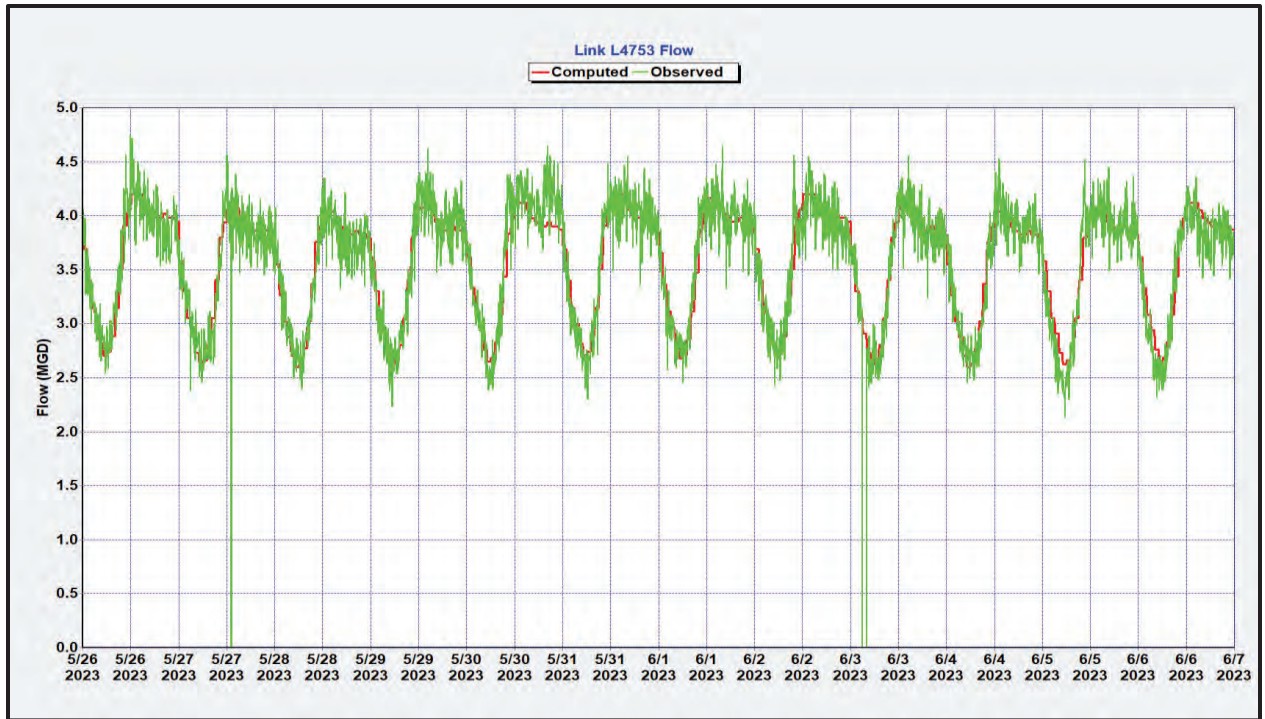
MH 8391 - 36-inch Influent: Flow (MGD)



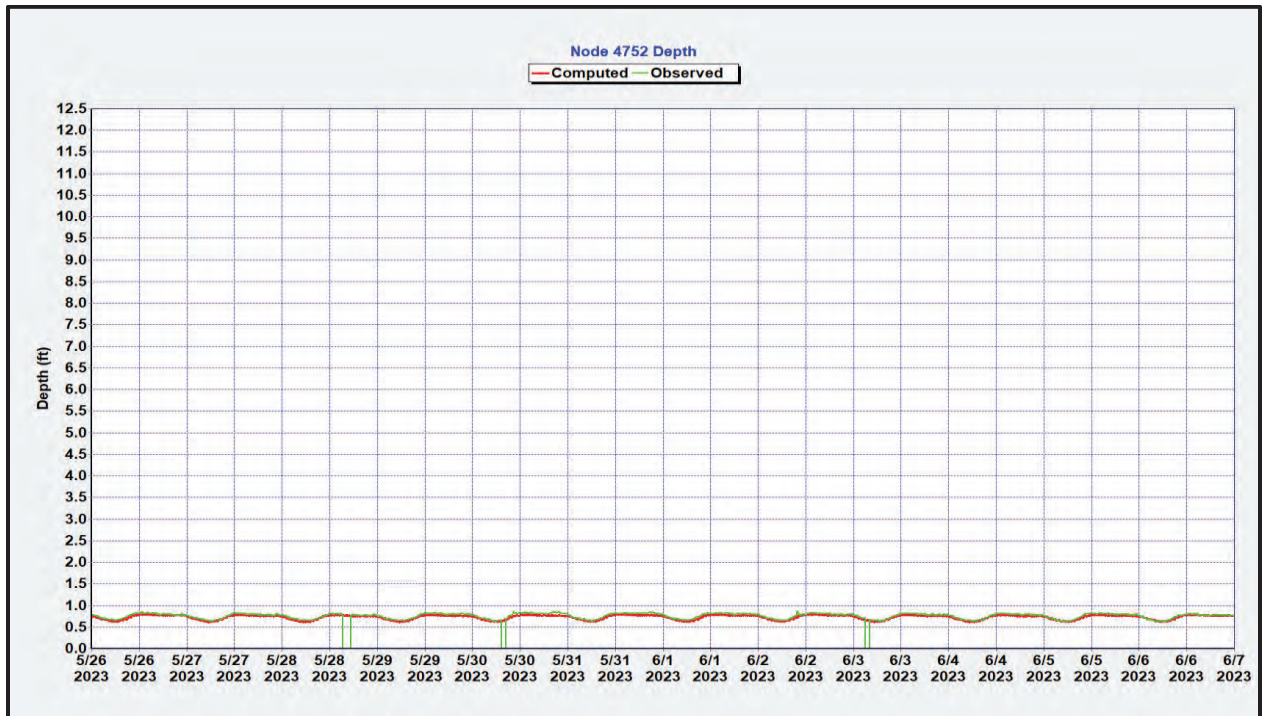
MH 8391 - 36-inch Influent: Depth (ft)



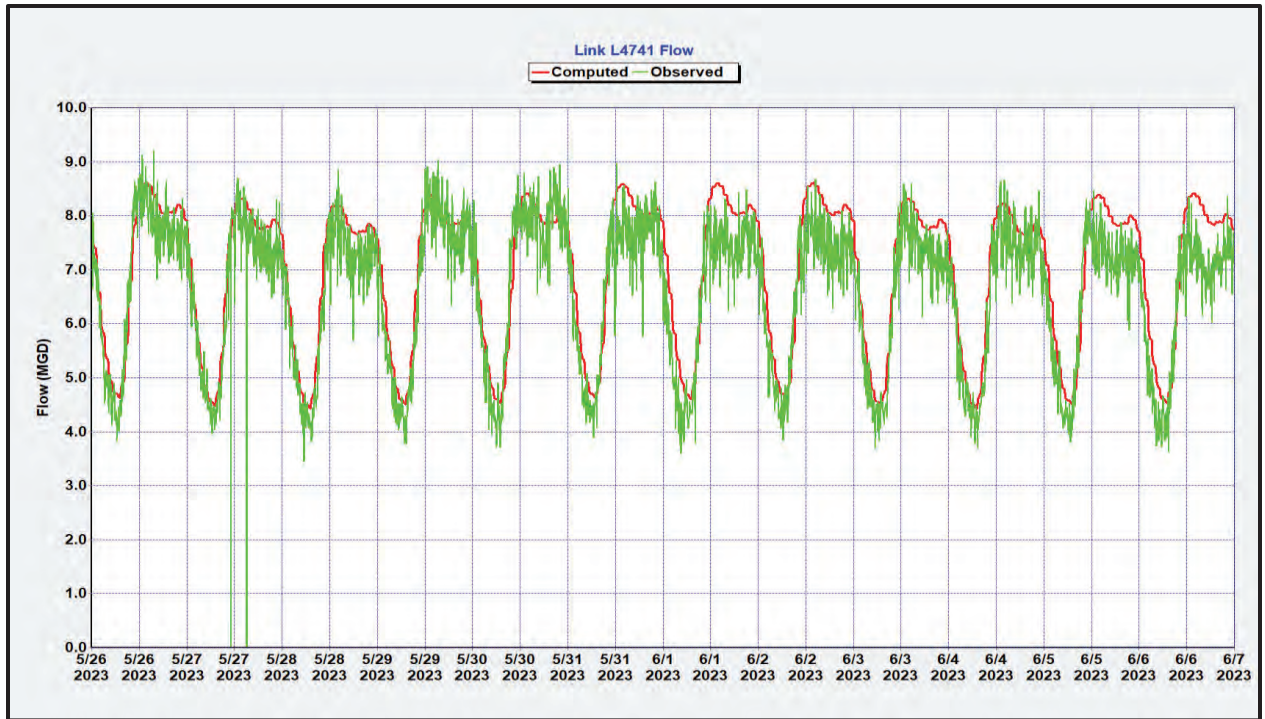
MH 4752 - 42-inch Influent: Flow (MGD)



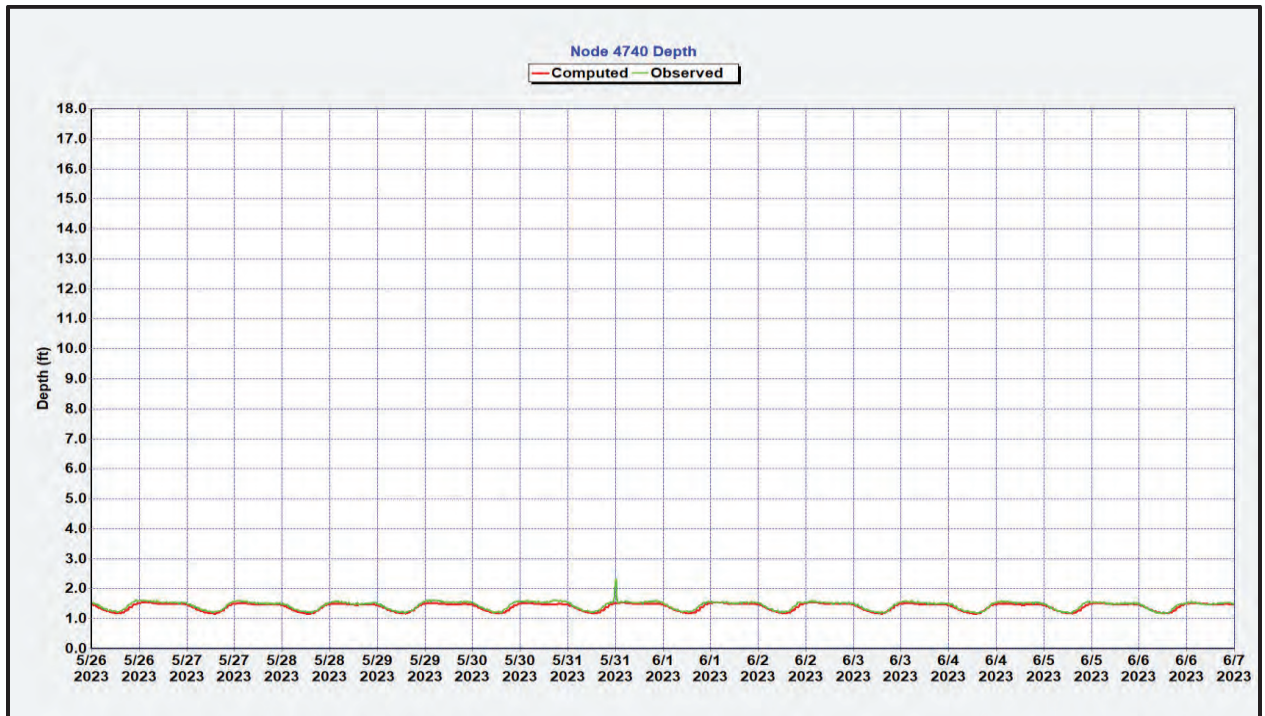
MH 4752 - 42-inch Influent: Depth (ft)



MH 4740 - 48-inch Influent: Flow (MGD)



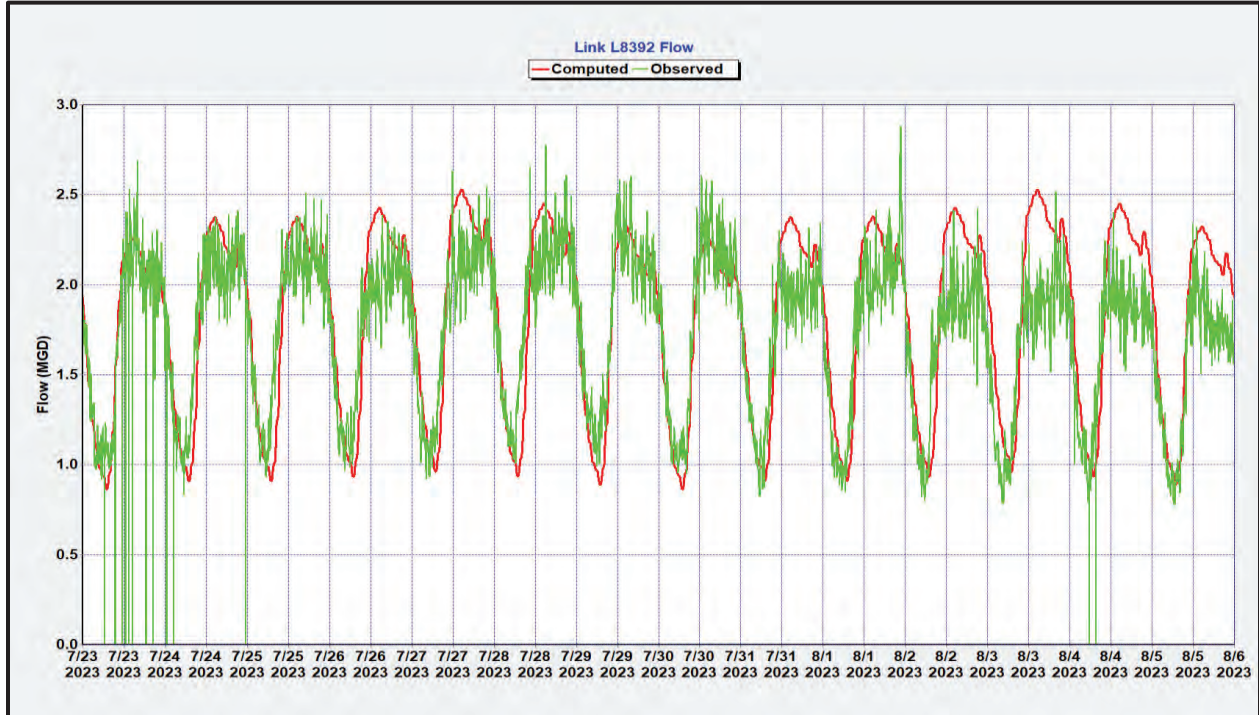
MH 4740 - 48-inch Influent: Depth (ft)



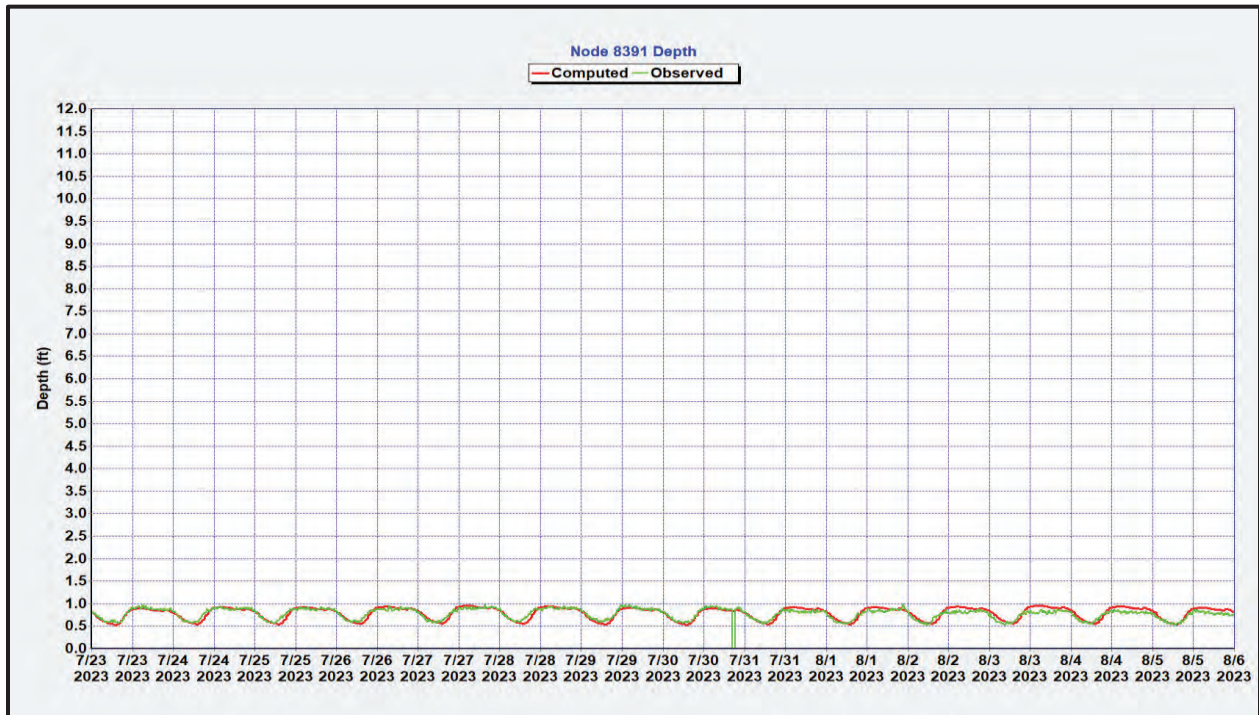
Dry Weather Validation Period

July 23, 2023 – August 6, 2023

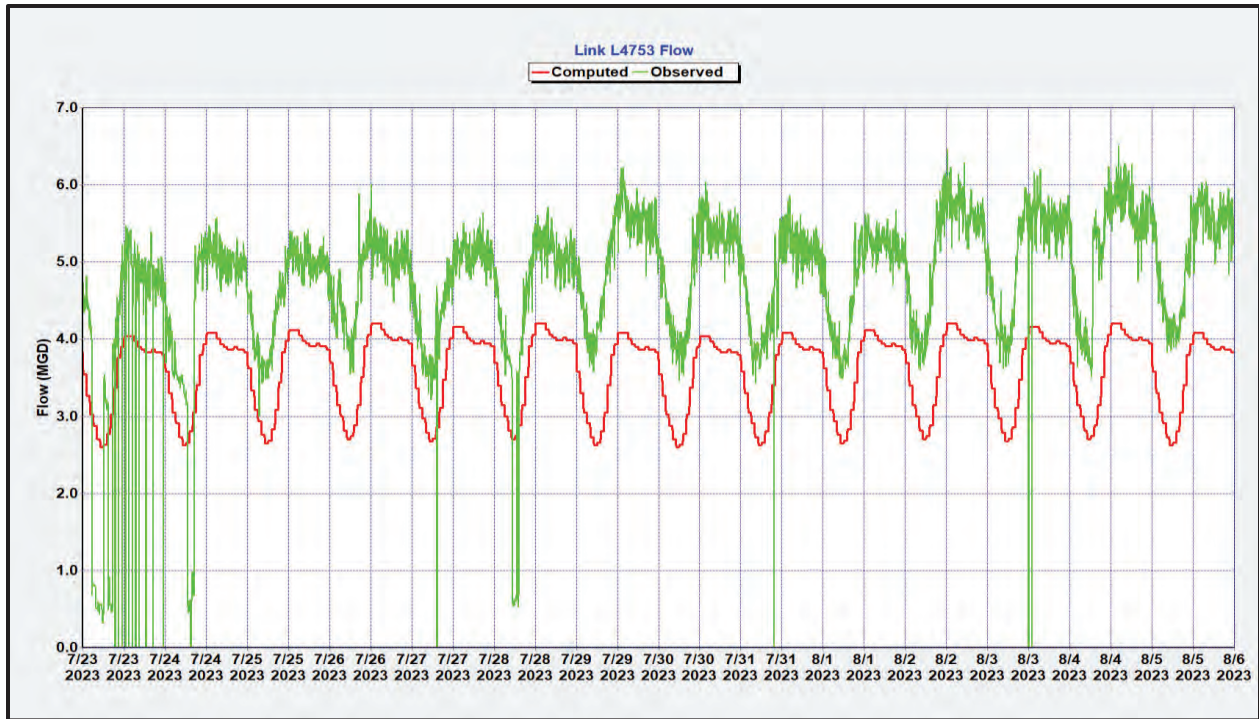
MH 8391 - 36-inch Influent: Flow (MGD)



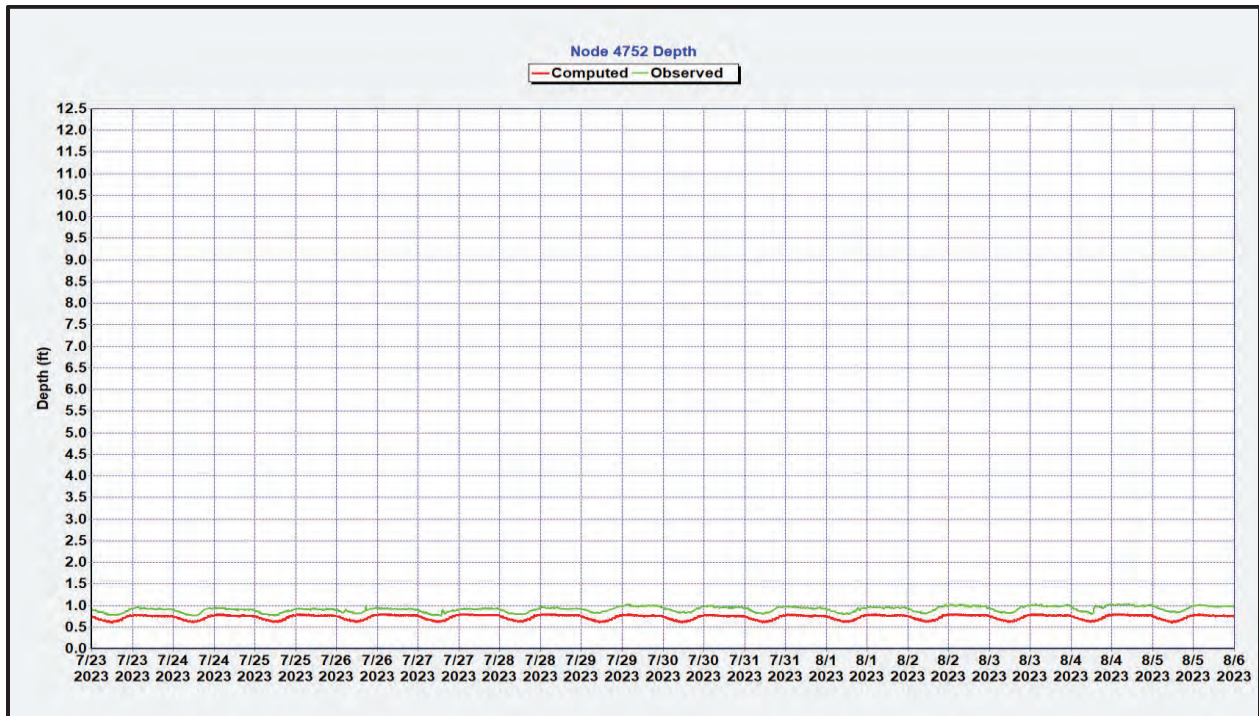
MH 8391 - 36-inch Influent: Depth (ft)



MH 4752 - 42-inch Influent: Flow (MGD)



MH 4752 - 42-inch Influent: Depth (ft)



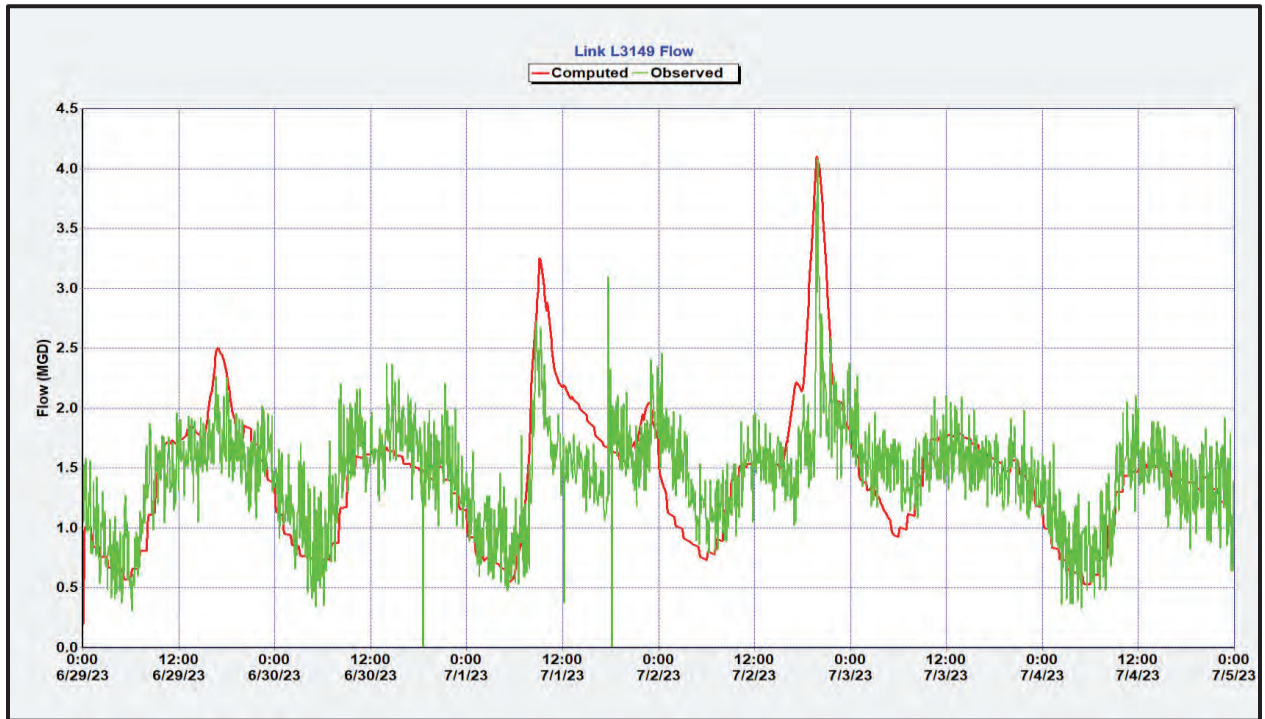
Attachment 3

Wet Weather Calibration & Validation Figures

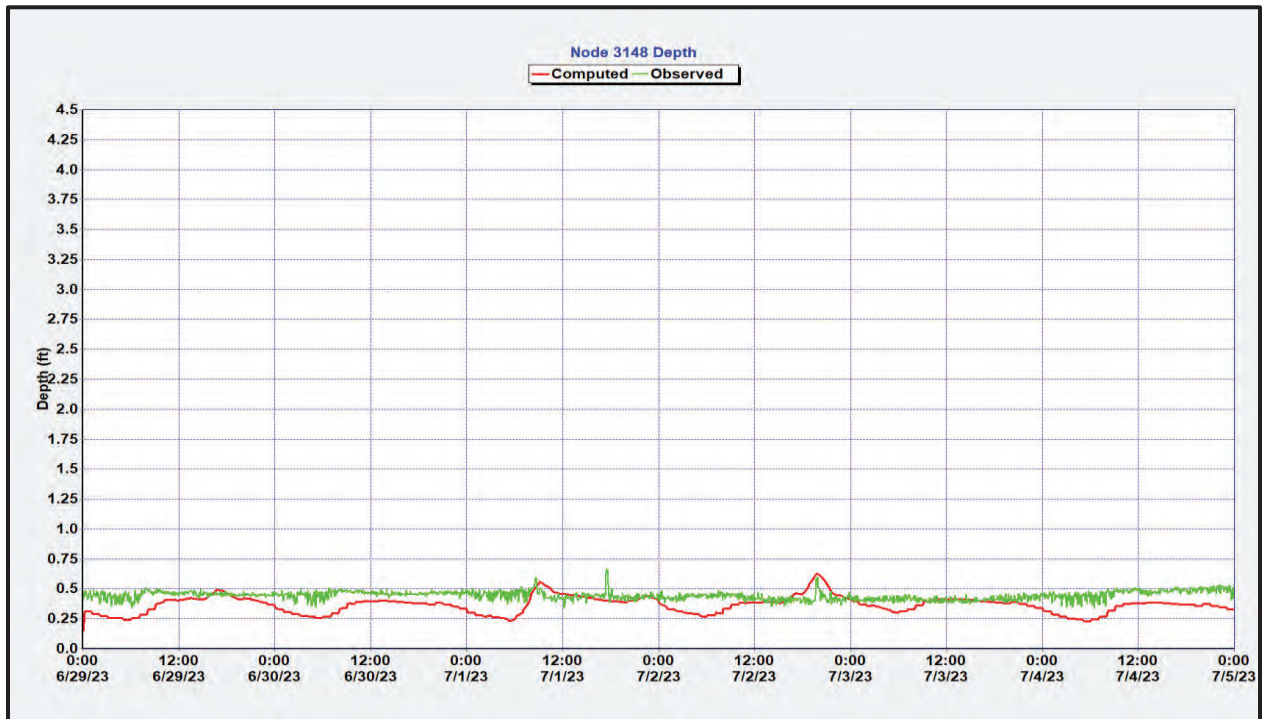
Wet Weather Calibration Event

July 2, 2023

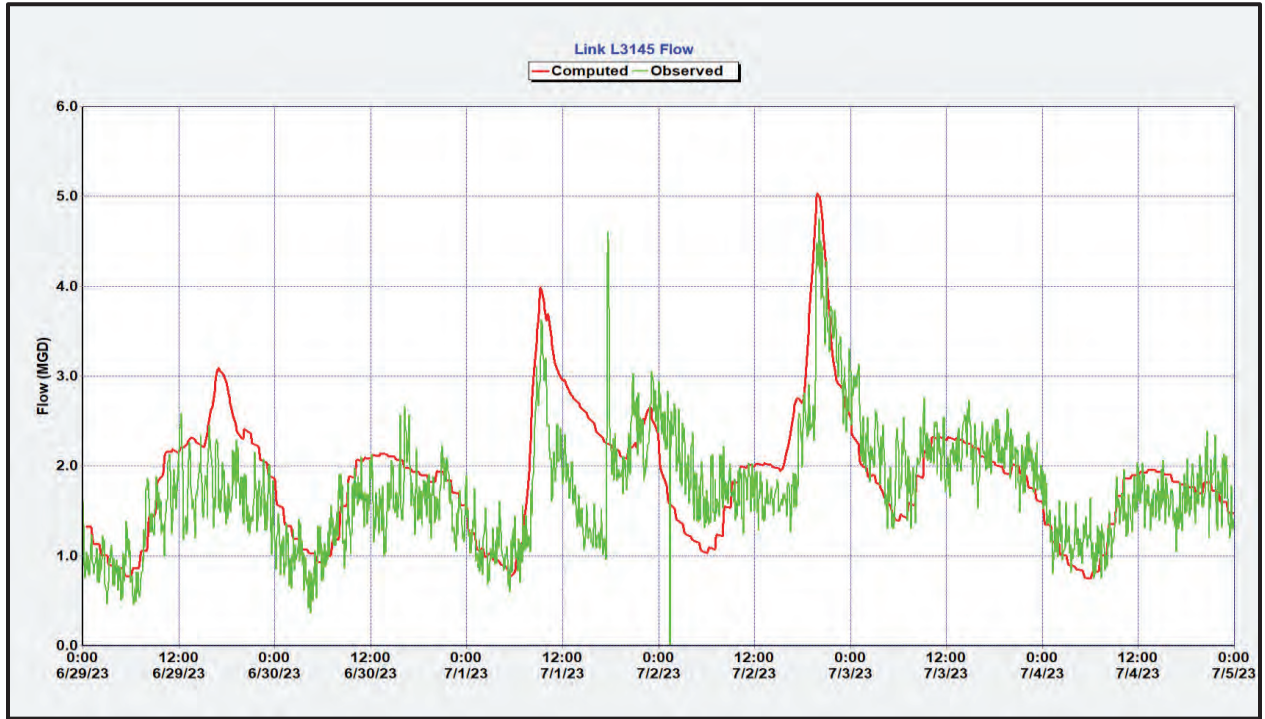
MH 3148 - 30-inch Influent: Flow (MGD)



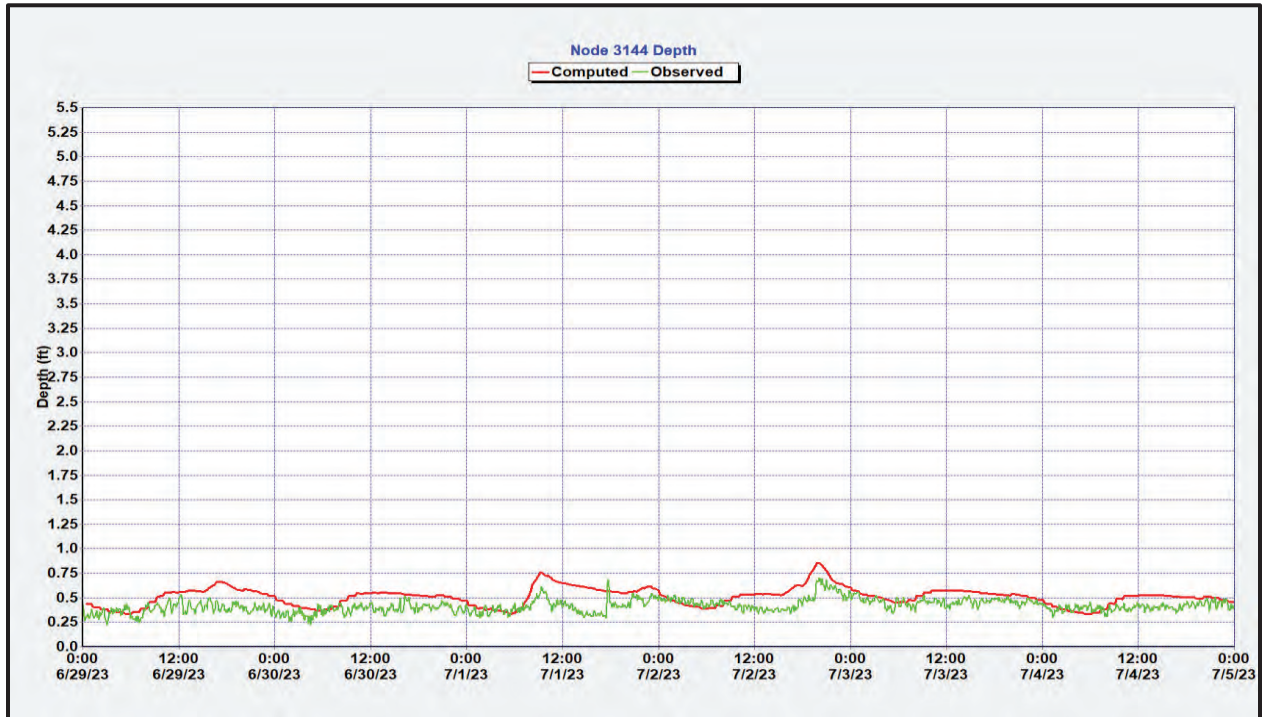
MH 3148 - 30-inch Influent: Depth (ft)



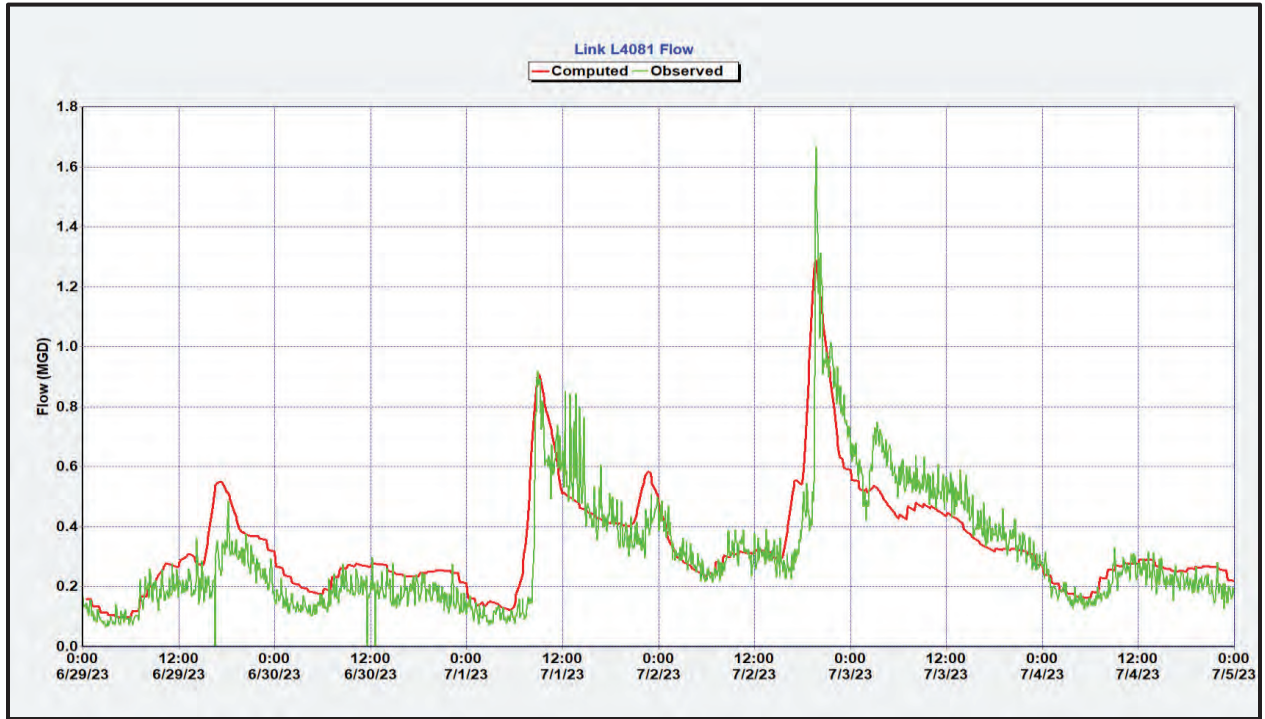
MH 3144 - 30-inch Influent: Flow (MGD)



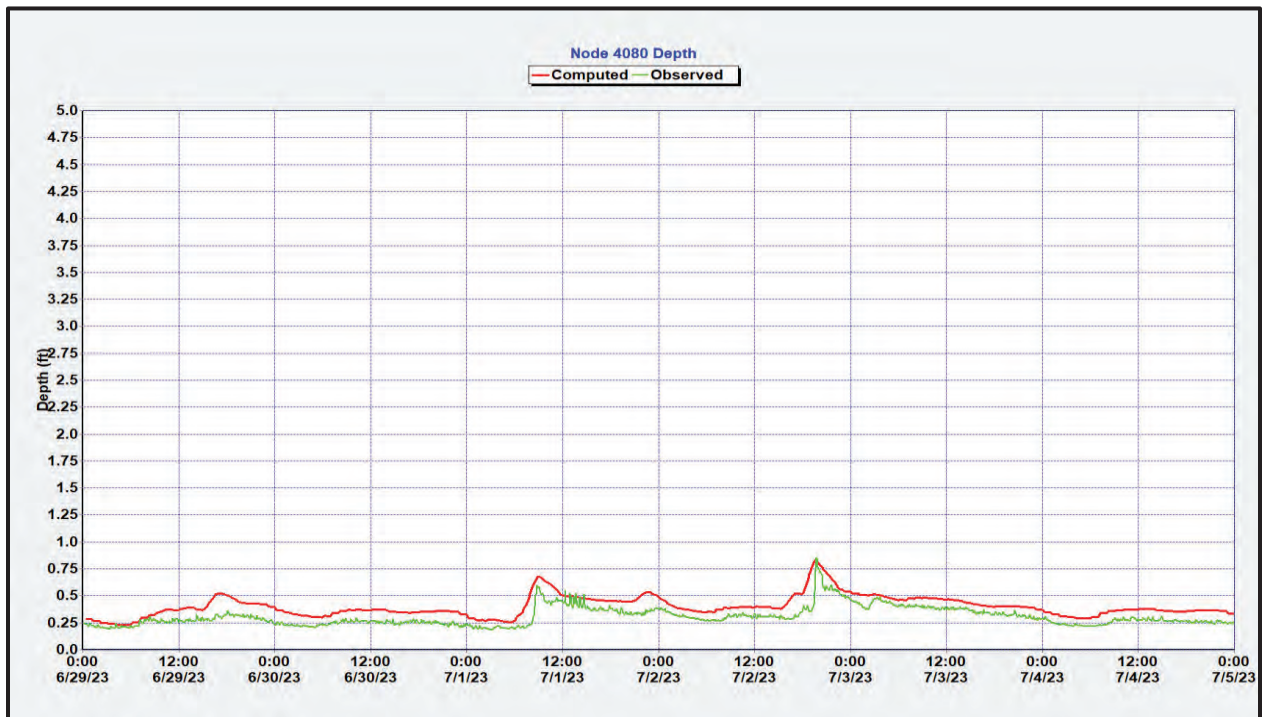
MH 3144 - 30-inch Influent: Depth (ft)



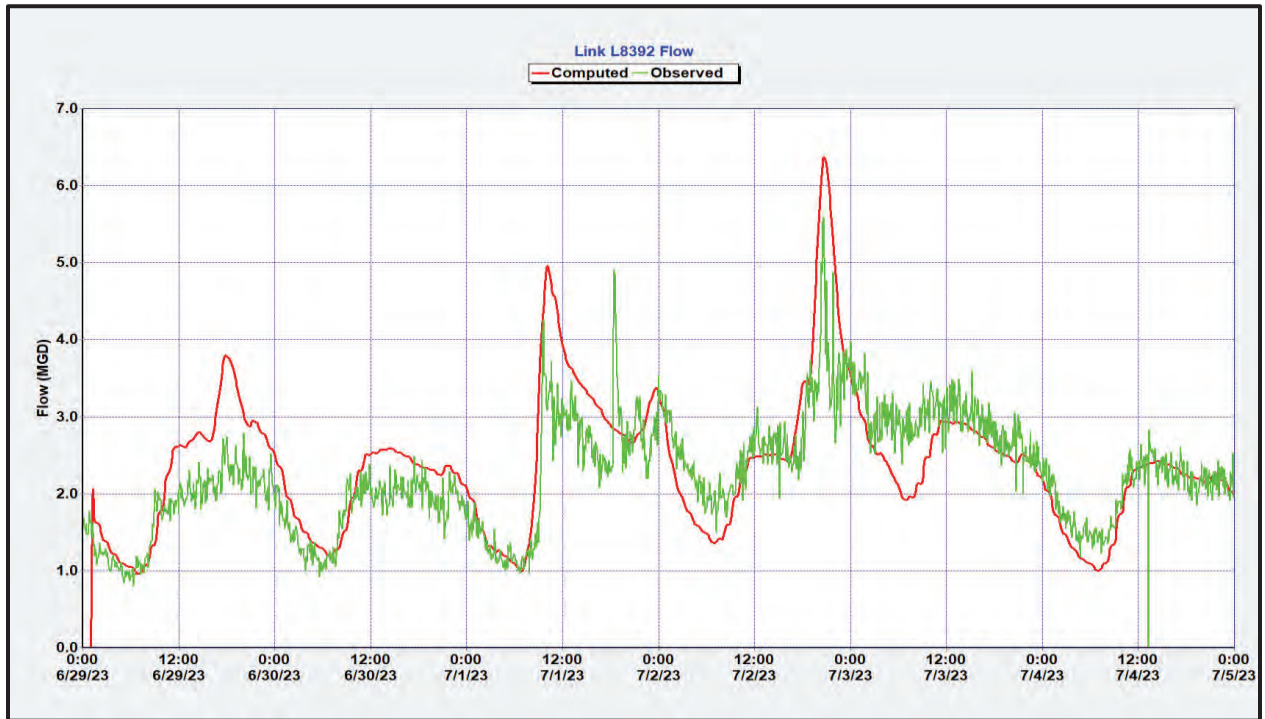
MH 4080 - 15-inch Influent: Flow (MGD)



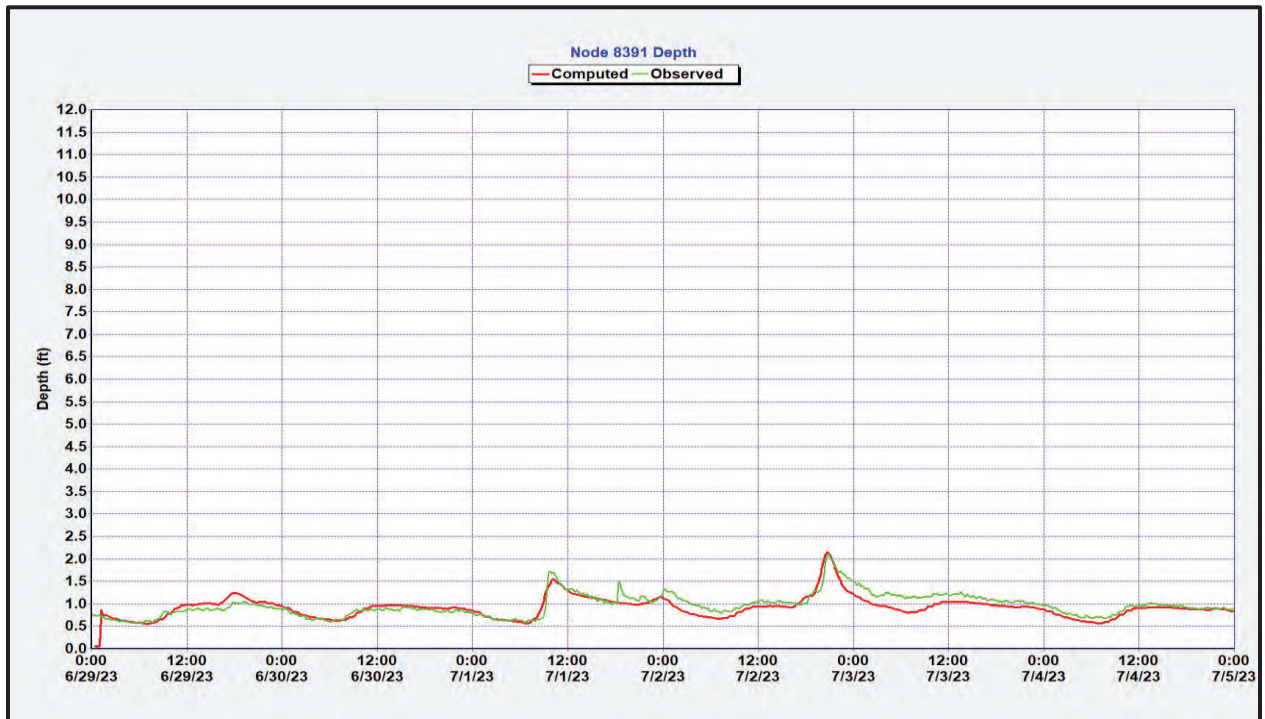
MH 4080 - 15-inch Influent: Depth (ft)



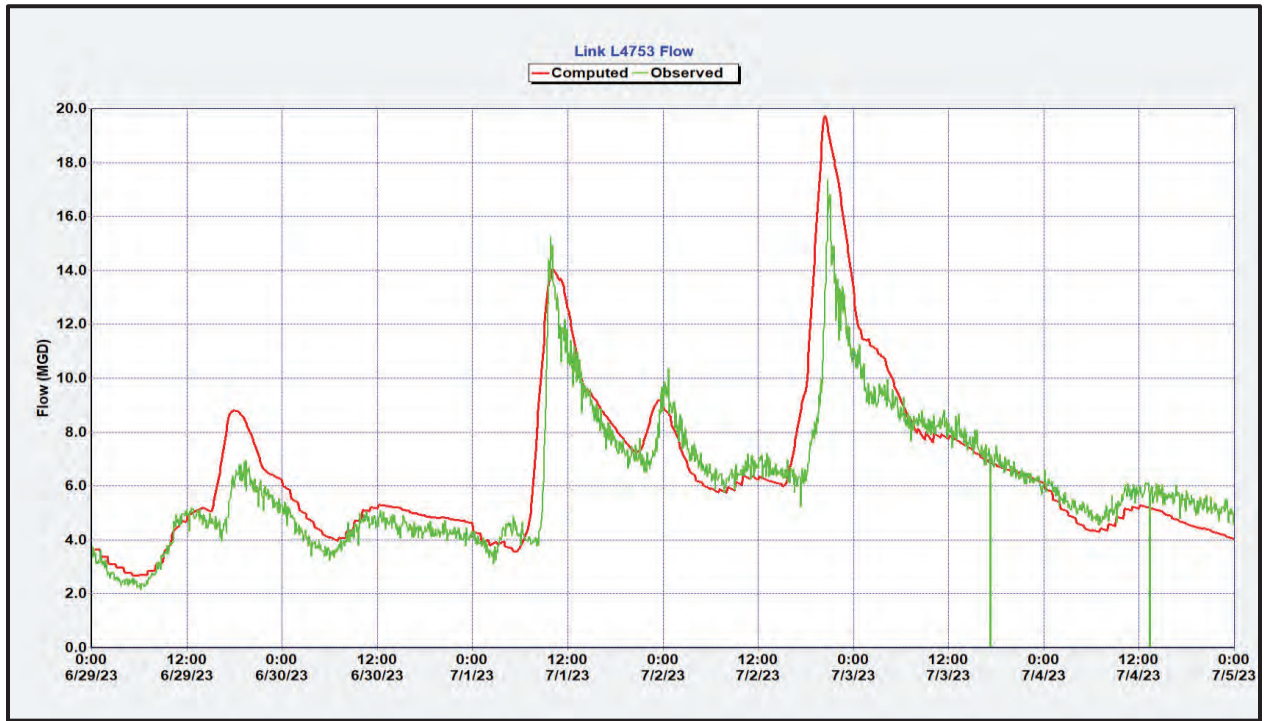
MH 8391 - 36-inch Influent: Flow (MGD)



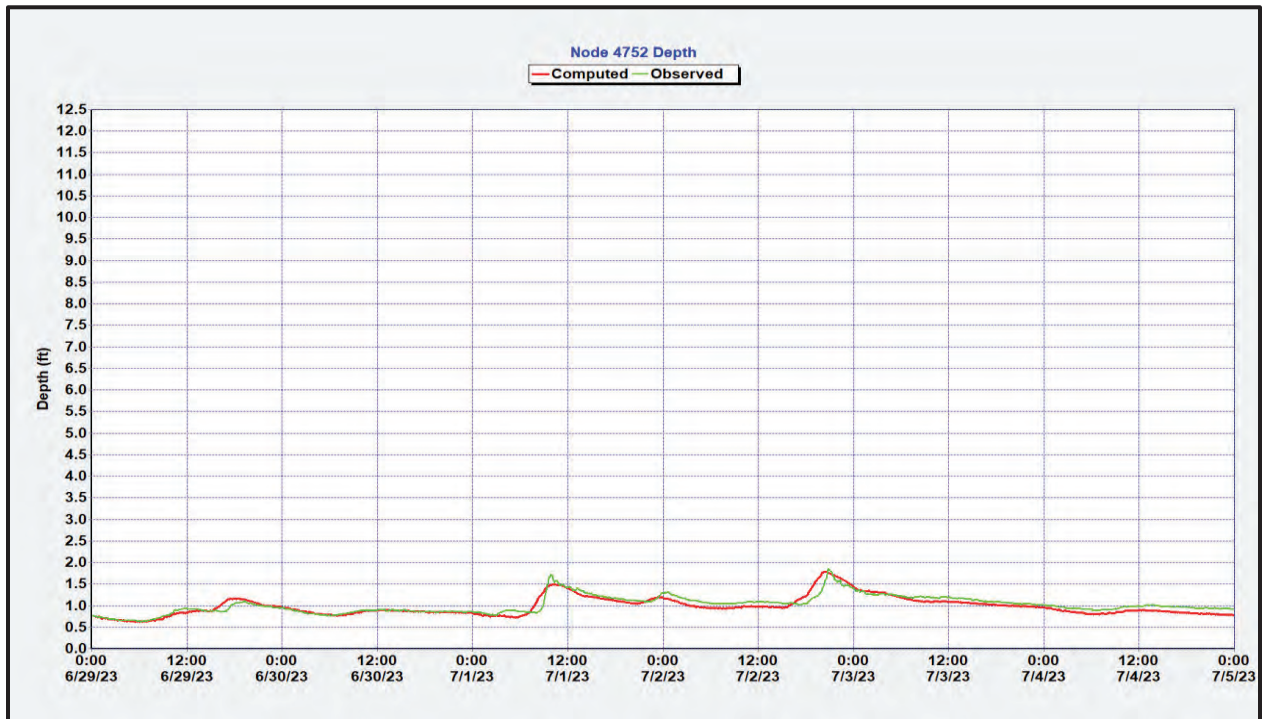
MH 8391 - 36-inch Influent: Depth (ft)



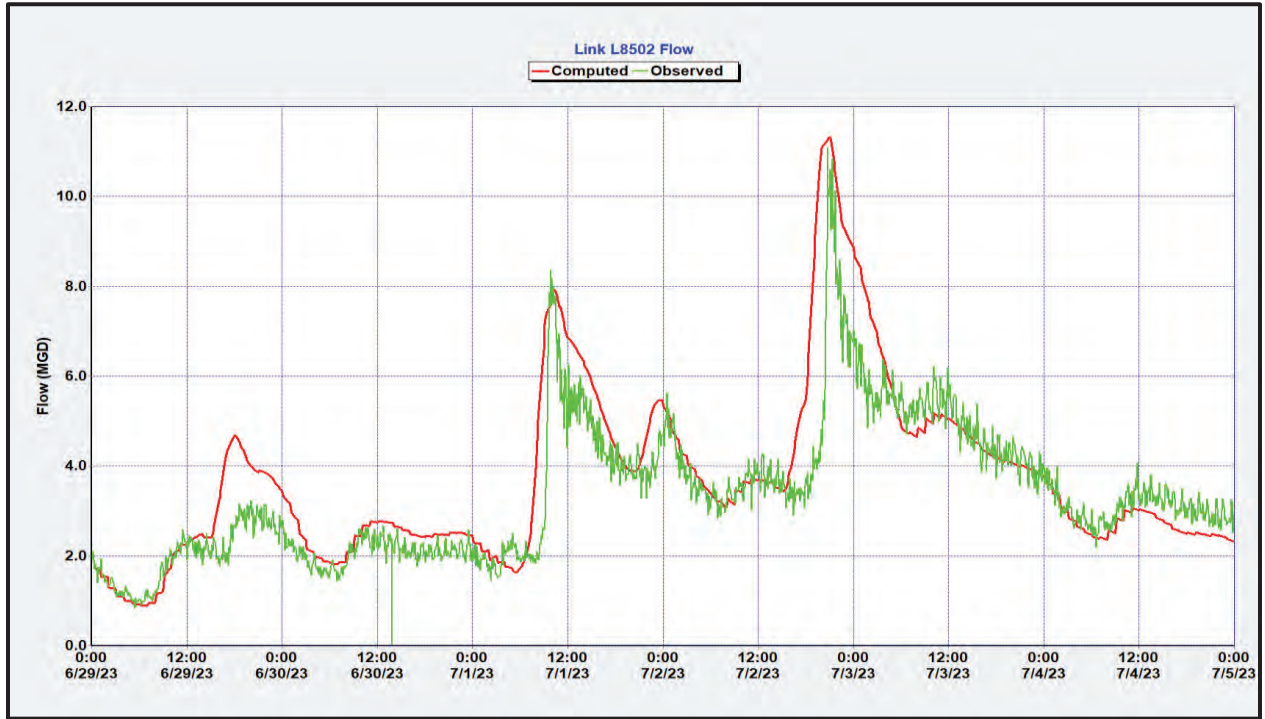
MH 4752 - 42-inch Influent: Flow (MGD)



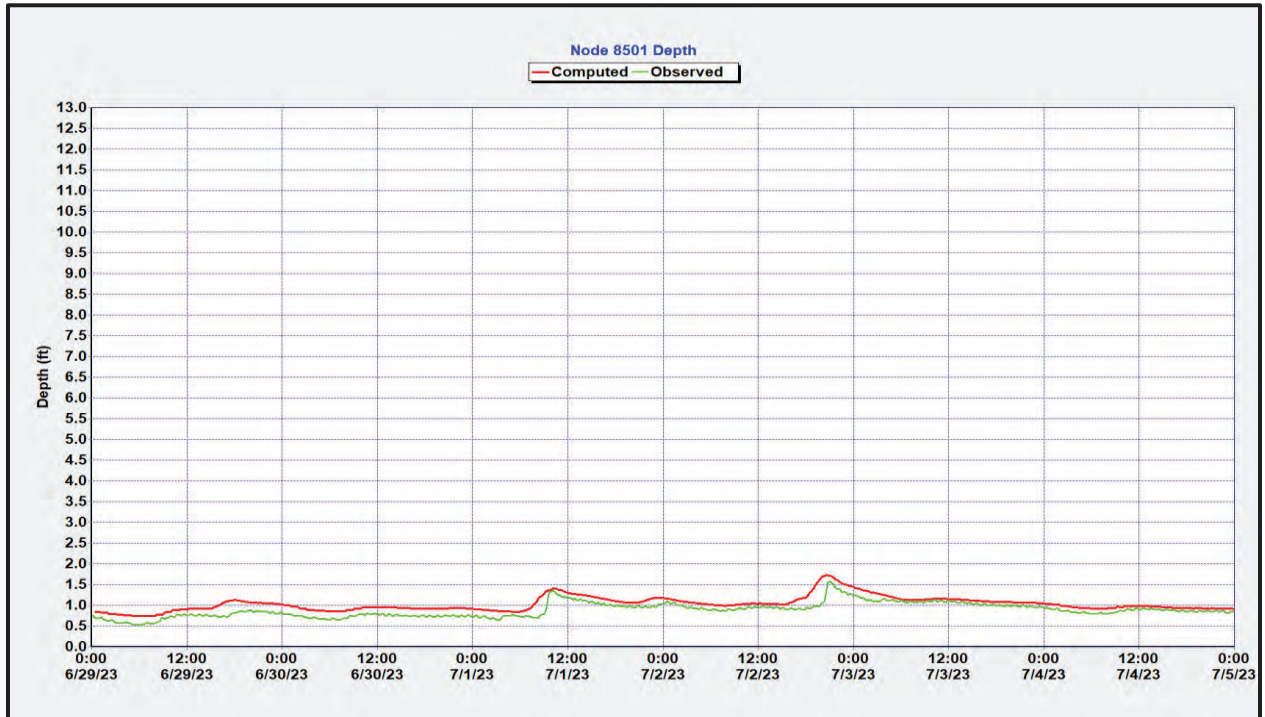
MH 4752 - 42-inch Influent: Depth (ft)



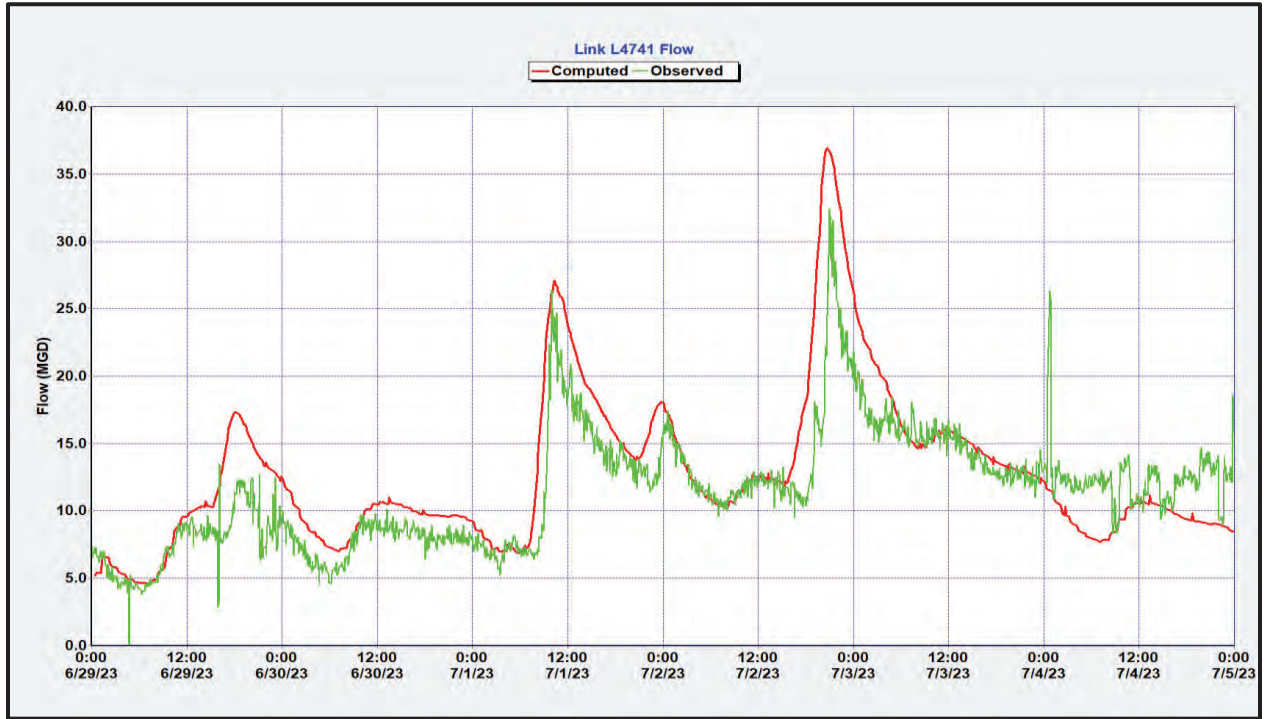
MH 8501 - 42-inch Influent: Flow (MGD)



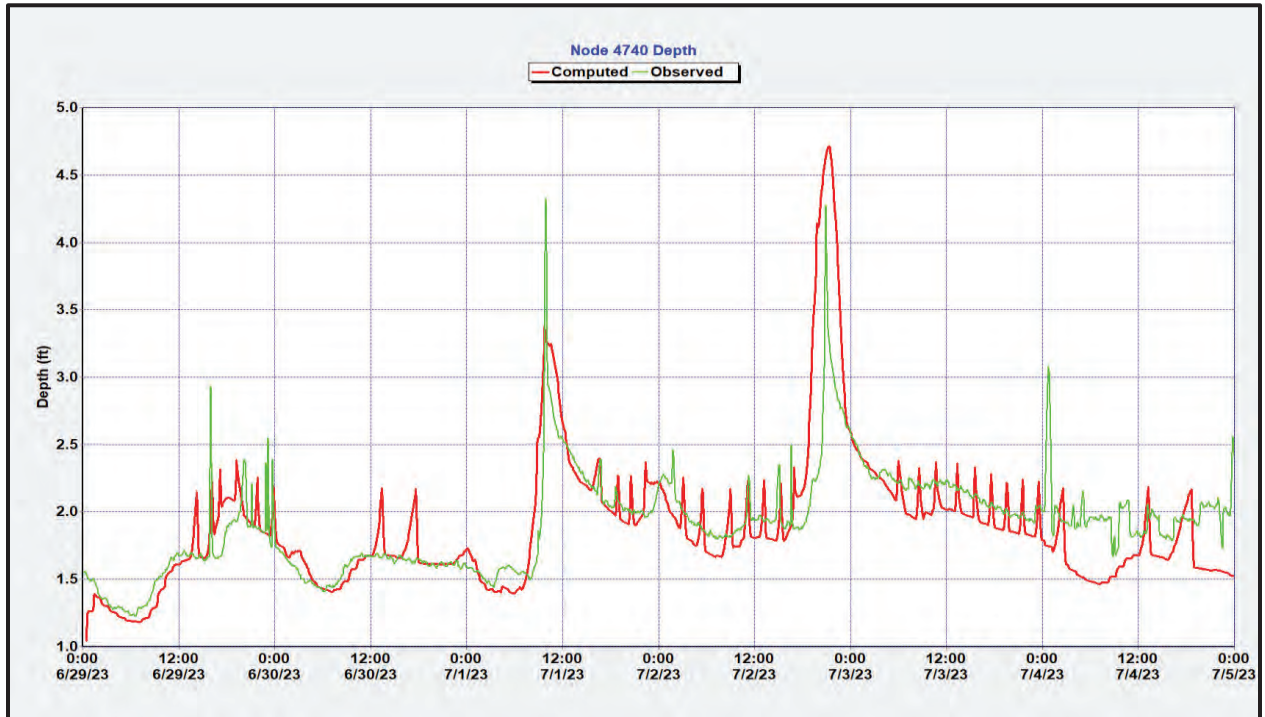
MH 8501 - 42-inch Influent: Depth (ft)



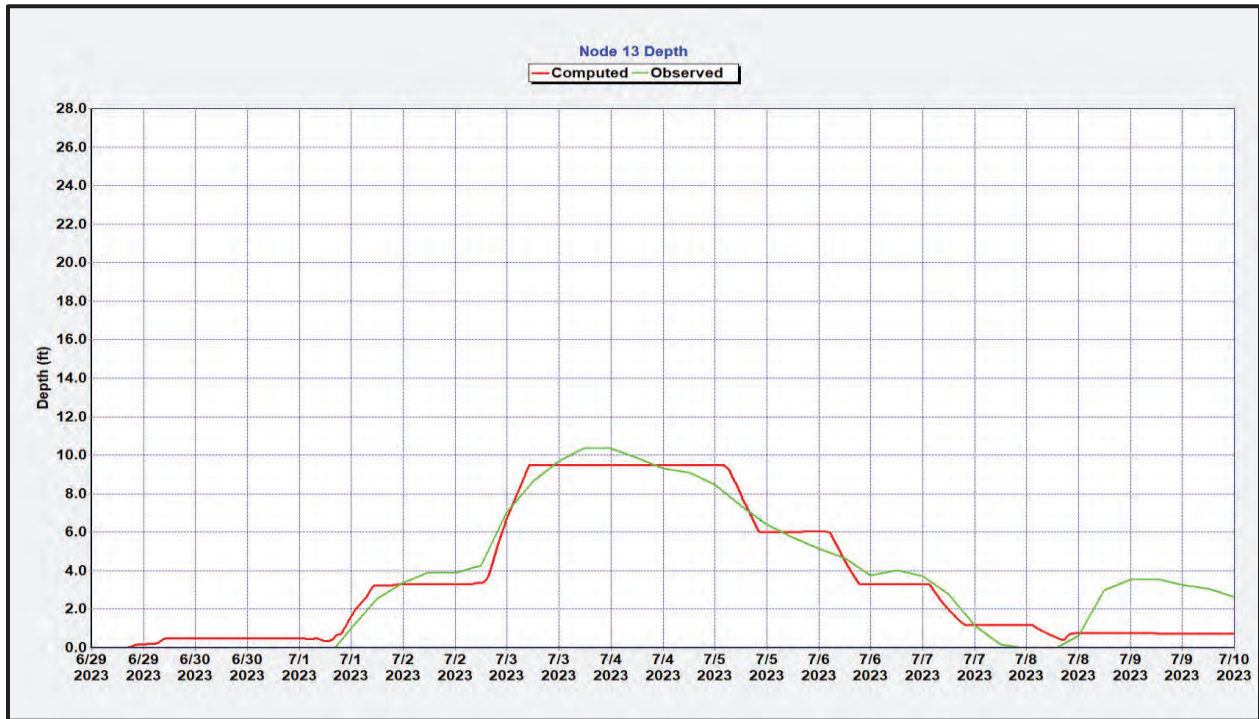
MH 4740 - 48-inch Influent: Flow (MGD)



MH 4740 - 48-inch Influent: Depth (ft)

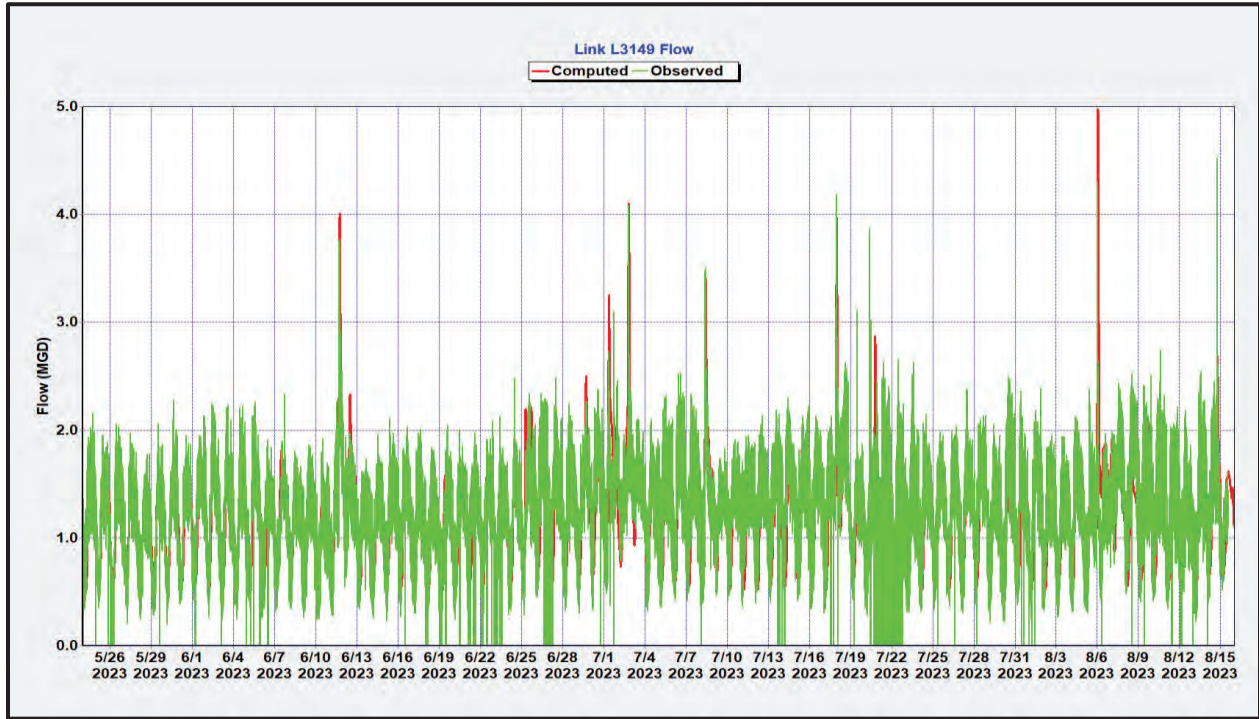


EQ Basin: Depth (ft)

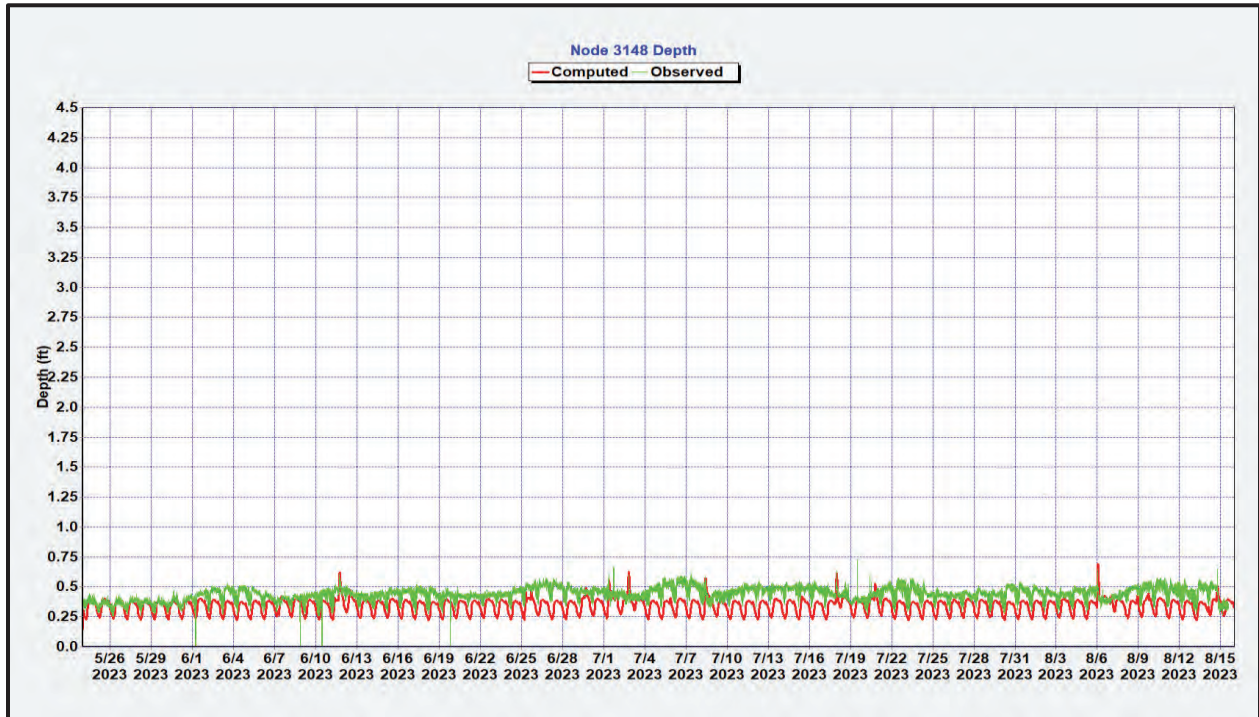


Wet Weather Full Span Validation Period
May 24, 2023 – August 14, 2023

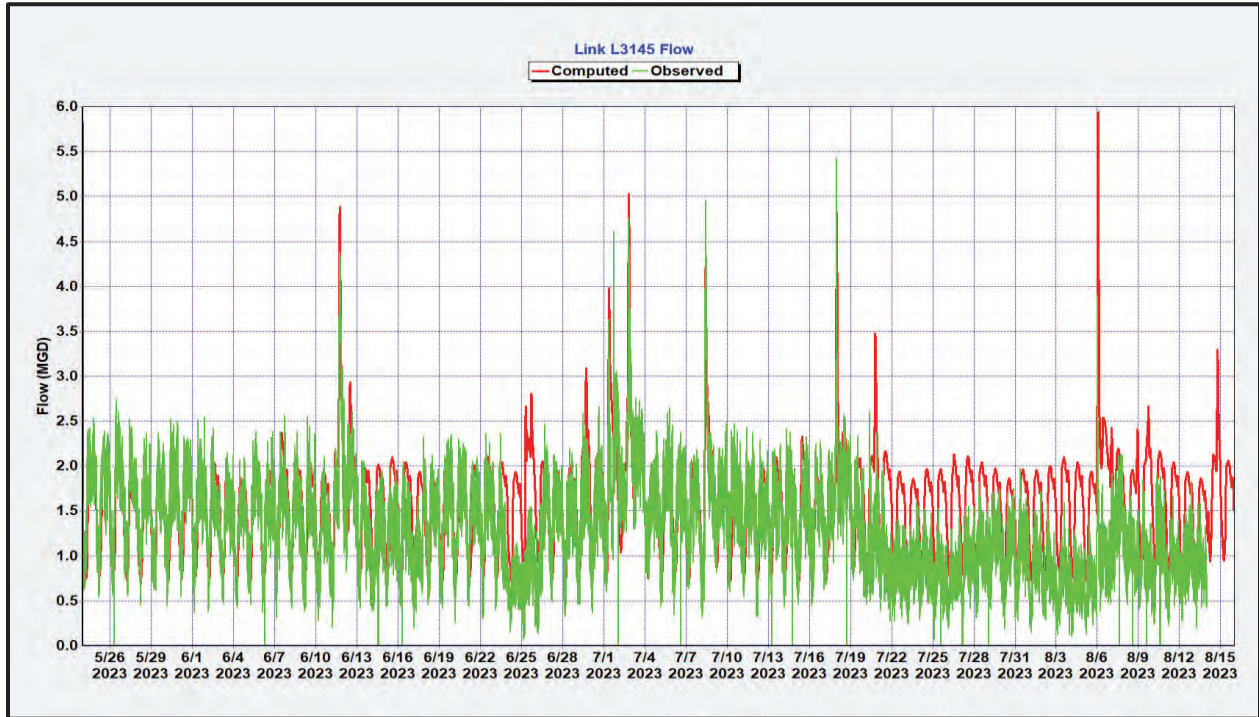
MH 3148 - 30-inch Influent: Flow (MGD)



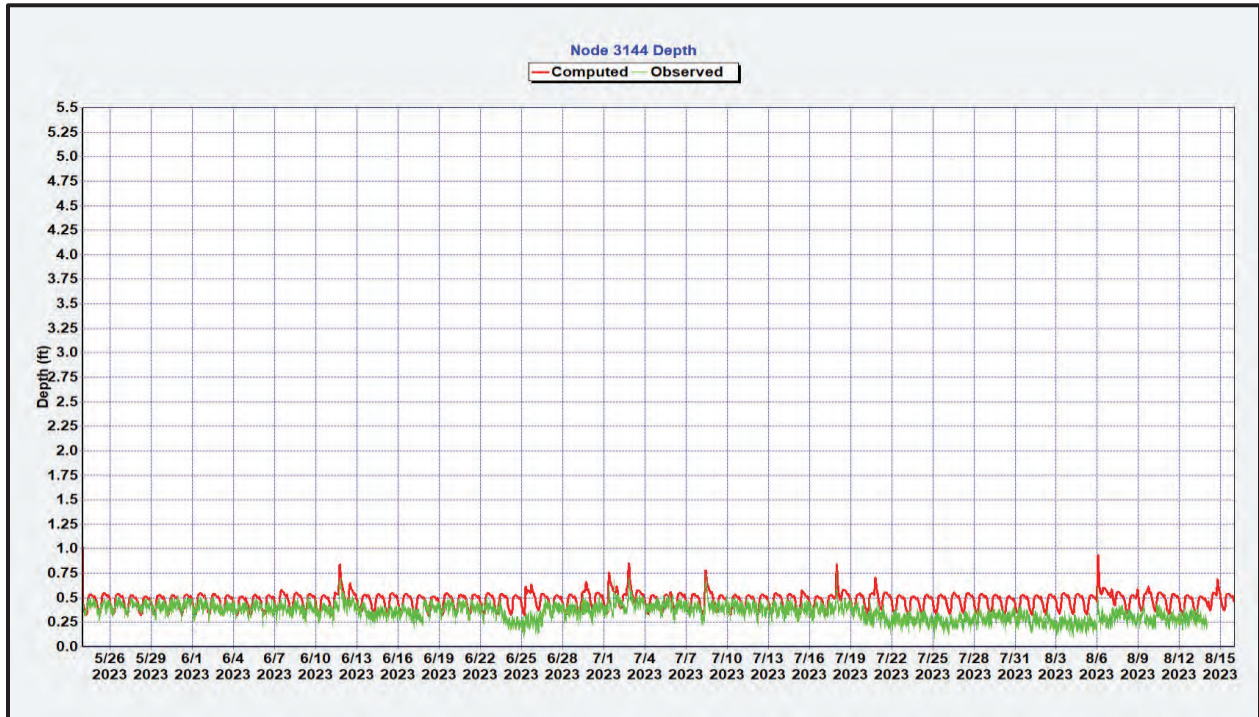
MH 3148 - 30-inch Influent: Depth (ft)



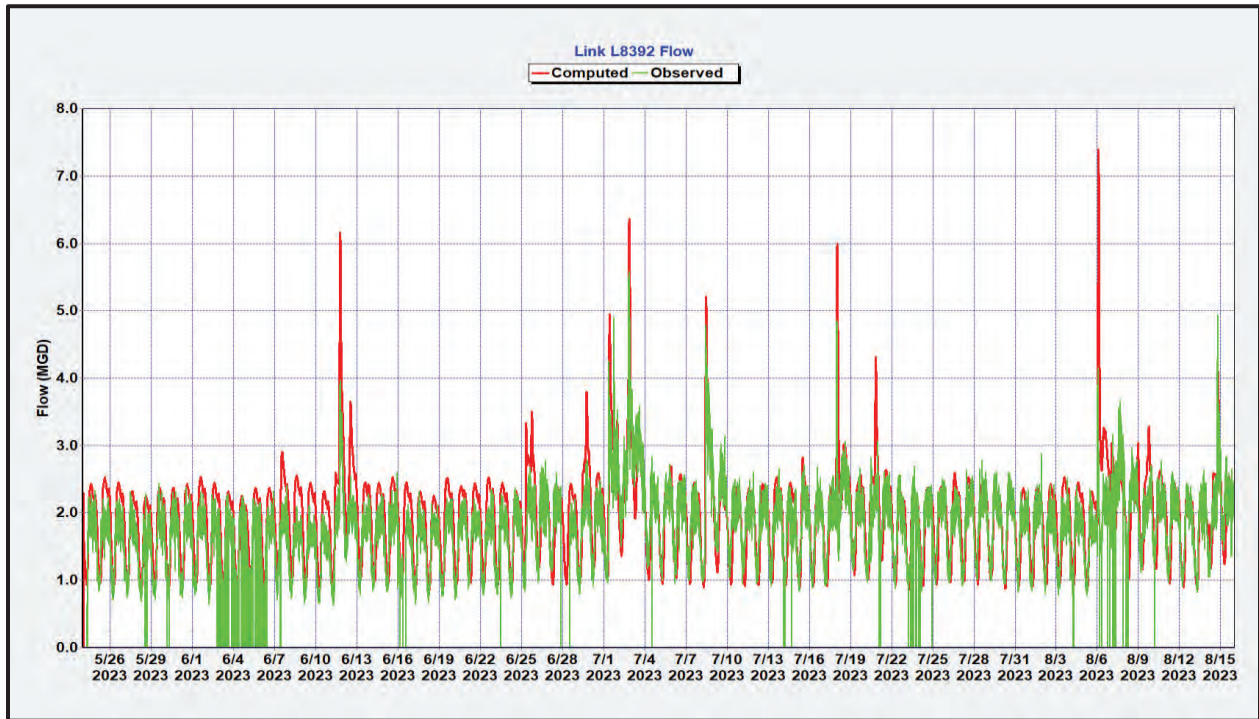
MH 3144 - 30-inch Influent: Flow (MGD)



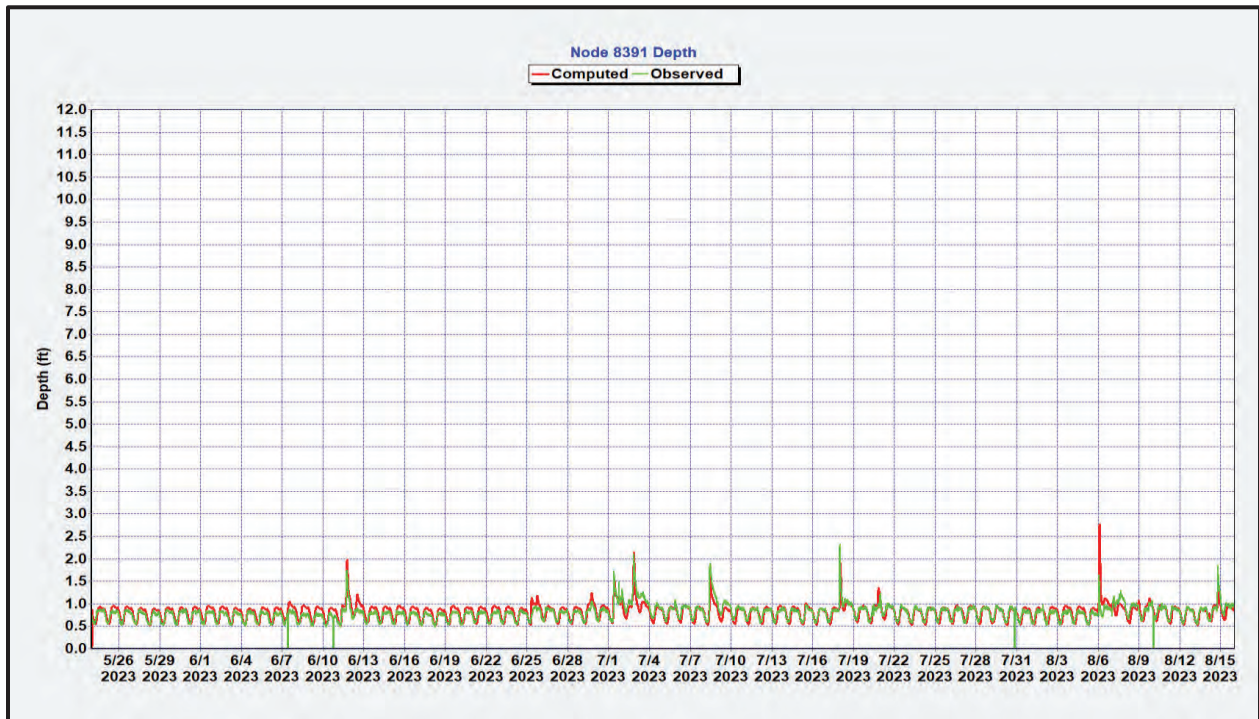
MH 3144 - 30-inch Influent: Depth (ft)



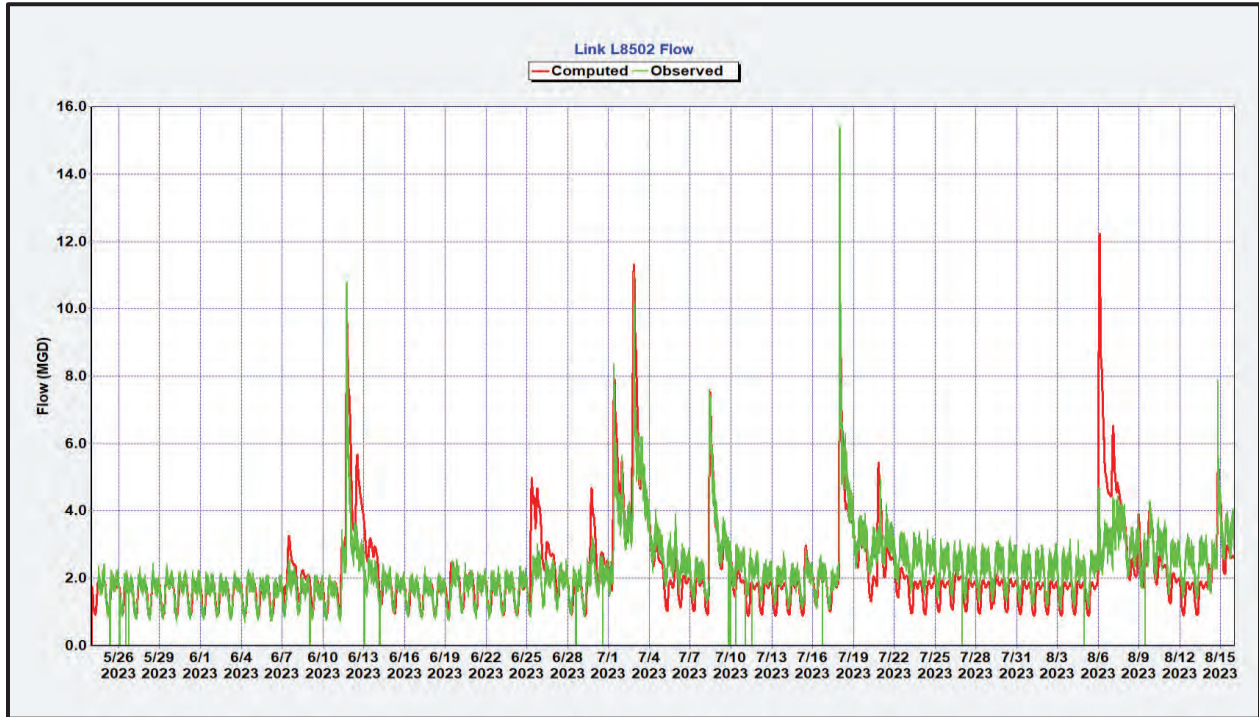
MH 8391 - 36-inch Influent: Flow (MGD)



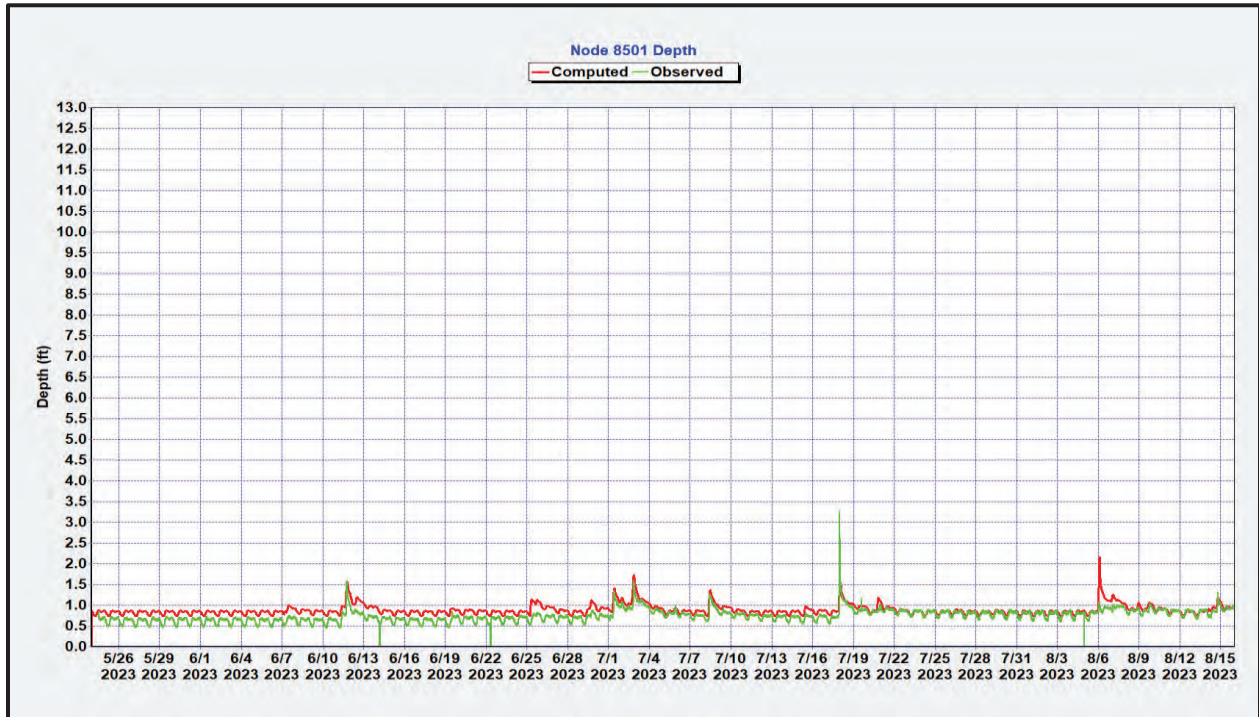
MH 8391 - 36-inch Influent: Depth (ft)



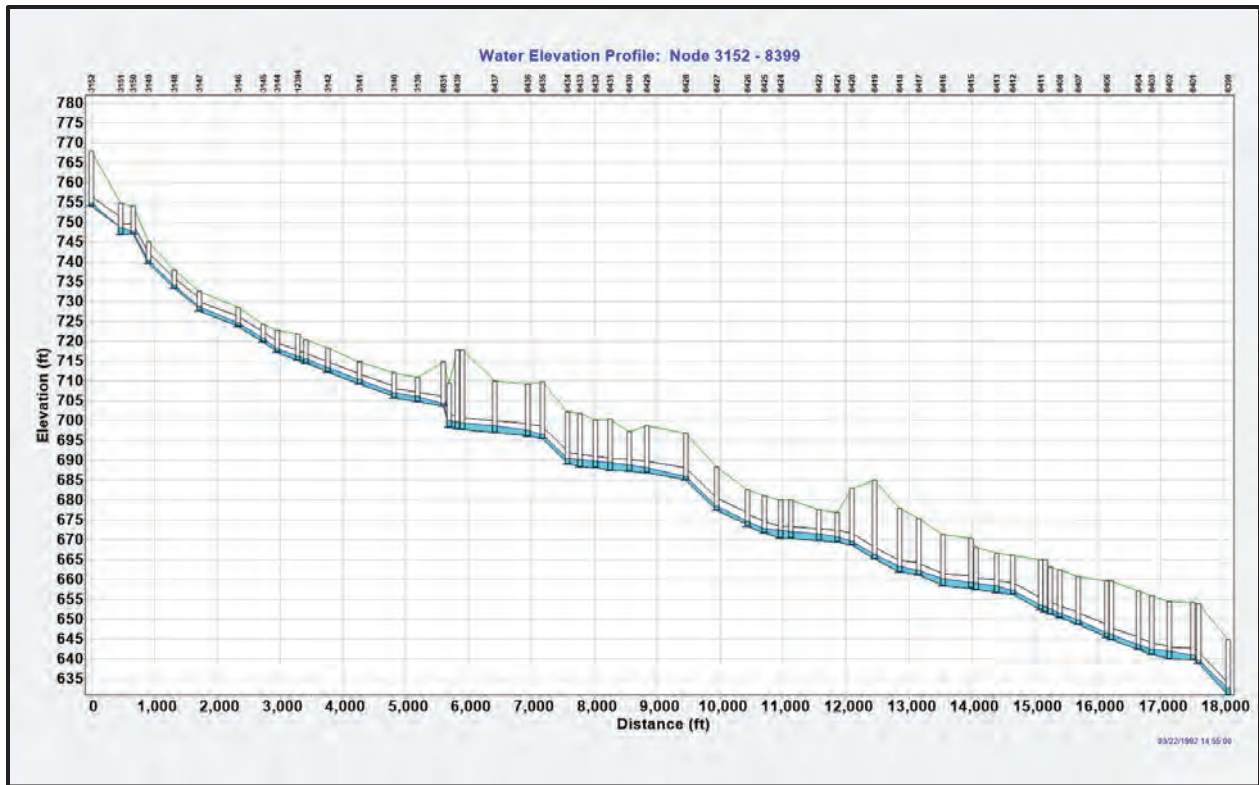
MH 8501 - 42-inch Influent: Flow (MGD)



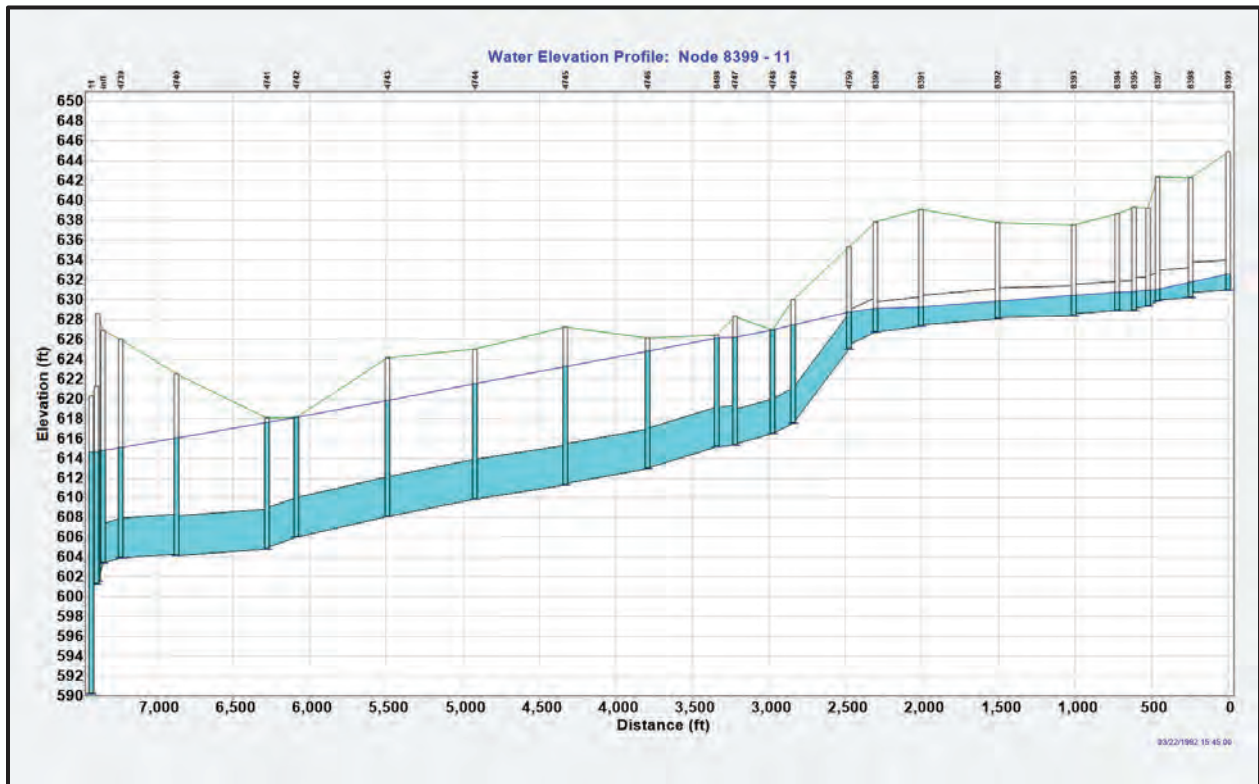
MH 8501 - 42-inch Influent: Depth (ft)



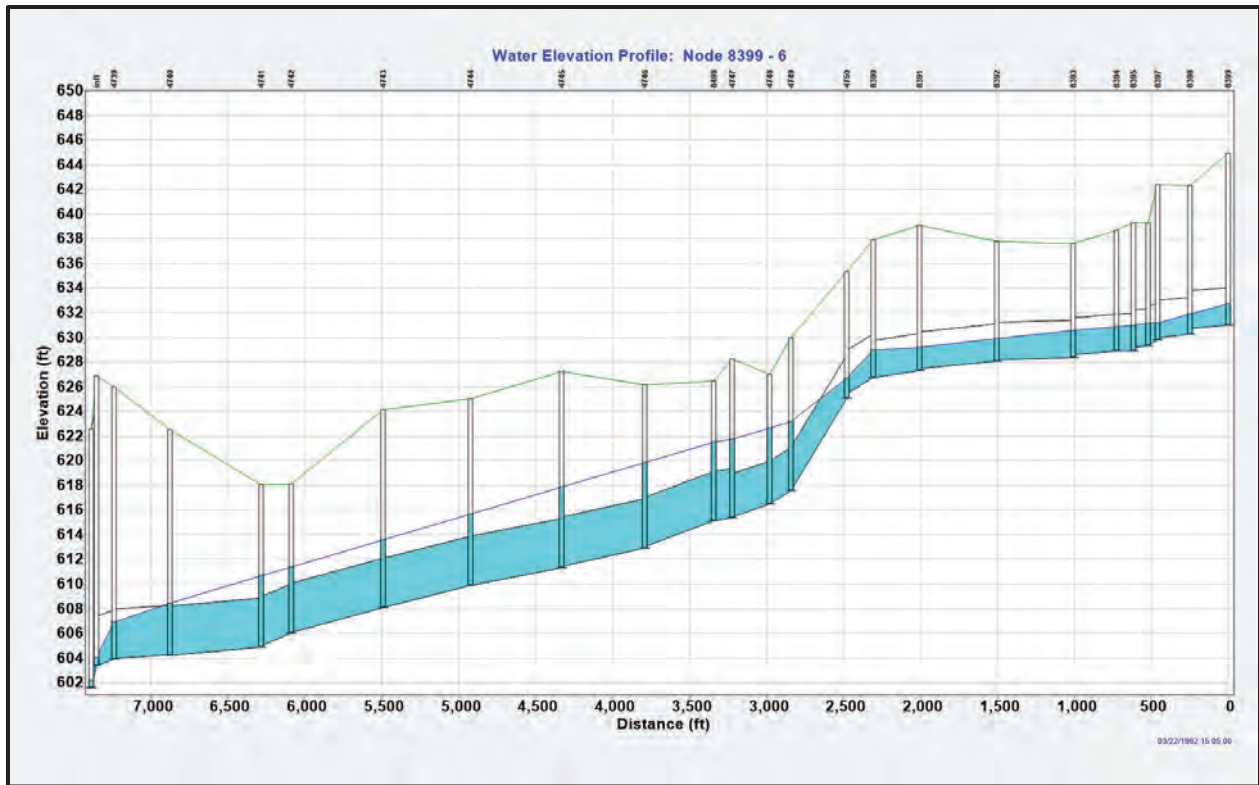
Attachment 4
Peak Hydraulic Grade Lines



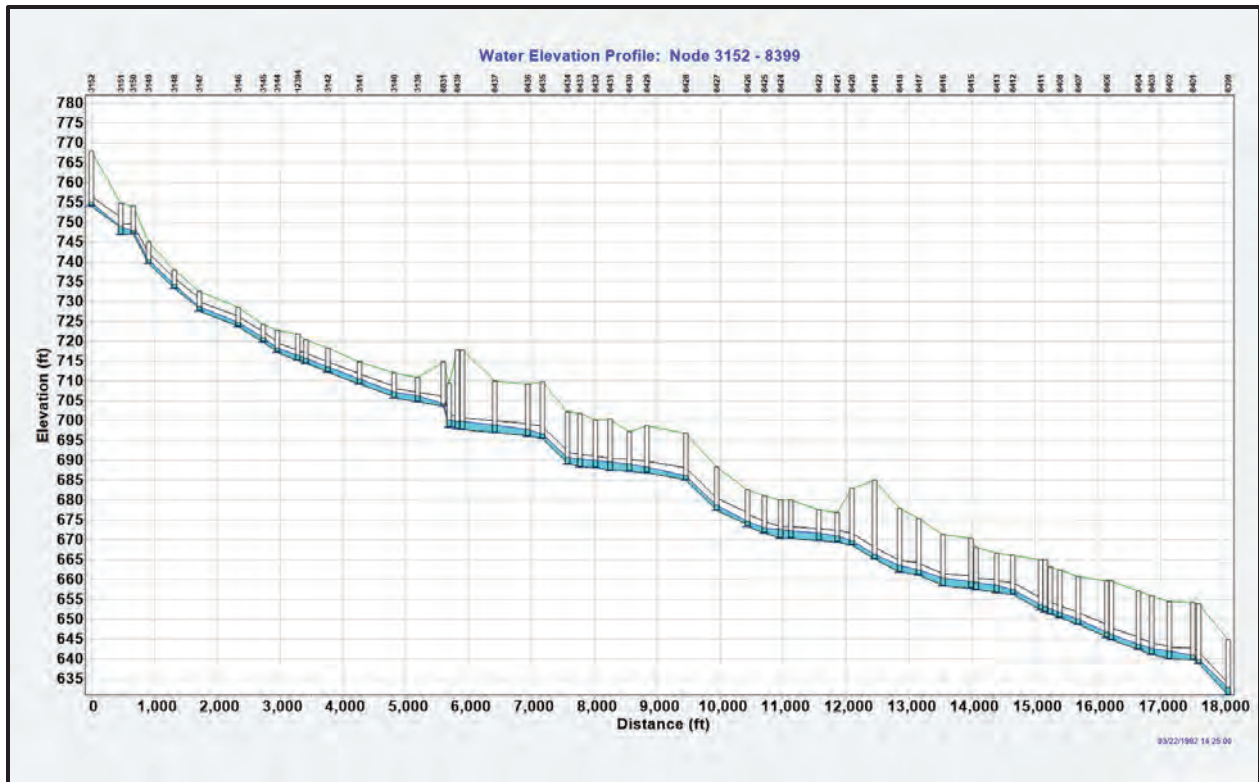
Upstream West Interceptor Hydraulic Grade Line 10-Year, 1-Hour Design Storm



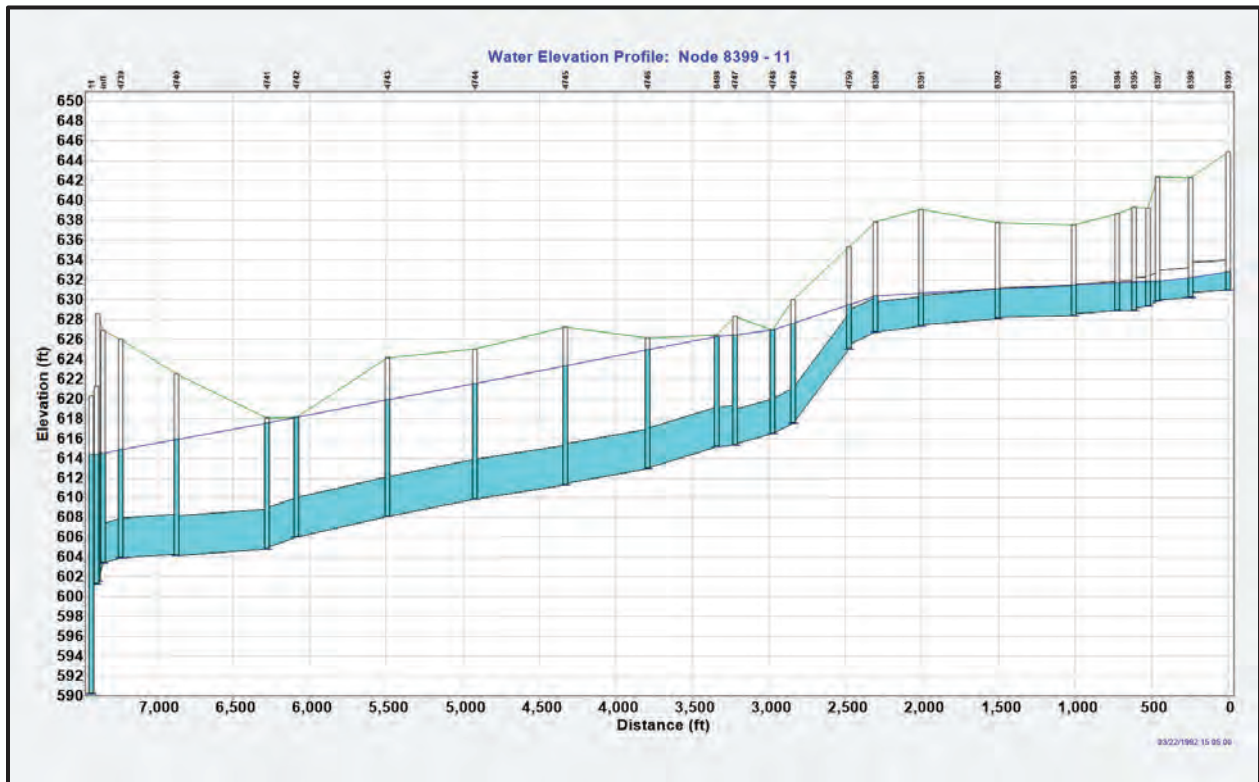
Downstream West Interceptor Hydraulic Grade Line 10-Year, 1-Hour Design Storm



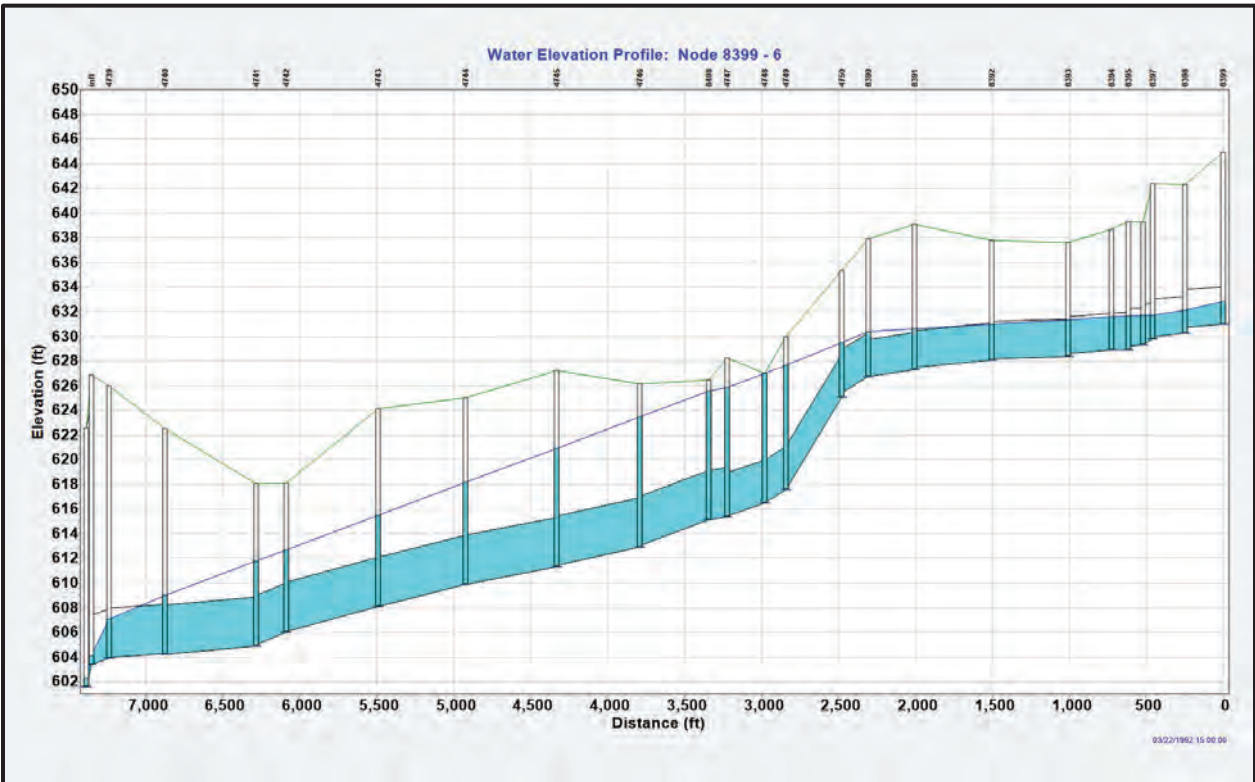
Downstream West Interceptor Hydraulic Grade Line 10-Year, 1-Hour Design Storm Without WWTP Capacity Limitations



Upstream West Interceptor Hydraulic Grade Line 25-Year, 1-Hour Design Storm



Downstream West Interceptor Hydraulic Grade Line 25-Year, 1-Hour Design Storm



Downstream West Interceptor Hydraulic Grade Line 25-Year, 1-Hour Design Storm Without WWTP Capacity Limitations

Attachment 5
Cost Estimate

ALTERNATIVE 1

Item	Description	QNTY	UNIT	UNIT COST (\$)	TOTAL COST (\$)
1	MOBILIZATION/ DEMOBILIZATION (5%)	1	LS	2,076,000	2,076,000
2	CONTRACTOR CONSTRUCTION ENGINEERING (2%)	1	LS	814,000	814,000
3	MISC. UTILITY RELOCATION ALLOWANCE	1	LS	100,000	100,000
4	MAINTENANCE AND PROTECTION OF TRAFFIC	1	LS	100,000	100,000
5	TEMPORARY EROSION CONTROL	1	LS	100,000	100,000
6	BYPASS PUMPING	1	LS	100,000	100,000
7	36 MGD LIFT STATION	1	LS	34,434,200	34,434,200
8	36-INCH DIA. FORCE MAIN	3,050	LF	480	1,464,000
9	36-INCH DIA. FORCE MAIN - TRENCHLESS	400	LF	2,250	900,000
10	EQ BASIN DISCHARGE	1	LS	185,000	185,000
11	DIVERSION STRUCTURE WITH FLOW CONTROL	2	LS	222,000	444,000
12	42-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 8399 TO MH 8397)	460	LF	1,130	519,800
13	36-INCH DIA. GRAVITY SEWER	200	LF	1,000	200,000
14	30-INCH DIA. GRAVITY SEWER	600	LF	880	528,000
15	BEDROCK EXCAVATION	4,840	CY	250	1,210,000
16	36-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 3139 TO MH 8831)	415	LF	1,000	415,000
				CONSTRUCTION COST SUBTOTAL (\$) =	43,590,000
				10% CONSTRUCTION CONTINGENCY (ROUNDED) =	4,359,000
				TOTAL CONSTRUCTION COST =	47,949,000
				25% NON-CONSTRUCTION COSTS (ROUNDED) =	11,988,000
				TOTAL COST =	59,937,000

ALTERNATIVE 2

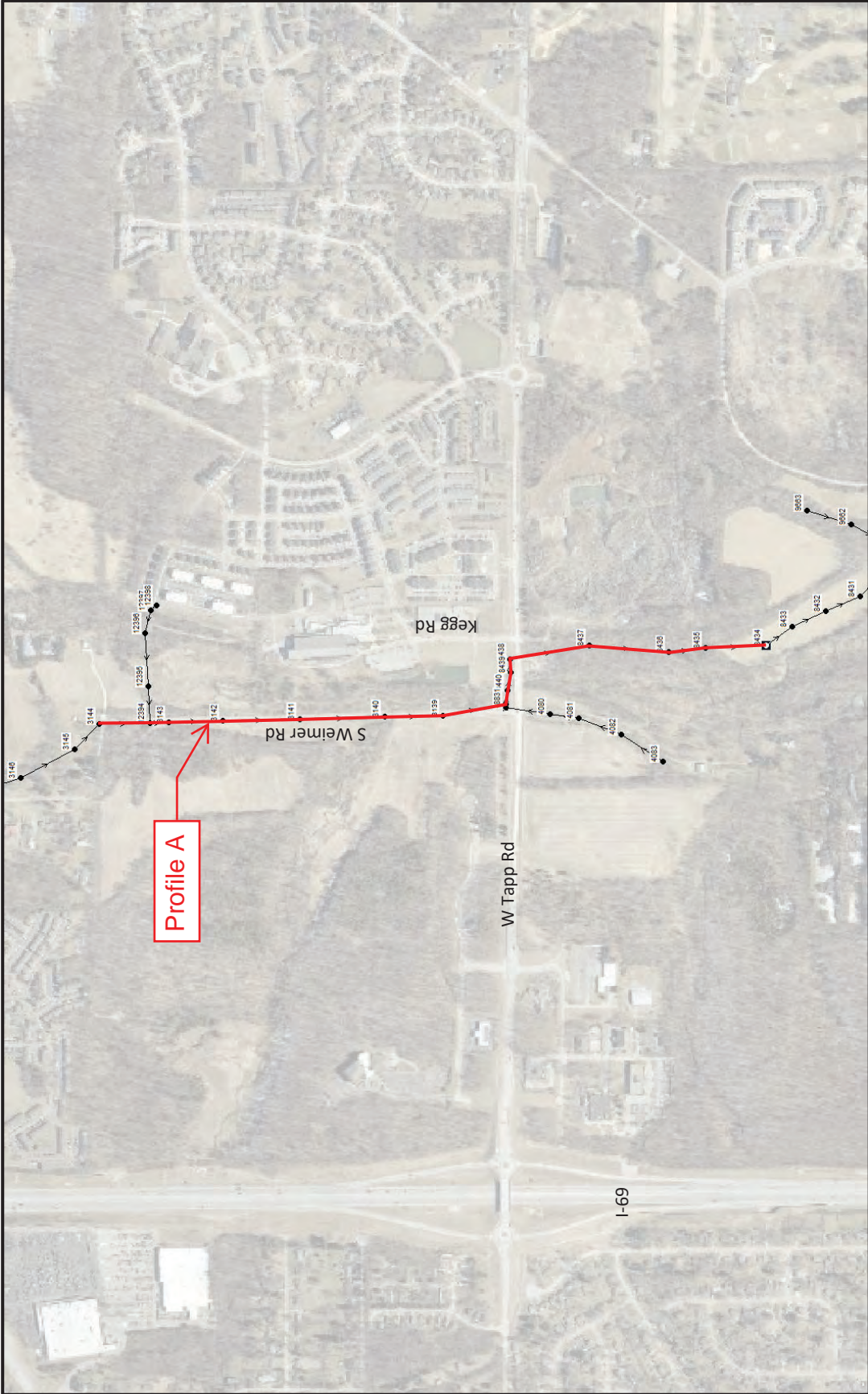
Item	Description	QNTY	UNIT	UNIT COST (\$)	TOTAL COST (\$)
1	MOBILIZATION/ DEMOBILIZATION (5%)	1	LS	1,604,000	1,604,000
2	CONTRACTOR CONSTRUCTION ENGINEERING (2%)	1	LS	629,000	629,000
3	MISC. UTILITY RELOCATION ALLOWANCE	1	LS	100,000	100,000
4	MAINTENANCE AND PROTECTION OF TRAFFIC	1	LS	100,000	100,000
5	TEMPORARY EROSION CONTROL	1	LS	100,000	100,000
6	BYPASS PUMPING	1	LS	100,000	100,000
7	14 MGD LIFT STATION	1	LS	13,946,500	13,946,500
8	24-INCH DIA. FORCE MAIN	2,100	LF	370	777,000
9	EQ BASIN DISCHARGE	1	LS	185,000	185,000
10	CONNECTION FROM LIFT STATION	1	LS	500,000	500,000
11	54-INCH DIA. GRAVITY SEWER	1,400	LF	1,430	2,002,000
12	54-INCH DIA. GRAVITY SEWER - UNDER I-69	400	LF	8,080	3,232,000
13	48-INCH DIA. GRAVITY RELIEF SEWER	2,250	LF	1,280	2,880,000
14	42-INCH DIA. GRAVITY RELIEF SEWER	970	LF	1,130	1,096,100
15	30-INCH DIA. GRAVITY RELIEF SEWER	1,830	LF	880	1,610,400
16	DIVERSION STRUCTURE	3	LS	185,000	555,000
17	BEDROCK EXCAVATION	15,400	CY	250	3,850,000
18	36-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 3139 TO MH 8831)	415	LF	1,000	415,000
				CONSTRUCTION COST SUBTOTAL (\$) =	33,682,000
				10% CONSTRUCTION CONTINGENCY (ROUNDED) =	3,369,000
				TOTAL CONSTRUCTION COSTS (ROUNDED) =	37,051,000
				25% NON-CONSTRUCTION COSTS (ROUNDED) =	9,263,000
				TOTAL COST =	46,314,000

ALTERNATIVE 3

Item	Description	QNTY	UNIT	UNIT COST (\$)	TOTAL COST (\$)
1	MOBILIZATION/ DEMOBILIZATION (5%)	1	LS	1,563,000	1,563,000
2	CONTRACTOR CONSTRUCTION ENGINEERING (2%)	1	LS	613,000	613,000
3	MISC. UTILITY RELOCATION ALLOWANCE	1	LS	100,000	100,000
4	MAINTENANCE AND PROTECTION OF TRAFFIC	1	LS	100,000	100,000
5	TEMPORARY EROSION CONTROL	1	LS	100,000	100,000
6	BYPASS PUMPING	1	LS	500,000	500,000
7	14 MGD LIFT STATION	1	LS	13,946,500	13,946,500
8	24-INCH DIAMETER FORCE MAIN	2,100	LF	370	777,000
9	EQ BASIN DISCHARGE	1	LS	185,000	185,000
10	CONNECTION FROM LIFT STATION	1	LS	500,000	500,000
11	54-INCH DIAMETER GRAVITY RELIEF SEWER	1,400	LF	1,430	2,002,000
12	54-INCH DIAMETER GRAVITY RELIEF SEWER - UNDER I-69	400	LF	8,080	3,232,000
13	48-INCH DIAMETER GRAVITY RELIEF SEWER	2,250	LF	1,280	2,880,000
14	48-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 8390 TO MH 4747)	920	LF	1,280	1,177,600
15	42-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 8396 TO MH 8390)	1,790	LF	1,130	2,022,700
16	DIVERSION STRUCTURE	1	LS	185,000	185,000
17	BEDROCK EXCAVATION	9,865	CY	250	2,466,200
18	LATERAL CONNECTIONS	2	EA	25,000	50,000
19	36-INCH DIA. GRAVITY SEWER REPLACEMENT (MH 3139 TO MH 8831)	415	LF	1,000	415,000
				CONSTRUCTION COST SUBTOTAL (\$) =	32,815,000
				10% CONSTRUCTION CONTINGENCY (ROUNDED) =	3,282,000
				TOTAL CONSTRUCTION COST =	36,097,000
				25% NON-CONSTRUCTION COSTS (ROUNDED) =	9,025,000
				TOTAL COST =	45,122,000

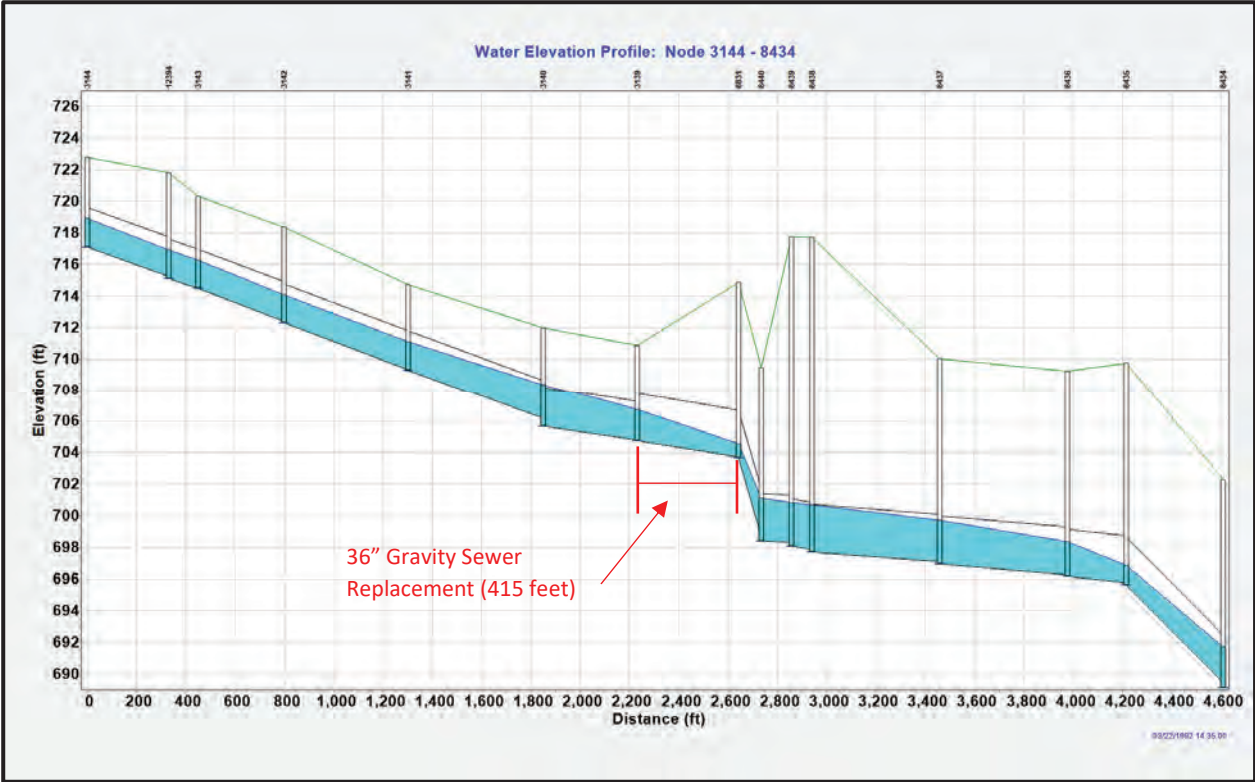
Attachment 6
Alternatives Hydraulic Grade Lines

Upstream Solution for Alternatives 1, 2, and 3



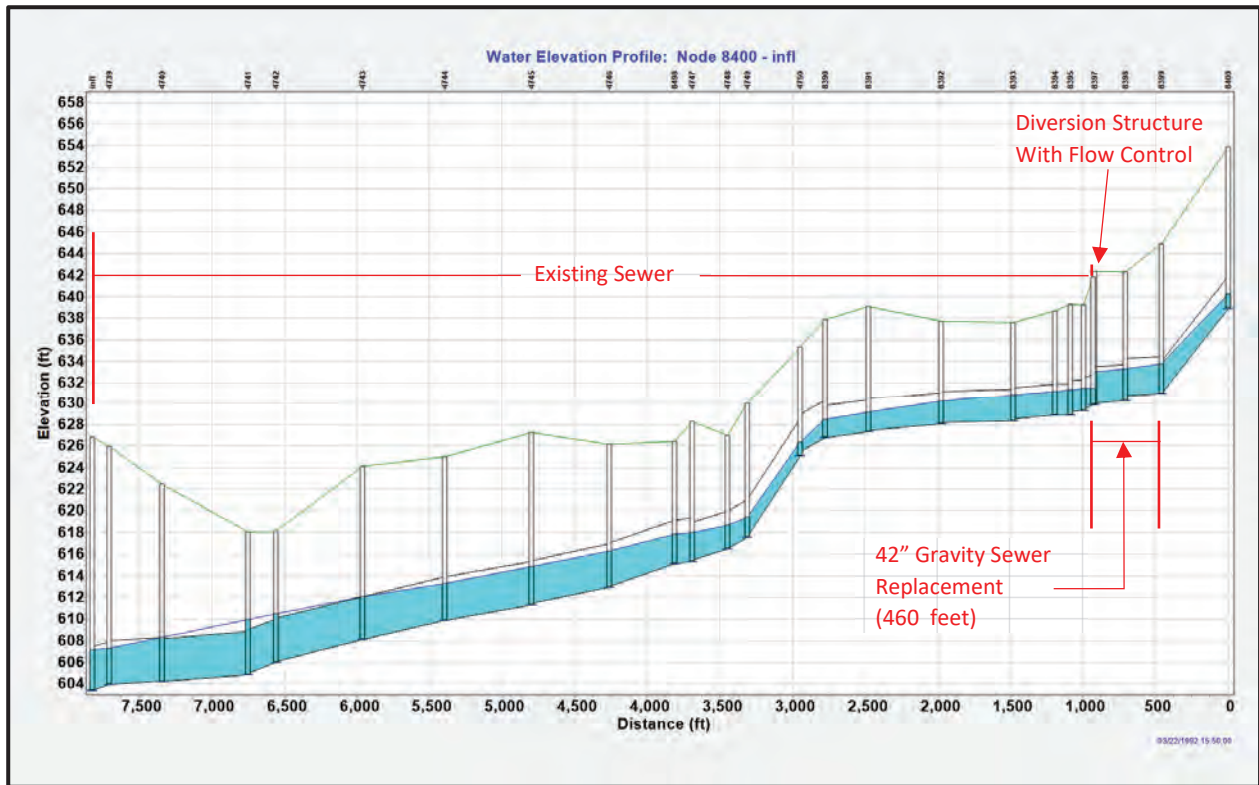
Profile A

Profile Shown

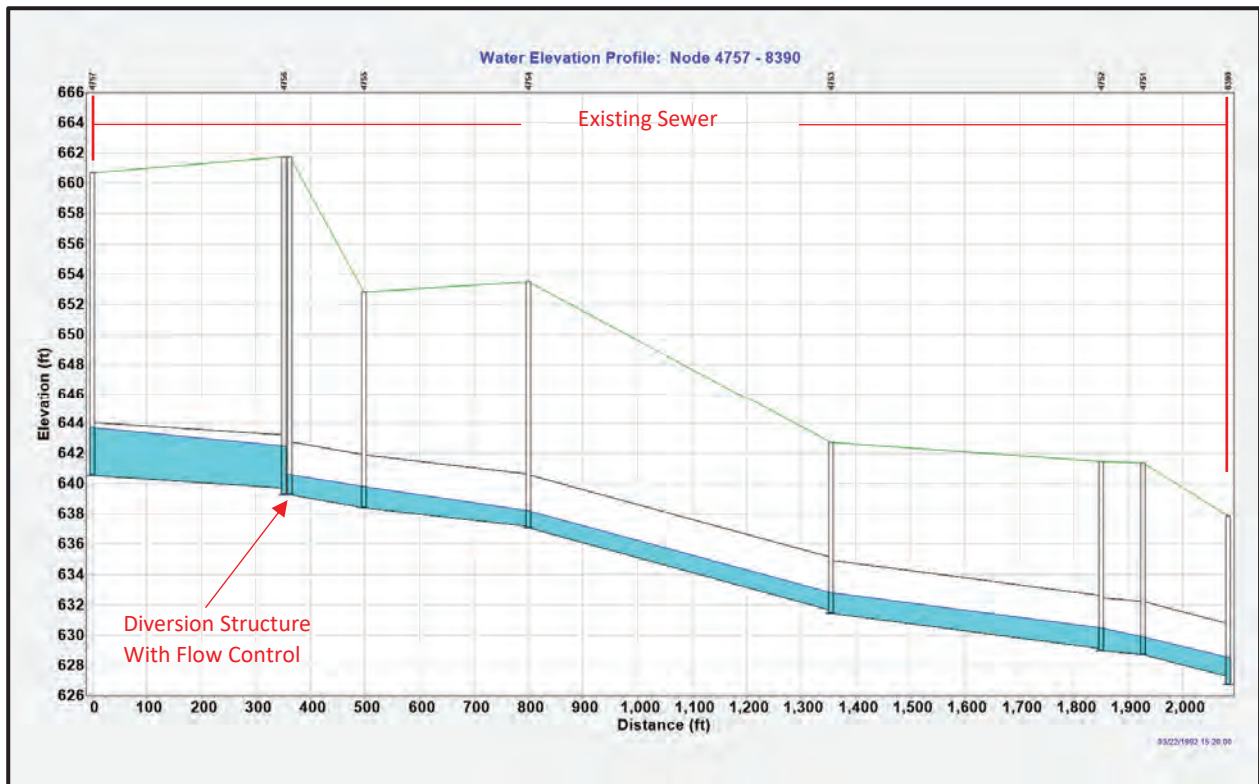


Profile A Hydraulic Grade Line 50-Year, 1-Hour Design Storm

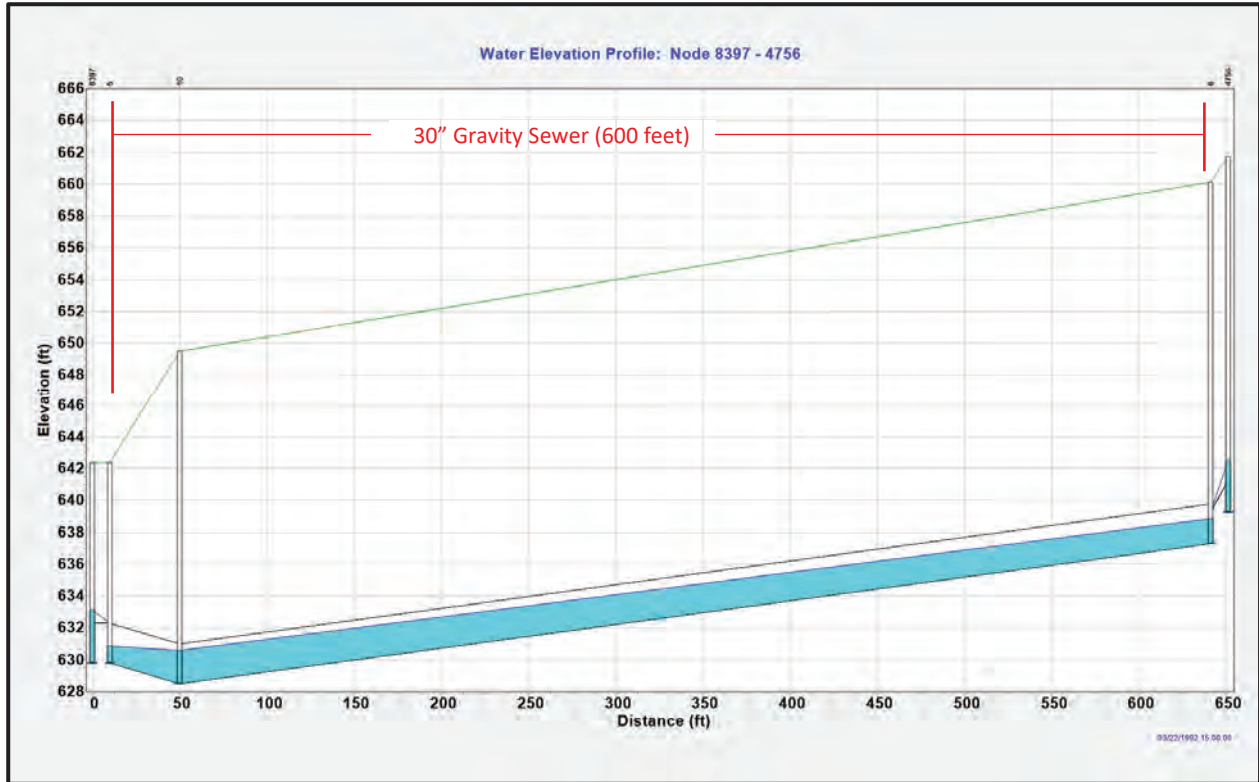
Alternative 1



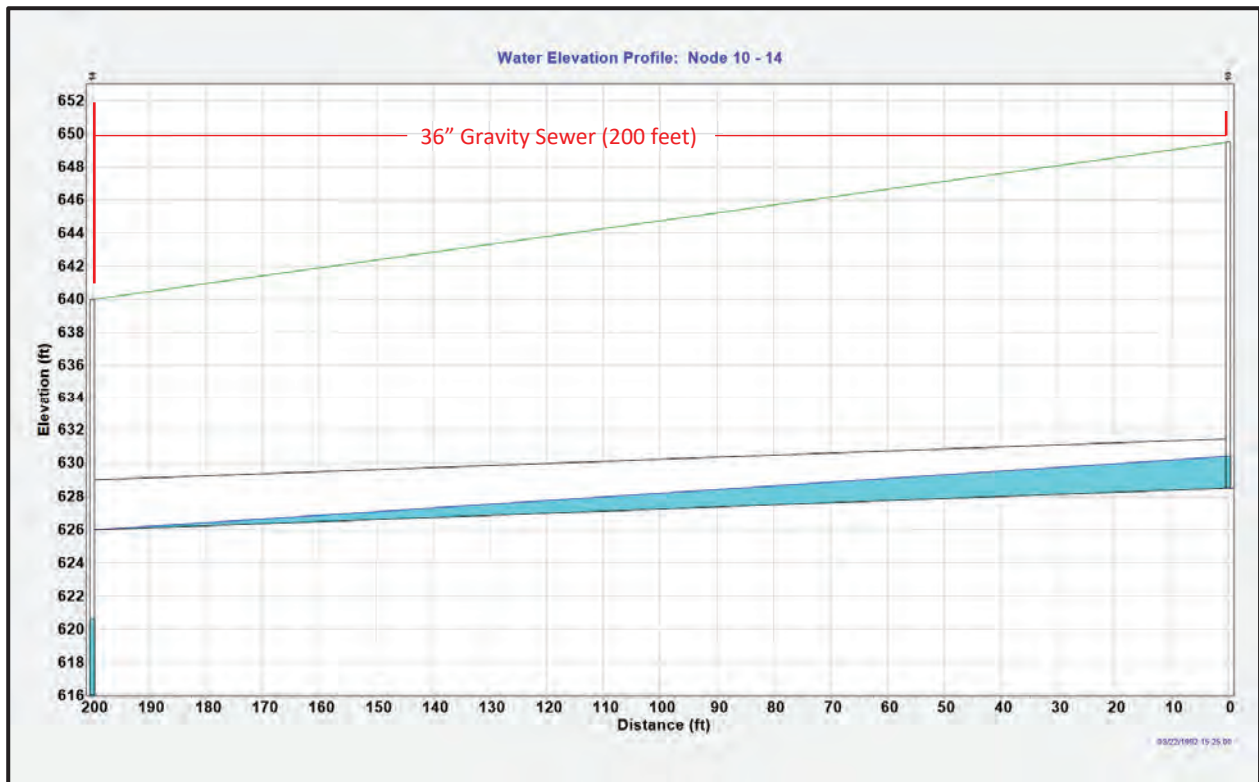
Profile A Hydraulic Grade Line 50-Year, 1-Hour Design Storm



Profile B Hydraulic Grade Line 50-Year, 1-Hour Design Storm

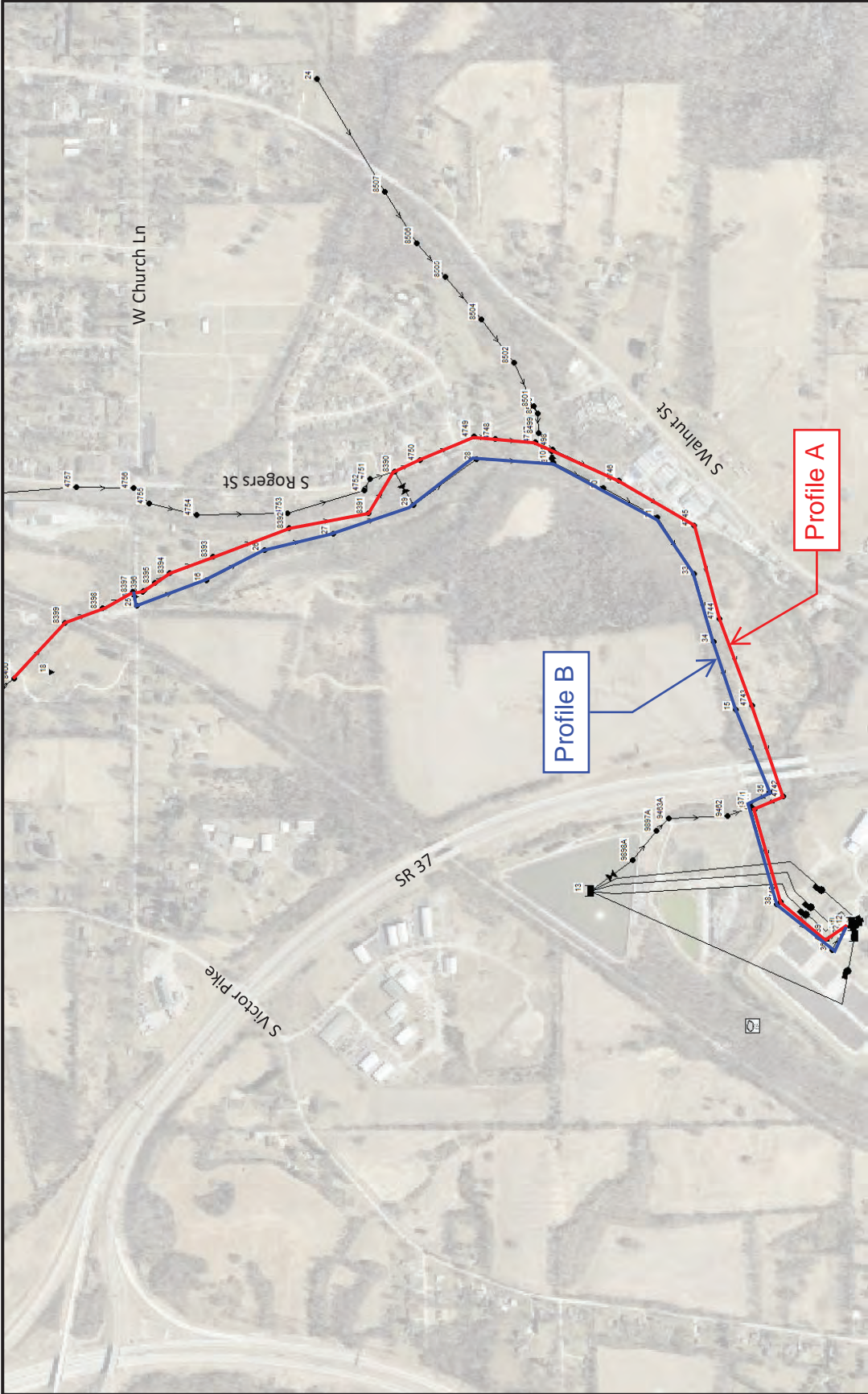


Profile C Hydraulic Grade Line 50-Year, 1-Hour Design Storm



Profile D Hydraulic Grade Line 50-Year, 1-Hour Design Storm

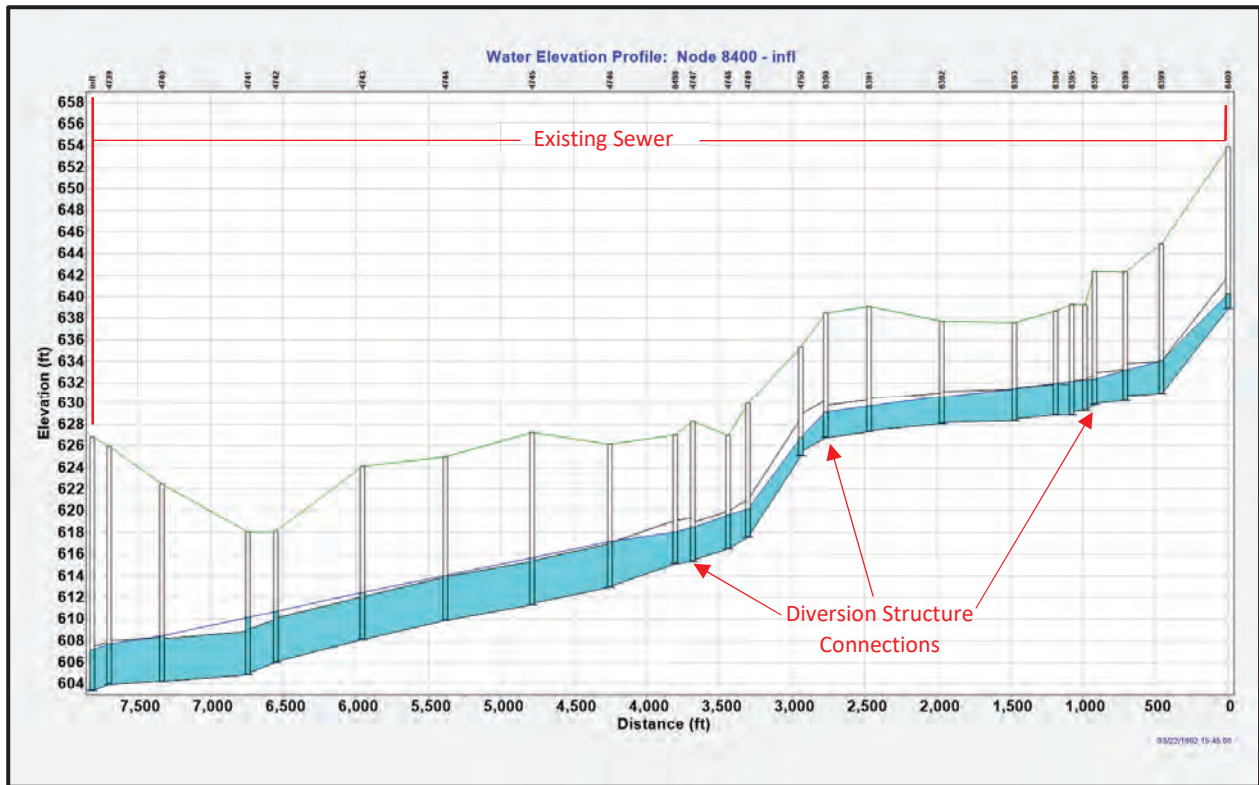
Alternative 2



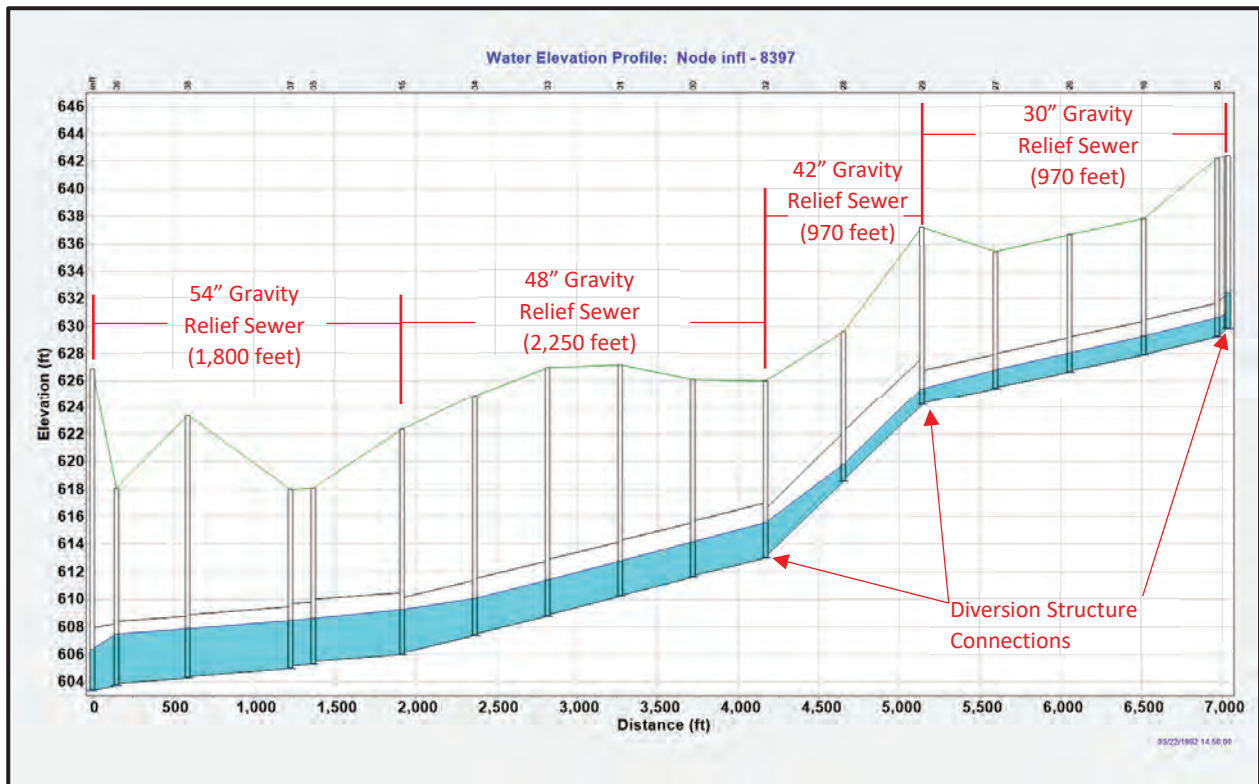
Profile A

Profile B

Profiles Shown



Profile A Hydraulic Grade Line 50-Year, 1-Hour Design Storm

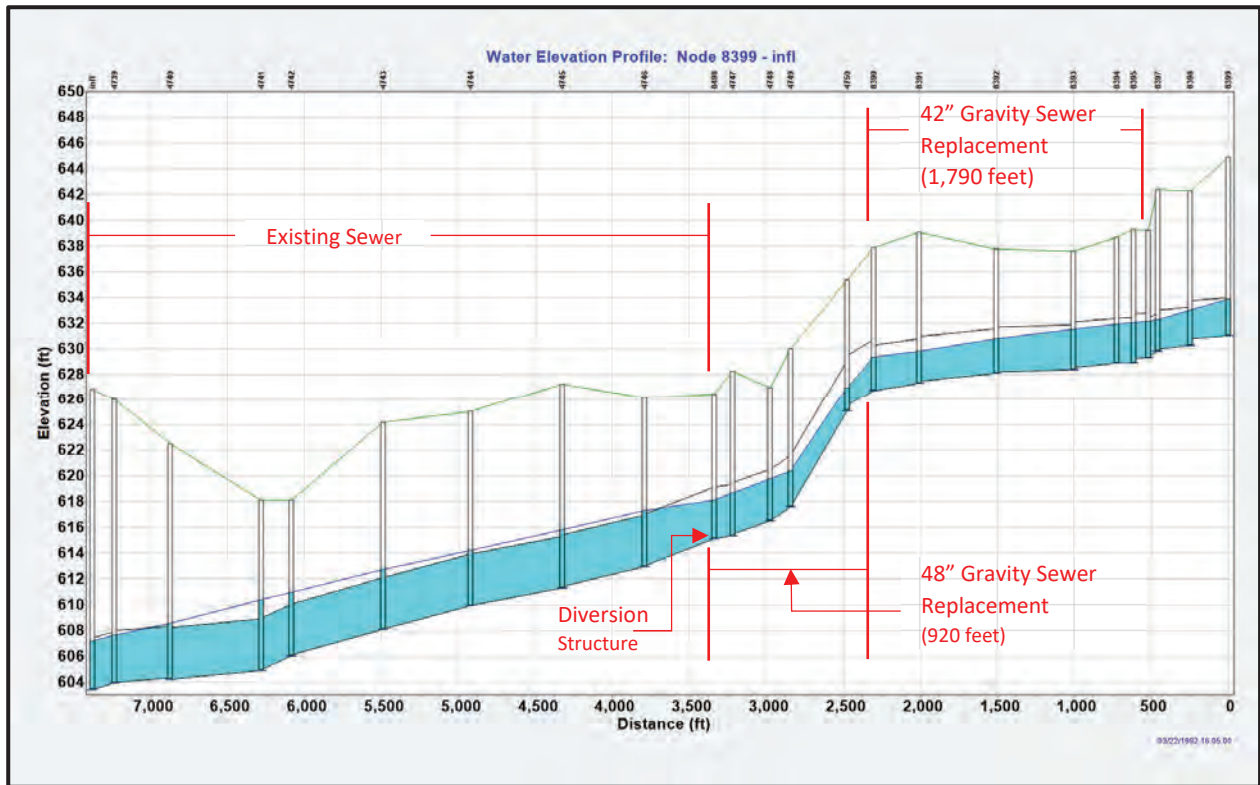


Profile B Hydraulic Grade Line 50-Year, 1-Hour Design Storm

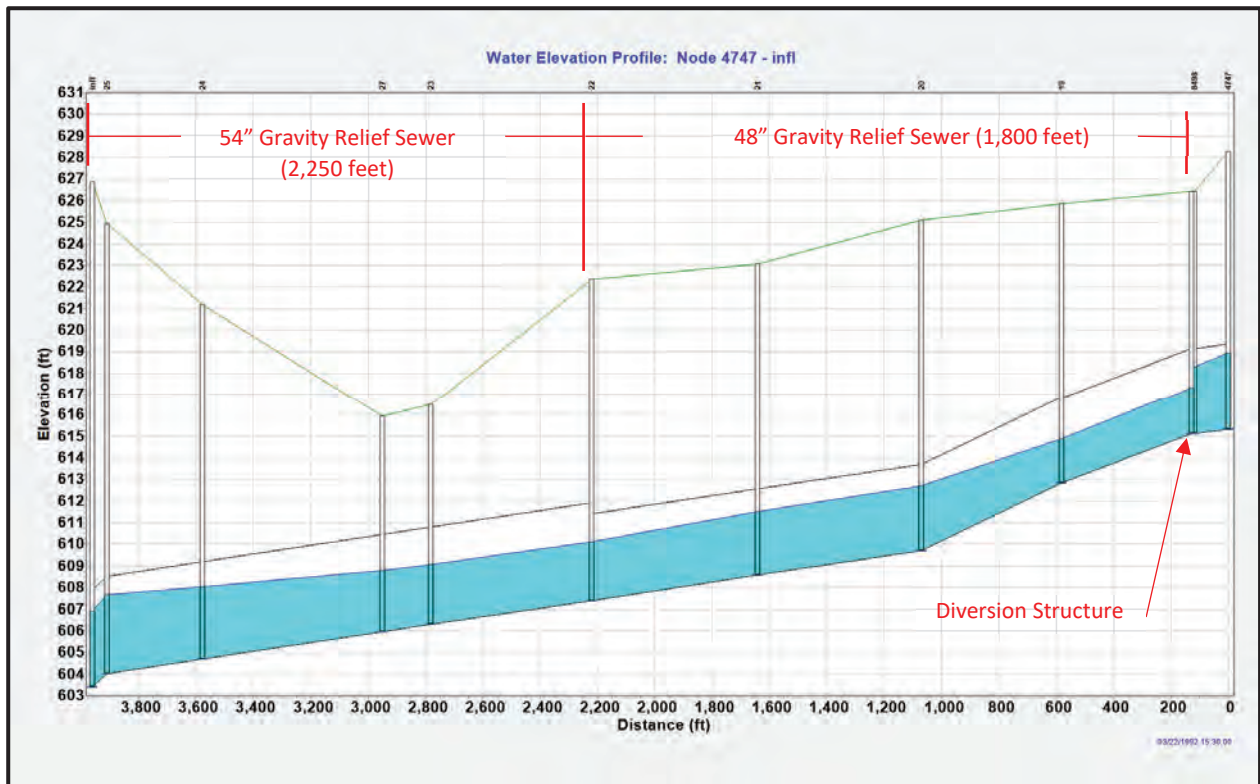
Alternative 3



Profiles Shown



Profile A Hydraulic Grade Line 50-Year, 1-Hour Design Storm



Profile B Hydraulic Grade Line 50-Year, 1-Hour Design Storm